The 6th International Conference on Virtual Learning
VIRTUAL LEARNING – VIRTUAL REALITY

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Phase II - Period 2010-2020: e-Skills for the 21st Century
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# Proceedings of the 6th International Conference On Virtual Learning

**October 28 - October 29, 2011**

MODELS & METHODOLOGIES, TECHNOLOGIES, SOFTWARE SOLUTIONS
**Phase II - Period 2010-2020: e-Skills for the 21st Century**

ICVL 2011
INTERNATIONAL CONFERENCE ON VIRTUAL LEARNING

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# MOTTOS

***„The informatics/computer science re-establishes not only the unity between the pure and the applied mathematical sciences, the concrete technique and the concrete mathematics, but also that between the natural sciences, the human being and the society. It restores the concepts of the abstract and the formal and makes peace between arts and science not only in the scientist' conscience, but in their philosophy as well."***

**Gr. C. Moisil (1906-1973)**
Professor at the Faculty of Mathematics, University of Bucharest,
Member of the Romanian Academy,
Computer Pioneer Award of IEEE, 1996
http://www.icvl.eu/2006/grcmoisil

***"Learning is evolution of knowledge over time"***

**Roger E. Bohn**
Professor of Management and expert on technology management,
University of California, San Diego, USA,
Graduate School of International Relations and Pacific Studies
**http://irps.ucsd.edu/faculty/faculty-directory/roger-e-bohn.htm**

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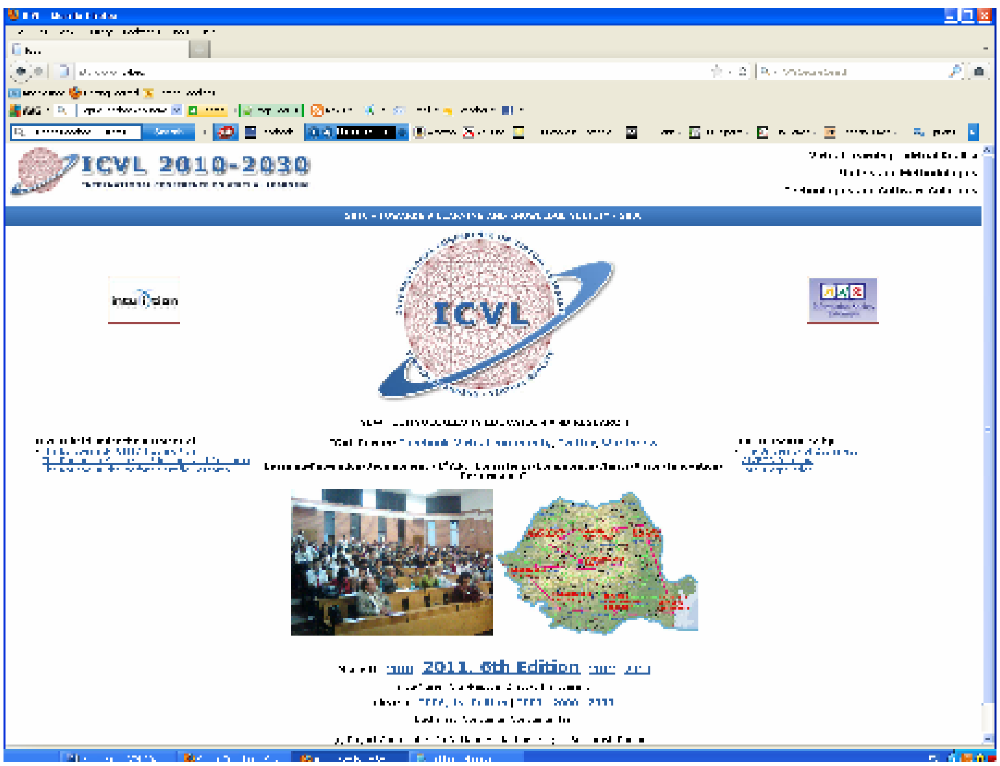
**VIRTUAL ENVIRONMENTS FOR EDUCATION AND RESEARCH**

**$C^3$VIP**: "Consistency-Competence-Clarity-Vision-Innovation-Performance"

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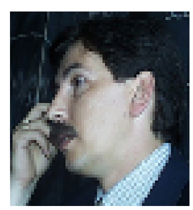

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**October 28 – October 29, 2011 – CLUJ-NAPOCA, ROMANIA**

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## Participate

The Conference is structured such that it will:

- provide a vision of European e-Learning and e-Training policies;
- take stock of the situation existing today;
- work towards developing a forward looking approach.

The Conference will consider the perspectives and vision of the i-2010 programme and how this will stimulate the promotion, and development of e-Learning content, products and services and the contribution of these to lifelong learning.

Participation is invited from researches, teachers, trainers, educational authorities, learners, practitioners, employers, trade unions, and private sector actors and IT industry.

## Research papers – Major Topics

The papers describing advances in the theory and practice of Virtual Environments for Education and Training (VEL&T), Virtual Reality (VR), Information and Knowledge Processing (I&KP), as well as practical results and original applications. The education category includes both the use of Web Technologies, Computer Graphics and Virtual Reality Applications, New tools, methods, pedagogy and psychology, Case studies of Web Technologies and Streaming Multimedia Applications in Education, experience in preparation of courseware.

## Thematic Areas / Sections

- **MODELS & METHODOLOGIES (M&M)**
- **TECHNOLOGIES (TECH)**
- **SOFTWARE SOLUTIONS (SOFT)**
- **"Intel® Education" – Innovation in Education and Research (IntelEdu)**

## Objectives

**2010 – Towards a Learning and Knowledge Society – 2030**

At the Lisbon European Council in March 2000, Heads of State and Government set an ambitious target for Europe to become **"the most competitive and dynamic knowledge-based economy in the world"** by 2010. They also placed education firmly at the top of the political agenda, calling for education and training systems to be adapted to meet this challenge.

Relevant topics include but are not restricted to:

- National Policies and Strategies on Virtual Learning
- National Projects on Virtual Universities
- International Projects and International Collaboration on Web-based Education
- Dot-com Educational Institutions and their Impact on Traditional Universities
- Educational Portals for education and training
- Reusable Learning Objects for e-Learning and e-Training
- Testing and Assessment Issues of Web-based Education
- Academia/Industry Collaboration on Web-based Training
- Faculty Development on Web-based Education
- Funding Opportunities for Projects in Web-based Education

**Learning and the use of Information and Communication Technologies (I&CT) will be examined from a number of complementary perspectives:**

- **Education** – supporting the development of key life skills and competences
- **Research** – emerging technologies and new paradigms for learning
- **Social** – improving social inclusion and addressing special learning needs
- **Enterprise** – for growth, employment and meeting the needs of industry
- **Employment** – lifelong learning and improving the quality of jobs
- **Policy** – the link between e-Learning and European / National policy imperatives
- **Institutional** – the reform of Europe's education and training systems and how I&CT can act as catalyst for change
- **Industry** – the changing nature of the market for learning services and the new forms of partnership that are emerging

## General Objectives

**The implementation of the Information Society Technologies (IST) according to the European Union Framework-Programme (FP7)**

- The implementation of the Bologna Conference (1999) directives for the Romanian educational system.
- The development of a Romanian Framework supporting the professional and management initiatives of the educational community.
- The organization of the activities concerning the cooperation between the educational system and the economical companies to find out an adequate distribution of the human resources over the job market.
- To promote and implement the modern ideas for both the initial and continuing education, to promote the team based working, to attract and integrate the young graduates in the Research and Development projects, to promote and implement IT&C for initial and adult education activities.

## Particular objectives

**The development of Research, projects, and software for E-Learning, Software and Educational Management fields**

- To promote and develop scientific research for e-Learning, Educational Software and Virtual Reality
- To create a framework for a large scale introduction of the e-Learning approaches in teaching activity.
- To assist the teaching staff and IT&C professionals in the usage of the modern technologies for teaching both in the initial and adult education.

- To improve the cooperation among students, teachers, pedagogues, psychologists and IT professionals in specification, design, coding, and testing of the educational software.
- To increase the teachers' role and responsibility to design, develop and use of the traditional technologies and IT&C approaches in a complementary fashion, both for initial and adult education.
- To promote and develop information technologies for the teaching, management and training activities.
- To promote and use Educational Software Packages for the initial and adult education.

## Thematic Areas/Sections

**Models & Methodologies (M&M):**

- Innovative Teaching and Learning Technologies
- Web-based Methods and Tools in Traditional, Online Education and Training
- Collaborative E-Learning, E-Pedagogy,
- Design and Development of Online Courseware
- Information and Knowledge Processing
- Knowledge Representation and Ontologism
- Cognitive Modelling and Intelligent systems
- Algorithms and Programming for Modelling

**Technologies (TECH):**

- Innovative Web-based Teaching and Learning Technologies
- Advanced Distributed Learning (ADL) technologies
- Web, Virtual Reality/AR and mixed technologies
- Web-based Education (WBE), Web-based Training (WBT)
- New technologies for e-Learning, e-Training and e-Skills
- Educational Technology, Web-Lecturing Technology
- Mobile E-Learning, Communication Technology Applications
- Computer Graphics and Computational Geometry
- Intelligent Virtual Environment

**Software Solutions (SOFT):**

- New software environments for education & training
- Software and management for education
- Virtual Reality Applications in Web-based Education
- Computer Graphics, Web, VR/AR and mixed-based applications for education & training, business, medicine, industry and other sciences
- Multi-agent Technology Applications in WBE and WBT
- Streaming Multimedia Applications in Learning
- Scientific Web-based Laboratories and Virtual Labs
- Software Computing in Virtual Reality and Artificial Intelligence
- Avatars and Intelligent Agents

Topics of interest include but are not limited to:

**Virtual Environments for Learning (VEL):**

- New technologies for e-Learning, e-Training and e-Skills
- New software environments for education & training
- Web & Virtual Reality technologies
- Educational Technology and Web-Lecturing Technology
- Advanced Distributed Learning (ADL) technologies
- Innovative Web-based Teaching and Learning Technologies
- Software and Management for Education
- Intelligent Virtual Environment

**Virtual Reality (VR):**

- Computer Graphics and Computational Geometry
- Algorithms and Programming for Modeling
- Web & Virtual Reality-based applications
- Graphics applications for education & training, business, medicine, industry and other sciences
- Scientific Web-based Laboratories and Virtual Labs
- Software Computing in Virtual Reality

**Knowledge Processing (KP):**

- Information and Knowledge Processing
- Knowledge Representation and Ontologism
- Multi-agent Technology Applications in WBE and WBT
- Streaming Multimedia Applications in Learning
- Mobile E-Learning, Communication Technology Applications
- Cognitive Modelling, Intelligent systems
- New Software Technologies, Avatars and Intelligent Agents
- Software Computing in Artificial Intelligence

**Education solution towards 21st Century challenges (IntelEDU):**

- Digital Curriculum, collaborative rich-media applications, student software, teacher software
- Improved Learning Methods, interactive and collaborative methods to help teachers incorporate technology into their lesson plans and enable students to learn anytime, anywhere
- Professional Development, readily available training to help teachers acquire the necessary ICT skills
- Connectivity and Technology, group projects and improve communication among teachers, students, parents and administrators

# W o r k s h o p

## Haptic Feedback Systems in Education

This workshop will be devoted to developments and issues involving haptic systems in education. Topics will range from haptics in human computer interaction to haptic applications in medical training

- Haptics is the science of merging tactile sensation with computer applications, thereby enabling users to receive feedback they can feel (in addition to auditory and visual cues). Multimodal environments where visual, auditory and haptic stimuli are present convey information more efficiently since the user manipulates and experiences the environment through multiple sensory channels
- The availability of haptic systems enables the augmentation of traditional instruction with interactive interfaces offering enhanced motivation and intellectual stimulation. Although the haptic devices have not made large inroads into education, we believe that the potential for revolutionary change now exists due to the recent availability of both the hardware and software component

# SenseGraphics - Medical Simulators Built on H3DAPI

**Tommmy Forsell**

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## Abstract

*H3D API, SenseGraphics flagship product, is a dual commercial and GPL (open source) licensed software that has been recognized by many in the haptics industry as an ideal development platform for multi-sensory applications. H3D API uses the open standards X3D and OpenGL, and leverages on a diverse range of haptics platforms and technology including those of SenseAble, Novint and ForceDimension. We also offer professional haptic training, support and consulting services, as well as custom hardware solutions..*

**Keywords**: haptics, medical simulators

## 1. Introduction

SenseGraphics' vision is to facilitate application development of haptic, and co-located hapto-visual, applications. Founded in 2004 in Stockholm, SenseGraphics represents over twenty years of experience in the haptics and graphics industry. Our company provides a high performance application development platform which enables integration of haptics and 3D stereo visualization into multimodal software applications. Our development platform consists of two main components, hardware and software solutions, offering the complete set of technologies needed to initiate 3D or haptics application development.

H3D API, SenseGraphics flagship product, is a dual commercial and GPL (open source) licensed software that has been recognized by many in the haptics industry as an ideal development platform for multi-sensory applications. H3D API uses the open standards X3D and OpenGL, and leverages on a diverse range of haptics platforms and technology including those of SenseAble, Novint and ForceDimension. We also offer professional haptic training, support and consulting services, as well as custom hardware solutions.

## 2. Our Technology

While it promises many exciting possibilities, haptics development and research are still costly practices, in part due to the sophistication of haptic hardware and in another, due to proprietary haptics software. Our open source haptics and 3D stereo technology seek to minimize these expenses, thereby promoting development of haptic applications.

Our technology comprises: haptics development platforms and hardware.

### 2.1. Haptics Development Platforms

***H3D API***

The brainchild of SenseGraphics, H3D API is fast becoming the standard for high performance haptics application development. This open source, hardware independent platform is designed for anyone interested in building haptics applications from scratch. The H3D API uses the open standards X3D, OpenGL and SenseGraphics haptics. It offers a unified scenegraph which simplifies haptic and graphic rendering.

The big plus point that H3D API offers users is the ease with which haptic applications can be built. It is possible without extensive programming experience to build haptics applications using solely H3D (which extends from X3D) or with the scripting language Python. Additionally, C++ programming may be used in H3D API for any advanced developments. As H3D API is open source and released under the GNU General Public License, users are free to modify and extend it as needed.

The H3D API has been used widely by many research and academic institutions including the Royal Institute of Technology (KTH) and Norrköping Visualization and Integration Studio in Sweden, Cork University Hospital and University of Wales, Bangor in the United Kingdom, and Iowa State University and Armstrong Atlantic State University in the United States.

***HAPI***

HAPI is the new haptics rendering engine by SenseGraphics which supports a variety of haptics devices including those from SenseAble, ForceDimension and Novint. With HAPI, users are now able to choose between four rendering algorithms. It's modular design also meant that users are able to add rendering algorithms of their own.

While H3D offers quick creation of new haptics applications, HAPI allows users to add haptics to existing applications. The choice rests with the users whether to complement HAPI with H3D API, or with other graphics platforms, including but not limited to OpenGL and DirectX.

HAPI is written in C++ and like H3D API, HAPI is open source.

### 2.2 Haptic Hardware

Our technology also encompasses the hardware settings in a haptics system. We provide haptics interfaces, and build fully immersive 3D stereo systems with co-location of haptics and graphics.

Both our immersive hardware and H3D API have been applied in various projects, including the haptic stroke rehabilitation system by Curictus AB.

## 3. Medical simulators

SenseGraphics is helping companies bringing their products to the market in a fast and cost effective way. Below you will find examples on products for the dental and medical industry where SenseGraphics has been a successful technology provider and application development partner.

### 3.1. MOOG Simodont Dental Trainer

MOOG is a worldwide designer, manufacturer and integrator of precision motion control products and system. The Simodont Dental Trainer (fig. 1.a) is a high quality, high fidelity simulator allowing for future dentists to be trained in operative dental procedures in a realistic dedicated virtual environment while receiving haptics, visual and audio sensory information.

SenseGraphics has been part of the development team of the MOOG Simodont Trainer, providing both haptics and 3D visual functionality to the simulator. The first 50 units of the Simodont Dental trainer was installed in the new ACTA Dental School building in August 2010. ACTA, who aslo funded the development of the Simodont trainer, is a world-class dental educator based in the Netherlands.

The main features of Simodont trainer are the advanced control technology by a unique admittance control paradigm using a force sensor for high fidelity feel; a flexible software interface by providing maximum flexibility in creating new applications; and strong reliability by proven technology and patented control algorithm that allow the full spectrum of movement from very high to very delicate forces.

At any given moment, in training centers around the world, a Moog simulation solution is always at work providing an unsurpassed level of performance, fidelity and reliability.

a) b)

*Figure 1.* **a) Simodont dental trainer setup, b) ScanTrainer in practice**

The dental trainer provides high-end dental simulation and training. It is a complete, proven training system for dental schools committed to helping students progress faster and professors track progress and plan student work efficiently.

Simodont® Courseware is developed by (ACTA) Academic Center for Dentistry, Amsterdam, the Netherlands.

**3.2. MedaPhor ScanTrainer**

MedaPhor is one of the UK's leading ultrasound training companies. The Medaphor ScanTrainer (fig. 1.b) is an ultrasound training simulator which provides effective ultrasound training, independent of a clinical setting, using a virtual environment with the feel of a real procedure.

The ScanTrainer was brought to the market in 2010, built on H3DAPI and with haptics expertise from the SenseGraphics software development team. Conclusion

ScanTrainer provides sophisticated ultrasound learning in a non-clinical environment without any impact on clinical service delivery, solving the current resource conflict between provision of clinical service and need to train. It also helps overcome the current shortage of learning capacity in hospitals and training centers.

The structured ScanTrainer learning environment, with tutorials, assignments, tasks and metrics, ensures an effective and reproducible training program with reduced impact on clinical services and reduced expert supervision.

Moreover, it improves the quality and breadth of ultrasound learning prior to the trainee's exposure to patients by offering self-directed learning with feedback means that the system can be used without an expert's direct supervision, and is thus highly cost-effective.

**3.3. The Haystack Project**

A hapto-visual simulator for training in and assessment of performance of Ultrasound guided Peripheral Nerve Block (USgPNB). Built on H3DAPI, and with SenseGraphics haptics expertise, the Haystack is a collaboration by NDRC (National Digital Research Centre), the HSE (Cork University Hospital Department of Anaesthesia), and MedaPhor Ltd.

**4. Conclusions**

The potential of haptic interfaces in support of practice based learning in medical training is tremendous. More, it starts to be proven in many domains, even in rehabilitation, due to the capability of H3DAPI force feedback haptic technology to create a realistic environment for the patient, enhancing the training experience and facilitating the relearning processes.

**References**

SenseGraphics, http://www.sensegraphics.com/index.php

# An approach for teaching mechanisms using haptic systems

**Tiberiu Butnaru[1], Florin Girbacia[2], Silviu Butnaru[2], Andreea Beraru[2], Doru Talaba[2]**

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**Abstract**

*This paper presents a methodology and a prototype system for teaching mechanisms in mechanical engineering courses, by using haptic devices. The paper begins with the presentation of an experimental study on using generic haptic devices for simulation of mechanism. Based on the results of the conducted study a custom haptic system with 1 DOF was developed. Afterwards it is presented the proposed methodology, which integrates the haptic device developed for the specific case of articulated mechanisms. In order to increase the realism of the simulation, the virtual mechanism model is co-located with the user's real hand using augmented reality techniques and see-through featured head mounted display. Therefore, the mechanical system used for the experiments is composed of one or more real and virtual elements and joints (for example a crank linked to a torque controlled electrical motor). The software, hardware and methodology, as well as the results are described in detail. The advantage of this system is the use of inexpensive haptic equipment for intuitive learning of the simulation of mechanisms.*

**Keywords**: Haptics, Augmented Reality, Mechanism, Teaching methodology

## 1. Introduction

An undergraduate mechanical engineering curriculum invariably includes a course about the Theory of Mechanisms and Machines through which students learn modelling and analysis of mechanisms. Teaching Theory of Mechanisms and Machines has traditionally relied on physical models. These physical models provide an intuitive representation of the mechanical structure, allowing students to explore aspects such as type and construction of joints, mobility etc. The classical teaching method is a difficult task, which requires students' imagination or use of expensive mechanical installations. Moreover, it seems that it is not well understood by the students because they are more interested in other interdisciplinary fields related to this topic, e.g. robotics and mechatronics.

Recent advances in Computer Aided Design (CAD) and Engineering (CAD/CAE) have allowed creation of virtual prototypes that represent mechanical systems at any scale and complexity. By using CAD/CAE systems for virtual prototyping, the user has to be a skilful engineer because these systems only allow the visualisation of the simulation results as 2D drawings, plots or graphs and require a mental transformation of 2-D objects into dynamic 3-D objects, which is a difficult process for an undergraduate student.

Virtual Reality technologies facilitate the development of new industrial applications by providing advanced visualization capabilities and multi-sensorial human interaction interfaces.

Positive results where reported by applying VR technologies to automotive engineering, aerospace engineering, medical engineering, and in the fields of education and entertainment (Craig et al., 2009).

Recently, haptic interface has been proposed as an ideal interface for teaching systems dynamics to mechanical engineering undergraduate students (Butnariu and Talaba, 2010; Duma, 2010; Gillespie et al., 2003; Okamura et al., 2002, Wiebe et al., 2009). Using haptic systems, the numerical results of simulations and tests can be converted into forces that the user can percept. This way the plots and graphs can be replaced with the actual experience of switching a virtual device reproducing the force feedback that would characterize the real counterpart with a high degree of fidelity (Erdelyi and Talaba, 2010).

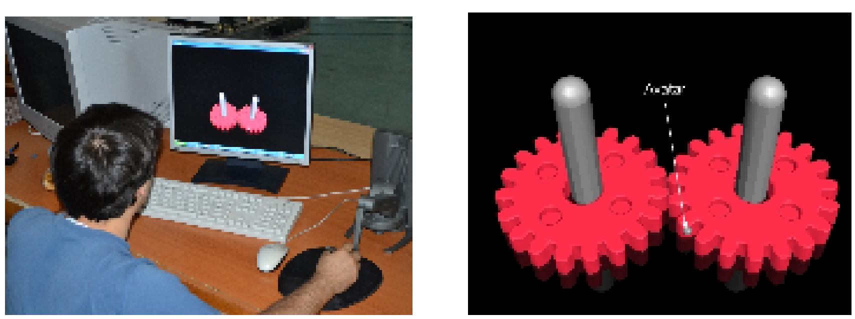
This paper presents a methodology and a haptic prototype system for teaching mechanisms in mechanical engineering courses. This method to achieve such results consists of augmented reality technologies (Azuma, 1997) used to co-locate computational (virtual) models with the real physical models and haptic feedback to provide additional information about the augmented models. Using this teaching concept, a variety of computational mechanism models can be studied, which reduces the need for classical experiment involving expensive installations.

**2. Experimental study on using generic haptic devices for simulation of mechanism**

Before introducing the haptic devices in the mechanism teaching process, we conduct an evaluation study for the generic haptic devices (like Sensable PHANTOM). The objective of this evaluation study is to assess the efficiency and the usability of generic haptic devices for interaction/manipulation of mechanism in virtual environment. The study was performed considering the case of manipulation of a gear mechanism in a virtual environment (fig. 1b).

The interaction between the real object (haptic device) and the virtual mechanism is achieved through an "avatar" - graphical representation of the haptic device implemented in the virtual environment (fig. 1b). The avatar handling is done by using a Sensable PHANTOM haptic device and the perception of the virtual environment is done trough a "desktop" virtual reality system (fig. 1a). The user manipulates the haptic avatar through the Phantom device, interacting with virtual mechanism. When a collision with the virtual gear is detected, the equipment returns the corresponding haptic feedback. The force feedback is calculated according to the collision between the avatar and the virtual mechanism. For this experiment a haptic library called Chai 3D (www.chai3d.org) has been used, which incorporates algorithms used to detect collisions between virtual objects and the Open Dynamics Engine (www.ode.org) applied for dynamics simulation of multibody systems.

Five subjects with mechanical background participated at this experiment. After conducting the experiment, we can conclude that the interaction with a virtual mechanism is particularly difficult using such a haptic device because of the punctual virtual contact.



a) b)

*Figure 1*. **Interaction with PHANToM device (a) haptic avatar and mechanism (b)**

In order to manipulate the mechanism and to feel the forces that appear in the system, the user has to push one of the gears. This process has proven to be difficult, because the avatar is not fixed on the gear and it can move freely on its surface, meaning the loss of contact with the mechanism in a very short time.

The usability of generic haptic devices is limited to applications based on the punctual virtual contact. Thus, we have decided to develop and use custom haptic devices dedicated to simulation of mechanisms. In the next section is presented the design and development of haptic systems with one degree of freedom dedicated to simulation of mechanisms.

**3. The development of the dedicated 1 DOF haptic interface for simulation of mechanisms**

The virtual simulated mechanism is connected to a real system consisting of a DC brushless motor and a real crank. The motor is controlled by a special controller which communicates with a computer trough an RS232 interface. In this controller are implemented some control functions, like: proportional derivative (PD) element which assesses the speed mode, proportional integrative (PI) feature used for controlling the motor in current mode and proportional integrative-derivative (PID) for control motor in position mode. Movement of the real crank is measured by using an optical encoder assembled in the motor. The data provided by this sensor is converted in angle and used as input for the simulation of the mechanisms. A schematic diagram of the complete system is presented in figure 2 where “1” represents the DC brushless motor equipped with a real crank element, “2” represents the computer that runs the simulation and “3” is Trivisio HMD device used for visualization of the simulation. The motor is controlled in current mode because the force provided from simulation is directly proportional with the current applied to the motor. To increase force to the user hand, a planetary gearbox with ratio 150:1 is mounted at the output of the motor. The refresh rate of displayed force at the human hand level is approximate 300Hz because of the speed limitation of the serial port RS232.. Baud rate for read/write to motor controller is 115200 bauds. We test this interface with multiple users and interaction was very realistic, all users feel mechanism manipulation like real one.

For good immersion of the user, augmented reality (AR) techniques are used to render the virtual crank over imposed to a video string achieved by a video camera mounted at the user’s head level. Using these techniques, position and orientation of a custom marker is detected in the real environment using image processing algorithms. The marker data must be stored in a file on computer and compared to the data processed in the video string. Position and orientation of the marker is used as input for render engine. Users can view the mechanism over imposed in the real environment using a Head Mounted Display (HMD) (fig. 2b). An HMD is a display device mounted to the user head that display images using two little Liquid Crystal Display (LCD). At Transylvania University from Brasov, we have a Trivisio HMD with two video cameras on it and users can view stereoscopic images over imposed to the video stream.

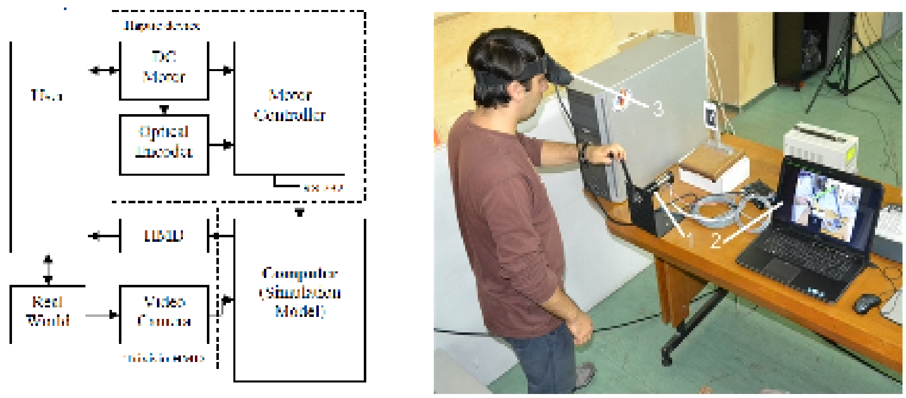
**4. Methodology and results**

The course that we are reporting on this paper is delivered during one semester (14 weeks, 4 hours a week). In the laboratory, students complete a project wherein they implement a simulation of an articulated mechanism with haptic feedback. During the first weeks of the semester, each student has received a different articulated mechanism with following input parameters: construction, geometry, masses and operating characteristics. The methodology followed by the student to complete the assigned project involves the next steps:

(1) Generating the virtual 3D model of the mechanism - using specialized Computer Aided Design software (for example Solidworks).

(2) (2) Conversion of the 3D model mechanism data. The virtual model cannot be loaded in the AR software because there is not standard interoperability procedure. Therefore this step

consists in extracting the entire geometric data of the CAD model and conversion of standard CAD file to an appropriate common exchange file format (for example 3ds, VRML, X3D etc.) that can be loaded by general AR dedicated framework.




a) b)

*Figure 2*. **1 DOF haptic system architecture (a) components of the haptic system (b)**

(3) Integration of the virtual mechanism model in AR software. Consists in the configuration file generation that contains the marker tracking setup and the 3D scene file.

(4) Generation of a unique marker. Consists in generation of a unique fiducial marker for each 3D CAD model and storage the marker shape data in the AR software.

(5) Registration of the co-located virtual mechanism model. This step involves modification of scale, 3D position, and orientation, relative to the camera transformation matrix by using the keyboard.

(6) Development of the mechanism kinematics and dynamics model. For the calculation of forces and movements of virtual mechanism classical multi-body systems dynamics formalism was used. The rigid elements of mechanism are interconnected through joints. On some elements of the mechanism, there are applied forces (springs, dampers) in order to achieve haptic effects. The equations of motion are:

[1]
$$M(q)\ddot{q}(t) = f(t,q,\dot{q},\lambda) - G^T(t,q)\lambda,$$
$$0 = g(t,q),$$

Where: q- coordinates of bodies; $M(q)$ - generalized mass matrix; $f$ - vector of applied forces. The joints decrease the number of degrees of freedom in the system, generating constraints, which are introduced in dynamics mathematical equations through the GT forces (t, q) = (∂ g / ∂ q) (t, q) using Lagrange multiplier λ.

(7) Calculate the force feedback. Consist on conversion of calculated forces from dynamic model of the mechanisms to level of current to be applied to the motor.

To demonstrate the methodology presented above we present a project where this was applied for a slider-crank type mechanism (fig. 3).

The slider-crank type mechanism is composed of two rigid bodies and three articulations and has only one degree of freedom:

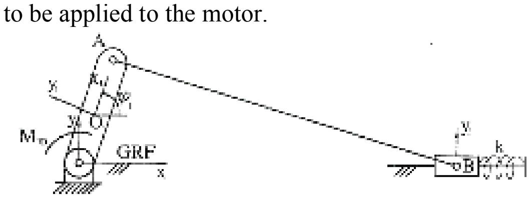



*Figure 3.* **Schematic representation of slider-crank mechanism with dynamic elements**

[2] $L = 3n_c - \sum r_i = 6 - 5 = 1$

To move this mechanism we need to know only crank angle φ1. In order to solve the problem, they will follow the steps outlined in presented methodology. First, the students analyze the mechanism in order to establish the components, their position and the couplings between them. Then, a 3D model of the mechanism needs to be created, using dedicated software studied in other classes (e.g. CATIA CAD software).

The 3D CAD model is composed from separate parts corresponding to the components of the mechanism. Each component of the mechanism is modelled as a distinct CAD part, and then all of the parts are assembled in their position. The 3D model can not be used in native CATIA format because of lack of interoperability between AR and CAD systems. The CAD system can export the CAD graphical models in other formats (for example Virtual Reality Modelling Language). Therefore, the VRML language is used for the representation of the 3D virtual mechanism it. Using the conversion function directly from the CATIA software will not maintain all the data of the original assembled model. Important features of the CAD model are not transmitted, such as topology of parts. Therefore, the geometrical parts of the mechanism are suitable to be used for visualization, but not for interaction. Consequently it is necessary to export each part individually by activation of the "hide" command in order to conceal other components different from one selected. The result is a VRML file, which contains each entity of the CAD models treated as an individual object.

Software architecture was created for the visualization of the mechanism simulation in a co-located environment. The software architecture is discomposed in an AR co-location software module, an interaction haptic device module, a module for simulation of virtual mechanism and a module for generation of haptic feedback.

The AR software module allows identification of the square marker, determines 3D position and orientation of identified markers in order to align the virtual mechanism onto the real environment and simulates the movement commands of the mechanism.

The code written for the AR software module is based on an open source library called Instant Player (www.instantreality.org). The advantage of using this library is the possibility to integrate various VRML and X3d graphical formats of virtual objects and possibility to create External Authoring Interface (EAI) to transmit data from other C++ or .NET standalone applications using Ethernet.

With the purpose of registration of virtual mechanism model onto the real environment and co-located with the haptic device, a unique square marker was generated and attached in the real workspace. Each marker in the system has a black border and a unique symbol inside the black frame. The Instant Player framework uses the unique symbol to identify the markers. Before using a marker within this framework, the marker's shape data has to be specified through an .xml file. The Instant Player includes computer vision functions that allow analyzing each video frame and identifying markers. In this way, Instant Player gets the camera transformation matrix as well as the marker's id. The 3D position and orientation are used to overlay virtual objects in the real environment. The user can modify scale, 3D position and orientation relative to the camera transformation matrix by using the keyboard. In this way, the registration of the virtual mechanism onto the real environment and co-location with the haptic device (fig. 4) can be adjusted.

In the next step, the kinematics and dynamics calculation was made using analytical methods presented during the course. We do not propose to discuss in this paper about inverse dynamic model of the mechanism. Information about this calculation can be found in (Talaba and Antonya, 2006). After validation of the models, the students will implement a subroutine using C++ programming language. The outputs of the program are the forces from the spring used for generation of haptic feedback and the positions of the mechanism elements used to update the visual representation of the mechanism.

Each student works individually on a computer to generate CAD models, VRML files and C++ simulation programs. After finishing these steps, for the haptic feedback generation and visualization of the simulation in the co-located environment, depending on mechanism characteristics, the students use the presented experimental haptic device where they can interact with virtual simulated slider-crank mechanism. Any change to the input data will lead to changes in kinematics or dynamics features of the studied mechanism.

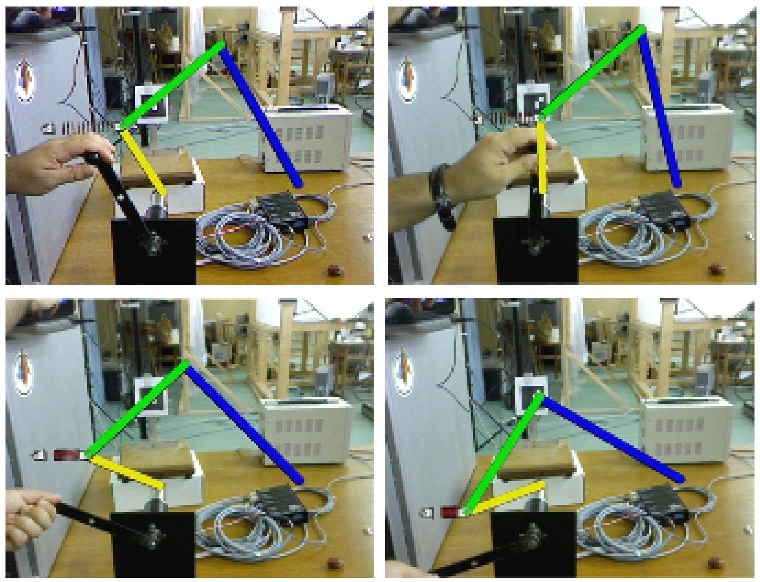


*Figure 4*. **Student testing a virtual mechanism with the proposed system**

In doing this project, students learn (i) generic concepts of virtual prototyping (ii) specific features of interfacing a motor to a PC, (iii) generic concepts of mechanism simulation (iv) generic concepts of VR and AR, and (v) had a lot of fun programming and experimenting with interesting virtual worlds.

**5. Conclusions**

In this paper was presented a methodology to study kinematics and dynamics of mechanisms that includes all steps from design to conversion of a CAD model into a VRML virtual scene in order to obtain both quality simulations and haptic feedback delivered to the user in a very similar manner as in a real experiment.

This methodology can be applied to students of the Mechatronics and Robotics departments, assuming knowledge of CAD and programming. This approach proved to be a powerful tool that offers important advantages to the classic teaching methods.

The haptic device can be used only for mechanisms with mobility M=1. In the future, we intend to use this type of interface to make simulators of mechanical machine like manual drilling machine for educational purpose and training. Vibration forces that appear at contact with different materials and different drill speed will be simulated and applied to the motor.

**Acknowledgements**
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# Knowledge Capture inside a Haptic Soldering Environment

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**Abstract**

*In the electronics manufacturing industry, soldering plays a key role in the process, whether it is carried out manually, semi-automatically or fully automatically. Even though the basic techniques in manual soldering are comparatively straightforward, to master it at a high level still requires a lot of time and effort. The research presented in this paper aims to identify the motor skills involved in soldering and the ability to recognise when a soldering process is likely to go wrong. If this soldering knowledge was able to be captured, this would allow the development of automated soldering processes that work more efficiently. By simulating the manual soldering process in a haptics environment, the aim is to employ automated user logging to investigate human hand dexterity and learn how novices and experts operate differently. A pilot study was conducted to compare users carrying out a basic soldering task in real-life and in the haptic environment. By automated parsing of the logfiles obtained from the soldering sessions, important user actions were extracted and formalised using several knowledge representations. Future work will involve developing a more sophisticated haptics environment and to conduct a more intensive user trial involving more users.*

**Keywords**: Haptic simulation, soldering, knowledge capture.

## 1. Introduction

The advent of surface-mount technology (SMT) coupled with industries' need for productivity and reliability has spawned the development of automated soldering machines. Selective soldering machines have since been developed however, no matter how technology evolves or how small components become, the decades-old hand soldering process remains.

Since the automation of the soldering process is still expensive and often inflexible, it has caused manual soldering to still be common even in high labour costs economies, particularly in low and medium volume production environments, so hand soldering is an essential process in PCB assembly and rework. However, based on feedback from industry, adaptations in equipment and techniques are needed to meet the temperature concerns of today's packages and remove any variability in the soldering process. Soldering is also a skill that must be taught correctly and developed with practice. However, if the skills involved were able to be identified more precisely, this would allow the teaching of the process to be more effective as well as aiding in the development of more efficient automated soldering processes.

In the presented research, a haptic device has been used to simulate a soldering environment, and by logging the movement of the haptic pen, the forces, velocities and motion of the user's hand can be obtained. By parsing the resultant log files, important steps performed by the user are extracted and formalised using several knowledge representation formats used in previous research (Sung et al, 2009). Through the analysis of the experimental data, the aim is to identify what is required to achieve a good soldering process.

An overview of the research in haptics and hand tremors is presented in section 2 while the haptic soldering environment is detailed in section 3. Next, details of a pilot study are presented in section 4 while the results are shown in section 5. Finally, a discussion of the results is given in section 6 and the paper ends with some conclusions.

**2. Overview of Haptics & Hand Dexterity Research**

This section will give an overview of the varied research involving haptics as well as the study of hand tremors – an important characteristic which has a significant effect on the quality of manual soldering process.

**2.1. Haptics Research**

Since the appearance of haptic devices, there has been widespread research involving the use of the technology to simulate real-world applications and to study hand motion. In one study (Broeren et al, 2007), 58 healthy subjects were required to use a haptic device to move a cursor towards several targets on a screen. The aims of the study was to investigate whether repeating the test with each subject would have any training effect, and also whether it was possible to generate the 3D trajectories of the users' hand motions. The results showed that there was good test-retest reliability, and the users' performance did improve when comparing the first and third session results of each user.

Next, a system was proposed which enabled a user to tele-operate a robot to perform the assembly of micro components (Estevez et al, 2010). A benchmark application has been created to assess the requirements of the final micro-assembly haptic system, and a micro-drive is used as the test assembly during the analysis. From the results of the analysis, it was found that most of the assembly operations involved aligning components with a vertical axis and also performing peg-in-hole operations. The system is still being designed and built so no results exist.

In another paper, a system called HAMMS (Haptic Assembly, Manufacturing and Machining System) is detailed (Lim et al, 2009). Experiments were carried out in which participants had to assemble a pump assembly in the real world and in the haptic environment and the results were compared. As well as analysis of the assembly times, the motion of the haptic pen was also studied to determine if it can be used as a gauge of how confident the user was. The experimental results showed that the haptic assembly times were generally longer than those in the real world - due to factors like haptic damping – but there were similarities in both cases when considering the overall trend of the assembly times; one example of this was that in both cases the same component took the longest time to assemble.

In the research field of virtual welding environments, a lot of work is done in this area. Whereas some systems rely on having the user operate a real welding torch that is either attached to a force feedback device (Fast et al¸2004) or is motion tracked (White et al, 2009), other systems make use of an off-the-shelf haptic device (Wang et al, 2006; Wang et al, 2009]. Furthermore, there is also research carried out on algorithms that are used to display realistic-looking weld beads (Jo et al, 2009), which is relevant to the research presented in this paper if the realistic rendering of solder flow is required.

From the review of the literature, a diverse range of research involving haptics was witnessed but there is a noticeable lack of work in the area of soldering. One system was found which used a graphics tablet instead of a haptic device to simulate the soldering process (Venkittarayan et al, 2010). The user operates the system using a stylus and the quality of the soldering can be varied by adjusting the pressure and tilt of the stylus. From the results of the user study, the feedback was encouraging but users with soldering experience found the system lacked realism compared with the real-world process. At present, the system only utilises one stylus, whereas the system presented in this paper uses dual haptic devices. Furthermore, the use of a graphics tablet means that the force feedback will be fixed in one plane – a problem not encountered with a haptic device.

Due to the small amount of research in the area of virtual soldering environments, the research presented in this paper is warranted, and based on the various successful virtual training environments in other areas such as welding, a virtual soldering system could potentially bring many important time and cost benefits.

## 3. Haptic Soldering Environment

The haptic soldering environment consists of two Sensable Phantom Omni™ devices (Figure 1) that run the software environment developed using the OpenHaptics API.

The standard configuration has the right-hand side Phantom Omni controlling the soldering iron and the left-hand side controlling the tweezer that is used to position the resistor that is to be soldered, as shown in Figure 2. Depressing a button on the left-hand side controller also displays the soldering wire so solder can be applied onto the soldering iron. The 3D model of the soldering iron was created in Siemens NX™ while the model of the printed circuit board was obtained from the Opal Kelly site (Opal, 2011). To use as a benchmark for the haptics environment, the user trial also involved performing a real-world soldering task that required each user to solder a resistor to a PCB, as shown in Figure 2.

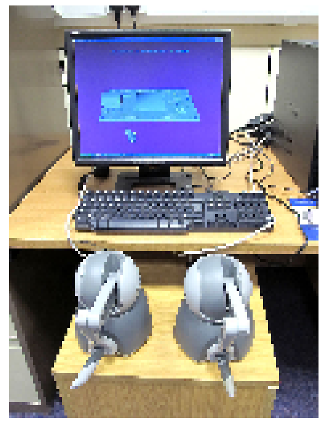

*Figure 1* - **Two Phantom Omni Haptic Devices**

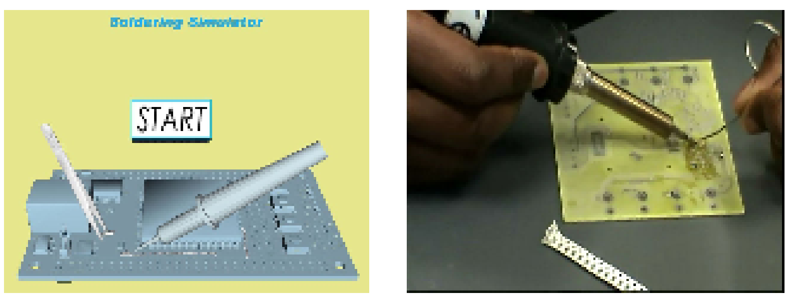


*Figure 2* – **Virtual (left) and Real-World (right) Soldering Environment**

## 4. Experimental Methodology

The pilot study involved two users with prior soldering experience carrying out a soldering task in real world and in the haptic environment. Both users were male and right-handed. User activity in the haptic environment is automatically and unobtrusively logged in the background so properties such as the force, velocity, position and angle of the haptic pen is recorded, as well as the haptic pen buttons that are pressed. Furthermore, a timestamp in milliseconds is associated with each logged action.

In the real world case, the user has to solder a resistor onto a PCB, while in the haptic environment the user has to replicate the action of the soldering process. After each user had completed both tasks, a questionnaire was filled-in, the purpose of which was to find out the following information from the participant:

- Their demographic characteristics;
- Their soldering experience;
- What they liked and disliked about using the haptic device;

- What they liked and disliked about the virtual soldering environment;
- Give comments on what improvements they would like to see in a future revision of the virtual soldering environment.

By automated parsing of the log files obtained from the haptic session using a spreadsheet macro, important user actions were extracted and formalised using several knowledge representations used in previous research (Sung et al, 2009). The representations used are:

- XML (Extensible Markup Language) (EML, 2011);
- PSL (Process Specification Language) (Gruninger and Bock, 2005);
- IDEF0 (Integrated Definition Methods) diagrams (IDM, 2011);
- DRed (Design Rationale Editor) (Kim et al, 2004;
- English-syntax instructions.

Both XML and PSL are codified representations that are used in industry (Sung et al, 2009], which means prior knowledge is required to be able to understand the representations. Unlike XML and PSL, IDEF0 diagrams and DRed graphs give a more visual representation so the processes that occurred during a soldering session can be seen at a glance. Figure 3 shows the components that make up an IDEF0 diagram but the "Call" component will not be required in this research.

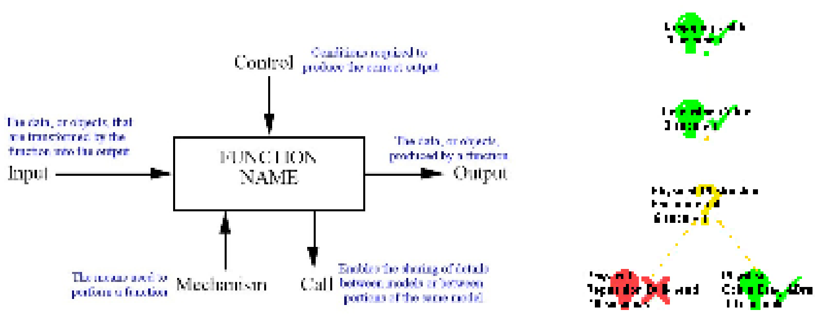


*Figure 3* – **Examples of an IDEF0 Diagram (left) and DRed Graph (right)**

DRed graphs were developed to record decisions that were made during a meeting and the graphs are traditionally manually constructed as a meeting progresses. One key benefit of DRed graphs is that as well as showing correct solutions, rejected solutions are also shown, which are indicated by a red light bulb icon next to a cross, as shown in Figure 3. This means that there is a record of any mistakes that are made so new users studying the graph can learn not to perform the same errors in the future.

In addition, the arrows connecting each node in the graph are colour-coded depending on how long the user has taken to complete a task. For example, if a task is completed quickly, the arrow is green, but if it has taken a long time, the arrow is red, which may indicate a part of the soldering process where the user is experiencing difficulty.

Finally, English-syntax instructions are another knowledge representation that is automatically output from the parsed log files to produce a document which can be easily-understood and can be used as a training aid for novice users.

**5. Results**

This section will present various knowledge representations that have been automatically generated from the automated parsing of the log files.

### 5.1. Knowledge Representations

From the automated parsing of the log files, the following knowledge representations were obtained:

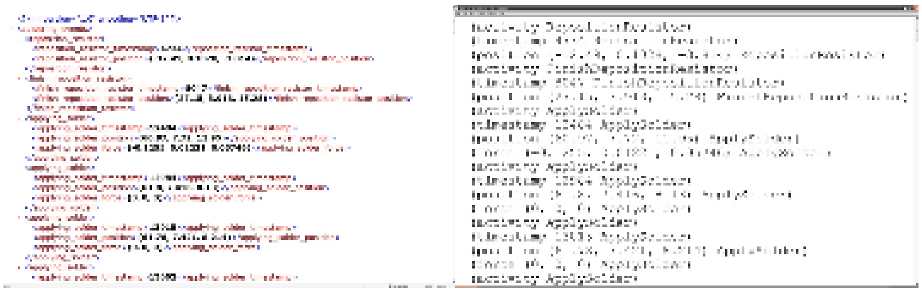

*Figure 4* – **XML (left) and PSL (right) Knowledge Representation**

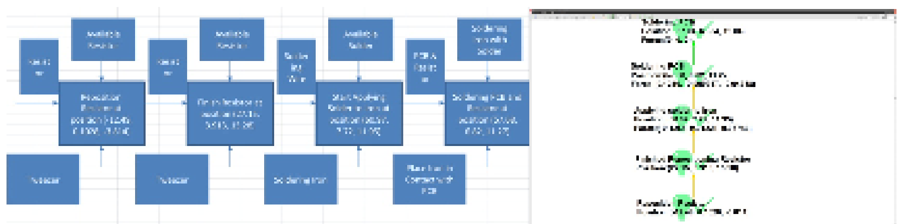

*Figure 5* – **IDEF0 (left) and DRed (right) Knowledge Representation**

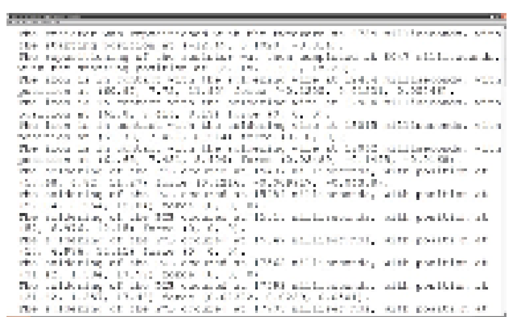

*Figure 6* - **English Syntax Knowledge Representation**

## 6. Discussion

From the preliminary knowledge representations that have been automatically generated, the fundamental processes involved during a soldering session have been extracted. In addition, important characteristics like times, positions and forces have been associated with each step to allow the soldering techniques to be studied and learned by other users. From the obtained knowledge, it is envisaged that this will aid the development of more sophisticated automated soldering machines which more closely mimic the intricate soldering techniques of human soldering experts. To also allow the information in the representations to be more easily shared with other users, as a form of training aid, the data can be stored in some form of database in a company. From previous studies on various knowledge representations (Sung et al, 2009), it was discovered that users preferred representations that had a more visual aspect to them, such as storyboards and annotated video clips, so greater focus will be placed on this in future work.

Regarding task completion times between the haptic and real world environment, it was generally quicker in the haptics environment because not all the soldering tasks have been implemented in the current setup. For example, the soldering flux paste that is required to be applied during the real world task is not modelled at present but this will be added in the next revision of the environment. Another key difference is that the flow of solder is not observed on the screen so there is no visual indication of when a solder is complete.

From the questionnaire that was completed, both participants gave positive comments on the intuitiveness, tactile feedback and graphics quality on the haptic soldering environment. However, the users also commented that they would have liked shadows to aid with depth perception as well as the ability to zoom in on and rotate the PCB model, which is not possible with the current configuration. Furthermore, both users also would have liked better modelling of the solder – such as the ability for it to melt and flow – and the ability to monitor the PCB temperature and cleanliness.

Currently, it is possible to generate a 3D scatter plot in a spreadsheet of the path followed by the haptic pen during a soldering session by utilising the log files, but since an equivalent plot for the real world soldering session cannot be generated, it is not possible to compare the soldering iron motion of the two environments. One possible solution would be use some form of motion tracking system, such as an optical tracker, to follow the path of the soldering iron so this will be investigated. In addition, another aspect of the real world soldering process which is not currently measured is the forced applied by the soldering iron, which is an important characteristic to investigate in a task that requires fine motor skills. To measure the force, one method could be attached a load cell to the printed circuit board.

Other future work will involve adding a stereoscopic view to aid with the depth perception and also the ability to alter the position and orientation of the PCB. More importantly, the vertical arm movement required by the user when operating the haptic device needs to be reduced so the user can rest their wrist on a support, which then mimics better what happens in the real world. After these revisions have been completed, a more thorough user trial involving more participants – including both novice and expert users – will be carried out.

## 7. Conclusions

This paper has presented a pilot study in which a haptic soldering environment has been developed to investigate the skills that are required to perform successful soldering operations. By identifying these skills, it will be possible to improve the efficiency of automated soldering processes.

A pilot study was carried out which compared user activity during a real world soldering exercise and one in the haptic environment. Log files of the soldering sessions were automatically parsed to generate knowledge representations using various formats. From the representations, the key steps taken by expert users during a soldering process have been captured and future work will focus on extracting more intricate detail from the log files.

Additional future work will involve adding a stereoscopic view and allowing users to manipulate the viewpoint of the printed circuit board model.

Encouraging results have been obtained from the pilot study so further investigation is essential to fully realise the potential benefits from the virtual soldering environment.

**Acknowledgments**

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# Haptic User Interfaces and Practice-based Learning for Minimally Invasive Surgical Training

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**Abstract**

*Recent advances in haptic hardware and software technology have generated interest in novel, multimodal interfaces based on the sense of touch. Such interfaces have the potential to revolutionize the way we think about human-computer interaction and open new possibilities for simulation and training in a variety of fields. In this paper we review several frameworks, APIs and toolkits for haptic user interface development. We explore these software components focusing on minimally invasive surgical simulation systems. In the area of medical diagnosis, there is a strong need to determine mechanical properties of biological tissue for both histological and pathological considerations. Therefore we focus on the development of affordable visuo-haptic simulators to improve practice-based education in this area. We envision such systems, designed for the next generations of learners that enhance their knowledge in connection with real-life situations while they train in mandatory safety conditions.*

**Keywords**: haptics, laparoscopy, surgical training, liver disease diagnosis

## 1. Introduction

Computer based simulation and training environments are primarily relying on the visual and auditory senses for human-computer interaction. The past decade has seen an accelerated evolution of both hardware and software, specifically hardware capable of simulating touch (i.e. haptics).

Haptics is the science of merging tactile sensation with computer applications, thereby enabling users to receive feedback they can feel in addition to auditory and visual cues. Multimodal environments where visual, auditory and haptic stimuli are present convey information more efficiently since the user manipulates and experiences the environment through multiple sensory channels (Hamza-Lup, 2009). Such environments were proposed, and analysed in the past decade in conjunction with medical training, specifically minimally invasive surgery. In the area of medical diagnosis, there is a strong need to determine mechanical properties of biological tissue for both histological and pathological considerations. One of the established diagnosis procedures is the palpation of body organs and tissue. Therefore we focus on the development of affordable visuo-haptic simulators to improve practice-based education in this area by proposing a simulation system for liver palpation.

The paper is structured as follows. Section 2 presents a brief review of the practice-based learning paradigm followed by the visuo-haptic user interface architecture in Section 3. In this section we also present a brief description of the main frameworks and APIs for Haptic User Interface (HUI) development. Section 4 illustrates the use of two APIs H3D and CHAI3D in the development of a HUI for a haptic liver palpation system. We conclude in Section 5 with remarks useful in the development of HUI for laparoscopic surgical simulators.

## 2. Practice-based Learning

Practice-based learning is best understood in contrast to “theory-based” learning. It is related to terms such as “work-based” or “'work-centred” learning. Practice-based learning main focus is the formation of effective and self-renewing practices, often backed by a solid theoretical foundation. Practice-based approaches potentiate understanding and knowledge retention in learning and training settings.

Recent trends related both to higher education and healthcare delivery systems have created an environment of change for medical education. Educators, physicians and administrators face a number of challenges, such as the introduction of more complicated technology with which to deliver health care, limitations on orientation times, a need to address concerns related to patient safety and quality of care - all of which require new and creative solutions.

One solution to the growing concerns linked to these trends is the advent of health care simulation and training in medical education programs and in hospitals. These simulations, which serve as adjuncts to didactic learning, represent the closest possible technology to real patients and allow for a repetitive “hands-on” learning in a safe environment where mistakes can be safely made. The students who participate in simulations gain experience and confidence on their ability to make critical clinical decisions in acute care situations, where time and skill have critical consequences.

The practice of medicine has always relied on visualizations. These visualizations have either been direct or have required extensive mental reconstruction. The revolutionary capabilities of new three-dimensional (3D) and four-dimensional (4D) imagining modalities underscore the vital importance of spatial visualization to this science (Knottnerus et al., 2008).

The introduction of the sense of touch through haptic technology in simulations opens new realms/perspectives in the endeavour of teaching and practicing medicine, specifically in surgical simulation. Depending on the specific task, force feedback can provide benefits (both passive and informational) at little cost to cognitive demand because of its intuitive nature (Wagner et al, 2005).

## 3. Haptic User Interface Architecture

HUIs rely on two components, the visual component (i.e. 3D objects and their visual behaviour) and the haptic behaviour associated with the elements of the scene. The main software components of a HUI for a virtual environment simulating surgical procedures are illustrated in Figure 1:

Multimodal input (mouse, keyboard, haptic device)
Multimodal output (3D visualization system, haptic device)
Simulation engine (rendering cycle per modality + synchronization)
Environment persistency (database).

The multimodal input component controls the user interaction devices: the keyboard, mouse, 3D navigation (SpaceMouse) and haptic device (Phantom Omni). It allows the user to express his/her actions in the virtual environemnt. The multimodal output component conveys information to the user through multiple sense: visual – the 3D visualization system, tactile – force feedback felt through the Phantom Omni device and possibly audio using external speakers.

The simulation engine consists of several cycles that interleave to generate the multimodal feedback: a graphic rendering cycle and a haptic rendering cycle (and possibly an audio rendering cycle).

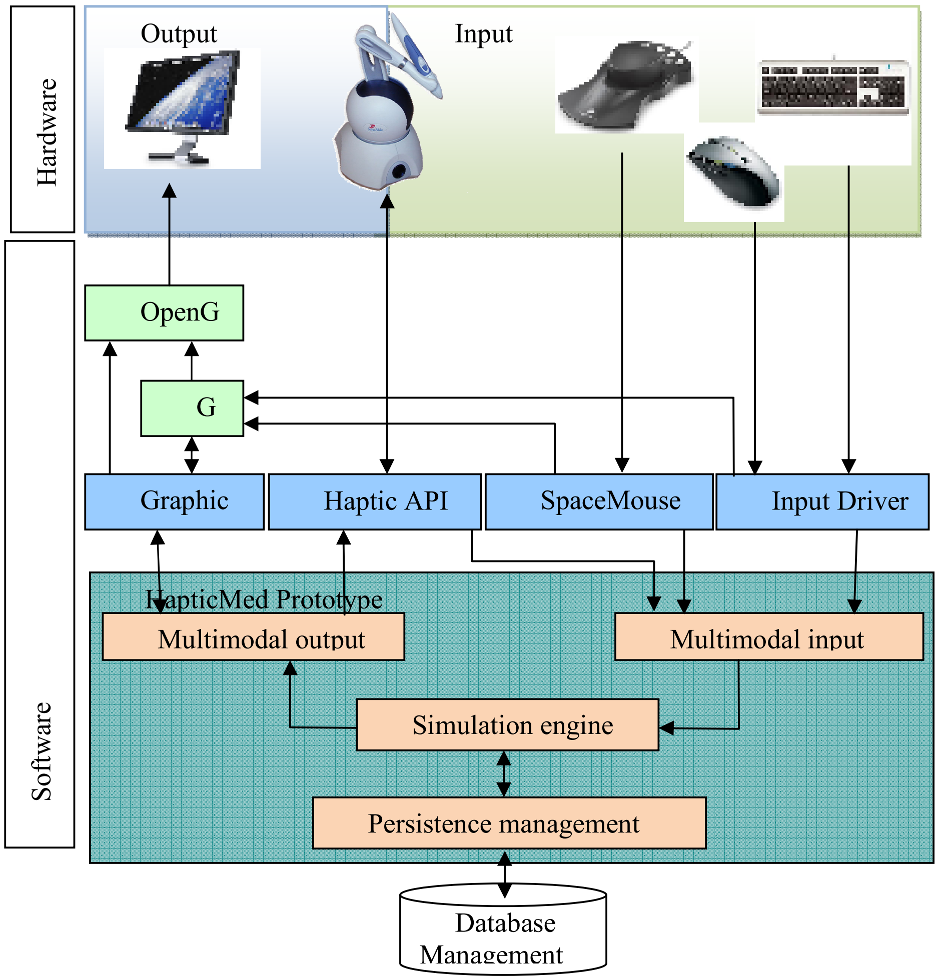


*Figure 7.* **HUI the interconnections among the software components and the hardware components involved**

The simulation engine receives the user input data from the devices through the software components associated with each device. The simulation engine will compute the behaviour and appearence of each component in the virtual environment based on specific laws of physics, collisions, providing realistic behaviour as an effect to user's actions. Specifically for surgical simulations, the tissue deformation dynamics must be accurately simulated both visually and tactile. The graphic computational cycle varies between 20 to 60 frames per second while the haptic cycle must be kept at 1000 frames per second (1KHz). The cycles must be synchronized to assure correct visual and haptic rendering. The simulation complexity as well as the surgical task accuracy requires a careful balance and tradeoff among geometric complexity, deformation accuracy and execution speed.

The simulation engine uses the Database Management System (DBMS) to store/retrieve specific elements used in the description of the virtual world. The DBMS enables actions like object geometry and object properties memorization.

### 1. 1. The Visual Component - the Scene Graph

One of the best known libraries for computer graphics development is undoubtedly OpenGL (OpenGL, 2011). OpenGL is a low level graphics library that allows development of 2D and 3D graphics using low level primitive like vertices, lines and polygons. A competitor for OpenGL is DirectX. Microsoft DirectX is a collection of application programming interfaces (APIs) for handling tasks related to multimedia, especially game programming and video, on Microsoft platforms.

While both standards have been used in computer graphics project development, new higher level standards and API have emerged in the past decade. One of the most proeminent example is the successor of VRML (Virtual Reality Modeling Language), X3D (Extended 3D Graphics) (X3D, 2011). X3D is a royalty-free open standards file format and run-time architecture to represent and communicate 3D scenes and objects using XML.

In virtual environments the visual component is usually quite complex. In order to cope with such complexity a specific data structure is necessary. A scene graph is a general data structure commonly used by vector-based graphics. The scene graph is a structure that arranges the logical and often spatial representation of a graphical scene.

A scene graph is a collection of nodes in a graph or tree structure. A node may have many children but often only a single parent, with the effect of a parent applied to all its child nodes; an operation performed on a group automatically propagates its effect to all of its members. A common functionality is the ability to group related shapes/objects into a compound object that can then be moved, transformed, selected, etc. as easily as a single object.

This scene graph is augmented with tactile attributes corresponding to virtual objects that the user manipulates inside the virtual environment. To employ the haptic paradigm in the simulation one needs to use a haptic-oriented framework.

### 1.2. The Haptic Component – Toolkits, APIs and Frameworks

In recent years as the haptic (force feedback) paradigm became more popular, several APIs and later frameworks have surfaced. We explored the most actual haptic frameworks and APIs and compared their features and capabilities. In the following paragraphs we provide a brief description of each framework and API investigated along with their main architecture.

#### *1.2.1. OpenHaptics Toolkit*

The OpenHaptics toolkit (OpenHaptics, 2011) developed by SenseAble Technologies includes the QuickHaptics interface, the haptic device interface (HDAPI), the haptic library interface (HLAPI) as well as utilities and drivers for the Phantom haptic device family. The toolkit is backed by a solid documentation and a programmer's guide. The toolkit architecture is illustrated in Figure 2.

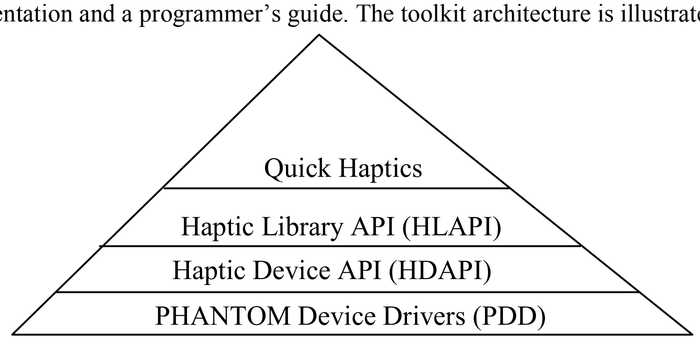


*Figure 8*. **OpenHaptics toolkit - architecture**

The HDAPI provides low level access to the haptic devices. The programmer can replay forces on the device and has access to the device driver configuration settings and debugging support. The HLAPI covers haptic feedback at a higher level and requires OpenGL development knowledge. QuickHaptics allows haptic application development or extensions for existing applications.

### *1.2.2. ReachIn API*

The ReachIn API (Reachin, 2009) is a modern development platform that enables the development of sophisticated haptic 3D applications in the user's programming language of choice, such as C++, Python, or VRML. The API provides a base of pre-written code that allows easy and rapid development of applications that target the specific user's needs. UK Haptics (UK Haptics, 2011), a recently established medical software development company, used ReachIn API as the core haptic technology platform for their Virtual Veins project, a medical simulation package for training medical staff in catheter insertion.

The ReachIn API (illustrated in Figure 3) is organized as follows:

External device interfaces: haptic, graphic, audio and other non-haptic devices.

The rendering engine synchronizes three rendering cycles: haptic, graphic and audio or a cycle without haptic devices.

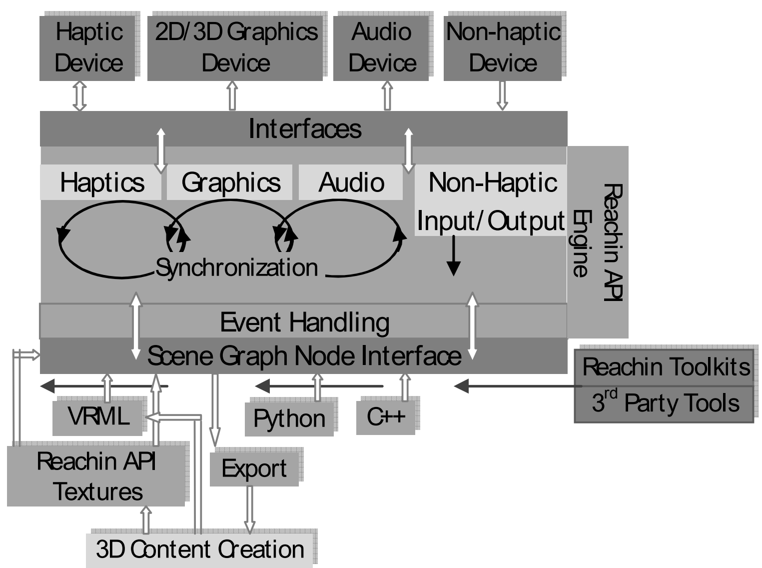


*Figure 9*. **ReachIn API – architecture**

The simulation engine follows the scene graph to find and execute the graphic and haptic routines based on the scene structure. The node is the structural unit and stores the visual and haptic properties for each object in the scene.

### *1.2.3. Haptics 3D API*

Haptics3D (H3D, 2011) is one of the best-known open source APIs that bridges OpenGL and X3D with haptic components. Figure 4 illustrates the architecture of H3D.

This API is designed mainly for users who want to develop haptic-based applications from scratch, rather than for those who want to add haptics to existing applications. The main advantages of H3D are the rapid prototyping capability and the compatibility with X3D, making it easy for the developer to manage both the 3D graphics and the haptic rendering. H3D API uses the X3D and OpenGL standards and builds on haptic technology from SensAble's OpenHaptics™ toolkit (OpenHaptics, 2011). It allows users to focus their work on the behaviour of the application, and ignore the issues related to haptics geometry rendering. The API is also extended with scripting capabilities, allowing the user to perform rapid prototyping using the Python scripting language.

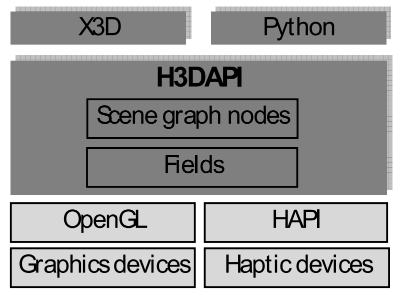


*Figure 10.* **H3D API - Architecture**

### *1.2.4. Computer Haptics and Active Interfaces Framework*

Developed with medical applications in mind, the Computer Haptics & Active Interfaces (CHAI 3D) (CHAI3D, 2011) is an open source set of C++ libraries supporting haptic-based systems, visualization, and interactive real-time simulation. The API facilitates the integration of 3D modeling with haptic rendering. Moreover, the applications are portable and can be executed on different platforms. This quality attribute is obtained by saving object characteristics in XML files. The applications can be tested using a real haptic device (e.g., PHANToM Omni), or a virtual representation using the mouse as a substitute for the haptic device. The API was recently extended with a simulation engine for rigid/deformable objects.

CHAI3D supports multiple commercial interfaces (e.g. IEEE 1394, Servo2Go, Sensoray626) facilitating haptic device connection with the application. The framework can be extended using ODE modules. (ODE, 2001) is an open source, high performance library for simulating rigid body dynamics. It is fully featured, stable, mature and platform independent with an easy to use C/C++ API. It has advanced joint types and integrated collision detection with friction.

CHAI3D architecture is organized as a set of packages (as illustrated in Figure 5) that contain classes and interfaces for 3D scene development and for the application of material properties on the objects in the scene. For example, the InPort package contains classes that support the I/O device communication e.g. mouse, joystick, glove and the Phantom Omni haptic device.

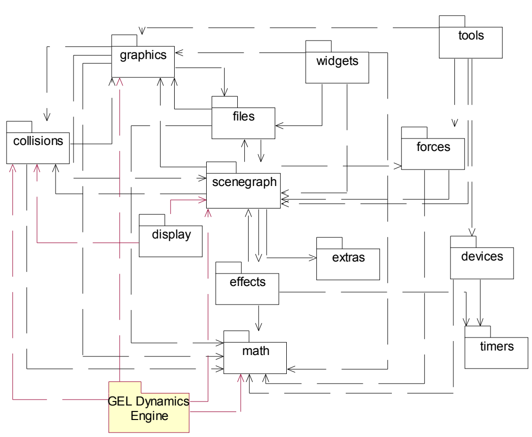


*Figure 11.* **CHAI3D framework – architecture**

### *1.2.5. Simulation Open Framework Architecture*

The need for standardization and inter-project cooperation gave rise to the Simulation Open Framework Architecture (SOFA, 2011). SOFA is targeted at real-time simulation, with an emphasis on medical simulation. It allows the development of multiple geometrical models and the simulation of the dynamics of interacting objects using abstract equation solvers. An additional advantage of this framework is the use of the XML standard to streamline the parameters of the simulation like deformable behaviour, collision algorithms, and surface constraints.

Objects representation is represented through several models: a dynamic model, where the object mass and composition are specified, a collision model, used to compute the object collision behaviour, and a visual model, containing the object's geometry (Figure 6).

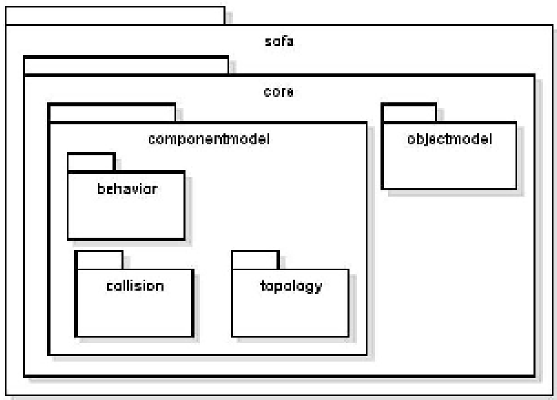


*Figure 12*. **SOFA framework – architecture**

***1.2.6. General Physical Simulation Interface***

Another effort targeted at applications of haptics in surgical simulators is the General Physical Simulation Interface (GiPSi, 2011). It is a general open source/open architecture framework for developing organ level surgical simulations. The framework provides an API for interfacing dynamic models defined over spatial domains. It is specifically designed to be independent of the specifics of the modeling methods used and therefore facilitates seamless integration of heterogeneous models and processes. The framework contains I/O interfaces for visualization and haptics integration in applications, a set of modeling and computational tools and a simulation kernel as illustrated in Figure 7.

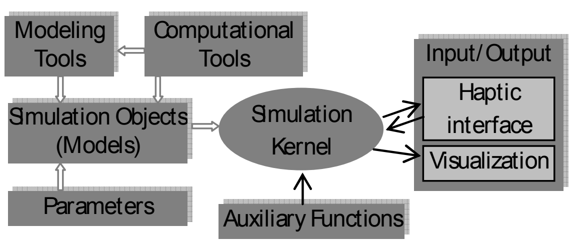


*Figure 13*. **GiPSi framework - architecture**

GiPSi is known for the simulation of internal organs specifically the heart (Cavusoglu, 2004).

In the context of the HapticMed project (HapticMed, 2011) we are focusing on the development of a set of simulation tools for minimally invasive surgical training. Laparoscopic procedures are frequently used in surgical treatment of liver diseases.

## 4. Haptics@work – Liver Diagnosis through Palpation

The liver is the largest organ in the human body. During development, liver size increases with increasing age, averaging five centimetres span at five years and attaining adult size by age fifteen. The size depends on several factors: age, sex, body size and shape, as well as the particular examination technique utilized (e.g., palpation versus percussion versus radiographic). By percussion, the mean liver size is seven centimetres for women and about ten centimetres for men. A liver span two to three centimetres larger or smaller than these values is considered abnormal. The liver weighs 1200 to 1400 g in the adult woman and 1400 to 1500 g in the adult man (Gilbert, 1994).

The normal liver is smooth, with no irregularities. When the liver can be felt, it is usually due to:

increased diaphragmatic descent;

presence of a palpable caudate or Riedel's lobe;

presence of emphysema with an associated depressed diaphragm;

thin body habitus with narrow thoracic cage;
fatty infiltration (enlarged with rounded edge);
active hepatitis (enlarged and tender);
cirrhosis (enlarged with nodular irregularity);
hepatic neoplasm (enlarged with rock-hard or nodular consistency).

In laparoscopic surgery internal tissue palpation is an important pre-operatory activity (Kim et al, 2004; Khaled, 2004). The normal liver may be slightly tender upon palpation, but the inflamed liver (hepatitis) is often exquisitely tender. The nodularity, irregularity, firmness, and hardness of the liver can be characterized.

In the framework of the HapticMed project we have designed a visuo-haptic prototype for liver palpation. We have implemented a 3D deformable model of the liver. The simulator replicates several disease conditions that must be recognized by the user. The final goal is to provide an advanced testing mechanism to assess medical student knowledge related to liver pathology. The simulator was implemented using H3D API as well as the CHAI3D framework to provide us with additional information regarding ease of development using different software systems.

### 1.3. Prototype Implementation with the H3D API

The H3D implementation relies on a deformable mesh model. The liver 3D model uses the X3D (X3D, 2011) triangle set. We started with a 40.000 polygonal model and we reduced it to 3.200 in order to obtain real-time deformation behaviour. The deformation algorithm is a classic spring-damper, meaning that the haptic device will render a force directly proportional with the penetration distance into the deformable object (illustrated in Figure 8).

Two important parameters when implementing a deformable 3D object is the object's surface type and its stiffness. The first one defines the visual and haptic properties at touch while the second one is part of the deformation algorithm that provides visual as well as force feedback during object palpation and/or penetration.

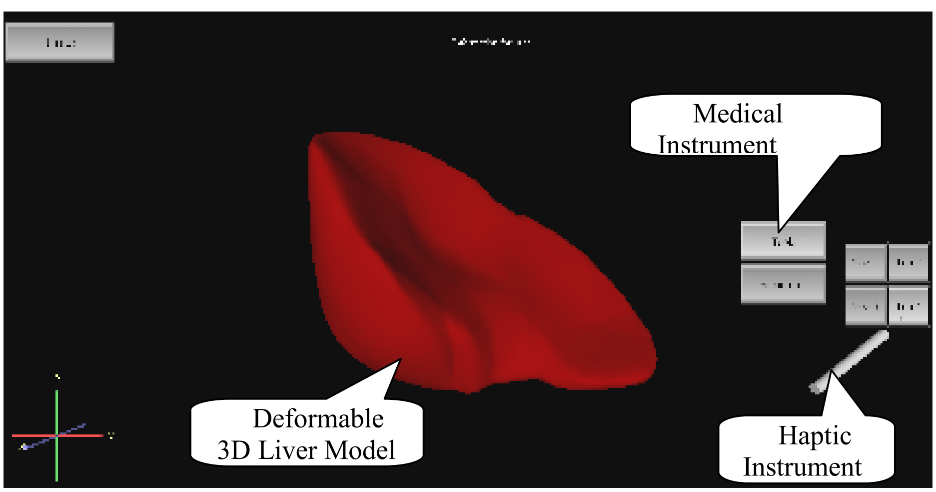


*Figure 14.* **HUI liver palpation simulator with H3D**

The H3D API provides an easy solution for visuo-haptic deformation through the use of the DeformableShape node that uses two kinds of geometries: a haptic geometry and a visual geometry.

### 1.4. Prototype Implementation with the CHAI3D Framework

CHAI3D haptic deformation we relies on the GEL framework based on a set of nodes (spheres) attached with springs as illustrated in Figure 9.

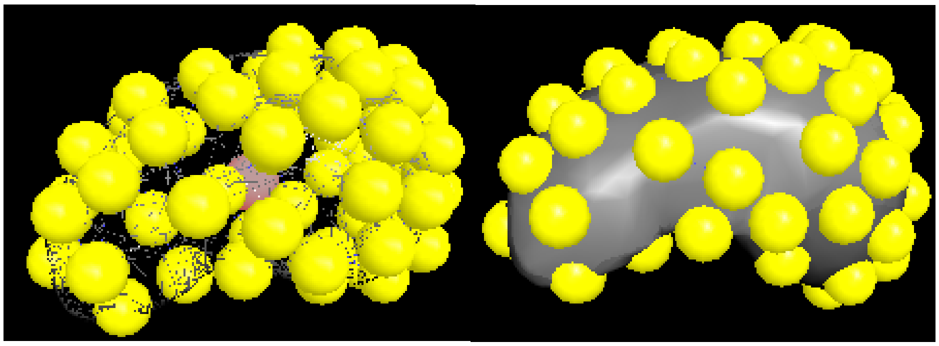

**Figure 15. HUI liver palpation simulator with CHAI3D (wireframe-left)**

In this framework the real-time deformation of a complex structure is possible through spherical skeleton models. Collision detection between different objects can be effectively estimated by computing the collision between their skeletons.

For the liver dynamics simulation we employ three spring connectors for each node. The nodes are spread on the surface of the liver taking in consideration the distance between two nodes, such that we obtain a uniform distribution as illustrated in Figure 9. We are in the process of adjusting the spring model damping factor to obtain a realistic behaviour for the liver deformation and for force feedback computation.

### 5. Conclusion

The potential of haptic interfaces in support of practice based learning is proved more often in medical training. Even if the haptic hardware is more affordable, the development of haptic based simulations is hampered by the lack of existing software adaptability and extensibility.

We are in the process of developing and assessing a set of simulation tools for minimally invasive surgical training which are both useful and affordable for large scale deployment in hospitals.

### Acknowledgments

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# A Brief Survey of Visuo-Haptic Simulators for Dental Procedures Training

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**Abstract**

*Recent advances in haptic technology and the wider availability of the haptic devices allow developers to construct visuo-haptic interfaces and simulators employed to simulate especially medical procedures. The visuo-haptic simulators combine visual and tactile information and provide training scenarios which help gaining or improving the trainee's skills. In this paper we review visuo-haptic simulators for dental skills training. We explore these systems focusing on the simulated dental procedure, the models of the real objects from both perspectives: visual and haptic, and the system evaluation. Regarding the evaluation we were interested in the methodology employed for evaluation, the number of evaluators considered in the process and its results. The results showed that the visuo-haptic simulators may help trainees to develop dental skills and most of the existent systems need to be improved in order to provide realistic simulations.*

**Keywords**: haptic feedback interface, visuo-haptic simulator, dental training

**Introduction**

Sense of touch has four submodalities: cutaneous, kinesthetic, proprioceptive, and pain.

Cutaneous sense is stimulated upon contact with an object to feel the surface properties (like smoothness, slippage, and texture) and surface temperature of the object.

Kinesthetic sense is stimulated by both hand and body movements and tensions. If the hand is moving on the surface of an object, we can identify shape, surface roughness, contact pressure, weight and inertia of the object.

Proprioceptive sense refers to sensing the user's body position or posture. It is stimulated by receptors placed in muscles, tendons and joints. Proprioception provides spatial and motor information about object properties – also interaction is strongly based on the forces experienced during touch action.

Because of differences in the submodalities there are two types of interfaces in virtual reality applications:

- Interfaces with tactile feedback, which combine the cutaneous and kinesthetic senses. They are used in applications to explore the contact surface of a virtual object;
- Interfaces with force feedback, which combine the proprioceptive and kinesthetic senses. They are only used in applications where contact forces are given during the user interaction.

These types of interfaces can be built independently or can be combined. When combined, they are called haptic feedback interfaces.

The classic setup of a haptic feedback interface supposes the existence of 3D (stereoscopic) visual rendering (formed by stereoscopic display, polarized mirror and stereo glasses) together with a haptic interaction device (a metaphor of the real tool) (**Error! Reference source not found.**).

The user actions are expressed using the haptic interaction device which is part of the human interface devices category. This device is also a rendering one, since it is used to give a haptic feedback to the user as consequences of his/her actions. The user is also aware of the simulated environment's reactions through visual connection.

### 1.1. Visuo-Haptic Simulators

In order to treat visuo-haptic simulators term we need to briefly review multimodal and visuo-haptic systems.

Multimodal system is a software system enhanced with multimodal capabilities for human/machine interaction and it is capable to interpret information gathered through different communication and sensorial ways.

Visuo-haptic system is a multimodal system that provides the capabilities of (immersive) graphical rendering of objects, and computation and haptic rendering of virtual objects by the system as an answer to the user's actions. Forms of answer are: force, topological changes, etc.

It can simultaneously receive input from the haptic interaction device, and output results as forces to the haptic interaction device or as 3D images to the stereo display. In some cases visuo-haptic systems may also output sounds to the user (**Error! Reference source not found.**).

Visuo-haptic simulator is a visuo-haptic system that simulates the structure and the functions of a real operation or process, etc., used for training or testing.

The system is responsible with the coherence between the simulated environment outputs and the user input. To this end, the challenge for a visuo-haptic simulator to be successful is, first of all, to synchronize visual collision and deformation with tactile feedback, each of these signals at a proper frequency. The collision between the virtual tool manipulated by the user through the haptic interaction device frequently produces local shape deformations on the virtual object geometry. These shape changes depend on object entropy and are counted in visuo-haptic simulator generated multimodal feedback. Here the simulator manages aspects such as friction, stiffness, viscosity and elasticity in order to compute the forces that have to be returned at haptic device level as reactions to the user actions.

The role of simulators has been recognized as an important aspect of training in the health field that supports and improves the patient safety (The National Institutes of Medicine, 1999).

In this paper, we provide a survey of visuo-haptic simulators for dental skills training. We explore these systems focusing on the dental procedure simulated, the real objects modelled from the both perspectives: visual and haptic, and the system evaluation.

The paper is structured as follows. In Section 2 we provide a brief survey of dental visuo-haptic simulators. Section 3 summarizes the results of the evaluation of some visuo-haptic systems. The paper ends with conclusions and bibliography.

## 2. Brief Survey of Visuo-Haptic Simulators for Dental Training

Acquiring abilities and skills to perform dental procedures is essential for dental students. To date, these are gained in the laboratories of the dental medicine faculties in two stages. In the first one, dental students are trained on artificial teeth—sometimes placed within a manikin head—using real dental instruments, like burs, etc. The artificial models cannot provide the level of detail and material properties of real life teeth and procedures.

In the second stage, the students perform dental procedures on real patients under the close supervision of their professors. So, the students go through a trial and error process achieving better and more consistent experience and safety performance of medical procedures.

Haptic feedback interfaces have been introduced between the two instruction stages with better outcomes and less medical errors according to (Buchanan, 2001), (Leblanc et al, 2004) and (Jasinevicius et al, 2004). Instead of using real burs on patients, the trainee holds the haptic device stylus which has as virtual representation 3D models of real dental tools (burs, diamond tools, bevel instruments, etc.) and executes movements over virtual models of human teeth or mouth. Depending on the simulated dental procedure, the feedback of the employed simulator is represented by topological changes of the tooth structure or forces (sensations) in the hand of the trainee. The sensations are similar with those felt by the trainee when he/she executes the same dental procedure on a patient.

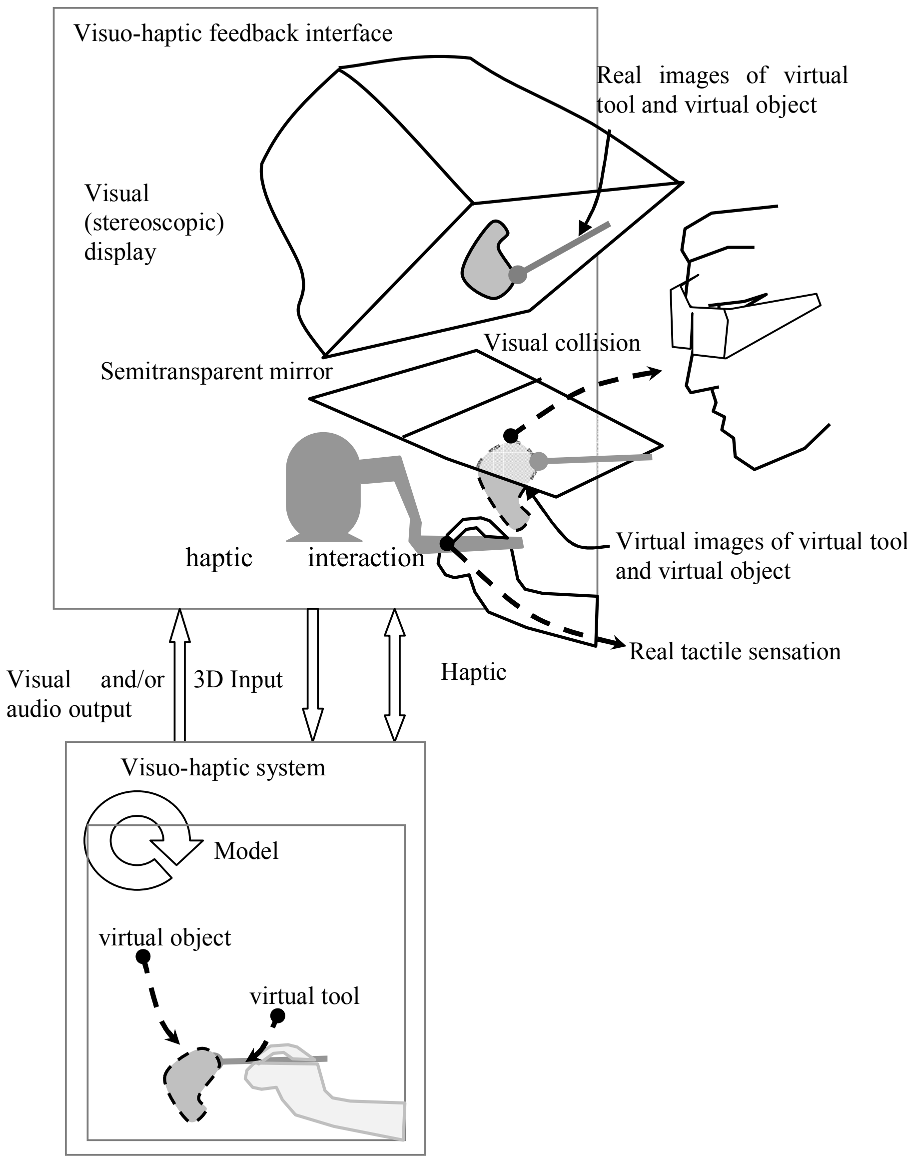


*Figure 16*. **The link between a visuo-haptic interface and a visuo-haptic simulator**

**1.2. Dental Visuo-Haptic Simulators**

The followings are some of the most well-known haptic-based dental simulators developed until now. After a brief description, for each simulator we focused on the simulated dental procedure, the real objects modelled by the system and, in the next section, the results of the system evaluation. This activity has been carried out after training sessions performed by evaluators.

One of the most important skills for any dentist is the ability to prepare and restore damaged tissue resulting from carious lesions. To date, this skill can be achieved by employing one of the next dental haptic simulators.

Virtual Reality Dental Training System (VRDTS) has been developed by Novint Technologies and the Harvard School of Dental Medicine (Novint Technologies, 2011). It simulates the tissues which form the tooth structure (enamel, dentin, and pulp), the carries and the amalgam material that the trainee has to employ to fill a decayed tooth. The system also simulates dental instruments (explorer, drill, carrier, tamper and carver) enabling a trainee to practice cavity preparations.

Iowa Dental Surgical Simulator (IDSS) has been developed by the College of Dentistry at the University of Iowa in collaboration with the Graphical Representation of Knowledge (GROK) Lab (Iowa Dental Surgical Simulator, 2011). The trainee employs a joystick and a modified handle from an explorer, a dental instrument with which he or she can explore tooth surfaces for carious lesions. During the exploration, he or she can feel healthy enamel, healthy dentin and carious dentin of a virtual tooth (Thomas et al, 2001).

During the HapTEL (haptics in technology-enhanced learning) project (HapTEL, 2011) a visuo-haptic system has been developed in order to teach dental students how to operate the drill. The students feel the difference between drilling hard enamel and softer decayed tooth and gain experience in how much pressure is needed.

The dental drilling simulation for the cavity preparation is also provided by the Virtual Dental Patient system (Marras et al, 2006). The trainee can perform drilling operation directly on the virtual model of tooth using either the mouse or the stylus of a Phantom Desktop haptic device. In the second case, the virtual representation of the stylus is the model of a dental bur. Holding the stylus, the trainee feels the contact/resistance forces which were calculated depending on the properties (stiffness, static and dynamic friction) of the objects.

The removal of caries at various locations is also simulated by the VOXEL-MAN Dental (VOXEL-MAN Dental, 2011). In order to perform the dental procedure, the trainee employs the stylus of a haptic device to make cavities in the decayed teeth. The stylus has as virtual representation on the 3D display virtual models of burs of various shapes which are controlled by a foot pedal, as well as a dental mirror.

Another study has proposed a visuo-haptic system that simulates probing and cavity preparation (Konukseven et al, 2010). To this end, the properties of enamel, dentin, pulp and carries were modelled and a trainee can feel the differences among these tissues. The system also renders 3D models of maxillary and mandibular dental arches and various dental instruments such as mouth mirror, probe and dental drills.

The same process of drilling and removing of carious lesions is also simulated by the system introduced in (Kim et al, 2005). In order to increase the realism of the application, a drilling sound plays when the virtual drill collides with the virtual tooth.

Simodont Dental Trainer simulates tasks for removal of tooth decay, filling cavities or crown and bridge preparation (Moog Inc., 2010).

Achieving the skills needed to differentiate pathological and normal conditions, as well as to diagnose and treat periodontal diseases, can be realized by employing one of the two visuo-haptic systems: PerioSim (Steinberg et al, 2009) and a periodontal simulator.

PerioSim has been developed at the University of Illinois at Chicago through the collaboration between the Colleges of Dentistry and Engineering (Steinberg et al, 2003). The application simulates clinical periodontal procedures, such as periodontal probing, the use of the periodontal explorer in the detection of subgingival calculus and a variety of other subgingival topographies (Steinberg et al, 2007).

The periodontal simulator was designed and implemented by the Electronic Visualization Laboratory of the Department of Computer Science, the Industrial Virtual Reality Institute of the Department of Mechanical and Industrial Engineering, and the Department of Periodontics at the University of Illinois at Chicago (Luciano, 2006). The application simulates three dental instruments: a periodontal probe, a scaler and an explorer. With the first tool, the trainee measures the pocket depth and determines the tissue health and, in case of pathological situations, the severity of the periodontitis. The second one is used by the trainee to feel the virtual calculus on the root surface. With the same instrument, the trainee removes plaque and calculus from below the gum line. The third one may be employed to determine if the calculus has been completely removed. The periodontal explorer is also used to evaluate the area of the root surface covered by the gingiva to assess for the presence of dental caries on the root surface, assess abnormalities in root morphology and evaluate the presence of improperly finished dental restorative margins (Luciano, 2006).

The system presented in (Wang et al, 2003) simulates two operations used in surgical dental training: probing and cutting using a high-speed rotating tool. These are essentially performed in cavity preparation and other procedures.

The cutting tool is simplified to the geometry of a sphere. The centre of the sphere is corresponding to the top of a Phantom stylus.

The cutting procedure for tooth preparation is also simulated by the system proposed in (Rhienmora et al, 2008). The trainee performs the cutting operation with a cylindrical bur on one of three of maxilla (upper) teeth. The system has been enhanced to include: a) a virtual mirror that is optionally controlled by a second haptic device; and b) a video see-through head-mounted display (HMD) with an attached monocular camera. Real-time head tracking is made possible by continuously grabbing camera images, detecting augmented reality markers, and registering the 3D tooth accordingly (Rhienmora et al, 2010).

The same cutting procedure of a tooth is simulated by the HAP-DENT system (Yoshida et al, 2011). The procedure is performed by a trainee that uses the stylus of a haptic device to control the bar mounted on a turbine and to feel a feedback force.

Preparation of primary tooth stump is an important skill for performing the dental restorations. The other skills needed to prepare teeth for ceramic crowns are given in the paper (Bogdan and Popovici, 2011). Acquiring these skills by trainees is the main objective of using the virtual and augmented reality technologies in therapeutic interventions simulation in the fixed prosthodontics (VirDenT) system. The dental instruments (such as turbine and counter-angle hand piece with multiplication) needed in all-ceramic prosthetic restorations were modelled. To date, a trainee can carry out the procedure only on the virtual central incisor, but in the near future the procedure will be realized on other two teeth: first premolar and first molar.

## 3. Simulators Evaluation

Most of the dental simulators reviewed in the previous section have been evaluated by trainees, novices and/or experts. The evaluation objective is to prove the effectiveness of the system for training tactile skills to dental students. Table 1 summarizes the results of the evaluation of some previously reviewed visuo-haptic simulators.

*Table 1*. **The results of the evaluation of some visuo-haptic dental simulators**

| Visuo-haptic | Assessment procedure | Number of | Results |
|---|---|---|---|

| simulator | | trainees | |
|---|---|---|---|
| IDSS | Questionnaire with 10 items related to the realism of the simulator execution, the usage of the haptic stylus and the importance of different improvements to the simulator. | 12 | The trainees were generally satisfied (Thomas et al, 2001). |
| (Konukseven et al, 2010) | Questionnaire with 25 items intended to measure the usability, clarity, effectiveness, supportive-ness of the system and satisfaction of the users. | 10 | The system needs further improve-ments (Konukseven et al, 2010). |
| PerioSim | Questionnaire with 36 items intended to measure the realism of the simulation and the usefulness of this kind of simulators (Steinberg et al, 2007). | 30 | The simulation is realistic, excepting the visuo-haptic ren-dering of the gingi-val soft tissues. |
| Periodontal simulator | Questionnaire with 7 items and a survey with ranking questions. | 43 | The virtual reality environment and haptic feedback were realistic enough to serve as a useful instruction tool with high teaching potential on periodontal procedures (Luciano, 2006). |

## 4. Conclusion

The evaluation results showed that the visuo-haptic simulators may help trainees to develop their dental skills. However, in order to assure the realism of the dental procedures simulated, more hard work is required to develop the visual and haptic components of the simulator and to properly synchronize them.

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# VirTeaSy a haptic simulator for dental education.

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**Abstract**

*Implantology is now in full development. However, although different types of training exist, they all suffers from the same problem: the training by practice. The aim of the project VirTeaSy is to propose for the implantology a solution of global formation, using virtual reality. This article will show the VirTeaSy project from a technical and educational point of view; and explain the contribution of the activity analysis in the design of the simulator.*

**Keywords**: dental surgical simulators, haptic feedback, virtual reality, VET, Activity analysis

## 1. Introduction

Implantology is a technique which consists in drilling the bone, to put in a titanium artificial root supporting a prosthetic tooth. It includes (1) a phase of planning to make decision on the type of implant and (2) a surgical phase incorporating a set of surgical procedures. This technique is now in full development. A study by the Conseil National de la Formation Continue Odontologique (2009) indicates that training in implantology correspond to 48% of all training opportunities offered to dentists in 2008.

The training development coming from implantology is not or almost not teached in universities. Thus, implantology is taught to dental surgeon in activity. There are three categories of training. Universities offer a 2 years training to pass a diploma. A training is also offered by private formation center or implant manufacturer. Finally the third type is assured by different associations.

In spite of the huge variability between the trainings in term of theoretical contents, time of training or, implemented pedagogy; they all use the same method for practical teaching: plastic jaw, human or animal corpse, or operate under the supervision of an expert. However these three solutions have limits. The plastic jaws don't give a good enough haptic feedback and don't have good support points. Practicing on corpse is expensive, difficult to organize, and you can't reuse them. In consequence, most students are followed by experts. However, this solution also provides problems: availability of experts, lack of training on certain conditions, risk to the patient involved in a learning situation, training situations not built for educational purposes (Vadcard, 2005).

The VirTeaSy project is developed by DIDHAPTIC1 and is on the market. This project treats all the difficulties that implantology meets using virtual reality. In fact, as we can see in many researchs (Fuchs, 2006 ; Ost & al, 2001 ; Datta & al, 2002): virtual reality is nowadays a serious alternative for pratical training. The objective of the VirTeaSy Project is to design a simulator to

1 http://www.didhaptic.com/?lang=fr

teach implantology. Therefore, this simulator is within the field of VET (Virtual Environment for human Teaching). This simulator is provided with a software to help planning operations and a virtual 3D environment, and an arm force feedback to improve the hand skills. The training offer by the simulator is in 2 phases: decision making and surgery performing.

The aim of this article is to present the VirTeaSy project and to show the contribution of the activity analysis in the design of the simulator. Section 2 presents existing simulator in implantolgy and reviews the pedagogical relevance of each simulator. Educational and technical dimension will be presented in section 3. And in the last section, we will explain the contribution of the activity analysis in the design of the simulator.

## 2. Overview and limits of implantolgy simulators.

The use of virtual reality technology has become common in various fields such as aviation, driving or military settings (Salas et al., 2002), but also in the medical field (Liu et al, 2003). Specifically in the field of dentistry, solutions using virtual reality techniques are tested (Luciano, 2006). These solutions borrowed techniques developed in other medical fields: endoscopy, endovascular surgery, hysteroscopy and laparoscopy. Even though complex and realistic medical simulators are becoming more and more common in medical education, the use of simulator in the field of implantology has not been well exploited yet (Luciano, 2009).

Before starting the state of the art, it is important to define the word « simulator ». Simulator is an experimental device or a computer program that can reproduce the real performance of a device for study, demonstration or explanation; using a model or a computer program (Silveira, 2004, p72). So, it is not just computer simulator.

The next state of the art focuses on the simulators for implantology (and dentistry) and review the pedagogical relevance of each simulator. For a complete review of surgical simulators in the medical field, see Silveira (2004) and Vidal et al (2004).

### 2.1. Typology of implantology simulator.

Simulators can be classified into four categories (Silveira 2004): The anatomical simulator (AS), the virtual simulator (VS), the virtual simulator with force feedback (VSFF), and anatomical virtual simulator (AVS).

#### *2.1.1 Anatomical Simulator (AS) :*

This simulator is the simplest. It consists of a model representing the anatomy of humans. This type of simulator is called "passive" because there is no interaction with the operator. It may be plastic, cloth, rubber, or deformable materials such as silicone or latex. This type of simulator does not have a visual system.

The system "DSEplus" by Kavo2 attempts to overcome the difficulties associated with plastic jaws. This system simulates a patient and a complete unit of dental care. The student can adjust the position of the patient, has a suction module, pressurized water module, the entire implantology kit and a foot switch to activate the engine dental hand piece. The mannequin is made of rubber. It includes a plastic jaw as the student can drill using suitable support points. However, this system is rarely used in training in implantology since it was originally designed for dentistry. Moreover, the trainers do not consider useful to make the changes necessary to perform implantology gestures with plastic jaws, given their limitations.

The virtual simulator refers to the use of computer tools. They don't provide interactivity with the operator, except a 3D interface for viewing data. Some of these simulators can be based on mathematical models representing the anatomical and biomechanical behavior of bodies.

2 http://www.kavo.com/Default.aspx?navid=5210&oid=002&lid=fr

The anatomical virtual simulators combine the advantages of anatomical simulators (immersion and interaction with real environment) and benefits of information technology (transducers position and pressure). These simulators are called "active" because they take into account the actions of the operator. They increase the immersion of the operator through the haptic interface, graphics (3D display) and acoustic.

These simulators have the same characteristics that virtual simulator, in addition they provide a force feedback that allows the user to interact with the virtual environment and to feel its movements.

To our knowledge, this type of system doesn't exist in implantology. However, there is an example in dental field: Haptik3 system developed by the company Digisens. It consists of a computer screen with a 3D stereoscopic view of objects, and an arm force feedback in three degrees of freedom for tactile sensations. However, the educational content of this simulator was limited to one exercice. This has greatly limited its use..

The virtual simulator with force feedback seems to offer a real interest in implantology, provided it has an educational content. Because first, they can resolve the majority of problems of other systems and secondly, they can respond effectively to the difficulties identified in the training practical for implantology. The VirTeaSy project is a response to the current lack of such a training solution to the implantology.

## 3 The VirTeaSy project : technical and pedagogical point of view

### 3.1 Objectives of VirTeaSy

The objectives of VirTeaSy project is to design a virtual simulator with force feedback for the overall training in implantology. The simulator is intended to train dentists: first in planning the surgery, without 3D interface, based on a set of clinical cases representing the main cases found in practice, and secondly surgical procedures with good feelings and points support representing the different contexts of intervention on human jaws.

To do this, the VirTeaSy project consists of two subsets: VirTeaSy Scan Implant and VirTeaSy Implant Pro. Each subset has a specific hardware and different features but the whole is complementary.

### 3.2 VirTeaSy Scan Implant

VirTeaSy Scan implant is also called the "student workstation". Its function is to allow the student to choose a clinic case from a database to treat it; to plan this event, comparing his plan to that of an expert and finally to view information on the assessment of its virtual surgery.

The logic of VirTeaSy Scan implant is teaching the treatment planning, remaining as close as possible to traditional training. In a traditional training, the students learn to plan with slices of scanner, and layers representing the database of implants (shape, diameter, length). Planning occurs in two steps: (1) put the slices of the scanner on a X-ray illuminator, select the work slice , and superimposed the layers of the implants. (2) Choose the appropriate implant according to the theoretical rules of implantology.

To follow up the process of traditional training, VirTeaSy Scan Implant was designed as a true "numerical X-ray illuminator". Indeed, the student sees on the touch screen the different slices of the scanner, selects those who are interested in superimposed digital layers representing implants and determine the appropriate implant. Once planning is complete, the student knows the characteristics (shape, diameter, length) of the implant to perform, and its location (location, angle, depth-landfill) in the jaw.

According to the willingness of teachers in implantology, VirTeaSy Scan Implant does not provide 3D reconstruction of the jaw (see Fig. 1). Therefore the student must be able to achieve

[3] http://www.digisens.fr/fr/gamme.php

this mental reconstruction to anticipate the result of planning. Furthermore, the simulator has a pedagogical purpose. First, it is able to provide important information to consider. Secondly, the student can compare in real time its planning with the expert one. The expert's planning is detailed step by step and connected to academic courses. Finally the simulator has a database of clinical cases which were selected by experts in implantology training, to represent all the difficulties we may encounter in implantology.

### 3.3 VirTeaSy Implant pro

VirTeaSy Implant Pro is also called the "simulation workstation" (see Fig. 2). Its function is to allow the student to perform virtual surgery cases planned in VirTeaSy Scan Implant. Indeed, VirTeaSy Implant Pro reproduces a virtual patient from the scanner of a real patient. This virtual patient has the same anatomical characteristics (bone density, shape and size of jaw and anatomical structures) that the real patient. The student will therefore follow the planning defined in VirTeaSy Scan Implant in order to succeed the virtual surgery in the VirTeaSy Implant Pro.

Moreover, to achieve all operations in the virtual (sequence of drilling, making measuring, implant placement) and to advance the learner, the simulator needs a system of force feedback , a visualization system, a system of assessment and help, and an interface for teachers.

The force feedback is essential to make realistic training on surgical simulator (Chase et al, 1997). So we had to reproduce the dentist's sensations during drilling of the jaw. To do this, the system VirTeaSy Implant Pro uses an arm force feedback. This arm is the Virtuoso ™ 6D Desktop by Haption4. It is composed of three parts hinged motor, which provide a force feedback on the axis translations and rotations, which can act on the six degrees of freedom. This arm can work in a spherical volume of ten centimeters of diameter. Moreover, at the end of the arm force feedback, there is the tool set of the dentist (the cons angle). Thus, the learner manipulates his usual tool, while receiving accurate and realistic sensations during drilling of the jaw. The updating frequency of the arm force feedback is 1000 Hz, which is the value recommended by Liu et al (2003) in their study of surgical simulators.

To observe the virtual patient, VirTeaSy Implant Pro uses stereoscopic glasses (Emagin Z800 3D Visor5) with two opaques screens and a tracking system with six degrees of freedom ("Patriot" by Polhenus6). The head movements of student are reflected in the virtual world, allowing him to navigate intuitively. The updating frequency of the display is 60 Hz: twice upper to the recommendation of Liu et al (2003).

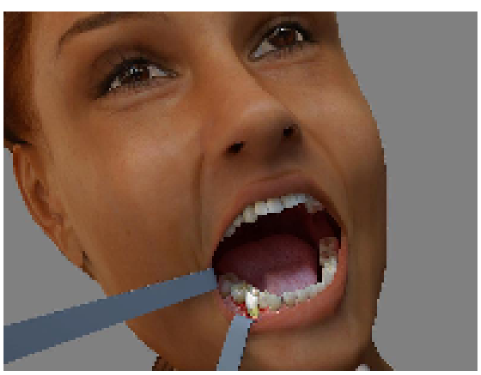

*Fig. 1*: **View of a patient**

VirTeaSy Implant Pro is able to evaluate the learner's actions according to the planning. Indeed, for each drilling, the student can know the difference between what he did and what he planned (or what the expert had planned) aiming at the drilling's localization, angle and depth.

In addition, a system of help is available. This help may be active or not, according to the will of the teacher or student. They affect :

- Location: a cross appears where drilling should be conducted,
- Angle: a cone of color indicates the ideal angle for drilling,

4 http://www.haption.com/site/fr/html/materiel.php?item=0
5 http://www.emagin.com/products/systems/systems.php
6 http://www.polhemus.com/?page=Motion_Patriot

- Depth: a measure in real time shows up the depth at which the drill is, compared the top of the peak bone,
- Overheating of the bone: a gauge of color indicates the level of overheating of the bone.

At the end of surgery, the learner can see the effects of its actions on the scanner. Finally, surgery is recorded. The student can look at his surgery with his point of view or with another point of view (such as the assistant for example).

VirTeaSy Implant Pro has a screen deported. This screen is real-time interface between teacher and student performing a virtual surgery. The teacher can look at the actions of the learner, with the chosen point of view. It can also :

- Zoom in on the scene,
- Adjust the help based on student needs
- Assess the drilling of the student by checking the real time scanner of the patient.
- Finally in the near future we plan to implement a function that enables the teacher to cause complications and thus to change the scenario of the intervention at its convenience.

This screen is also a support for the teacher to comment, for the other students, what do the student who perform the virtual surgery. Teachers can give advice, explain the reasons for success or failure. This feature makes it possible to maintain attention for students who do not manipulate the arm force feedback.

**3.4 Interaction between the two subsets : VirTeaSy system**

The two subsets VirTeaSy Scan Implant and VirTeaSy Implant Pro are complementary. The learner begins by planning the case on VirTeaSy Implant Scan, then transfer the data from the planning to VirTeaSy Implant Pro. These data will be used to evaluate operations and adjust the help. Once surgery is complete, the result of the evaluation and the record of the surgery are transferred to VirTeaSy Scan Implant. Thus, the student returns to VirTeaSy Scan Implant to look at his surgery, and conduct an reflective and retrospective activity of his actions. Finally, he can extend his learning by consulting academic courses in connection with the case treated, or by performing a new virtual surgery. So we have a learning loop implementation: preparation-perform - back on its own activity - regulation.

*Fig. 2* : **VirTeaSy Implant Pro**

The system architecture allows to separate (1) actions requiring a simple computer (2) actions requiring the arm force feedback and 3D glasses.

A student spends on average five times more time to plan (and come back on his actions and consult academic courses) than to perform virtual surgery. That is to say that the student will use five times more "workstation student" that the "workstation simulation". This observation leads us to design an organization of classroom with one VirTeaSy Implant Pro for five VirTeaSy Scan Implant, which allows to optimize the training costs per student.

**4 Activity analysis to design a simulator**

To carry out this project, we adopted a multidisciplinary approach, combining skills in virtual reality (for designing the virtual reality devices), computer science (algorithms for designing mechanical simulation and obtain a sensory realism in applications ), and pedagogical engineering (to analyze the activities of practitioners and develop pedagogical content).

This fourth part will focus on the last skill: an analysis of the activity. The theoretical framework mobilized to carry out the activity analysis is the "didactique professionnelle" (Pastré 1999). The objective of this analysis is to characterize the expert in implantology. To do this, we record ten implantologist's experts in situ: during a real surgery. Then, we conducted self-confrontation interviews with each implantologist recorded. During these interviews, the implantologist look at the video of his surgery and explains its activity with the assistance of the researcher.

From analysis of these interviews, we were able to extract several important information which helped us in designing the simulator VirTeaSy. This important information will be detailed in this section.

### 4.1 The situation

One central point in activity analysis is the distinction between task and activity. Indeed Leplat (1997) showed that there is always more in the real work (activity) than in the prescribed task. And it is the analysis of the gap between the prescribed task and real activity that will help us to identify the meaning of activity of the implantologist. Our analysis will proceed in two phases: an analysis of the task and activity analysis of implantologist.

With the analysis of the prescribed task, we identified the tools needed to the surgery, the sequence of actions, and the organization of the room. With the analysis of the activity of the implantologist, we identified the meaning of the actions and the meaning of the tool's location. And with this meaning given by the expert, we could identify the important elements for a successful implant surgery and the minors elements.

Therefore only the important information (needed for learning) have been implemented in the simulator, and all elements not specific to implantology or not essential have been set aside.

### 4.2 The hand skill

Similarly, we conducted a very detailed analysis on the gesture of implantologist during surgery. What interested us were the positioning of the surgeon, the hand position relative to the workspace, the positioning of support points, and the force exerted on the tool.

The conclusion of this analysis is that there is huge variability among practitioners, and it is impossible to define a typical gesture. Therefore, we have conducted several experiments (paper being written) to design an ergonomic workstation to respond optimally to this variability. Although the support points vary between practitioners, all in taking. The support points are extremely important. Thus we have added a physical jaw with his chin for implantologists can take realistic points of support.

### 4.3 The main difficulties in implantology

The activity analysis of implantologists (not of the task) allowed us to determine the steps, actions, conditions that posed difficulties in the surgery. We have identified and classified these difficulties. Then to help learners to overcome them, we have created workshops: some decontextualized environments where the student can work specifically on a difficulty.

For example, one of the difficulties of the implantology is to determine the bone density of the jaw, just with the sensations during drilling. This skill is important because the surgical procedure must be adjusted according to bone density, and the scanner does not determine it accurately.

Explanation of the workshop : The typology of bone density shows that there are four types of bone (d I, d II d III, IV d). Therefore, we have made four blocks representing the four types of bones. The objective is to drill each block and recognize its bone density. For that, initially, a label indicates the density of the block. The learner drills each block : the goal is to combine a type of bone with a sensation (haptic feedback). Secondly, we remove the labels and change location of the blocks: the goal is that the learner recognizes the density of the bone block just using sensations (haptic feedback).

### 4.4 Pedagogical content

As we saw in the introduction, the best training method in implantology is perform a real surgery with an expert. But with this training method, the teacher relies on cases that come to the hospital. Therefore, it does not define teaching modules with learning objectives based on a classification of patients. But he treats the patients in the order they appear.

The activity analysis, allowed us to characterize and classify each case and identify the "simple case" in implantology. Following this, we have defined pedagogic modules, which are divided into pedagogic objectives.

Specifically, we define the simple case as the putting of a single implant recessed between two teeth at the level of a mandibular premolar. Furthermore, we identified three pedagogical modules (put a single implant, put several implants, put implants on a toothless patient). Within each module, we have identified five pedagogical objectives (perform a simple case, dealing with anatomicals difficulties, dealing with orientation and parallelism problems, dealing with aesthetic issues, dealing with multiple difficulties).

## 5 Conclusion

The aim of this article was to present a training solution to the implantology using virtual reality. The state of the art has shown that in the field of implantology, there is no virtual reality device to train at the planning phase and the surgical phase. VirTeaSy is part of category of the virtual simulators with force feedback. He is composed of two complementary subsets: VirTeaSy Scan Implant and VirTeaSy Implant Pro. The first allows to plan a case, to consult academic courses and to conduct a retrospective and reflective activity on its actions. The second allows to perform a virtual surgery. Finally, we saw how the activity analysis of dentists has allowed us to design this simulator.

However the design of such a simulator is not the end. It allows starting a second project called "Formarev. The aim of this project is to evaluate the simulator. What skills are learned by students through the simulator and how fast? Is there a transfer of skills learned in the simulator to reality? The training through virtual reality is as good as traditional training? To answer these questions, we are currently conducting a test to compare traditional training to training in virtual reality. To do this, we have three groups. The first group follows a traditional training, using plastic jaw. The second group follows a training using virtual reality, with the simulator VirTeaSy. The third group is a control group: there is no training. All participants are novice in implantology but hold the diploma of dentist. Finally, participants in the three groups must put an implant on a human corpse. What interests us here is to compare the performance of the implant's location between the three groups. To do this we use two indicators: the axis of the implant and its depth. The results of this research are being analyzed.

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# S e c t i o n

# MODELS & METHODOLOGIES

**Models and Methodologies (M&M):**

- **Innovative Teaching and Learning Technologies**
- **Web-based Methods and Tools in Traditional, Online Education and Training**
- **Collaborative E-Learning, E-Pedagogy,**
- **Design and Development of Online Courseware**
- **Information and Knowledge Processing**
- **Knowledge Representation and Ontologism**
- **Cognitive Modelling and Intelligent systems**
- **Algorithms and Programming for Modelling**

# The Romanian Projects for e-Learning Technologies

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## Abstract

*This paper presents some aspects regarding the development of e-Learning technologies. In Romania, the emergence of a knowledge-based economy and the need to insure conditions of social inclusion to all for the 21st century have brought into light the necessity to enhance the continuous development of the human capital according to a lifelong learning perspective. In these regards, innovative education strategies aiming to integrate ICT are effective and viable when supported by several stakeholders: companies, European institutions, NGOs, schools, teachers, education managers, parents and students themselves. The SEI Program (The Romanian IT-based Education System) offers new tools for use in schools, thus increasing the quality of the education process. Teachers are training to use ICT for education, research and innovation. Implementation and use of modern technologies in education and research require the mobilization and support of various initiatives, programs and projects of public institutions, professional organizations or individuals of e-Learning professionals, researchers and university teachers in education, inspectors, advisers, teachers, psychologist's pupils and students.*

**Keywords**: Educational Software, Web-based education, e-learning projects

## 1. From Information Society to Knowledge Society

The contemporary world is marked by a rapid and unpredictable development in all respects (economic, political, social, and scientific). This development marks all over the world and all spheres of social life. It is definitive, multidisciplinary, with many strong connections. Faced with these epistemological approaches, people tend to use multidisciplinary, transdisciplinary and unidisciplinary approaches and feel confused and overwhelmed. Computer image incites to permanent reconfiguration of the areas we have knowledge by accessing different sources of information and it thus gives us another way to learn and produce knowledge. The educator is no longer in control of the information entering the world of students. He should facilitate the understanding of the external world, subjective correspondence between the external world and internal world and the computer may be helpful in his approach to a uniform instruction for all students and as an individual, each according to needs and potential biopsychology (Vlada, & Nica 2009).

The results and performances in the fields of computer science, telecommunication and information technology have always been spectacular. Today, many computer types are meant to fulfil human dreams about a partial or integral cybernetic world and about a super library of information. In other words, information, knowledge and communications will be at the base of the tomorrow society. Today, with the appearance of diverse technologies, programming languages, operating systems, and specialized programmers etc., "Information and Communication Technologies" (ICT) is used; including a great variety of information processing and a great utility of these processing in all activity fields. However, at each development level of the human society there was a foundation on information. Information is the first step towards achieving knowledge. All this contributed to a better utilization of information in society and to an increase of human welfare and knowledge. In other words, it can be said that the global information society is the normal human society of all times with an informational modernism stamp due to the informational and

knowledge avalanche. In the period 2012-2030 it is desired to get from an information society to a knowledge society. European programmers (FP6, FP7) are conceived to fulfill this goal.
Today, starting from primary school, children find out about the impact of computer in their lives. Because of these reasons, the educational systems of many countries are conceived to implement developing strategies oriented to computer utilization for both initialization and continuous learning process. “Human society development is accomplished by knowledge and learning” (Vlada, & Țugui 2006). Daniel Pink's book contains a description of the new age - the Conceptual Age (Pink, 2006):
Agricultural age (farmers) – 18th Century
Industrial age (factory workers) – 19th Century
Information age (knowledge workers) – 20th Century
Conceptual age (concept workers) – 21st Century.
The responsibility for education is nowadays shared: collaborative demarches and adequate commitment from all stakeholders is very much increasing the effects of education as a whole, oriented towards preparing competitive human resources equipped with competences for the 21st Century: cooperation, communication, critical thinking, creativity, innovation. In the United States and also in UNESCO strategies these are referred to as the 21st Century Skills. The European Union in the Lisbon framework outlines eight domains of Key Competences for Lifelong Learning. These 21st Century Skills are critically important to support the challenges of the modern workplace and its dynamic and the rapidly changing knowledge society. There is a growing and widely accepted understanding that a different set of skills need to be developed by our students in our school systems. Highly structured and disciplined schooling systems do not necessarily prepare students well for the dynamics and challenges of the 21st century workplace and society. More self-motivated, individualized, group and collaborative learning processes, supported by ICT will contribute significantly to the preparation of a more agile modern workforce (Hamilton, & O’Duffy 2009).
The 21st Century Skills and Key Competencies for the Knowledge Economy are presented in Table 1:

*Table 1.* **Skills and Key Competencies for the Knowledge Economy**

| 21st Century Skills identify: | The EU eight domain of key competence are: |
|---|---|
| 1 Creativity and innovation | 1 Communication in the mother tongue |
| 2 Critical thinking | 2 Communication in a foreign language |
| 3 Problem solving | 3 Mathematical literacy |
| 4 Communication | 4 Basic competences in science and technology |
| 5 Collaboration | 5 Digital competence |
| 6 Information fluency | 6 Learning-to-learn |
| 7 Technological literacy | 7 Interpersonal and civic competences |
| | 8 Entrepreneurship and Cultural expression |

For Dr. Howard Gardner (American Psychologist and Educator), intelligence is (Building the 21st-Century Mind: www.howardgardner.com, Gardner, 2009):

- the ability to create an effective product or offer a service that is valued in a culture;
- a set of skills that make it possible for a person to solve problems in life;
- the potential for finding or creating solutions for problems, which involves gathering new knowledge

## 2. Romanian IT Based Educational System (SEI, 2001-2010)[1]

In Romania, the emergence of a knowledge-based economy and the need to assure conditions of social inclusion to all for the 21st Century have brought into light the necessity to enhance the continuous development of the human capital according to a lifelong learning perspective. In these regards, innovative education strategies aiming to integrate ICT are effective and viable when supported by several stakeholders: companies, European institutions, NGOs, schools, teachers, education managers, parents and students themselves. One of the most effective governmental

[1] Gold Winner: E-Learning Awards, 2010 London - Best e-learning project securing widespread adoption, www.elearningage.co.uk

actions is the SEI Programme (Sistem Educațional Informatizat, in Romanian – IT-Based Education System), started in 2001, aiming to equip schools with computer labs, to train teachers in the use of ICT, and to provide educational software to support the teaching and learning (Vlada, Jugureanu, & Istrate, 2009).

The IT Based Educational System (SEI) is a complex project initiated by the Ministry of Education, Research and Innovation, aiming to offer ICT support for the Romanian education system (Vlada, Jugureanu, & Istrate, 2009). The SEI program promotes ICT in education through specific projects designed both for administrative and educational purposes. The SEI Program offers new tools for use in schools, thus increasing the quality of the education process. It offers a substitute for expensive or dangerous instruments and experiments by means of virtual counterparts. Within SEI Program (www.portal.edu.ro), the local, regional and country administration is provided with managerial and administrative support. The main components of the solution are: Hardware (IT laboratories); Learning, Content Management Solution (the AEL software system); Educational software and electronic educational content; Teacher training; Internet connectivity. AeL is an integrated Learning and Content Management System developed by SIVECO aimed to support professors/tutors, students, content editors, administrative staff and other stakeholders in the learning process (Noveanu, & Potolea, 2008).

AEL is a qualified for the management and delivery of various content types such as interactive multimedia, tutorials, exercises, simulations, educational games etc. Its powerful knowledge base, which acts as a content repository and management solution, adaptive, configurable and searchable, allows first-time users to easily:

- create content (built-in HTML editor, mathematical formulae editor, test editors and wizards, glossaries/dictionaries editor);
- import/export content from files, archives/folders of resources, standard packaging formats like SCORM and IMS;
- adapt or modify content;
- derive their own courses from common content components.

These are the stages in the SEI implementation:

- *SEI-1 (2001-2002):* the pilot period – design and experimental use of the main components, adjustments at different levels based on the data that were obtained;
- *SEI-2 and SEI-3 (2003-2004):* the transition period – the communication lines and technical support were established, the general methodology for implementation was developed and the favorable area was covered at high-school level; the methodology for construction, approval and distribution of multimedia educational contents;
- *SEI-4 (2005-2010):* period of the construction and generalization of ICT in the education system.

**About SEI project**

On the 16th of November 2010 - SIVECO Romania was successful in London at the prestigious and exclusive eLearning Awards (http://elearningage.co.uk/awards.aspx), where it has won the Gold Medal for the IT-based Education System (SEI). At international level, SEI is the most known and awarded Romanian project in the field of education, receiving awards in the biggest competitions such as World Summit Award, European eGovernment Awards, European IT Excellence Awards, International Project Management Association, eEurope Awards for eGovernment. SEI figures: over 4 million beneficiaries an national and international level, 140,000 trained teachers, 15,000 computerized labs, 192,000 computers, 3,700 AeL multimedia lessons, 1,500,000 candidates in the Baccalaureate exam (2003-2010), 441,953 participants in the teachers' nomination upon vacant positions exam (2003-2010), 2,000,000 pupils distributed in high schools (ADLIC 2001-2010), 180,000 users registered on the portal edu.ro, 2,000,000 visitors, over 7,500 articles and 1,300,000 messages posted on the forum (Press Release, www.siveco.ro).

An in-depth investigation carried out in 2008 by a group of researchers from several institutions reveals the following aspects of the SEI Programme (Noveanu, & Potolea, 2008): We can already say that the SEI Programme establishes in the Romanian schools working practices based on 1:1 student-computer interaction model. In time, “lessons in the SEI laboratory” will become regular lessons – as frequent as the other lessons – where each student has access to an individual computer (Table 2).

*Table 2.* **Situations in which ICT is used for teaching-learning-evaluation**

| **Situation** | In the lab, using AeL | In a computer Lab, without AeL | In a regular class, with computer and videoproject | Other situation |
|---|---|---|---|---|
| **Procent** | 58,70% | 4,00% | 12,30% | 25,00% |

The main purpose of education is knowledge sharing, and, in this context, it is obvious that
In [different programmes of studies (undergraduate, postgraduate, doctoral, postdoctoral).

**3. Promotion of modern technologies in Education and Research**

*Learning* is a cognitive process of acquiring knowledge and skills. It’s a journey that continues throughout one’s life till death, learning results in change of behaviour and attitude. These changes may be easily observable or elusive. It’s not necessary that a person be actually aware that he or she is learning something right at that time. Learning may occur even without people being aware of it. Learning solutions focus on developing or enhancing the competencies and behaviours needed by individuals and teams in order to accomplish meaningful goals and create a positive work climate that encourages and values clarity, interaction, openness, diversity, community and results.

Thus, after 2000, when expanded and developed Web 2.0 and Learning 2.0 programs and projects were discussed in relation to: strategy development and training; project management; working in teams; implementation methodology. Also, the initiators had to promote and integrate new technologies in education and training, so that Romanian educational system could adapt to new requirements and challenges of building the knowledge society in accordance with the European Strategy "*training in the knowledge society*". The general trend of the Romanian society towards an intensive use of new technologies, generated by the need to keep up with the evolving European economy, is encouraged, supported and pushed ahead by governmental programmes and complemented by several European initiatives or by projects developed by private companies. For example, refer to the resources (Vlada, 2009):

- **Initiatives**: ICVL Project (2006, www.icvl.eu), CNIV Project (2003, www.cniv.ro), Intel®Teach Program (2007, www.siveco.ro), ELSE Project (2005, www.adl.unap.ro ), Elearning. Romania Project (2006, www.elearning.ro), AEL Project (2003, www.advancedelearning.com), Siveco Cup (2003, www.portal.edu.ro), Didactic.ro (2003, www.didactic.ro), TimSoft (2001, www.timsoft.ro), SEI Project (2001, www.portal.edu.ro), 2009-2010 Program "Training in the Knowledge Society", 2007-2013 National Plan for Research, Development and Innovation.
- **Coordinators**: Marin Vlada, Grigore Albeanu, Radu Jugureanu, Florin Ilia, Delia Oprea, Dorin Mircea Popovici, Adrian Adăscăliței, Ion Roceanu, Olimpius Istrate, Dana Vladoiu, Cătălin Radu, Emil Onea, Carmen Holotescu.

**ICVL and CNIV Projects**

In Romania, this year, there were 2 main scientific events: ICVL (*The 6th International Conference on Virtual Learning*) and CNIV (*The 9th National Conference on Virtual Learning*). The ICVL (http://www.icvl.eu) and CNIV (http://www.cniv.ro) projects promote innovative technologies and methodologies in education, research and continuous improvement, both in media education (i.e. University) and in business. Structured and organized according to european principles and standards, the two projects encourage and promote work on projects, collaborative activities, methods and scientific experimentation, creative thinking and intuition, argument and demonstration. Conference theme refers to the use of modern technologies in education and research with the objective of building the knowledge society. The Conference is organized in four sections (*New Technologies in Education and Research*: Virtual Environments for Education and Training, Software and Management for Education): Models & Methodologies (M&M); Technologies (TECH); Software Solutions (SOFT); "Intel® Education" - Innovation in Education and Research (IntelEdu) (Vlada, Jugureanu, & Istrate, 2007). The International Conference on Virtual Learning contributes to the development of both theory and practice in the field of Virtual Learning. The ICVL was structured to provide a vision of European e-Learning and e-Training policies, to take notice of the situation existing today in the international community and to work towards developing a forward looking approach in Virtual Learning from the viewpoint of modeling methods and methodological aspects, information technologies and software solutions. Participation is welcomed from researches, teachers, trainers, educational authorities, learners, practitioners, employers, trade unions, and private sector actors and the IT industry. Selected best papers already published in proceedings and presented during the conference are invited to be published by scientific journals (ISI or CNCSIS recognized journals). Also, after an evaluation procedure, the best projects are awarded. Evolution of CNIV audience is presented in Table 3.

*Table 3.* **Evolution of the number of papers published at CNIV (2003-2010)**

| **CNIV edition** | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|
| **Received papers** | 63 | 103 | 105 | 76 | 80 | 71 | 99 | 117 |
| **Published papers** | 43 | 62 | 83 | 53 | 66 | 58 | 71 | 66 |

## 4. The Initiative eduVision 2020: Shaping the vision of education

The Initiative eduVision 2020 is an international conference aimed to present the newest trends in education and eLearning, best practices on using IT&C in education and a vision for the future of education. The Initiative promotes active participation in international working groups, initiatives and processes aimed at promoting the Information Society, as well as contributions on the educational dimension in relevant international debate forums (working groups of the WSIS, UNESCO, ITU, European Commission). Given the major impact that this transition process begins to have on modern civilization and recognizing the significant pressure on education systems worldwide, the eduVision 2020 Conference launches the Initiative eduVision 2020. The Initiative welcomes all public, private and non governmental actors that have relevant activity in the integration of IT&C in school education (www.eduvision2020.ro).

*"Our children's minds have changed, we are dealing with a new generation, who grew up interacting permanent with the digital means. Such digital interaction change mind, therefore in schools have a different mind before the child's mind.*" Mircea Miclea (Palace of the Parliament, Sept. 16th-17th 2011, eduVision2020, www.eduvision.ro - Shaping the vision of education)

**EduVision 1$^{st}$ edition 2011: sept. 16$^{th}$-17$^{th}$ Palace of the Parliament,Bucharest**

Shedule (Day one):
- Keynote Presentation: Toward an e-learning vision & strategy in Romania.
- Plenary Session I: eLearning – Glimpses into the future

- Plenary Session II: eLearning Best Practices around the World
- Plenary Session III: Tehnologies for eLearning

Shedule (Day two):
- Plenary Session I: Transition to Digital Education
- Plenary Session II: Steps toward a national project of eLearning
- Plenary Session III: eLearning Technologies

The conference focused an audience of about 200 people/day, key people representing: European Comission; UNESCO Romania; Education Ministries from more than 25 countries from Europe, the Middle East, Africa and Commonwealth of Independent States (CIS); Members of Embassies and Consulate Representancies in Romania; Executive management of MECTS and MCSI; Decision makers and decision influencers from the Romanian educational system; Professors and Teachers from High Schools and Universities; NGO's; International and Romanian Mass Media.

**Conclusions**

The results and the performance attained through the use of computers have boosted the development of all sciences. Man and the world interact continuously, reality is seen from multiple perspectives, the information we received through various channels so as to have an adequate response, the knowledge we have produced, not reproduced. Learning is individualized and the cognitive and emotional development plan cannot ignore the cultural, social, and technological factors. Computers incite the ongoing reconfiguration of the image that we have about areas of knowledge by accessing different sources of information and provide another ways to know and to create knowledge. Learning is broadly defined as change. The focus can be on what we learn (the product of learning) or on how we learn (the process). It is about how we change and how we adapt, grow, and develop. This adaptation, growth, and development occur from inside out.

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# Complex IT Projects in Education: The Challenge

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## Abstract

*The rapid development within society of the use of information and communication technologies has meant a revolution in the way schools and training institutions work, following the general trend of the whole society. Not only academic institutions apply IT tools in the management of their day-to-day activity, but the eLearning 2.0 paradigm involves the implementation of virtual collaboration and communication learning environments based on web 2.0 tools, including delivery of multimedia-rich simulations and experiments for a personalized curricula. In the same time, education poses a significant amount of issues related to adoption and impact. Because an IT project in education is primarily an education project, and typical project and software models and metrics are not applicable as such. The term "complexity" in project management moved from the status of attribute to the status of discipline. Complexity does not necessarily relate to size, but it relates to interdependencies and interactions between the project's components, between the project and external factors. A complex project is described by nonlinearity, complex feedback loops and significant impact of small factors (Lorenz's butterfly effect). The project management theories have starting to evolve since the late 1990s to incorporate a dimension of complexity. Still, these are not fully integrated. And especially in education, the development of a framework methodology for the setup and management of complex projects is required in order to tackle with the complexities of combining the intrinsic complexity of IT projects, the education aspects and the risks introduced by the wide range of stakeholders involved in major education transformations.*

**Keywords**: eLearning; Education; Complex projects; Project Management; Education Management

## 1. The Intrinsic Complexity of IT Projects

Software projects still are, after tens of years of experience and research, difficult to estimate, plan, execute and evaluate, especially with regard to impact. The industry lacks a practical definition of complexity as regards project management (the existing definitions are vague and non-measurable, which reduces the classification to "expert-judgment"). The execution of a (complex) project remains defined by a combination of personal skills, experience and formal methods – where formal methods remain difficult to adapt to specific organizations and projects, and their usage is still extremely rare in practice, in organizations of all sizes. The project manager continues to search for the right question rather than for the right answer, and to use methodologies for organizing his own ideas rather than follow them. In the same time, a practical but systematic approach should give the project manager a framework in which he/she should be able to construct, organize and manage his project in a more structured fashion.

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**2. Education of the future**

Education and training are the keys to success in the current global information society. To succeed in today's environment, new skills must be developed that will continue to respond to changes; these skills depend on the ability of employees to think critically, to solve problems and anticipate new opportunities.

The rapid development within society of the use of information and communication technologies has meant a revolution in the way schools and training institutions work, following the general trend of the whole European society[2]. The key components defined in 2001 were equipping the schools, training of the teachers, networking and resources. The strategic focus demanded creating a theoretical, psychological and pedagogical framework for the integrating of ICT resources in education. In the same time, a strategic approach to their implementation was required.

Throughout history, education and training, as engines of development in any society but also mirroring their environment, in all its forms – formal, continuous, vocational, has adopted naturally the technological evolution. Higher education has influenced and even provided leadership for the technological advance of our society. Lower levels of education have always been lagging behind, with technology adoption rates lower than the society itself. This is currently expressed in the slower adoption of Internet connectivity, IT resources for education (such as multimedia educational content or eLearning platforms) and ITC resources in management.

More than this, information technology has a higher degree of development than teaching. The basic education model throughout the world is still following industrialist principles and is only recently being influenced and slightly changed by the less recent theories of Piaget[3] (social constructivism), Vîgotski (social constructivism), Bloom-Anderson (taxonomies of learning objectives) or Gardner[4] (multiple intelligences), as facilitated by the introduction of new educational resources – the computer, the Internet. We are facing a change comparable to the introduction of paper and printed books in schools[5].

Introducing IT in the basic education systems of the world is a strategic, political priority on all continents. From strategic formulation, this priority translates into complex technical problems of implementing mass-projects, with wide geographical coverage, and with tight deadlines. The national programs of introducing IT in education were pioneered approx. 10-15 years ago, initially in highly-developed countries (US, Britain, France) and did not reach a significant coverage until recently. As all pioneering projects, the failure rates were incredibly high for the initial projects and their impact on education was irrelevant, but the literature is rarely quoting failures – both for political reasons, as huge amounts were invested, as well as from practical measurement difficulties as described hereafter.

One difficulty is time-span: the results of a project implemented on a large scale in an education system can only be measured after years, and the results on the society itself may be fully perceived only after one generation. This is a perfect application of the principle “The impact of Technology is often overestimated in the short-term and underestimated in the long-term”[6]. ICT

[2] Commission of the European Communities. The concrete future objectives of education system. Brussels, 2001

[3] Piaget, J. & Inhelder, B. (1969). The Psychology of the child. New York: Basic Books, Inc

[4] Gardner, Howard. (1983) "Frames of Mind: The Theory of Multiple Intelligences." New York: Basic Books.

[5] Jugureanu, R. (2010) Project based learning on multi-touch systems, The 6th International Scientific Conference - eLearning and Software for Education, April 2010

[6] Usually credited to Bill Gates or to popular culture: http://elearningtech.blogspot.com/2006/02/what-is-elearning-20.html

resources in education are changing slowly the way we learn today, but change dramatically the way society will function tomorrow.

Another difficulty is establishing the targets, as the success indicators vary widely from project to project; from mere quantitative metrics related to provided resources (such as number of computers), to more elaborated usage rates of the provided resources and satisfaction-surveys, and very rarely to impact on pedagogical results[7]. It is obviously difficult to measure the success of a project when the business concept itself evolved dramatically over the last 10 years. eLearning was described 10 years ago as delivering text on a computer or over the Internet, using web or email, typically as a faster replacement for regular mail in distance learning programs. Currently we are talking about an eLearning 2.0 concept[8 9 10] which uses virtual collaboration and communication environments based on web 2.0 tools, including delivery of multimedia-rich simulations and experiments through highly personalized curricula, facilitating project-based learning models and collaborative web-based learning environments. Not including the various sub-categories and sub-types of eLearning that evolved: CBT/CBL (usually self-paced, asynchronous), CAT/CAL (usually instructor-led, synchronous or asynchronous), WBT/WBL etc.

And this is all only one of the aspects of the IT projects in education – the pedagogical area. The other major area is the management at all levels – classroom, school, district, region or country, focusing on automating administrative processes, managing resources (human, material and virtual), managing time, examinations, paper-work, projects and funding. We are no longer implementing eLearning projects – we are implementing integrated eEducation projects covering both pedagogical aspects as well as administrative aspects; management of teaching and learning; management of examinations; collaboration and communication within the physical school and outside; decision-making at all levels.

### 3. Complex Projects – The Underlying Challenge

A project is defined by PMBoK as a temporary (time-delimited) endeavor undertaken to create a unique product or service[11].

As stated by Cova and Salle, a project can thus be described as a one shot approach, to scan, bid and negotiate[12]. The uniqueness of a project gives it the characteristic of innovation as well[13].

Projects have always been faced with problems in managing duration, costs, in measuring progress and managing quality.

In 1995, in a highly controversial report, Standish group reported that 31.1% of projects were cancelled before completion, 52.7% of projects cost 189% of their original estimates and only 16.2% of software projects were completed on-time and on-budget. Regardless of the controversy surrounding Standish's research methods and exact numbers, these reflect a state of mind and fact in IT, that was initially observed in the 1930's and is still obvious, and which is popularly expressed through a significant set of software paradoxes: the Mongolian horde concept, the 1st

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7 ISTRATE, Olimpius (2009), The Evaluation of eLearning Programs, 2009

8 The term was invented simultaneously by several persons including the author, but was popularized mostly by Tony Karrer from TechEmpower.

9 Karrer, T (2006), What is eLearning 2.0? Retrieved from http://Elearningtech.blogspot.com

10 Downes, Stephen (2005), E-learning 2.0, retrieved from http://www.elearnmag.org/subpage.cfm?section=articles&article=29-1

11 Project Management Institute (2003). A Guide To The Project Management Body Of Knowledge (3rd ed. ed.). Project Management Institute. ISBN 1-930699-45-X.

12 Cova, Bernard and Robert Salle (1992). Project Marketing and Network Theory: A Gift Approach. 8th IMP Conference, Lyon

13 Terje I.Vaaland Håkan Håkansson, Exploring interorganizational conflict in complex projects, retrieved from http://www.impgroup.org/uploads/papers/130.pdf

law of cycling, the LOC paradox. Experience shows that if a rolled-out IT system has no problems, than nobody is using it, and if a testing team finds no bugs then they are simply not testing. “A program that is used in a real-world environment necessarily must change”[14].

The problems related to IT projects are increasingly important as projects become more and more large and complex. The cowboy programming or hero programming paradigms, which were the rule between 30 and 10 years ago, are becoming more and more exceptional situations, as modern IT projects require an army of experts specialized in niche domains: graphic designers, software architects, system architects, networking and communication experts, security experts, system analysts and designers, system administrators, functional administrators, technical leaders, project managers and project coordinators, ergonomists, QA, QC, business-domain experts, trainers, technical support experts, database designers, and – yes - programmers.

The traditional line of thought in defining complex projects was based on size. According to this approach, a complex project was a project difficult or complicated because of high risk or involvement of a multitude of management and technical factors[15] [16]. This description refers to a structural complexity. In the same time, according to this definition, one can easily reduce a complex project to a set of simple smaller projects, by using simple decomposition methods. This type of “complex project” is thereafter manageable by traditional methods – the challenge is reduced to managing several (even many) simple, smaller projects. This leads to the conclusion that 2 non-interdependent simple projects, or 100 non-interdependent simple projects, if added, still make a simple project – a bigger but simple project. The keyword here being… non-interdependency.

Complex projects are better defined in the sense of complex systems, using the definition of complexity from natural and social sciences, where the term is used to describe systems that consist of several *interacting* parts. Complex systems are defined by nonlinearity, continuous interactions with their environment and complex feedback loops[17]. They also display emergent behaviour and significant changes provoked by small factors (Lorenz's butterfly effect[18]: does the flap of a butterfly's wings in Brazil set off a tornado in Texas?). The complex project was thereafter defined as consisting of many varied *interrelated* parts[19]. A complex project is thus primarily defined by interdependencies and dynamic complexity, rather than structural complexity. A complex project is unpredictable to a large degree and influenced heavily by small differences in initial conditions as well as by changes in the surrounding environment.

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[14] Belady, L. and Lehman, M. (1985), Program evolution: processes of software change; Academic Press, London, UK, 1985.

[15] Stephen Jonathan Whitty, Harvey Maylor (2008), And then came Complex Project Management , International Journal of Project Management 27 (2009) 304–310, retrieved from http://www.itee.uq.edu.au/~jonw/And%20then%20came%20Complex%20Project%20Management%20(revised).pdf

[16] Kailash Awati, Rumours of a new project management paradigm, retrieved from http://eight2late.wordpress.com/2007/11/03/rumours-of-a-new-project-management-paradigm/#project_paradigm_complex_defns

Kailash Awati, Project complexity redux, retrieved from http://eight2late.wordpress.com/2008/07/02/project-complexity-redux/

[17] Cooke-Davies, T., Cicmil, S., Crawford, L., and Richardson, K., We’re not in Kansas anymore, Toto: Mapping the strange landscape of complexity theory, and its relationship to project management, Project Management Journal, 38 (2), 50-61 (2007).

[18] Lorenz, Edward N. (March 1963). "Deterministic Nonperiodic Flow". Journal of the Atmospheric Sciences 20 (2): 130–141. Retrieved from http://journals.ametsoc.org/doi/abs/10.1175/1520-0469%281963%29020%3C0130%3ADNF%3E2.0.CO%3B2

[19] Baccarini, D, The concept of project complexity-a review. International Journal of Project Management, 1996, 14, 201± 204. Retrieved from http://ieg.ifs.tuwien.ac.at/~aigner/projects/planninglines/evaluation/Project_Management/papers/baccarini96complexity.pdf

To this definition we should still add size. Even if size was already defined as not a key characteristic of complex systems in a purely theoretical definition, the impact of size is considerably significant on projects in practice. A small project, even if complex following the “complexity theory” definition, cannot actually be considered a real complex project in practice, since the costs for solving a complex, but small problem, will not justify implementing special methodology or tools.

On the other hand, managing size is a problem per se. The size of a project determines as well the size of its team and in practice one rarely can split a project into non-interdependent parts. According to Fichtean/Hegelian Dialectics, quantitative change leads to qualitative change[20]. Also, as Bennett puts it, from 100 line programs 45 years ago to multi-million line systems now, it is impossible for one person to understand a complete software system[21]. And productivity is a reverse function of the size of the team - due to communication issues and planning constraints. Ideally, we have a small team working on the project for a long period of time, which requires little overhead of communication, information transfer, interpersonal relations.

The basic equation of (software) project management is the triangle of cost + time + scope (+quality, but quality can be seen as a component of the scope and is usually considered as an underlying characteristic, not an individual dimension in software project management – thus being visually placed in the center of the triangle). If the scope remains constant, time is reverse proportional to cost, so theoretically the project will be less expensive if it has a very long duration (and accordingly a reduced effort). In practice, constraints such as marketing environment (opportunity costs for not marketing a product in time), financing arrangements and costs, legal or customer-imposed constraints, force all projects to compromise between cost and time – an increased cost is accepted for finishing the project faster (usually by project crashing or fast-tracking). Even if the technology allows a faster development time (e.g. by using COTS, frameworks or tools), this adds even more to the complexity of a project by including new dependencies.

For example: if the development of a new version of a mass-marketed software product (computer game, mobile phone software) would be 5 years, the software would be developed chipper, but it would be completely out-fashioned at the time of release – the functionality would be deprecated and the hardware and communication infrastructure (computing power, bandwidth) would significantly surpass the software capabilities.

If detailed planning is extremely difficult in project management in general (thus wave-crest planning being the norm), in complex projects it becomes impossible, as even the definition of the work breakdown structure might change, and sometimes even the objectives are impossible to define before-hand[22].

The mainstream importance in the management of complex projects has subsequently moved on individuals rather than on frameworks and models[23]. Since a complex project is difficult or even impossible to plan, processes are less important than managerial skills. The skills, training

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[20] Hegel, Georg Wilhelm Friedrich. 1874. The Logic. Encyclopaedia of the Philosophical Sciences. 2nd Edition. London: Oxford University Press.

[21] Bennett, K., (1995) Legacy Systems: Coping with Success, IEEE Software (12:1), Jan 1995

[22] College of Complex Project Managers And Defence Materiel Organisation, Competency Standard for Complex Project Managers, Version 2.0 September 2006, retrieved from http://www.defence.gov.au/dmo/proj_man/Complex_PM_v2.0.pdf

[23] T M Williams, The need for new paradigms for complex projects, International Journal of Project Management Vol. 17, No. 5, pp. 269±273, 1999, retrieved from http://www.imamu.edu.sa/Data/abstract/management/pm/The%20need%20for%20new%20paradigms%20for%20complex%20projects.pdf

Morris PWG, Hough GH. The anatomy of major projects: a study of the reality of project management, Wiley, Chichester, 1987.

and experience of project managers have always been considered key success factors of the project; but when project management practice is recognized officially as not functioning for the most critical tasks – management of complex projects – their competence and expertise becomes even more important.

As Dalchar stated in a milder formulation of the controversial Chaos reports[24], "contemporary project management practice is characterized by: late delivery, exceeded budgets, reduced functionality and questioned quality. As the complexity and scale of attempted projects increases, the ability to bring these projects to a successful completion dramatically decreases"[25].

Project management practice has always been a balance between skill and method. For complex projects, there is an increasing need for formal methods of project management in order to re-equilibrate the balance.

Moreover, there is no clear practical demarcation between "structurally complex" projects and "real complex" projects. All software projects have a degree of complexity in them – be it only because of the unpredictability of the development process per se, if not taking into account external or (inter)dependency factors. There is no such thing as a project without problems; a well-managed project is not a project without a mess, but a project with a well-managed mess.

Even if the definition is that a complex project is unpredictable and cannot be planned (by analogy to a complex system), this does not mean that all complex projects are in practice open-ended. The "good enough" solution is not sufficient in industry. As an example, a research project is typically a complex project. One does not know exactly where one would arrive. One will never conclude that the research job finished – research is open by design (there will always be a new problem or question to solve, even if the research topic was defined in a very narrow scope). Still, for a research project as well as for a development project, sponsors demand for milestones, deadlines and quantifiable results.

Sponsors of projects (complex or non-complex) demand planning, milestones and targets. Not meeting the objectives equals to failure even if the project has been defined as a complex project.

So the issue remains that, even if in theory complex projects cannot be planned or measured, in practice this answer is not acceptable. The question is how to plan and manage complex projects in practice.

The agile approach is answering well to the problem of open-ended projects. In the same time, it answers badly to the problem of meeting the objectives. In an agile project, sponsors must agree to the principle that the objectives are open both in terms of scope and deadlines. This works reasonably well for instance in the development of products, where features are added one at a time. This does not work well in fixed-terms projects, where deadlines are fixed and the exact definition of scope/objectives has a huge importance. Real-life projects have targets and deadlines to be reached, and penalties attached to these milestones.

The definition of a complex project itself is at the moment sufficiently abstract to be interpretable. In practice, organizations have defined quantitative metrics for raising flags that a project may fall under the "complex project" definition. These quantitative definitions cannot be perfectly aligned with the abstract definition of complexity (there is no practical way to define numerically that a project has "complex" interdependencies); even more, they are usually defining structural complexity on mere size. Examples of such flags for raising attention are:

- the number of team members required;

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[24] Chaos, tech. report, Standish Group Int'l, 1994.
J. Laurenz Eveleens and Chris Verhoef, The Rise and Fall of the Chaos Report Figures, retrieved from http://www.cs.vu.nl/~x/chaos/chaos.pdf

[25] Dalcher, D. The new project management mindset for the 21st century. Proc. 1st British Project Management Colloquium, Henley-on-Thames, UK, December, 1993.

- the effort required;
- the organization's expertise in the area of the project;
- the number and size of stake-holder organizations (e.g. subcontractors);
- the number of business areas involved in the project;
- diversity of the components to be included in the solution. This is usually linked to the diversity of business problems, but also includes technical requirements such as:
- integration (components that solve individual business problems must be integrated into a single solution);
- customization (components must be adapted and thus new custom components appear);
- infrastructure components that do not solve business problems but are required by the components that solve business problems: hardware (servers, workstations, storage, backup, communication devices), communication (wiring, power, internet, VPN solutions), software (operating systems, database management systems, application servers) and tools (for analysis, development, testing, support, administration).
- diversity of suppliers (usually a complex project is implemented in a specific ecosystem that includes, on the receiving side: customer, financing body, beneficiaries (end users, operators, administrators), consulted bodies; and on the supplier side: contractor, partners, subcontractors, suppliers of parts.

The final verdict regarding the complexity of the project is still a human decision, based on a set of qualitative rather than quantitative factors. It is the same principle as the basic decomposition rule: a project will be decomposed (into components, work packages, activities and tasks) not until each component has a clearly-defined size ("5 days"), but until the responsible of the lowest component understands exactly what needs to be done in the specific component.

**3.1. Scope Definition, Analysis and Design of Complex Projects**

The IT culture developed a significant set of analysis methods and tools, from simple concepts to complex frameworks, linked to corresponding development methodologies and life-cycles.

As simple analysis and design methods used independently, we could mention prototyping or RAD. Object-oriented analysis and design, functional analysis or data-oriented analysis and design are generic concepts that both may be used when using the classical life-cycle, which continues to be highly usable as development methodology for small/simple projects as it insures a clear identification of scope very early in the project.

As size and/or complexity of the project increases, the classical life-cycle model is no longer functional, nor the semi-formal development methods (rapid prototyping or rapid development). More sophisticated methods appear – models that allow for iterations and increments (spiral, RUP, agile, feature-driven, test-driven development), and which overcome the classical problems of the classical life-cycle: allowing for changes in scope during the project execution (after this 1st phase), changes in the requirements, new requirements being discovered, or old requirements becoming deprecated; or allowing for change in general.

One of the major challenges posed by complex IT projects is the impact of the project itself on its environment. The project itself will change its own initial requirements, underlining its characteristics of dynamicity and open-ending.

**A complex project should therefore consider, even from its inception, to have change management as one of its work packages.** The analysis of initial processes and of the resulting processes is a mandatory phase in the preliminary (general) analysis.

As a consequence of the uncertainty characteristic, in complex projects one cannot assume that the requirements will be discovered in only 1 initial stage, no matter of the analysis method. On the contrary, we should expect that new requirements will appear during the project's execution. A possible answer could be doing the analysis in increments (therefore choosing an incremental rather that iterative life-cycle). This would allow change (even in the definition of the scope) during the project, so as to better align to the real project objectives/requirements, not only to the formalized project objectives/requirements. Also, it would contribute to forcing the team to perform in smaller loops and thus reduce the "99% finished" risk, and keeping up the pressure on the team by imposing intermediary (but real) milestones. The term "real milestone" is used to differentiate between an externally-imposed milestone from an internal task deadline. A milestone imposed from the exterior (legal, contractual, assumed towards end-users or customers) has intrinsic authority, whereas an internal deadline (project plan, tasks) has only the authority transferred to it from the authority of the manager.

A major disadvantage and risk is of having the scope changed uncontrollably during the project. The stakeholders would usually discover new needs and change the requirements or even the scope during the project's execution. In this case, it does not suffice to claim that change is inherent in all projects and just needs to be controlled – the controlling process itself will be severely impeded. The application of a strict change management procedure is difficult in the context of a methodological framework that is built on the principle of changing scope and requirements – thus lacking a stable initial configuration.

While acknowledging that a key factor in selecting a method/tool is the level of knowledge/experience of the team with working with the method/tool, one of the open questions is how the complexity of the project should impact the selection of analysis and design methodologies.

**4. Complexity Extended: IT Projects in Education**

Projects in education are significantly difficult to manage and evaluate, considering the multitude of factors impacting the results of education, but also the time-span (the results of a project implemented on a large scale in an education system can only be measured after years, and the results on the society itself may be fully perceived only after one generation). ICT resources in education are changing slowly the way we learn today, but change dramatically the way society will function tomorrow. Establishing the targets is a challenge per se, as the success indicators vary widely from project to project; from mere quantitative metrics related to provided resources (such as number of computers), to more elaborated usage rates of the provided resources and satisfaction-surveys, and very rarely to impact on pedagogical results. It is obviously difficult to measure the success of a project when the business concept itself evolved dramatically over the last 10 years, and continues to evolve faster than society itself. eLearning was described 10 years ago as delivering text on a computer or over the Internet, using web or email, typically as a faster replacement for regular mail in distance learning programs. Today we have an eLearning 2.0 concept which uses virtual collaboration and communication environments based on web 2.0 tools, including delivery of multimedia-rich simulations and experiments through personalized curricula, facilitating project-based learning models and collaborative web-based learning environments.

This leaves the decision-makers and civil society trailing behind – as an example, even if all the education systems in Europe have already integrated eLearning (in various degrees), there is no European policy on eLearning. Teachers and pupils use eLearning. But decision-makers and society continue to reduce eLearning to eSkills (learning IT, not learning using IT as a resource). This creates an additional need to identify and manage the stakeholders of any eLearning project.

**5. IT Projects in Education: the Architectural Decision**

The choice of architecture in national education projects starts from the basic principle of centralized vs. decentralized systems. The choice of architecture is not only technical as much as economical and political. The economical environment defines the level at which central coordinating organizations (national or regional education administration) has the power to allocate financial resources and capabilities to manage them, in contrast to the power and capabilities of local educational administration. Politically, we should consider the strategic policy on the decision-level of each administration layer.

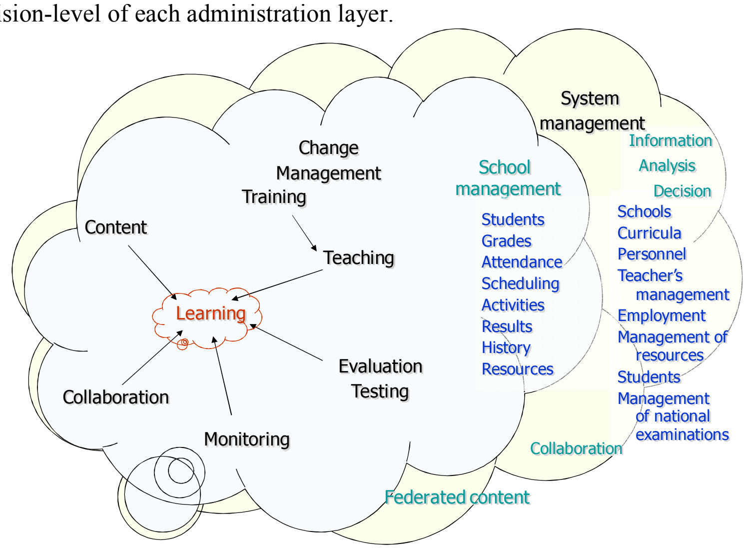


*Figure 17.* **IT projects in education - a holistic view**

Two major streams of thought dominate the political context worldwide: the necessity to standardize and mutually recognize qualifications, and the drive towards decentralization of the decision-making process. In the European context, these are reflected in the Bologna process (as part of the process of consolidation of the European Union) and in the decentralization strategy, respectively. The Bologna process is aiming through standardization towards a centralization of the decision-making process. The strategy does not aim for centralization per se, but centralization is an outcome of the process.

The technical environment of complex IT systems is benefiting from a new wave of technologies that allow for increased interoperability (SOA, XML, or in the context of eLearning: SCORM, IMS, AICC, SVG, MathML, ChemML) and common usage of resources (grid, cloud computing). As Bennett says, the means to deal with complexity in software development is to employ a modular design and build systems as separated layers of abstraction[26]. Modularization and reusable components, nowadays embedded in modern technologies such as OO, reduces impact of scale and complexity issues.

In practice, systemic decisions must account for individual conditions in each educational community that often build-up to external technical constraints to any project. The majority of schools do not have reliable Internet connection - not even in Europe, and Internet connection is a rare exception in Asia, South America or Africa. IT-adoption is both facing social problems, political problems[27] as well as technological problems[28]. While Europe develops strategies to

[26] Bennett, K., (1995) Legacy Systems: Coping with Success, IEEE Software (12:1), Jan 1995

[27] Jugureanu, A. (2010) A critical discussion in terms of the "digital divide" debates, The 6th International Scientific Conference - eLearning and Software for Education, April 2010

[28] Parayil, G. (2005) The digital divide and increasing returns: Contradictions of informational capitalism, Information Society, Vol. 21, no. 1, pp. 41-51

enhance even more an already accelerated rhythm of learning ICT skills for its graduates[29], in 2004 there were thirty countries with an Internet penetration of less than 1%[30] and the entire African continent had an Internet penetration of less than 3%.

Based on these underlying conditions, three types of projects may be identified in the area of major IT education projects:

- Projects decentralized as architecture, but centralized as decision and methodology. Case studies may be found in France, Morocco, Romania, Moldova.
- Projects centralized both as architecture and as methodology. Significant case-studies are North Ireland, Cyprus, UAE, Azerbaijan, Malta.
- Fully decentralized projects in UK or US.

We should be aware that there is no single rule to cover all situations. Each continent and country has specific circumstances that influence the choice-architecture.

## 6. The eEducation Concept

IT in education entered from two different directions: administration and pedagogy. There are various levels of interaction between the two areas.

### 6.1. eGovernment – support for management and administration

One area is eGovernment – the introduction of IT systems for the management of education. This area concerns two layers and various business processes:

- Management of schools;
- Management of the system.

The main business processes for the management of the schools are:

- Management of the school structure, organization and study groups;
- Management of students;
- Management of results: grades/grade-books, attendance, activities, performance evaluations, bonuses or penalties, extra-curricular activities, contests, awards.
- Communication with parents;
- Management of teachers;
- Curricula management;
- Evaluation and examination management;
- Social benefits;
- HR management;
- Management of material resources (buildings, classrooms etc.);
- Scheduling and calendars;
- Quality management.

The main business processes for the management of the educational system are:

- Management of the school life-cycle (authorization and evaluation cycle);
- Communication.
- Normalized examinations management;
- Standardized curricula management;
- Quality evaluation at systemic level;
- Decision support.

[29] Marianne Kolding, Curtis Robinson, Mette Ahorlu (2009) - Post Crisis : e-Skills Are Needed to Drive Europe' s Innovation Society, IDC White Paper, November 2009

[30] The Digital Divide at a glance, retrieved from http://www.itu.int/wsis/tunis/newsroom/stats/

### *6.1.1. Pedagogical support*

The second area of IT usage in education concerns the pedagogical approach. 3 different business processes are to be considered:

- Management of the learning process, with the main functions:
- Virtual classroom – synchronous teaching/learning sessions;
- Management of asynchronous/self-paced learning sessions;
- Testing, evaluation and results (up to personal portfolio functions).
- Management of courses: planning, scheduling, enrollment, executing, evaluation, monitoring.
- Communication and collaboration support.
- Management of the learning resources and curricula (virtual library):
- Management of atomic learning resources (RLOs);
- Management of course content and lesson plans.
- Content authoring.

## 7. Conclusions

Some key issues need answers in the sub-domain of software project management for complex projects.

While it is still difficult to define a complex project, even by using concepts from other sciences such as sociology and biology (such as the complexity and chaos theories), there is no practical definition or metrics to be implemented in real projects.

The project management theories have starting to evolve since the late 1990s to incorporate a dimension of complexity. Still, these are not fully integrated[31]. And especially in education, the development of a framework methodology for the setup and management of complex projects is required in order to tackle with the complexities of combining the intrinsic complexity of IT projects, the education aspects and the risks introduced by the wide range of stakeholders involved in major education transformations.

[31] Saynisch, Manfred (2010) Beyond Frontiers of Traditional Project Management: An Approach to Evolutionary, Self-Organizational Principles and the Complexity Theory—Results of the Research Program, Project Management Journal, April 2010.

# Professionalism in the Education System Today

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**Abstract**

*The pre-service and in-service training are the premises of a professional development pathway set to encounter actual diverse needs and challenges of the teaching profession. The responsibility for continuous development firstly belongs to the education practitioner, and this perspective raises a series of questions at individual level: what expectations have the society and the community from an educator?, what competences do I have to develop in order to succesfuly manage classroom situations and to correctly design, develop and evaluate adequate education situations?, what support do I need and who could offer it? Today, the professional of the education system is proactive, open to innovation, anchored in the technological, pedagogical and academic actualities, available to collaborating and sharing with colleagues. The present paper tries to reveal some of these aspects of the continuous professional development in the actual context, being centred on the curriculum habilitation and on the added value brought by the the ICTs, as the up-front elements of the education practitioners' development path.*

**Keywords**: teaching staff, continuous professional development, ICT skills

## 1. Pedagogical setup

The profile of an efficient education activity raises a serie of challenges for both the institution – in terms of capacity and readiness – and for the staff involved – in terms of preparedness, knowledge, skills and specific competences to cope with wide range of issues from communication and technical type to pedagogical and managerial ones. Usually, the new technologies are seen as having a great potential to surmount a set of limitations which caracterise conventional instruction; therefore, when we are talking about quality and efficiency in education, it is expected that the learning experience and outcomes to be higher in the education situation assisted by ICT, being they offline, online, self tutored, in fully integrated virtual campuses and so on. In this view, a complete elearning experience has several attributes which rely on a proper design and implementation:

- the learning sessions with digital support, especially the long ones, must be as interactive as possible and must emotionally involve the participants into learning;
- the new elements in the learning path, together with the innovative interaction ways have to be gradually introduced, and described based on the traditional, known experiences;
- the learning support and the feedback offered to participants must be in-time and on-topic; the tutor must monitor each learner' activity and to guide its learning towards achieving the education goals, as much as possible in the cognitive and socio-affective "zone of proximal development";

- from the design phase, there must be specified some alternative specific ways to support participants with different learning rhythms and to include/ encourage learners with different cognitive capacities;
- motivation of participants must be sustained through special methods and techniques;
- the learning rhythm must be constant, without long interruptions; accent should be put on variated, sufficient learning tasks, with clear deadlines;
- cooperation between participants (to collaboratively solve various tasks) must be encoraged and supported; equally, the autonomy in learning must be promoted.

Summarising, the following general scheme should be brought into attention of developers and instructional designers, but as well to the attention of course authors and support personnel involved in the elearning activities:

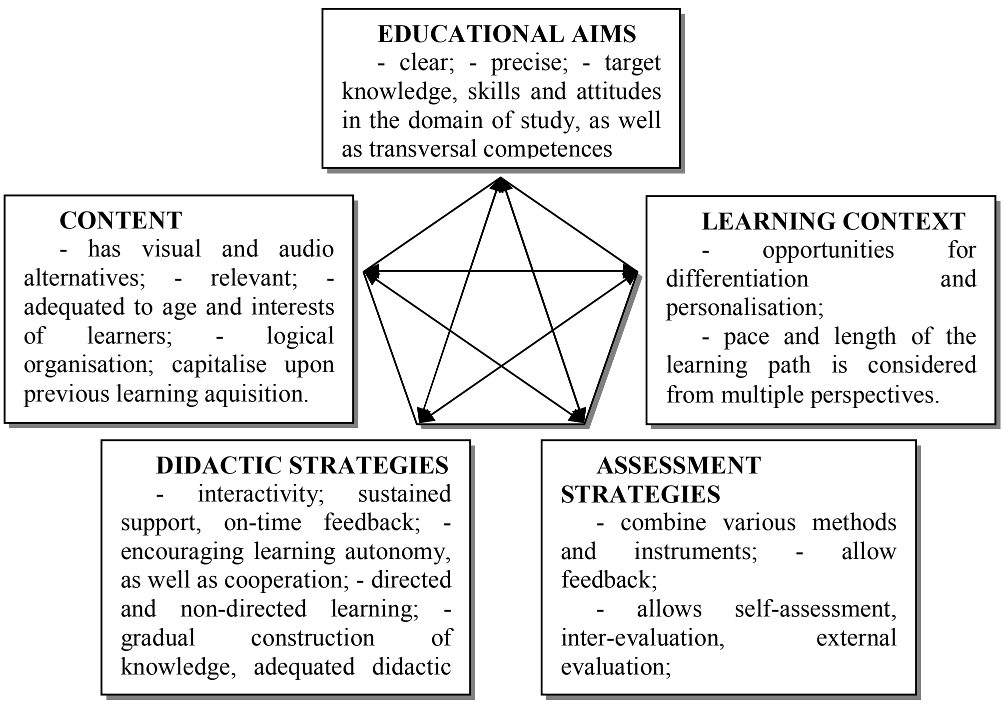


*Figure 1.* **Added value of ICT in education and training: a view upon the curriculum components**

## 2. Instructional design

At questions of whom?, which facts?, which moment, approach or instrument we owe the efficiency of teaching learning process?, the education sciences literature reveals different factors which in certain conditions increase the quality and the efficiency of instruction. These studies reveal some elements, principles, stakes which has to be taken in account for an efficient instruction design. These principles represent a sort of conditions, attributes or instructional standards (of the largest generality) for the designing and evaluation of activities from educational process.

A consistent orientation toward learning objectives, a clear structure of content, a guided learning, clear working tasks which allow student to check his aknowledgements, pre and post thematic organizers, a varied difficulty background of exercises together with their solutions (complete, uncomplete or multiple), illustrations which contribute to content understatnding and text attributes which facility searching, organization and integration of knowledge are required, too. From the specificity of presented elements, some important conclusions can be drawn, regarding to efficient education characteristics: a) first, the instruction can be conceptualised in pedagogical (educational sciences) reference frame, its attributes can be creatively promoted/uptaken in educational practice; b) second, an efficient instruction represents not only the result of teacher aknowledge, but his art/ability to use a strategy, method, procedure in proper moment and in agiven situation (Gage, 1978; Bîrzea, 1998); c) third, the instruction approach requests decision making from teacher, an objective situation analyse and turning to account the professional competence and avaible resources; d) fourth, the educator has to consider/see the student as an autonomous person, with individual features with makes him different.

**3. Roles and tasks of todays' education practitioners**

As many studies are indicating, the performance of the staff involed in elearning activities is highly correlated with the level of support received from the management, including the extent to which the procedures are regulated in specific documents and institutional policy papers. It is desirable that within the institution would exist a collaborative, stimulative environment, in which the personnel cooperate towards a better understanding of the nature of the tasks implied by the new technologies, as well as towards a more efficient practice within virtual educational platform. Motivation, implication, involvement – these are the dimensions supporting a high quality work, which are occuring in time, in a both constant and dynamic socio-professional medium, online or offline.

Main categories of competences necessary for dealing with the elearning situations are four:

- academic – knowledge, abilities and attitudes specific to the study domain;
- pedagogical – knowledge and capacities to design, develop and evaluate a learning situation;
- managerial – skills necessary to organise learners, resources, time and tasks;
- technical – ICT/ digital skills.

The big challenge for the education practitioners acting in virtual environments is to surpass the novelty not only through adequately use of the technologies, but also through knowledge and use of adapted virtual education practices. The technical aspects consist in appropriate use of some instruments such as forum, blog, wiki, bookmarking tools, collaborative documents – which suppose some hours of hands-on training. The pedagogical dimension is much more complicated, regarding development of some specific competences towards: a learner-centred approach, collaborative learning, continuous support and counseling, online assessment, motivational techniques and so on. Here is a list of tasks and roles associated with education staff in the virtual environments:

- design of educational activities
- organisation of the intructional process and context
- analysis of resources and instruments available
- choose of didactic strategies and methods
- design of instructional alternatives
- prevention of interruption and distractions
- facilitation of learning
- ensuring good conditions for learning and communicating
- provoking thinking, challenging previous knowledge/ prerequisites
- formulating answers

- stimulating debates
- encouraging students, motivating them to keep going
- suggestion of new paths for deep learning and alternative solution searching
- assistance, monitoring, assessment
- animating discussions, giving hints
- guidance, counseling
- prevention, management and capitalising upon education crisis situations
- decision and asking for opinion, proposal of themes and tasks
- coordination, organising groups and learning teams
- learning support
- moderation, communication.

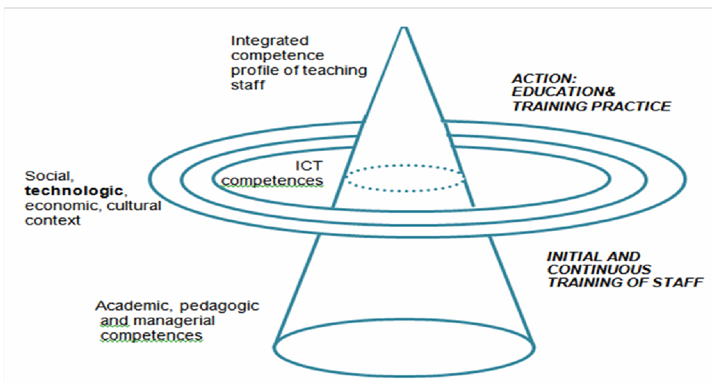


Figure 2. Categories of competences for the teaching staff

A detailed list of roles and tasks of a teacher is difficult to build. Anyway, when looking at the most activities in the classroom, it is quite clear the these roles and tasks are not linear, and therefore the skills and competences to be developed through preservice and inservice teacher training programmes are almost impossible to address without continuous practice and without solid grounding into nowadays technological and pedagogical frameworks.


Figure 3. Some roles and tasks of the teacher

The characteristics of an efficient education situation in the 21st Century are highly correlated with a proper set of skills and competences that the teaching staff should be acquainted with. A complete vision of the transformation in the set of skills necessary to education staff working on the virtual environments would include pedagogical and academic competences, filtered and refined through the present technological context, projected in a "*savoir faire*" which makes today the difference between good educators and the others.

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# Current Issues of Digital Education

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**Abstract**

*New technologies are often a catalyst for change in education at different levels, but they themselves do not determine the direction of change or the most appropriate type of change. Equally driven by practice and by theoretical advancements, computer-assisted instruction has various shapes and approaches, many of them leading the domain's knowledge base as best practices. Still, a number of issues remain on the agenda of current e-education programmes design and evaluation, tracing the boundaries that have to be conquered. The present article is looking towards these challenges faced by educators when employing digital application and new ICT tools.*

**Keywords**: computer-assisted instruction, ICT, elearning, digital education

**Introduction**

The evolution of computer-assisted practices in recent years is associated with a tremendous increase in complexity. By linking the concept to all situations and educational contexts in which the new technologies are used to improve or complement the process, the components, the learning stages, a extended range of activities and products are generated, staying under the sign of education innovation in recent decades.

Therefore, the need for epistemological clarification primarily consists in determining accurately the type of intervention, the level at which is implemented, the categories of stakeholders, the types of expected results, the time frame in which each category of effects is likely to occur, as well as other quantitative and qualitative frameworks in designing, monitoring and evaluation of elearning.

**Some challenges revealed by practice**

Analysis and interpretation of the computer-assisted programs conducted at international, regional, national or institutional level, as well as considering the theoretical basis of elearning development, can essentially contribute to improving the strategic vision that policy makers engage in to modernize the education process, to change the education systems and to build knowledge-based society.

The research results carried out so far in countries with a tradition of education through new technologies show that computer-assisted instruction is as effective as traditional forms of education, if an appropriate design is ensured. At the request of American Federation of Teachers and National Education Association, the Educational Policy Institute in the United States has initiated a research on the effectiveness of elearning programs, which was meant as an analysis of "*what the specific research is saying and what it is not*". The report suggests that many key questions about the way in which the teaching, learning and computer-assisted assessment happen are not answered. *Is education using new technologies better for certain academic subjects than* *others? Is it more appropriate for certain students? Are there enough libraries and information sources on the Internet? What elements are necessary for a student to successfully undergo a computer-assisted education program and how can he/she be assessed? How is the evaluation of an elearning program different from a traditional educational program? What can affect the quality of digital education?*

In the context of theoretical and practical development of the field of program and projects evaluation, of multiplication of the evaluation models, of the expansion of interest from different areas specialists to make evaluations, it emerged, naturally, a concern for quality: *What is a good evaluation? How to ensure quality of evaluation? What guidelines should drive the design of an evaluation?* The extension of these concerns in the programs evaluation, efforts to investigate the value and merits of elearning programs should be guided by a set of principles or specific requirements, grafted on a unitary conception of the epistemological parts that are core of the elearning domain.

New technologies are often a catalyst for change in education at different levels, but they themselves do not determine the direction of change or the most appropriate type of change. The most frequent difficulties signaled in the elearning evaluation reports generally correlate with a lack of a consistent vision on the system and process of education, and therefore with a weak configuration of the implemented program in terms of: harmonisation of ICT component with other innovative initiatives or with the level of readiness for change, integration within the program of interventions in other significant areas (curricular content, assessment, training of teaching staff), targeting all the aspects comprised by computer-assisted instruction approach (educational software, connectivity, training, equipment).

Among the limits of elearning programs implemented at institutional level, the literature reveals: difficulties in creating a proper learning environment from a socio-cultural perspective, in building a “warm” climate (Marshall McLuhan), empathic, in building an online community; the long time necessary to accommodate the technical characteristics and the visual design of the online learning environment; the long time required to train the skills and competencies necessary for tutors/ support staff; frequent distracting of learners’ attention from the learning objectives to the technology itself and to the facilities available for communication; students’ inconstancy throughout the training program, due to large variations of the motivational support, as effect of the lack of direct contact with colleagues and representatives of the training institutions. These limitations can be overcome through an increased attention paid to the design phase of elearning program, through strong pedagogical and psychological theoretical foundation of instructional design specifications, of visual design and user interface design.

**A model for designing and evaluating elearning**

A useful model for evaluation and for the first phase of design - analysis to determine the needs for development and implementation - is a grid of questions, developed on four dimensions: pedagogical, technical, organizational and socio-cultural, covering issues such as elearning program development, support, integration, quality assurance, standards and technology tools, functionality, users, structure, cultural context (apud Conole & Oliver 2007, pp 16-20). Let’s focus here on the pedagogical dimension only:

*Table. 1* - **Grid for initial analysis to develop elearning system and process – pedagogical dimension**

| Dimension | Themes and questions for analysis |
|---|---|
| Pedagogical | Understanding the learning process |
| | What are the educational theories of effective use of technology in learning?<br>Has the use of ICT resulted in new theories and pedagogical practices?<br>What are the experiences of learners in the use of technologies, what technology |

| | |
|---|---|
| | do they currently use and for what purpose? What types of approaches allow different types of technologies? What types of collaboration activities occur and how can be supported? Are the current forms of teaching and assessment suitable to digital education context? How current assessment practices can allow students to show what they learned and what is the role of assessment with new technologies? |
| | Development |
| | What are the issues regarding the design and development associated with the production of study materials for elearning? How much time the development team needs to develop courses? What pedagogical models the development team uses, how explicit are they, and how they can be effectively applied in practice? How the courses could be designed in order to target different learning styles and different cognitive levels? |
| | Delivery and integration |
| | What are the best ways to integrate ICT in the wider context of teaching and learning? Are there different pedagogical models grounding different elearning platforms? How they influence usage models of the elearning systems? How to better use the tools available within elearning platforms to support learning? What are the views of students on different elearning systems? What are the views of students on the usefulness of elearning resources? How much the students use additional resources and the Internet? What are the experiences of students in the online courses? What aspects of elearning platforms are found useful by students and for what purpose do they use them? What communication mechanisms are used within the online courses and for what purpose? What types and levels of interaction (administrative, social, to solve learning tasks) are available for students and between students and tutors? |
| | Support |
| | What effective ways can be used to support the effective use of new technologies by teachers in teaching? What is the minimum level of competence of the team and what mechanisms exist for professional development? What minimum level of competence students must have and what support mechanisms they need? What support mechanisms are established to support the development and delivery of distance learning and how effective are they? How do students receive feedback on progress in learning? What level of expertise in elearning have the tutors? What kind of support receive the tutors for the development of courses? What online support is available for students? |
| | Evaluation and quality assurance |
| | What methods are used to evaluate the elearning courses system? What quality assurance procedures are required for online courses? |

This grid of evaluation questions is far from being exhaustive and demonstrates on the one hand the elearning domain extension, on the other hand the complexity of designing a training approach, at the intersection of the pedagogical theory and the evolving technological support.

**A promising beginning**

In a meta-evaluation report published in 2009 by the European Commission and OECD, the authors noted: "There are too few studies on the complex interactions between various types of programs aimed at ICT and the effects of other factors such as interventions at school level, socio-economic status and budgetary allocations. It seems that we first need tools to evaluate and monitor the level of use and appropriate changes. Second, we must identify in a systematic manner the various sources and discrepancies [in the results of the evaluations] to determine the information available and desirable."(Scheuermann and Pedro 2009, p. 70)

The research on computer-assisted instruction is far from clearing the problems outlined by this form of teaching-learning-assessment always expanding. However, in the last two decades, the new information and communication technologies supported educational institutions to focus on key aspects of learning and teaching. Educational practice indicates an increase in the learning motivation when using new technologies, and a massive demand for computer-assisted education, grafted on a growing need to keep up with rapid changes in the skills profile required by the labor market. In this context, we need a solid theoretical foundation for ongoing elearning programs improvement and for developing others to meet the new challenges of knowledge society and of contemporary educational practice. Anchoring in theoretical grounds is possible only after a thorough evaluation of existing initiatives and a correlation with pedagogical theories, for a unitary construction.

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# Case Study: Using Drupal platform for eContent Management

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**Abstract**

*The paper presents a case study on using the Drupal content management sites CNIV and ICVL projects. Drupal is a CMS (Content Management System) or a content manager and dynamic web sites developed in PHP and requires connection to a MySQL database. With Drupal you can make different types of sites (web or intranet) to publish articles, sets of messages / comments, forums, blogs, images etc. collections. Drupal allows users to register and login so you can track who is the author of each content and allows the webmaster can use to access different levels of the groups (type "user", "moderate", "administer" etc). Drupal is "Open Source" and can be downloaded, distributed and installed. Administrators with experience in PHP can open access to modify application source code based on their experience. Use as-is or snap in any of thousands of free designs and plug-ins for rapid site assembly. Drupal meets the needs of different types of web sites from community to news portals, from corporate sites to educational institutions, from media sites to international sites. Drupal's content management features make it easy to create and manage site: creative content, organize and find, administer, collaborate, build,design and display.*

**Keywords**: open source, eContent, Drupal, PHP, CMS, MySQL

## 1. Introduction and motivation

Our society has been irreversibly affected by a new phenomenon- an unparalleled access to a wealth of online information, never before seen or heard of. Learning has truly become a lifelong pursuit, and it can happen anytime and anywhere in our Information and Knowledge Society [6].

*Informatics* has become a science because it uses methods, techniques and tools for investigating their own objects and processes that define and operating. Informatics treasure is the result of scientific knowledge and research from symbiosis and other sciences (mathematics, cybernetics, microelectronics, physics, chemistry, etc.), and the methods and techniques, and using special devices (computers, computer systems) process information and knowledge you need to interpret them, transform them and to communicate [7]. The emergence of Web 2.0 technology was achieved by the use of databases and information processing through a server. I first heard the phrase "Web 2.0" in the name of the Web 2.0 conference in 2004. At the time it was supposed to mean using "the web as a platform," which I took to refer to web-based applications. (http://www.paulgraham.com/web20.html)

The new generation of software product revolution in terms of involvement of users in creating and managing content. Web 2.0 technologies are associated with web applications that facilitate participatory information sharing, interoperability, user-centered design, and collaboration on the Wide World Web. The Web 2.0 websites allow users to do more than just retrieve information, and offers all users the same freedom to contribute.

The definitions of Web 2.0 about: the web as platform; an attitude not a technology; power and control via APIs; a new level of technological interactivity between web sites and services. In the decade 90 (20th Century) have developed programming languages, platforms, technologies have changed the design and application development. Probably, the project's success Linux (operating system) led to the initiation of many projects developed in Informatics. Such methods of programming have appeared at the server and client level. The enthusiasm of that period that made possible the development of open source systems (Open source content management systems: Today there are over 135 systems; http://en.wikipedia.org/wiki/Category:Open_source_content_management_systems.

**Note**: The term "open source" software is used by some people to mean more or less the same category as free software. It is not exactly the same class of software: they accept some licenses that we consider too restrictive, and there are free software licenses they have not accepted. However, the differences in extension of the category are small: nearly all free software is open source, and nearly all open source software is free. (http://www.gnu.org/philosophy/categories.html). Major change occurred after 2000.

Today, one can say with certainty that the Informatics, Mathematics, and Computer Science are scientists who have contributed to a rapidly developing *Information and Communication Technologies* (ICT), in addition to other sciences and areas: Automation, Electronics, Electrical Engineering, Telecommunications, etc. Below is a comparison between 1990 and 2010.

| **1990 vs. 2010 - There was, but now there are:** |
|---|
| www, web technologies, web programming, web server, router, proxy, spider, e-mail, HTML, XML, PHP, URL, My SQL, DNS, DHCP, cookie, .com, .edu, .ro, .eu, link, Google, Facebook, Yahoo, Mozilla, Chrome, chat, skype, Yahoo! messenger, twitter, SMS, RSS, BBS, CSS, SSL, SSH, Firewall, Page rank algorithm, e-learning, educational software, virtual learning, e-commerce, e-training, iPhone, iPad, SmartPhone, Tablet PC, Android OS, Blackberry, Cloud computing, Touch technology, interactive table, online journal, online courses, digital library, open source, Flash, PDF, CMS, Moodle, Drupal, Joomla!, Wikipedia, wiki, blog, Java, JavaScript, Windows OS, Linux, Azure platform. |

In 20 years appeared languages, platforms, technologies, devices, and have changed people's mentality. All these have produced major changes in educational systems of countries.

**An Example**: The "Smart Education" 2015 Project; S. Korea to digitize school books. The South Korean government has said it plans to digitize all textbooks for elementary, middle and high school students by 2015. This plan for "smart education" is aimed at helping students create their own study pattern, and lighten their backpacks. (Source: http://www.channelnewsasia.com/).

## 2. About Drupal platform

Drupal is an open source content management platform powering millions of websites and applications. It's built, used, and supported by an active and diverse community of people around the world. Drupal. It's a free software package that allows a person or a community to easily publish, manage and organize rich online content. Hundreds of thousands of people and organizations use Drupal to implement various websites, including community portals, discussion groups, intranet applications, personal websites and blogs, e-Commerce applications, repositories and social networks. Drupal is opensource software distributed under GPL (GNU General Public License) and it is maintained and developed by a large community of users and developers [2].

Drupal's History: *Dries Buytaert* began the Drupal software as an message board in 1999. Within a year or so, more people became interested using and contributing to Drupal, so the project was made open source. Drupal.org came online in 2001, and the Drupal community gained momentum in 2005 with several code sprints and conferences. Read more about the full history of Drupal and Druplicon (Drupal 5.x, Drupal 6.x, Drupal 7.x) [1].

Drupal is a free software tool written in PHP. PHP is the widely-used, free, and efficient alternative to competitors such as Microsoft's ASP. PHP is an extremely popular, Open Source scripting language, most commonly used on webservers to produce dynamic pages. The name "PHP" is a recursive acronym for "PHP: Hypertext Preprocessor" and was initially created by *Rasmus Lerdorf* in 1994. As of today, the current version of PHP is version 5, with version 6 in the making [3].

A database is your best choice for storing data in your web application, and the MySQL database server has always been the most popular choice among PHP developers. It's supported by almost any hosting company offering PHP, which makes it easy to get started with, and you can even download and install it on your own computer, for testing purposes. MySQL uses the SQL (Structured Query Language) programming language to work with the data, and PHP interacts with MySQL by simply passing SQL code through a set of MySQL functions to the MySQL server, which then returns a result that PHP can interpret [5].

PHP combined with MySQL are cross-platform (you can develop in Windows and serve on a Unix platform).

MySQL is a database server:

- MySQL is ideal for both small and large applications; MySQL supports standard SQL
- MySQL compiles on a number of platforms; MySQL is free to download and use

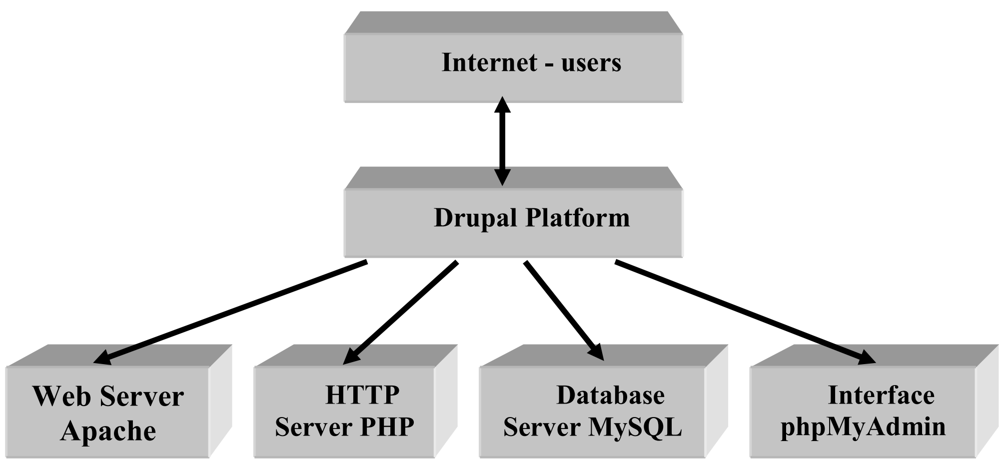



*Figure 1*. **Drupal Architecture**

The Apache Server combined with the power of PHP, MySQL, and phpMyAdmin, creates one of the best possible development environments for a web programmer (Fig. 1). phpMyAdmin is a free software tool written in PHP intended to handle the administration of MySQL over the World Wide Web. phpMyAdmin supports a wide range of operations with MySQL. The most frequently used operations are supported by the user interface (managing databases, tables, fields, relations, indexes, users, permissions, etc), while you still have the ability to directly execute any SQL statement.

**Objects in Drupal**

There are many constructs in Drupal that fit the description of an "object". Some of the more prominent Drupal components that could be considered objects are modules, themes, nodes, and users.

Nodes are the basic content building blocks of a Drupal site, and bundle together the data that makes up a "page" or "story" on a typical site. The methods that operate on this object are defined in node.module, usually called by the node_invoke() function. User objects similarly package data together, bringing together information about each account on the site, profile information, and session tracking. In both cases, the data structure is defined by a database table instead of a class. Drupal exploits the relational nature of its supported databases to allow other modules to extend the objects with additional data fields.

Modules and themes are object-like as well, filling the "controller" role in many ways. Each module is a source file, but also bundles together related functions and follows a pattern of defining Drupal hooks

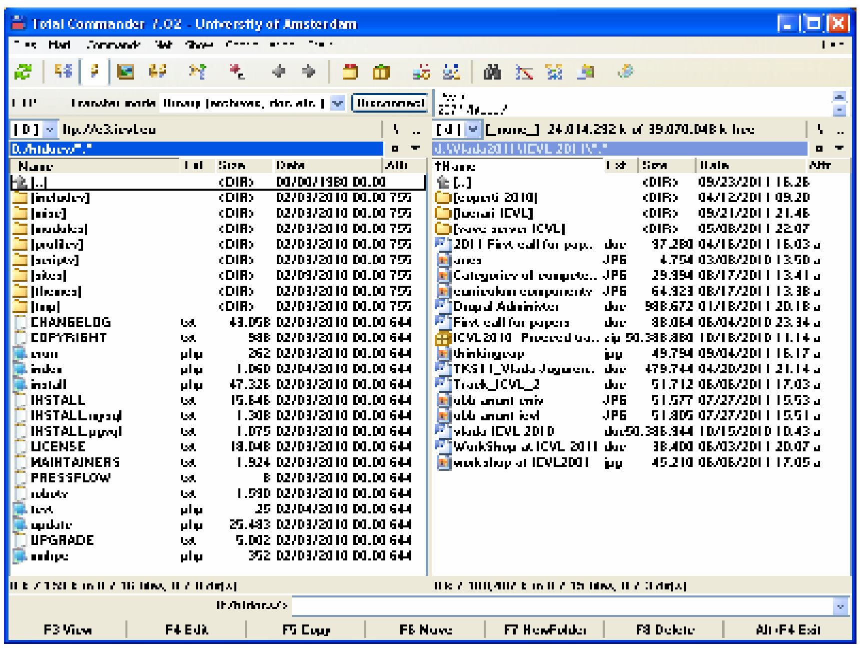



*Figure 2.* **Drupal Technology and software suport**

**Main Menu**: Content management; Site building; Site configuration; User management; Reports; Rules; Help; Log out admin.

**Content management**

- Comments - List and edit site comments and the comment moderation queue.
- Content - View, edit, and delete your site's content.
- Content types - Manage posts by content type, including default status, front page promotion, etc.
- Nodequeue - Create and maintain simple nodequeues.

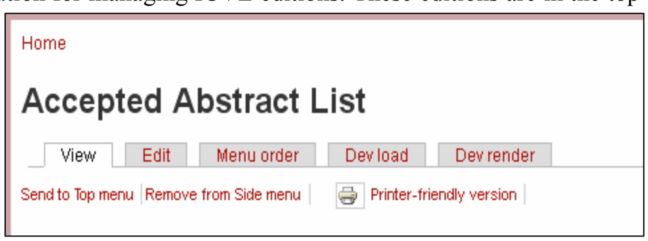
- Post settings - Control posting behavior, such as teaser length, requiring previews before posting, and the number of posts on the front page.
- RSS publishing - Configure the number of items per feed and whether feeds should be titles/teasers/full-text.
- Taxonomy - Manage tagging, categorization, and classification of your content.

**Site building**

- Blocks - Configure what block content appears in your site's sidebars and other regions.
- Context - Associate menus, views, blocks, etc. with different contexts to structure your site.
- Menus - Control your site's navigation menu, primary links and secondary links. as well as rename and reorganize menu items.
- Modules - Enable or disable add-on modules for your site.
- Themes - Change which theme your site uses or allows users to set.
- URL aliases - Change your site's URL paths by aliasing them.
- Views - Views are customized lists of content on your system; they are highly configurable and give you control over how lists of content are presented.

## 3 Using Drupal platform for eContent

Drupal platform use is adequate for the complexity of activities and information CNIV and ICVL projects. First Drupal offered a solution for managing ICVL editions. These editions are in the top of the site (2006, … 2013). They generate two types of menus: Top menu, Side menu. Every edition generate these menus are dynamic. Generation shall be made by using service: Send to Top menu, Send to Side menu (respectively Romove from … ).



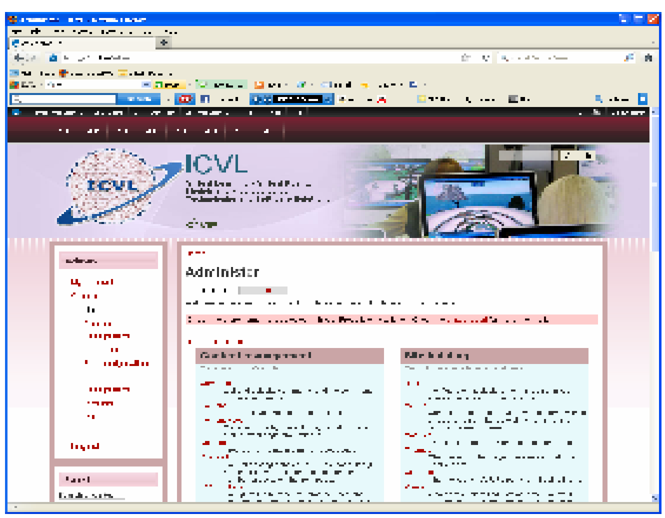




*Figure 3*. **Administer - http://c3.icvl.eu/admin/content/**

Create content (type of content):

- Edition – edition of conference (2010, 2011, 2012, etc.)
- Page - A page, similar in form to a story, is a simple method for creating and displaying information that rarely changes, such as an "About us" section of a website. By default, a page entry does not allow visitor comments and is not featured on the site's initial home page.
- Story - A story, similar in form to a page, is ideal for creating and displaying content that informs or engages website visitors. Press releases, site announcements, and informal blog-like entries may all be created with a story entry. By default, a story entry is automatically featured on the site's initial home page, and provides the ability to post comments.

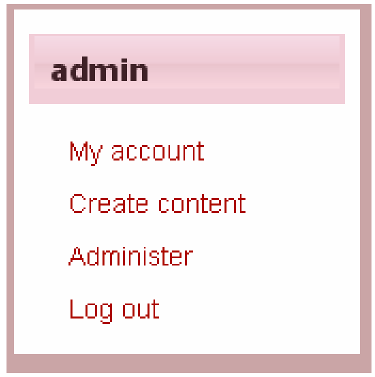




*Figure 4.* **Content management: http://c3.icvl.eu**

**Create Page and Story**

The page module allows users to create static pages, which are the most basic type of content. Pages can be collected in books via the book module. Users should create a page if the information on the page is static. An example would be an "about" page. When a page is created, a user can set authoring information, configure publishing options, whether readers will be able to post comments. They can also select the content type of the page (e.g., full HTML, filtered HTML, php) [1].

As an administrator, you can set the publishing default for a page (in its workflow): you can specify whether a page is by default published, sent to moderation, promoted to the front page, sticky at the top of lists, and whether revisions are enabled by default. You can set the permissions that different user roles have to view, create, and edit pages.

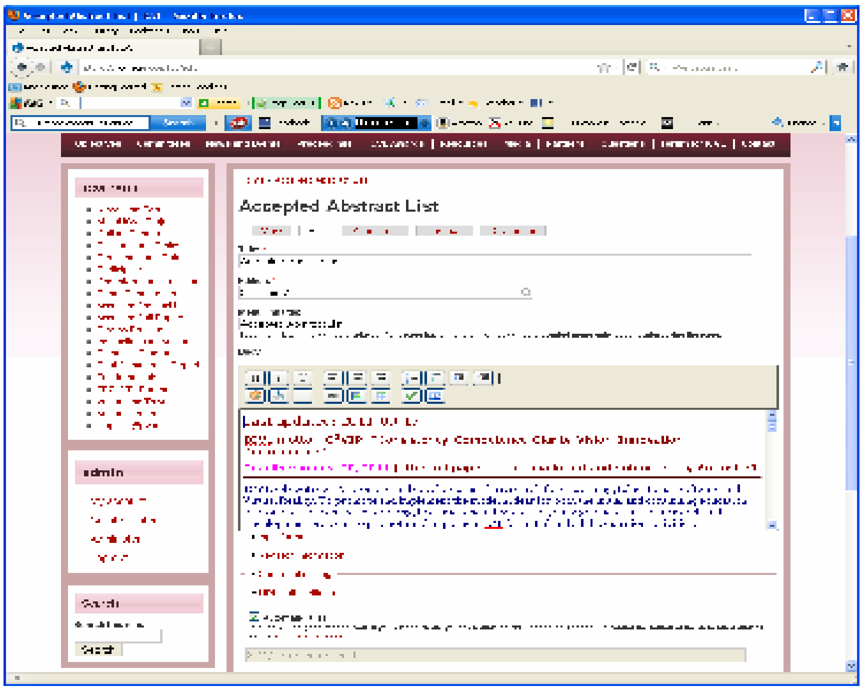



*Figure 5.* **Create Page**

## 4 Acknowledgement

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# Policy Considerations for Managing 3D Multi User Learning Environments – Achieving Usability and Trust for Learning

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**Abstract**

*3D Multi User Virtual Environments (3D MUVE) supported learning, often referred as 3D Multi User Learning Environments (3D MULE) have shown useful applications in education. 3D MULE are widely used for various educational and research requirements and show a proven success to consider as a mainstream educational paradigm. Although, 3D MUVE supported learning can be extended to various innovative and attractive use cases, the management of the learning environment can be challenging; teachers may find the underline system functionalities and use cases associated with the 3D environment are less cohesive for their educational processes, while students can be overwhelmed by the rich and engaging nature of the 3D immersion and might focus more on environment features over the Intended Learning Outcomes (ILO). Without the adequate awareness on 3D MULE benefits and limitations, users may practice inappropriate use cases, which they have been practicing with e-Learning and traditional learning activities, result in significant failures. Such failures can deteriorate the value of 3D MULE and user motivation for learning. We believe, if the teachers and students are properly guided on 3D MULE management while ensuring the system usability and trust would help for a successful learning experience. In this paper, we propose a hierarchical management policy directive for obtaining fruitful results through blended learning with 3D MUVE support.*

**Keywords**: 3DMUVE Learning, Usability & Trust, Policy Based Management, Supporting Learning, Learning Environment Management

**Introduction**

Technology supported learning has provided modern educational methods and models a significant benefit by increasing the effectiveness and efficiency. Various solution infrastructures have been developed to implement concepts associated with e-Learning, m-Learning and often as blended learning solutions. 3D virtual worlds (or MUVE), in this regard, play an important role by extending the learner environment with 3D support. 3D MULE are appropriate for educational use due to their alignment with the Kolb's (Kolb et al., 2001) concept of experiential learning, learning through experimentation and exploration. Dalgarno (et al., 2009) described how 3D virtual environments engage learners in the exploration, construction and manipulation of virtual objects, structures and metaphorical representations of ideas, demonstrating a high educational potential. However, managing 3D MULE and achieving usability and trust in learning can be a challenge as student interactions may be influenced by the varying levels of self-regulation practices. This research provides policy considerations to overcome that challenge. For our 3D MULE research, we choose Second Life (SL) (Linden Labs, 2003) and Open Simulator (2007) MUVE; details about the policy consideration we have developed referring these environments, will be discussed later.

The remaining sections of the paper are as follows: The section 2 reveals background details relevant to the research with our experiences on using 3D MULE. The section 3 explains the taxonomy that we propose for the management considerations; the section 4 explains the high level policy framework. The section 5 continues the policy considerations in a finer-granular level with an example. The section 6 relates the study with expected future research work, before concluding.

**Background and Related Work**

How 3D MUVE transform the existing e-Learning environments is an interesting research question. Hendaoui (et al, 2008) has discussed this while identifying key research areas to be studied as 3D MUVE are used for education. A recent study on use case implementations of 3D MUVE for blended learning approaches (Perera, et al, 2011) provides extensive insight on possible and beneficial learning processes while revealing the prevailing challenges at the system and user domains.

Facilitation for collaboration and usability are expected in blended learning (Brenton, 2009). Indeed, 3D MUVE provide extensible use cases for appropriate blended learning activities with collaboration and usability (Perera, *et al*, 2010). When consider the security and trust of the learning environment, broader interpretations can be found; mainly incorporating system-level security implementations. However, we believe that 3D MUVE learning activities introduce a novel set of security and management challenges at the application level irrespective of the implemented system security and control mechanisms. Recommendations given by Weippl (2005), on such challenges specific to e-Learning uses, have been considered with the appropriate adaptions in the 3D MUVE as blended 3D MULE.

University of St Andrews has been using 3D MULE for various educational projects and research. The Laconia Acropolis Virtual Archaeology (LAVA) (Getchell *et al.*, 2010) project allows students to engage in a simulated archaeological excavation, and then explore a recreation of the site. The WiFi Island (Sturgeon *et al.*, 2009) aids collaborative learning and exploration of wireless traffic simulations. Network Island in OpenSim is developed to facilitate teaching on network routing (McCaffery *et al*, 2011). Second Life and OpenSim were used for teaching Human Computer Interaction (HCI) through student projects (Perera *et al*, 2009). Research on integrating 3D MUVE with e-Learning infrastructure is conducted (Perera *et al*, 2010; Perera *et al*, 2011) and the outcomes facilitated this research.

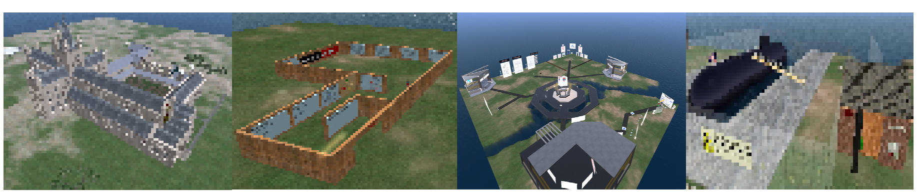

*Figure1*: **Some of the completed educational projects in 3D MULE: St. Andrews Cathedral, Network island, WiFi island, and an HCI project**

**Taxonomy for Policy Framework**

In line with the research hypothesis, we use an analysis of two parameters: environment management and self-regulation, as a mechanism to formulate policy considerations for 3D MULE. Environment management (EM) includes administrative and controlling mechanisms at the learning environment level whereas the self-regulation (SR) indicates the user behaviour adhere to the expected practices. Technology supported learning environments, can help to develop specific self-regulatory skills related to successful engagement in learning (Dabbagh and

Kitsantas, 2004). Further, the task variance on learning activities induces different forms of self-regulations; hence, suggest that design of learning activities should consider the suitable tasks and self-regulation requirements for success (Delfino, *et al.*, 2011). User ethical behaviour (self-regulation) helps to achieve the objectives of the use policies and their management (Rulghaver *et al*. 2010). Considering possible 3D MULE user engagements, we propose the following taxonomy of user interactions as the abstract directive of the policy considerations.

As the Taxonomy in Fig 2 depicts, four possible scenarios can be identified with 3D MULE user engagements. Briefly, **EM**-*Low* & **SR**-*Low* arrangement does not provide reliable and successful learning activities, as indicated in the scenario characteristics. The other quadrant of **EM**-*Low* (**SR**-*High*) suggests having small-scale learning activities with high reliance of mutual agreements, although it is learner supportive. As EM is low, there is a difficulty of enforcing controlling mechanisms to increase the trust and reliability of the learning environment among users and to meet the institutional regulatory requirements. Further if integrated, it can compromise the existing blended learning infrastructure. Learning activities with research and formative assessment might fit into this category.

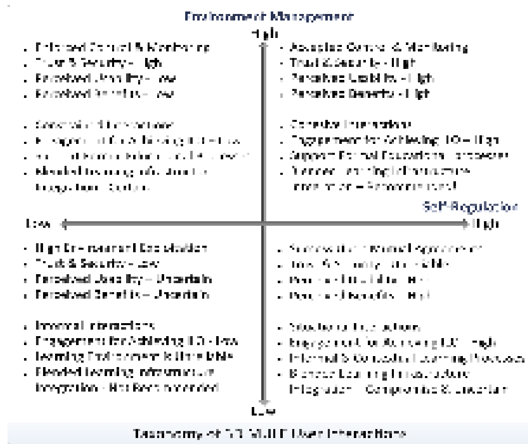


*Figure 2:* **Taxonomy for 3D MULE user interactions (EM and SR as parameters)**

The two quadrants with **EM**-*High* indicate that the 3D MULE can be considered as a part of the institutional blended learning infrastructure, as the required environment management methods are practiced. In fact, the proposed policy considerations are defined to achieve the **EM**-*High* state, while trying to incorporate **SR**-*High*. Even if the **SR**-*High* is not attainable, **EM**-*High* scenario would help to have formal educational activities at large-scale in an integrated blended learning environment, although, the students might not explore the rich and flexible features of 3D MUVE and may not be committed for achieving ILO, as they feel constrained against their preferred behaviour. However, **EM**-*High* & **SR**-*High* is the desired state, which provides higher usability, trust and educational value with cohesive student engagements. Learners with self-regulation are sensitive to the learning environment and possess the ability to follow the best suitable arrangements given by the learning environment without conflicts (Lynch and Dembo, 2004). This validates the rational of our aim at **EM**-*High* & **SR**-*High* state through policy recommendations and user guidance.

**Policy Framework**

As the next step of the policy recommendations, we identified the key policy areas with respect to 3D MULE, through extensive user and system studies, which is shown in the figure 3. The test 3D MULE were based on SL and OpenSim. The identified policy areas can be further grouped into three sections: Generic Learning Management, 3D MUVE functions and System Management Core functions, a sub section of 3D MUVE functions. Although, we may not be able to observe such demarcated boundaries clearly, this segregation would help for policy considerations.

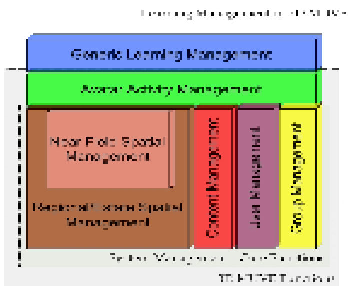

*Figure 3:* **Major policy consideration areas to manage 3D MULE for usability and trust**

### Generic Learning Management

This category indicates the management policies we have to consider when 3D MUVE are used as part of the blended learning infrastructure. 3D MUVE functions are not explicitly defined for this facilitation, although we have to transform the generic environment to implement 3D MULE with blended learning activities such as, learning content creation and display, learning activity engagement, and formative and summative assessment & feedback. Policies on learning management can be borrowed from the established e-Learning and blended learning practices and extend as required.

### Policy Areas on 3D MUVE Functions

3D MUVE specific policy considerations are defined in five key areas of functionality, namely: region management, content management, user management, group management and avatar activity management.

**Policies for Region Management** – These define the suitable management considerations on 3D environment spatial administration at the near-field (parcels) and regional (regions and estates) scale. Land ownership management, access and mobility rights, script execution, terraforming, and media stream management are some of the main functions. Teachers, students, course coordinators, etc. should have clearly defined policies on 3D environment engagement relevant to their roles and functions of the learning process.

**Policies for Content Management** – These define the management considerations on 3D content objects in the environment and user inventories. As we have to rely on 3D content objects for various educational use cases, appropriate management is essential for formal learning practices. Copy, Edit, Move and Delete are basic operations defined on the roles of, Creator, Owner, Group and Everyone, with the ability to overrule with administrator privileges (Allison *et al.,* 2010). However, derivative operations become complex when combined with different prim components to composite permissions and the content transfer methods. Student assessment on their created content in-world and achieving confidentiality and integrity of learning aids can be challenging if appropriate policies are not practiced.

**Policies for User Management** – These include user registration, user ownership and access management, and user privileges. The more emphasis is given on 3D environment functions; 3D MUVE user managements may appear less sophisticated than that of an e-Learning solution. However, correct user policies, such as user (avatar) naming, can be a significant factor for success. The degree of anonymity provided in the 3D MUVE can influence the user behaviour (Messinger *et al.*, 2008).

**Policies for Group Management** – Groups in 3D MUVE help to manage multiple users as a collection. Implemented group functions are not explicitly designed to support learning activities as group facilitation in e-Learning applications. However, by appropriate design of learning activities, we can transform available 3D MUVE functions and group roles to support educational processes. Group creation, membership management, ownership and access rights, and communication are main activities that policy considerations are defined.

**Policies for Avatar Activity Management** – Avatar activities are the fundamental mechanisms that students interact with the learning environment in 3D MUVE. Avatar actions such as fly, gesture, voice, create, touch, etc. are considered in this category. This can be the most challenging set of functions to manage as user interact with the environment through these; hence highly vulnerable to misuse by SR-Low users, yet the restrictions on these functions can be costly for the usability.

**Policy Considerations**

The policy considerations at this level describe finer-granular management policy guidelines based on the framework. Most of the given guidelines can be considered as acceptable use policies from users' context. However, accurate understanding and simplicity to follow are important to have effective results from defined policy guidelines; lengthy and too much technical information can distract the users from the ultimate objective (Hone and Eloff, 2002).

Policy guidelines can be expressed using natural language or mathematically with formal logic support. Natural language specification is advantageous for intuitive and easy user understanding, but can create ambiguities (Ahn and Sandhu, 2000). However, Formal logic-based policies are generally not intuitive and do not easily map onto implementations (Damianou *et al.*, 2001). In the context of our policy considerations, we believe that as we are not intended to implement or amend existing 3D MUVE functionality, but to use as they are, the main emphasis of the policy expressions should be the ease of understanding. Further, teachers and students from various disciplines would not welcome extensive mathematical and formal expressions result in them to have a challenging and steep learning curve, which may not appear as beneficial for their ultimate educational objectives. Since the policy framework is based on user functions and mainly aims users, it would be meaningful to express the considerations in natural language. Furthermore, the choice suites the 3D MUVE user expectations: flexibility and ease of experience.

Although, policy guides in natural language may appear easy to understand, in the context of six different areas, there is a high probability to confuse users due to the complex interrelations between different functions. For example, Avatar activity- content object editing can be controlled through Region settings: parcel and region land permission settings, object permissions, group management and system administration. If the users are given a large set of interrelated policies, they may not be able to envisage the 3D MULE management, holistically. An example policy statement with implementation mechanisms and possible conflicts is shown in Table1.

*Table 1*: **An example policy consideration statement for 3D MULE**

| | |
|---|---|
| **AAM-Mobility_Fly-01** | *Students must retain from flying during the lecture* |
| Implementation | Student voluntary practice and/or prohibit flying - Land settings |
| Possible Conflicts | i) Region Fly settings override Parcels' settings<br>ii) Group abilities on owned land override Parcel settings |

To overcome this challenge and analyse the inter-policy relationships, we employed a unique approach with Graph analysis. Graphs usually leverage humans to achieve rapid uptake of abstract information through visuals (Herman *et al*, 2000). A directed policy graph (di-graph) G can be defined as G = (V, E), where V is the set of functions related to policies (vertices), and E is the set of relationships (edges) between those function states. We use the network analysis and visualisation solution Gephi (Bastian *et al*, 2009), as it aids us to rapidly visualise policy interdependencies and statistical analysis of the policy network. Using a graph description language, such as DOT, we can programmatically implement the complex network of policy interrelations, as shown in figure 4. The node colours are used to differentiate policy categories, while the edge colours define the state of the interaction: orange – usual operational interaction, red – conflicting interaction, and green – supportive interaction. Further, cyan colour edges indicate complex interaction, which is expressed separately for the clarity. Black edges indicate relationships with the category. The directed graph edges indicate causing function/action (source node) and the result (target node).

The example in the Table 1 is a single policy statement on the action Fly, out of the many possible policies based on the context of use. Enormous sets of policies can be defined on the action Fly, considering the use (examination, laboratory simulation, etc.); this would be very complex if lengthy textual policy statements to be followed. The graph visualisation helps to understand the complexity of policies with their interactions and hence flattens the steep learning-curve of the 3D MULE management; as noted, "The learning curve for operating OpenSim is steep" (OpenSim wiki, 2011).

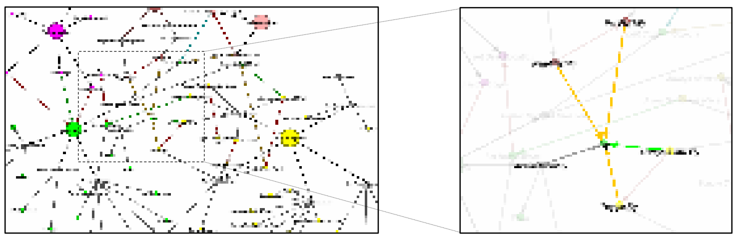

*Figure 4:* **A part of the policy considerations graph with interactions (Gephi [0.8-α])**

## Conclusion and Future Work

This research is in progress, and we expect to analyse the policy network as the next phase. This would help to identify important policies associated with critical functional nodes through centrality measures and eigenvector values. Although the findings have to be examined for correlations with critical activities of a learning process, those would unarguably help educationalists to understand clearly the complex functional interrelations of 3D MULE to design management considerations as appropriate.

This paper has briefly yet strategically proposed a unique blend of environment administration and user behaviour to overcome the challenges we encounter with 3D MULE uses. We hope to compare management policy consideration of an e-Learning system (Moodle) with 3D MULE policies to evaluate along with relevant user studies. By doing so, we expect to guide students to improve self-regulation and teachers to implement appropriate policies, for having a productive and reliable blended learning experience with 3D support.


## Acknowledgement

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# RENOVA - A Knowledge Transfer and Framework Construction for Nursing Staff across Europe to Develop Professional Skills as Managers

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**Abstract**

*RENOVA is a Leonardo da Vinci Transfer of Innovation project which belongs to the Lifelong Learning Programme. RENOVA mainly addresses to the nursing community, who are already practicing nursing and who want to develop organizational and managerial skills. The project consists in preparing and deplying training pilos, organized both in Poland and Romania, based on the transfer of French know-how and expertise and using face-to-face and eLearning sessions .*

**Keywords** : health management, nursing community, e-Learning, portal, lifelong training

## 1. Introduction

The RENOVA project is funded with support from the European Commission, within the Leonardo da Vinci Programme. The Leonardo da Vinci Programme funds projects in the field of vocational education and training. The persons who can benefit from the programme range from trainees in initial vocational training to persons who have already graduated, as well as VET professionals and anyone from organizations which are activating in this field. Leonardo da Vinci enables organisations in the vocational education sector to work with partners from across Europe, exchange best practices, and increase their staff's expertise. It should make vocational education more attractive to young people. The programme also boosts the overall competitiveness of the European labour market, by helping people to gain new skills, knowledge and qualifications. Innovation projects are essential to the programme; they aim to improve the quality of training systems by developing and transferring innovative policies, courses, teaching methods, materials and procedures.

## 2. Vision

The RENOVA project is an initiative of six partners across Europe: SIVECO-Romania SA - co-ordinator (Enterprise) – Romania**;** Universitatea de Medicina si Farmacie "Carol Davila" (Vocational training institute tertiary level) – Romania; TEHNE – Centre for Innovation and Development in Education (non profit organisations) – Romania; ORT FRANCE (non profit organisations) – France ; Searchlighter (Consultancy) – United Kingdom; Międzynarodowe Centrum Szkoleń i Kompetencji Sp. z o. o. (MCSK). Starting the 1st of October 2011, MCSK will be 100% took over by The International Centre for Trainings and Competences LLC (SYNTEA) – Poland. RENOVA is a training program dedicated to nurses from Romania and Poland. RENOVA is supporting participants in the acquisition and the use of skills and qualifications for professional development in the health management domain. The professional role of nurses is changing throughout the EU: there is more demand for qualifications which go beyond the traditional medical skills, as more nurses are required to play managerial roles in medical institutions. RENOVA will create an adequate instructional framework for this professional group that will contribute to enhance its labour mobility and professional development. RENOVA is committed to develop professional skills among nursing staff accordingly to labour market needs as set out in 'New Skills for New Jobs'.

### 3. Target Groups

#### General issues

A key criterion, with a major contribution to the quality of the instructional process, is the extent to which it addresses and meets the identified learning objectives/targets/goals of the target groups. Information about the target group strongly impacts the development of eLearning software. Thus, we take into consideration the following factors when analysing the target population:

- **Demographical**. Which are the general characteristics of the learners? Is there (or not) uniformity to *gender*, *age*, *educational* or *cultural background*?
- **Psychological.** Which is the cognitive structure, the level of cognitive development, intellectual ability, cognitive style? Do they want the information provided in a very direct manner or do they prefer a more time-consuming but engaging like a game format?
- **Attitudinal.** Which will be the learners' attitude towards the content presented or to training itself? Which will be the attitude towards the use of technology-based training?
- **Experience with technology-based training**. Are the learners already accustomed to using online materials? Are they comfortable with this approach or do they need an *ITC abilities/skills training* before?
- **Motivational.** Which are the learners' career goals? How can the instructional program assist them with achieving those goals?
- **Prior knowledge and experience.** What is the learners' level of skills and knowledge before training? To what extent are they currently working toward achieving the desired goals?
- **Organizational culture.** Which are the organizational culture features for different groups' members?
- **Accessibility**. Which are the general requirements of accessibility?

In accordance with the data available for all these factors, we design software adapted to the "target population" concerned. Any significant information from the list above will be reflected in the Storyboard Matrix and influence the development direction.

The modular structure of the eContent also offers the possibility to build different instructional paths, in accordance with the target group characteristics, giving a post development control upon the eLearning content.

#### Renova target groups

The nursing profession has a high proportion of women in its ranks, and among the men nurses there is also a higher than average proportion who are gay. The project aims at integrating and promoting these two specific groups in the labour market.

We consider that both groups are possibly disadvantaged in the workplace in terms of not being empowered to reach their potential as leaders in the labour market. Our training course will enhance nursing as a career choice for all people and make a direct contribution to challenging current bias in the labour market.

There is also the problem of knowledge deficits and social gaps between the usual forms of experience gained by nurses either in Romania or Poland and the EU market requirements. The majority of work force migration is taking place for "low level" jobs, while the higher value work experience is still in high demand but not available to persons coming from the new democracies. The project wants to create the necessary means to cover these gaps, by building a bridge to offer free access to information and to support, in the long run, the creation of a small training centre with free access. This will cover the lack of managerial skills and knowledge needed for the nurse staff to access higher levels in social and professional areas in their own countries as well as in others EU countries. Since there are several levels of management positions within a hospital, available for the chosen target groups, the project will address:

- Staff Administrators;
- Head nurses for a specific hospital area;
- Chiefs of staff.

## 4. Curriculum

The professional role of the nurse is changing throughout the European Union. There is more demand for qualifications that go beyond the traditional medical skills, as more nurses are asked to play organizational and managerial roles at various medical institutions. The set of skills associated with the managerial roles of nurses has numerous common features: it involves general knowledge about the health systems and policies, the health services market and its needs, and the foundations of management. The latter includes organizational cultures, the shaping of organizations, operational, strategic and quality management, leadership, motivating and control, change managing, negotiations and conflict solving, as well as issues specific to a given Member State, such as labour law and the respective health system of a given E.U.country. Therefore, an analysis of training models in EU Member States and a framework for a European model of training in this area would be very useful both for the nursing community as well as for various educational institutions that offer or plan to offer education programmes in this field of competence. The need for professional nurses acting in managerial roles is growing throughout the EU. By providing an adequate educational framework for this professional group would also enhance its labour mobility through the European Union and can be used and exploited in wider European context.

Our project will use French experience, know-how and expertise in Health Management dedicated to nurses to create specific curricula for Romania and Poland that will fill the gaps and create the premise for a new vision on this profession.

## 5. Learning Environment

The project will specifically provide:

- Virtual classrooms in which the intended target groups will participate and learn specific skills;
- Case studies (limited to the chosen area of the project but with a major possibility to be developed in the near future) for the chosen subjects;
- Development of an excellence centre which aims at offering free access and development support to the target groups mainly and, in the long run, to any areas of expertise.

The course will have on line component that will take place in a virtual learning environment built on the RENOVA portal (we will use a Moodle for the class and resources administration) as well as face to face sessions that will contribute to a complete learning experience.

## 6. Pedagogic Approach

***"eLearning is learning"***

A relevant education is more important today than ever because today's world demands a workforce that understands how to use technology as a crucial tool for productivity and creativity. These skills include "information reasoning", a process in which reliable sources of information are identified, effectively accessed, understood, contextualized and communicated to colleagues. Furthermore, employers require workers to have the skills necessary to collaborate, work in teams, and share information across global networks, meaning to analyze issues from a multidisciplinary perspective. Because these networks are international, employers seek out individuals who have the capacity to effectively interact with others.

eLearning has become a key factor to the actual informational world. The traditional educational institutions (schools, universities, lifelong formation) use it to prepare learners adapted to the society needs. Organizations use it as a powerful strategy to better leverage their intellectual capital and to create new skills and increase performance of their employees.

To be successful in the emerging e*Learning Space*, however, we had shifted our thinking from designing relatively static distance learning solutions (such as class-room extended, course-based experiences, and reconfiguring existing courses and content resources) to digital, interactive, reusable objects which can be used in different virtual spaces, in multiple scenarios and instructional sequences. The challenge calls for highly personalized learning solutions that help learners respond to their defined needs and allows them to manage their own learning experiences.

Better trained personnel has emerged as one of the major challenges for the global knowledge society, and the solution for this is lifelong training. The previous notions of a divided lifetime of acquiring knowledge (in school and universities) and applying knowledge (in working life) have become untenable. Professional activities are knowledge-intensive in a continuously changing Europe. It cannot be expected for the workforce to acquire all the knowledge needed for a lifetime in advance. The half-life period of knowledge keeps decreasing and thus, lifelong learning has become integral part of work activities in the form of continuous engagement in acquiring and applying knowledge and skills in the context of a current task at hand.

The new geographic boundaries of Europe impose a new concept of union, the union seen as a global assignment at an economical, social, and partly political level, a legislative harmonisation done for different cultural environments.

The accent is therefore on the optimisation of the European Union through structural laws, but also on maintaining a cultural independence of each country.

Based on these new approaches, our project will apply an innovative framework of ideas in the field of professional learning for multicultural and multi languages environments. Summarizing this framework, we can say that productive learning must be done in the local language and needs a learning by doing environment where learners make things collectively, facing real problems, where they can share ideas with others, where we help them to reflect on their projects and assumptions, where lecturing felicitously complete learning by doing giving learners the knowledge they need to perform the activities that are the core of their daily work.

Our eContent and content design is focused on providing adult, individual learners with the tools, resources, and tactics for achieving their specific learning/training outcomes. An intermediary step has been for our instructional designers to emphasize the reconfiguration of traditional, classroom-oriented instructional and training experiences to digital, online versions of the same. At this moment the situation has changed; we no longer want to copy the traditional learning method, but to apply a new theory of “eLearning” based on two important aspects: what the IT&C offers as learning means and resources and what are the new competencies and objectives of the eLearning process to be added to those of the traditional learning.

Our solution offers not only knowledge, information, communication, interactivity but also a friendly virtual environment, a place for changing experience, and a community to belong to.

The eLearning tools can provide individualized, personalized learning by profiling variables such as interests, learning and cultural styles, presentation preferences and performance requirements. They can diagnose skill gaps and prescribe professional development activities ensuring the link between learning events and on-the-job practice. Individuals can monitor their own progress and determine what the next step in their professional development should be. Learning resources, ranging from individual objects to online communities of professional practice can be available when and where the learner needs those resources.

The cognitive strategies used in the developed courses are open, heuristic, problem oriented. They are complementary to acknowledged instructional algorithms, while the active-participative methods used contribute to develop learners' abilities, skills, attitudes and behaviours and not only mere memorizations of information or behavioural routines.

The variety of materials is the necessary support for an efficient instructional practice, where the learner takes an active part in the construction of his/her own learning process, is permanently required to provide feedback and to take decisions.

The process of understanding the notions relies on methods defined by interactivity, cooperation, communication. The degree of assimilation and understanding of the notions is definitely superior to the degree achieved by classical instructional methods, since the whole process is aimed at forming a structure in which the learner is meant *to learn how to learn*, the accent being on the development of the critical thinking.

A major benefit of such curriculum presentation is the possibility to transform a virtual reality into an instructional environment. This environment makes it possible to have activities that could never take place in a classical learning environment: experiments, simulations of processes or phenomena, virtual tasks modelled after real situations that learners face at their work places.

## 7. Pilot Deployment

The core of our project is the pilot that will be organized in Romania and Poland and will consist of activities around the organization, deployment and conclusions of the nurses training.

The pilot is designed as a framework with different activities:

- **Selection** of certified trainers (Poland 4 trainers, Romania 4 trainers).
- **Selection** of trainees (nurses): in Poland nurses will be selected in collaboration with the Central Association of Nurses and Midwives through an open call; in Romania with the help of Carol Davila University that will present a methodology of selection; The estimated number of trainees in each country: 100 persons (60 in Romania, 40 in Poland).
- **Course deployment**: the course will have 4 modules and the duration of the course will be 76 hours: 40 hours face-to-face and 36 hours online.
- **Certification**: according to the Poland law, there is no need of certification; in Romania, the Midwives Association will authorize the course.
- **Evaluation**
  - Gather feedback, proposed changes and amendments to the pilot with the help of the participants;
  - Formalize results, cases, presentations and make them available through the project portal;
  - Evaluation of the pilots and assessment of the global methodology through interviews and semi structured interviews, on line questionnaires.

## 8. Conclusions

The project is a premier in the medical sector and targets to be the beginning of a new stage in the health sector, more accurate in the medical resources management. RENOVA is a training pilot project which helps nurses from Romania and Poland to use their professional skills in the health management domain. The results of such a program, meaning the feedback from the target groups will decide its efficiency and its necessity to develop into an international program at medical level.

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# An Educational Ontology for Teaching University Courses

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## Abstract

*The developers of some e-learning platforms, that were reported in the last years, started to design and implement educational ontologies. Such ontologies are key issues for the web-based education. As an ontology represents a conceptualization of a knowledge domain, in the particular case of an educational ontology, the content of the educational modules of a course is modeled. Any university course has several characteristics such as a curriculum, a length, a specific audience, learning goals etc. The organization of a course can be, for example, under the form of chapters and sub-chapters or modules and sub-modules. The main concepts that has to be taught are included in the educational ontology. The paper presents an educational ontology, Univ_Edu_Onto, developed in Protégé, that has general terms for a university course, and specific terms for the course of Artificial Intelligence, that is teached to undergraduate students.*

**Keywords**: Educational ontology, Web-based education, e-learning

## Introduction

The importance of the educational ontologies development was highlighted in the last years, and many developers of e-learning platforms started to design and implement them, in order to provide an efficient web-based education. As an ontology represents a conceptualization of a knowledge domain [5], an educational ontology models the content of the educational modules of a course. The purposes of using ontologies are knowledge sharing and reusing. The development of the semantic web and of the adaptive e-learning systems are dependent on the use of ontologies. Moreover, the use of different ontologies for the same domain by several web-based applications raises the problems of ontology mapping and ontology merging. Thus, it is necessary to have standard ontologies or, at least, some mechanisms to match and merge the ontologies. In the case of university courses, the educational ontologies have general terms specific to any university course, and specific terms for the knowledge domain of each course. In this paper it is described an educational ontology Univ_Edu_Onto, developed in Protégé, that has general terms with some synonims (for an easier ontology mapping), and specific terms for the course of Artificial Intelligence, that is teached to undergraduate students. The ontology can be adapted to the knowledge domain of other university courses.

The paper is structured as follows. In section 2 it is discussed the use of ontologies in education, and it is presented a brief overview of some work on educational ontologies that were reported in the literature. The educational ontology, Univ_Edu_Onto, is presented in section 3. The ontology was implemented in Protégé [11]. The final section concludes the paper.

## Ontologies in education

The main purpose of education is knowledge sharing, and, in this context, it is obvious that the development of an e-learning system has to be based on specific ontologies. Such ontologies are named educational ontologies. In an educational ontology the content of the educational modules of a course is modeled. Any university course has several characteristics such as a curriculum, a length, a specific audience, learning goals etc. The organization of a course can be, for example, under the form of chapters and sub-chapters or modules and sub-modules or sections and sub-sections, to name just some well known synonims for the same entity, that of dividing a course by topic, in its main components. The concepts that has to be taught are included in the educational ontology. The educational resources of a course are presented by using the concepts defined in the ontology.

In [6] it is described the framework of an e-learning system, and it is proposed a methodology for knowledge management that apply recommendation algorithms. In this context, ontologies are used to personalize the educational resources, according to the attendants' personality and preferences.

The evolution of IMA-CID, an integrated approach for modeling educational content is discussed in [2]. The authors had developed an automated tool for content modeling, AIMTool, based on Java, as a web application, that can be used to collaborative construction of the IMA-CID models (conceptual model, instructional model and didactic model). Ontologies are used as a supporting mechanism for modeling the content of the educational modules.

In [10] it is introduced the CADMOS-D method, based on UML, for the design of educational adaptive hypermedia applications. The conceptual model uses RDF-based ontologies.

The main issues and some methodologies used for the design and construction of educational ontologies are presented in [4]. Also, it is strengthen the necessity of developing educational ontologies for personalized learning and it is discussed the design and implementation of an educational ontology, named PEOnto, a Personalized Education Ontology.

In [8] it is presented an ontology model for specifying a knowledge domain in the teaching/learning process. The ontology can be used in different learning contexts.

In order to better use the educational resources, a framework for supporting communication between existing ontology-based educational repositories is described in [3]. The authors had defined a communication ontology.

In [12] it is described a semiautomatic framework, TEXCOMON, that produces domain concept maps from text, and then, derive domain ontologies (e.g. educational ontologies) from these concept maps. TEXCOMON can be used to build domain ontologies from English text.

A framework to automatically generate adaptive feedback from metadata of items, used by educational ontologies, is introduced in [7].

In [1] it is presented the AquaRing educational ontology and its use to annotate and retrieve learning contents within the AquaRing architecture.

The importance of defining and incorporating ontologies in the knowledge management system of a university is highlighted in [9], where it is described an ontology for knowledge management (KM) in universities. Such KM ontologies include apart from the ontologies specific to university management, the specific educational ontologies, for the disciplines that are teached in the university in different programmes of studies (undergraduate, postgraduate, doctoral, postdoctoral).

**Univ_Edu_Onto: An educational ontology for university course teaching**

We have developed an educational ontology, Univ_Edu_Onto, for a university course teaching. Figure 1 presents a block schema of a university course teaching system.

The course is teached by using an e-learning platform. Any course has some characteristics such as objectives, curriculum, length, audience, learning goals, overview, content, prerequisite courses. Each course has its pedagogical resources: pedagogical modules (PM), databases (DB - for applications, problems, exercises etc.), electronic books, articles, course notes (e.g. powerpoint slides or pdf documents); and an ontology (UC_KD_Ontology – **U**niversity **C**ourse **K**nowledge **D**omain Ontology).

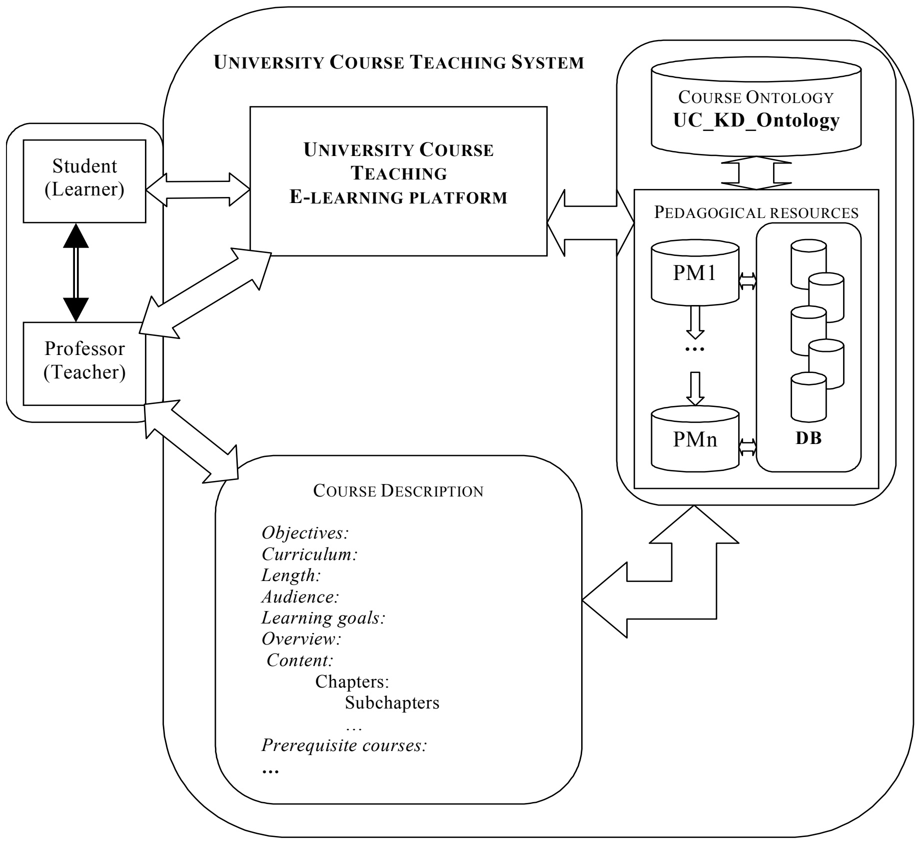


*Figure 1*. **The block schema of a university course teaching system.**

The ontology of a university course has a vocabulary with general terms and specific terms. Figure 2 shows the general structure of a university course ontology. The general terms are valid for any course and such examples are as follows: discipline, curriculum, length, audience, objectives, pedagogical resource, learning resource, number_of_credits, content, chapter (with the synonims section, module), sub-chapter (with the synonims sub-section, sub-module), examination (test, exam), problem, application, exercise, solution, lab, project, software, basic_concept, advanced_concept. The specific terms are particular to each course and include concepts from the domain of knowledge that is teached under that course. In the case of the Artificial Intelligence course some examples of specific terms are as follows: knowledge, inference, heuristic, cognitive_system, reasoning_system, informed_search_strategy, knowledge_base, inference_engine, knowledge_based_system, expert_system etc. In Figure 3 it is given a subtree from the Univ_Edu_Onto ontology hierarchy with some specific terms from the Artificial Intelligence discipline.

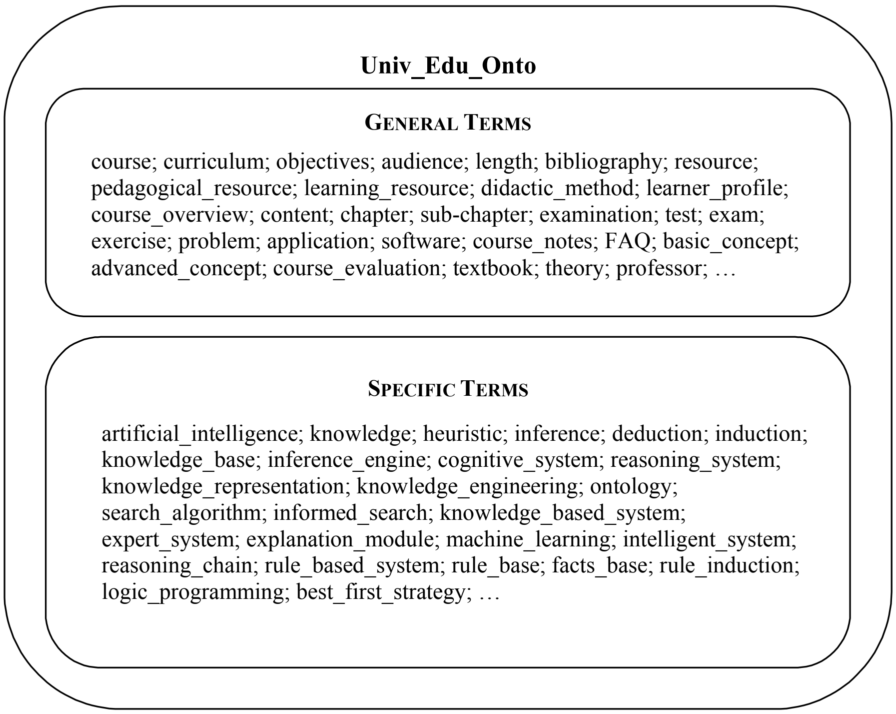


*Figure 2*. **The general structure of a university course ontology.**

Each term from the ontology has a description and several characteristics. Between the terms of the ontology there are some relationships. The main relationships used by the Univ_Edu_Onto ontology are *has*, *part_of*, *order*, *required_by*, *is_a* etc. Some examples of relations are given bellow:

*part_of*(course, chapter1); // chapter1 is part of the course
*order*(chapter1, chapter2); // chapter1 should be teached/learned before chapter2
*required_by*(chapter1, chapter3); // chapter1 is required by chapter3
*is_a*(heuristic, knowledge); // a heuristic is a particular type of knowledge
*has*(A*, heuristic_function); // the A* informed strategy has a heuristic function.

The terms given in Figure 3 are specific to the artificial intelligence discipline, more exactly to the chapter of problem solving in artificial intelligence (AI). In this chapter it is studied the application of various search strategies in solving different problems (toys problems such as chess, Tic-Tac-Toe, 8-queens, or real world problems such as robot navigation, automated planning).

The ontology was implemented in Protégé, a Java-based ontology editor. In Figure 4 it is given a screenshot with some classes of the ontology (in Protégé 3.0), and in Figure 5 it is given a screenshot with the Search_Space slot description for the Search_Algorithm domain (in Protégé 3.0).

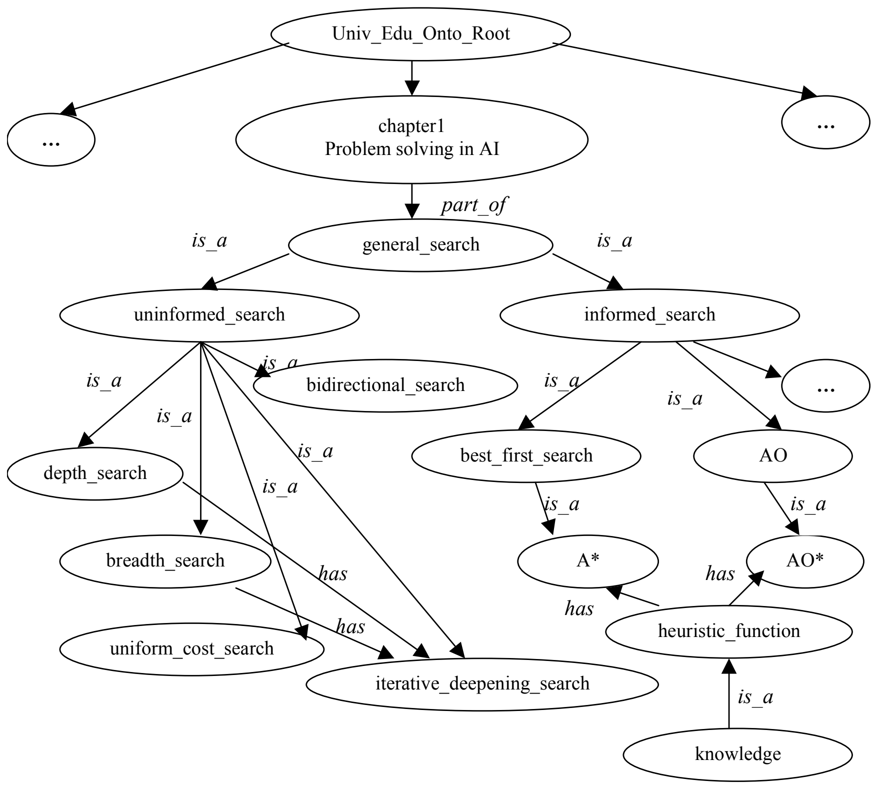


*Figure 3*. **A subtree from the Univ_Edu_Onto ontology hierarchy with specific terms from the Artificial Intelligence discipline (search strategies – chapter: Problem solving in AI).**

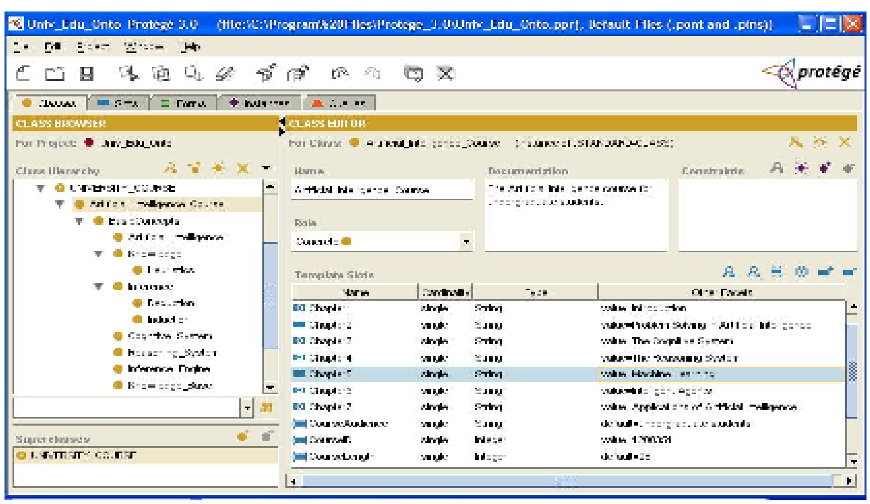


*Figure 4*. **A screenshot with some classes of the ontology (in Protégé 3.0).**

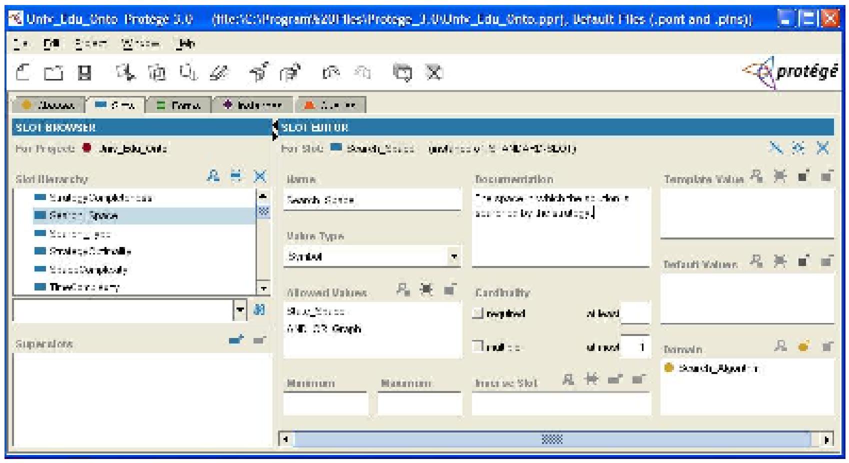


*Figure 5.* **A screenshot with the Search_Space slot description (in Protégé 3.0).**

## Conclusion

The paper presented an educational ontology, Univ_Edu_Onto, that was implemented in Protégé, and has general terms for any university course and specific terms for the course of Artificial Intelligence, teached to undergraduate students. The ontology can be incorporated in the university e-learning platform that is used for the teaching and learning activities.

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# Improving E-learning Assessment and Test Feedback through Bayesian Belief Networks

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**Abstract**

*Automatic testing is a standard feature of most e-learning systems. The students are usually informed about their level of knowledge through a test score, but there is rarely further information to help them know on what they need to study harder. In some cases, the students are given the correct answers after the test, but we believe that does not motivate them to study more considering sufficient to know the answers to the test. Our approach gives the students a weighted hierarchy of the study material sections on which they need to study harder according to the weights. We believe such an approach is both informative and motivating for the students, thus determining them to study more instead of just remembering the answers to a few questions. We propose a system that uses Bayesian belief networks to determine probabilistically from the test question results the study material sections which the student misunderstood or did not study enough. The Bayesian networks will rely on initial dependencies set by the professor between the test questions and the study sections, and on the history of the tests being given across semesters. To further motivate students, the system uses the history of tests and scores to inform the students of their predicted final grade. To avoid having the students lose their focus and intensity, they will only be shown the predicted grade if the chances for failing the course are higher than a predefined threshold. The proposed system should help the instructors maintain an appropriate academic level of teaching, and the students acquire more knowledge and obtain higher grades, which eventually will make them more desirable for employment.*

**Keywords**: e-Learning, assessment engine, Bayesian belief networks

## Introduction

The scope of education is [Dylan] one to accumulate new knowledge and information and use them to generate knowledge. In educational systems, the level of accumulation is measured in terms of marks and credits earned. In e-Learning systems, one methodology to quantify the knowledge of a student is represented by e-assessment.

Tests and other assessments measure the effectiveness of learning. The testing process results, mainly scores, can be used to supply subsequent study materials for students in order to improve their future results.

Testing can be easily performed when a testing tool (or engine) is used. These tools may differ in the way they implement the testing features, but most follow [Horton] a common direction related to developing, conducting and reporting test; this direction consists of authors creating tests, the tests are uploaded on a server, students request tests, then each student takes the test, the computed score is sent to server and the trainers visualize the scores.

Using a formative manner of assessment, learners get feedback related to their level of understanding of the presented material. Offering the feedback during the assessments helps learners make cognitive connections [Horton] and collect proper information in the future.

In this paper we focus on design of an e-assessment engine that gives the students, besides a summative feedback, a weighted hierarchy of the study material sections on which they need to focus, to study harder. We believe such an approach is more meaningful for the students regarding their level of understanding, thus determining them to study more to improve their results. We propose a system that uses Bayesian belief networks to determine probabilistically from the test question results the study material sections which the student misunderstood or did not study enough and even suggest them complementary study material.

**E-assessment**

Whereas summative assessment represents the development of learners as a hierarchical standing of student at a certain point (the end of a semester or year), the formative assessment consists of various processes and procedures conducted by trainers during the learning process in order to modify teaching and learning activities [Crooks] to improve student attainment.

Summative assessment can be perceived as assessment of learning whereas formative assessment would be assessment for learning.

In 2006, Nicol and Macfarlane-Dick analysed the area of formative assessment and feedback trying to explain how these processes could enhance the development of learners. Concluding their study, they stated the following principles related to formative assessment [Nicol]:

(1). Helps clarify what good performance is;
(2). Facilitates development of self-assessment and reflection in learning;
(3). Delivers high-quality information to students about their learning;
(4). Encourages teachers and peer dialogue around learning;
(5). Encourages positive motivational beliefs and self esteem;
(6). Provide opportunities to close the gap between current and desired performance;
(7). Provides information to teachers that can be used to help shape teaching.

Having most of these principles in mind, we thought of a system that would help students improve their results and teachers to get a more realistic idea about the level of understanding related to their presented material.

Because there is a sequential presentation of a course chapters and courses materials during semesters, there can be observed certain relations between chapters inside a course and between different courses; it can be observed that one who didn't receive good marks at a certain course or topic, is probably to obtain bad marks to the following course or topic tightly related to the above mentioned. Our proposed engine is intended to be used to determine what course materials should be studied in more depth in order to perform well to the next related course or topic. For this causal relation detection, we thought of Bayesian belief networks.

**System Architecture**

The system presented in this paper is an e-assessment engine that supports online testing and stores the test data in a back-end database. The stored data will be used to calculate the probabilities necessary to the Bayesian Network inferences and grade prediction.

The advantage of using Bayesian networks is that [Russel] probabilistic reasoning allows taking rational decisions even when there is not enough information to prove that any given action will work. We build the system based on a data structure called belief network used to represent the dependence between variables and to give a concise specification of the joint probability distribution. We then show how probabilistic inference can be done in practical situations.

The data stored in the database that are relevant to the support of formative assessment in our system are listed below. To support broad and comprehensive feedback we feed out inference engine, data related to all the courses and process it all together, without separating data by disciplines. This allows the system to make connections between the performance disciplines. For instance, a student that fails a Virtual Reality test may prove to have a weak understanding of Spatial Geometry, whose teaching is outside the scope of the Virtual Reality course.

S - Study material sections: all the courses stored in the database have their study materials divided into sections that can be referred individually;

A – Answers to test questions: every question is linked to one or more sections, each link having a probability attached to it;

G: Test grades: the grade of a test is a summative value assigned to the answers given by the student to a group of questions;

F: Final grades: the summative evaluation of a student's activities and performance in one course.

Given the powerful mechanism that a Bayesian network is, the e-assessment engine can perform many inferences using this data. We have chosen the following inferences as being the most relevant and useful for student and professor feedback:

A→S: suggest sections to be studied based on question answers;

S→S: suggest sections to be studied based on the results of A → S;

A→F: infer the probabilities for the final grade to be one of ten possible values.

**Study Material Suggestions**

The study material suggestions rely on the student's answers to the test questions and on initial probabilities set by the course instructor to link the questions to the study material. The result of the inference is a list of section associated with probabilities saying how likely it is that a section influence negatively the test result. The suggested sections are not necessarily part of the same course's study material.

This approach relies on the supposition that the instructor re-uses the same test questions across several course instances, and consequently there is historical data available to improve the inferences. In the case that the professor changes the test questions, only the initial probabilities can be used to determine the suggestions. While this is still useful, we can use in the Bayesian network the recorded suggested chapters instead of the recorded question results.

This approach can also be applied as a second phase to the inference presented above. After the initial set of suggested sections are determined from the question results (with or without having older recorded question answers), the engine will use the suggested sections in conjunction with the recorded suggested sections to suggest further study material.

The suggested study material is primarily displayed to the student to guide him or her to achieve better results. However, this data is also useful to the course instructor to see how the students understand the course and what are the problematic. A section widely suggested to the students can point to difficult material, or insufficient explanation and examples from the instructors.

**Inference Example**

In order to emphasize the way the engine should work, we give an example: students are given a test that contains 3 questions denoted Q1, Q2 and Q3 respectively. The topics that the 3 questions address are covered in 2 chapters of a course, chapters being denoted C1 and C2. The dependencies that can be observed between the questions and topics covered in the given chapters are: An incorrect answer to Q1 and Q2 results in the need of study C1; incorrect answer to Q2 and Q3 states that C2 needs further reading (Figure 1).

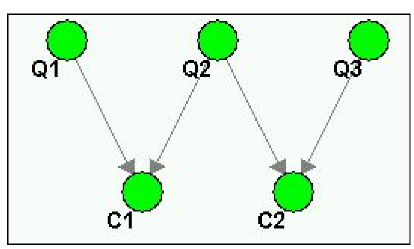



*Figure 1*. **Example of Bayesian Network**

Among the given questions, the first, Q1, is the most difficult one. The expected rate (probability) for a student to give a correct answer is 0.4 as depicted in Figure 2.

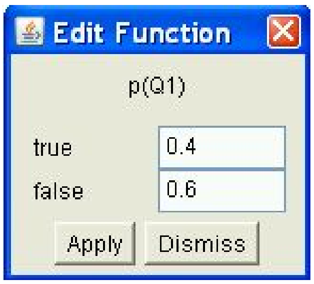
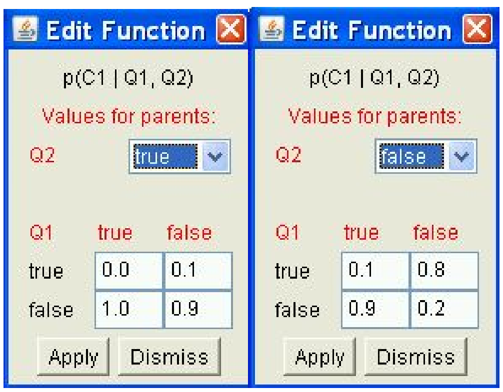



*Figure 2.* **Probability Distribution for Q1**




(a) (b)

*Figure 3*. **Conditional Probabilities for C1**

Moreover, we consider that P(Q2)=0.5 and P(¬Q2)=0.5, and for the third question P(Q3)=0.7 and P(¬Q3)=0.3 as it is the easiest one to answer. For a qualified person it should be easy to decide what direct conditional dependence relationships hold in the given domain and obtain the topology of the belief network. When relations are established, we have to specify conditional probabilities for the nodes that are related as direct dependencies, and use them to compute some other probability values. In Figure 3 are depicted conditional probabilities for C1.

Let us consider that the probability of reading C1 is true. If Q1 and Q2 are true, the result is that C1 doesn't need to be read. If Q1=false and Q2=true, meaning that Q2 was given a correct answer but Q1 an incorrect one, the probability of reading C1 (C1=true) is 0.1 (see Figure 3a). Reversing the idea, Q1=true and Q2=false results in probability of reading C1 (C1=true) in value of 0.1 (see Figure 3b). If both answers are incorrect, the probability of reading C1 (C1=true) is of 0.8 (see Figure 3b). The probability of C1=false can be easily computed for each of the above cases as 1-probability when C1=true.

In the case of lack of knowledge about the answers to any of the questions, the system can compute the posterior distribution related to C2 as follows:

```
probability (  "C2" ) { //1 variable(s) and 2 values table
       0.16999999999999998 // p(true | evidence )
       0.83;  // p(false | evidence );
```

For C1, the posterior distribution is:

```
probability (  "C2" ) { //1 variable(s) and 2 values table
       0.16999999999999998 // p(true | evidence )
       0.83;  // p(false | evidence );
```

Also, the system can compute posterior distributions based on observations on partial elements in the modeled network; if we observe that Q2=false, meaning that we only know that he didn't give the correct answer for Q2, but we know anything related to Q1 and Q3 as he didn't answer at all to these questions, the posterior distribution computed for C1 is:

```
probability (  "C1" ) { //1 variable(s) and 2 values table
       0.52   // p(true | evidence )
       0.48000000000000004;       // p(false | evidence );
```

and for C2:

```
probability (  "C2" ) { //1 variable(s) and 2 values table
       0.27999999999999997 // p(true | evidence )
       0.72;  // p(false | evidence );
```

Having the network modeled, even if a student doesn't complete the assessment, because of various reasons: didn't succeed to answer in the given time, had something else that made him abort the process, the engine can give a feedback suggesting whether he should or not read certain course materials in order to improve the results.

**Final Grade Inference**

Following a similar approach to the above, the engine uses the stored data to inform the student about this or her chances to get each of the ten possible grades. The table below shows the intended display.

| Grade | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Probability | 0% | 0% | 5% | 10% | 15% | **30%** | **35%** | 15% | 7% | 1% |

The data for this inference does not and cannot be initialized by the professor directly, but rather relies on recorded question answers and recorded final grades. These data serve as a base for calculating the initial probabilities for each final grade based on each question. The Bayesian network is thus initialized and produces the output shown in the table above.

The final grade inference is a useful feedback to the course instructor when aggregated across all the course students. This will show the expected class level and status and can point the instructor to corrective actions regarding the teaching or testing.

**Student Progress Curve**

The final grade calculation is often the time a linear combination of the intermediate test grades. Rarely the final grade takes into account the student's progress during the semester. Thus, students that, for instance, came from a different background and achieved initially poor results but later on caught up with the class will implicitly have a lower grade. Depending on the case, it may be encouraging to the student to get a bit higher grade that rewards their effort to catch up with the rest of the class. Many professors take this path but they usually don't have the necessary information easy at hand to make the decision.

Our engine will calculate the student's progress curve and detect those matching the criteria described above and suggested them to the instructor for re-evaluation. The detection criteria can be expressed in mathematical terms as: any student whose intermediate grades are on an ascending slope. For instance, student A

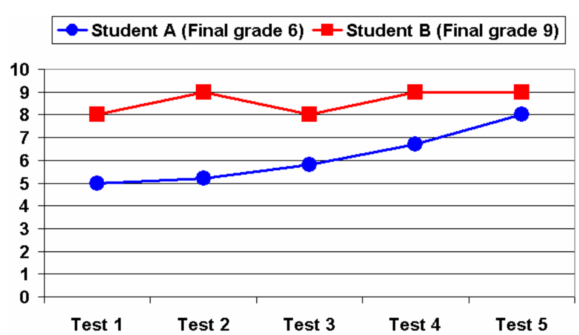



*Figure 4.* **Student progress curve**

in Figure 4 is considered a candidate for grade 7 instead of 6, while student B will stay at grade 9 and not be suggested for a re-evaluation based on progress.

**Conclusions**

This paper has proposed an e-assessment design model based on the incorporation of Bayesian networks in common learning management systems. The design allows teachers with minimal technical skills to construct e-assessment tasks and to discover sophisticated relations between different courses or even course chapters that a student needs to review in order to achieve higher order skills.

Design proposed illustrates not just the importance of student outcomes assessment but also the critical role that technology and e-learning strategies can play in an overall assessment program. With the increasingly dependent and vital role that technology plays in human productivity and knowledge acquisition it stands to reason that technology needs to play an important role in our efforts to evaluate instruction and learning outcomes, as well as drive the decision making that seeks to enhance educational effectiveness.

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# Usage of Petri nets in designing and evaluating interactive animations

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## Abstract

*Petri nets as a tool for modelling systems are currently one of the most used methods for modelling and simulating system processes in various fields. In the case of interactive animations we can use Petri nets for design and evaluation of course or flow of events in the current time interval in which the user actively participates. The aim of this paper is to highlight the possibility of using the methodology of design using Petri nets for interactive animation as well as the advantages and disadvantages that occur in the model and what can be achieved by evaluating the model. The paper is divided into practical and theoretical part. The theoretical part provides a brief overview of Petri nets, their use in the past and nowadays, the basic definition and characteristics of Petri nets and their usage from the pedagogical point of view. The practical part describes the procedure in designing Petri net model for a particular interactive animation and an explanation of how we can simplify and adapt this animation to users' needs using the model we created.*

**Keywords**: Petri nets, Interactivity, Animations, Modelling, Simulating

## Introduction

Nowadays, the development of modern ICT is closely related to the implementation of new manufacture technologies, operation controlling, realization of non-standard communication systems, etc. This relation, on the other hand, causes the problems for developers as the differentiation of hardware and software at the same time limits the system possibilities of the devices. From the point of view of complex characteristics of these systems, it is necessary to create such models that would characterise particular processes, e.g. the production process. This requires the usage of the tools of modelling and analysis in order to find the most optimal strategy. Prospective errors in the model simulation of the processes will thus markedly contribute to the reduction of time and price in creation of these systems as well as the increase of the efficiency of the systems.

Petri nets as the mathematical tool for modelling and simulation provide unified environment for modelling, formal analysis and design of discrete models. One of the main advantages of implementation of Petri nets models is that the same model can be used not only for the analysis of behavioural characteristics and evaluation of model efficiency but for the systematic construction of the discrete event simulators and controllers as well (Reisig and Rozenberg, 1998).

In case of definition of Petri nets as the mathematical tool, they represent a set of linear algebraic equations or mathematical models reflecting the system behaviour. Based on these it is possible to realise the formal analysis of the model. The outcomes of the analysis of model simulation, however, point out only limited set of possible states of the modelled system as well as the presence and/or absence of possible problems (error states). In other words, if we wanted to find out whether no problem occurs in the system, we would have to execute the simulation created using Petri nets in all possible states (Zurawski and Zhou, 1994).

**The possibilities and implementation of Petri nets from the pedagogical point of view**

In graphical representation of Petri net, places are represented by circles and transitions by bars. Transitions and places are connected into graph by directed arcs. Places in Petri net represent the states or conditions. If there is a token in the place it means that the condition is fulfilled. The basic construction of Petri net is displayed in Figure 1. The places $p_{i1}$, $p_{i2}$, ..., $p_{im}$ are input places of the transition $t_1$ and places $p_{o1}$, $p_{o2}$, ... $p_{on}$ are called output places of $t_1$ transition (Winskel, 1987; Klimeš and Balogh, 2008).

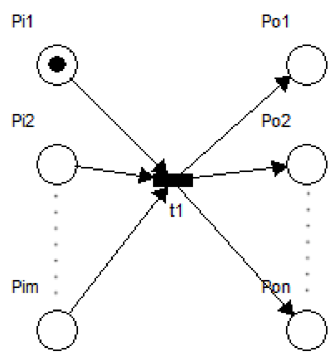


*Figure 1*. **Basic construction of Petri net**

From the pedagogical point of view we can use Petri nets as an effective tool that can enforce better explanation of various processes and system functions. Thus we are able to explain the progress of whatever action or process, whether deterministic or nondeterministic, without necessarily having the device or system realising the particular function.

Petri net as a modelling tool and graph of event routing in the system can serve as the model (algorithm) of progress of the action that is not understandable even by visual observation in reality. Examples of such actions are chemical reactions where Petri nets enables easy and effective modelling and simulation of compounding of chemical substances (Figure 2).

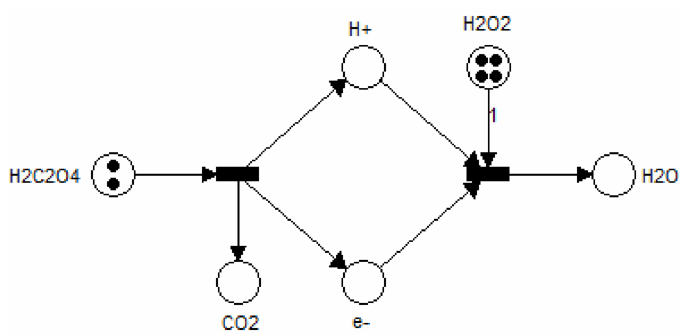


*Figure 2.* **Chemical reaction (number of tokens represents the number of molecules)**

In such Petri model, places represent compounds of chemical elements, transitions mean particular activity or influence, while tokens represent number of molecules of particular compound or element depending on the place where they are.

In this way, it is possible to provide the students with the understandable system without ineffective explanation. Furthermore, Petri nets from the pedagogical point of view can be implemented in modelling the educational system as well. Thanks to the model we are able to eliminate useless and ineffective activities. This has serious influence not only at the possibilities of modification, but at the effectiveness of the teaching process as well. In the following text we present the implementation of Petri nets on the example of interactive animation and we point out the possibilities of the model in design, evaluation as well as the optimization from the point of view of the user.

**Design and evaluation of interactive animations using Petri net**

Multimedia is a technology that allows us to present text, sound, images, animation and film in an interactive way that has the potential to create a tremendous impact on all different aspects of our day-to-day activities (Rahman et al, 1996).

Since the introduction of computers as educational tools, interactivity has been heralded by many as the one feature of this technology that holds the strongest promise for educational use (Hannafin and Peck, 1998). Interactivity makes it easy for students to revisit specific parts of the environments to explore them more fully, to test ideas, and to receive feedback. Noninteractive environments, like linear videotapes, are much less effective for creating contexts that students can explore and reexamine both individually and collaboratively (Bransford et al, 1999). In these and many similar claims, interactivity is presented as an attribute of learning environments that enhances the quality of educational materials and that can facilitate learning.

The notion that learning is not simply a process of information transmission, but that students have to become actively engaged for deep learning to occur, is certainly not new (Mayer, 2001; Renkl and Atkinson, 2007). Interactive learning environments are viewed as a promising option not merely for presenting information but for allowing the learner to engage actively in the learning process (Renkl and Atkinson, 2007). Interactivity in learning is a necessary and fundamental mechanism for knowledge acquisition and the development of both cognitive and physical skills (Barker, 1994 as cited in Sims, 1996).

Design of interactive animations first of all depends on the field of their usage. It means that it is relatively wide area and it still develops. Creation of interactive animations is a complex process in which it is necessary to follow certain rules. Interactivity in animation enables the user to actively enter into the progress of animation and modify its action flow according to his needs and ideas. It denotes that the animation will not always depict the same result. It will wait for the instructions, in this case entered by the user, and display the result in line with given parameters.

From the formal point of view it is thus possible to regard the interactive animations as state devices with asynchronous and concurrent events. Via Petri nets we are able to model such asynchronous concurrent systems with unknown but deterministic event sequences that represent the design of nonlinear script.

In this case, places in Petri nets are e.g. preview (graphic) changes in animation, i.e. graphical variation of the button, change of the animation background, or a change of representation of whichever object of the animation. Since these animations are regarded as deterministic automata, it is obvious that all possible previews are set in advance and it depends on the user's manipulation with the animation which of them will be displayed. Transitions in Petri net mean inputs, i.e. users' interaction with the animation. In other words the user has to realise certain step in animation to achieve possible as well as required display of the animation. The output represents the event at the transition from one state into another.

In the picture (Figure 3), there is the display of the animation that will simulate possible usage of Petri net from the point of view of design and evaluation of interactive animations.

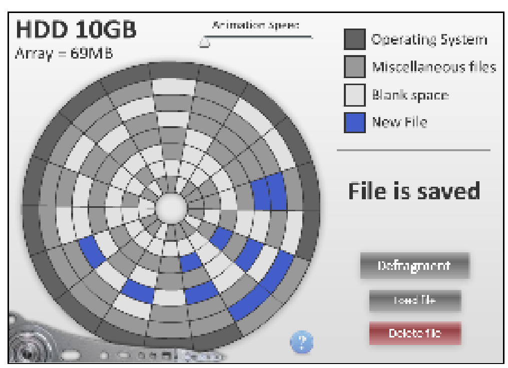


*Figure 3.* **Interactive animation – defragmentation of hard drive**

Interactive animation in the picture (Figure 3) introduces the structure of hard drive. It explains how the file defragmentation is realised. Main menu of the interactive animation is represented by 'Help' button, 'Animation Speed' tab, 'Defragment' button, 'Load file' button and 'Delete file' button.

The principle of interactive animation may be described in the following steps:

1. Saving the file to disk – the file is entered by sequential clicking on free segments of hard drive. The file is composed of 10 parts – as soon as they are all loaded the other options of the animation are available.
2. Defragmentation – animated defragmentation of those segments (file parts) that were realized in the first step.
3. File loading – fictive action when only the motion of reading head is performed to evidently display how reading is realised before and after the file defragmentation.
4. File deleting – moving the action to the beginning of the animation – after this it is possible to repeat the whole action.

This progress of interactive animation can be displayed via Petri nets (Figure 4):

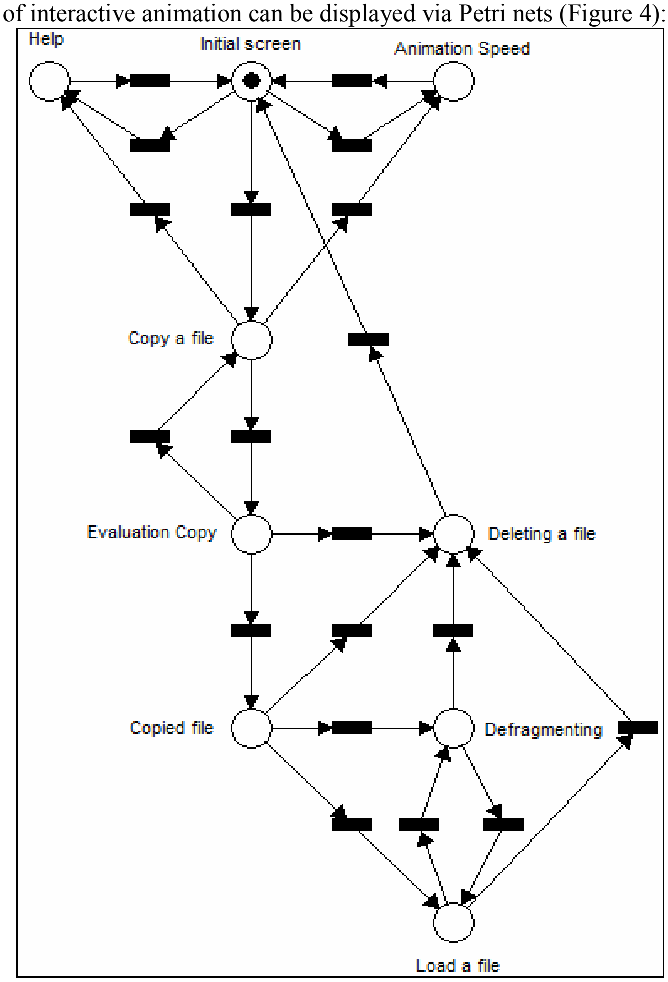


*Figure 4*. **Petri model of animation of hard drive defragmentation**

With such model we are able to evaluate the animation states and eventually also decide which states are problematic or useless, as well as the states that might disturb the user.

Design of the script and creation of this type of animations is considerably difficult process. Addition of any interactive element enlarges original script of Petri net model. This is also the reason why simplification from the programming point of view is used. Simplification of Petri model of interactive animation can be considered if it is possible to reduce (Shterev, 2005):

a) Two states among which there is a transition into one state if the function of the interactive animation remains unchanged (e.g. removal of graphical or acoustic signalisation of a button),
b) Number of several transitions to one state into one transition if the transition to this state does not change the function of the interactive animation (e.g. removal of Help button),
c) Two transitions and two parallel states into two transitions to one state.

Such exploration and evaluation of the animation ends in new design that helps us to modify the animation so that it is more effective and easier to use.

According to these defined rules it is possible to noticeably simplify the Petri net for interactive animation displayed in Figure 4 since the states ‘help’ and ‘change of speed’ match the rule B, i.e. in case of several transitions to one state it is possible to realise only one transition if it does not change the function of interactive animation. It is important to remind that this step is possible only from the programming point of view as it simplifies the programmers’ orientation in the Petri net.

The removal of the states is possible only if it does not disrupt the sense of the interactive animation itself. This case can be observed in Figure 5 where three states were removed from the previous model (Figure 4): ‘help’, ‘animation speed change’ and ‘file loading’. In this way we preserved the function and sense of the animation and also got the minimal model of Petri net of this particular interactive animation as well as the ideal transition of the user through the animation.

However, it is important to consider the target group of the interactive animation. The users, unlike the programmer, are not familiar with the usage of animation so the ‘help’ state is very important for them in spite of the fact that it is not important from the programmer’s point of view. In this case, its importance lays mainly in the pedagogical and psychological point of view because it provides the user with the possibility to confirm how to correctly manipulate with the interactive animation.

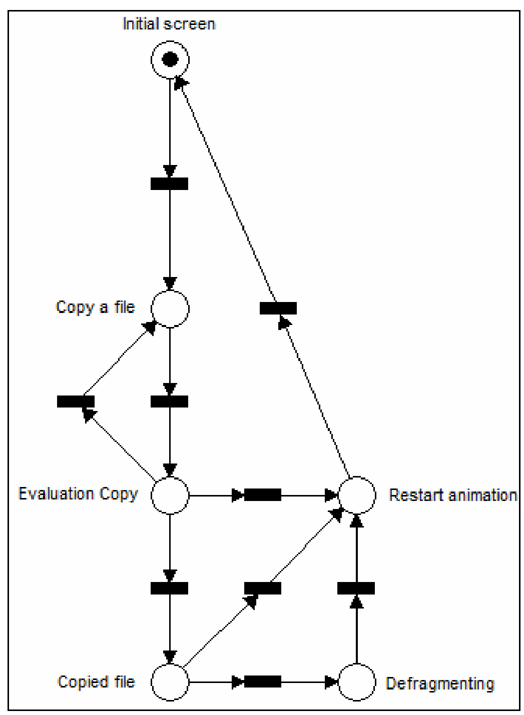


*Figure 5.* **Minimised model of Petri net of interactive animation**

**Conclusion**

In the process of implementation of Petri nets from the point of view of design and evaluation of interactive animations it is very important to understand deeply the functioning of Petri nets as well as to possess the knowledge of their features and possibilities. We came to the conclusion that under certain circumstances this system enables us to improve the interactive animation and to adapt it to the user's needs. This fact confirms the idea that Petri nets can serve as a strong tool for creating educational materials into which e.g. interactive media elements are implemented. In the paper we dealt with this concept and we proposed a solution of one simple interactive animation. In reality, design of interactive animations scripts is much more complex and difficult process, mainly because the whole realisation team should be incorporated – from the pedagogue, psychologist, graphic designer (eventually also sound editor) to the programmer. It is very difficult to propose a universal method of the design of such animation because we have to take into consideration also the target group that will use the animation after its creation.

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# Learnability Testing: a Case Study

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**Abstract**

*E-learning has gained in the last years a considerable traction in all the fields of life that require education. With the wide development of various e-learning applications, the creators need to assess not only how usable these applications are, through usability testes, but also how learnable they are. This paper offers a perspective on how learnability tests work and describes a case study emerged from an European project.*

**Keywords**: eLearning, Usability, Learnability, Case study

**Introduction**

In the last years e-learning has gained more and more adepts and has become a serious competitor for traditional tutor-led courses. Not only has e-learning became popular in the public and private school systems but also many organizations chose to adopt it as it provides on-demand training without the constraint of geographical, time or personnel factors. And of course, the online virtual resources are more cost efficient than the real, tangible ones (Rosenberg, 2006).

E-learning is learning (and thus the creation of learning and learning arrangements) where the Internet plays an important role in the delivery, support, administration and assessment of learning. Integrated e-learning is the result of combining dual, complex and flexible learning (Jochems et al, 2004), (Kirschner and Paas, 2001).

E-learning is associated with just-in-time learning and students are another type of knowledge workers (Goodyear, 1998). Consequently, we should try to design technology which is appropriate to their actual work rather than technology which embodies our teacher/managers' beliefs about what students should be doing. It is perfectly appropriate for us to have a view about what students should be doing. But we need to know what they actually do, in order to support them with better technology.

We could also say that e-learning is a mixture of media created and design for educational purposes.

However, there are a lot of constraints for an efficient use of e-learning systems mainly due to the quality of courses, relevance of content, useful technical support, and so on. One of the key problems is, however, the aspect of the poor usability, which is characteristic of many e-learning applications (Miller, 2005).

The most of today's efforts are put into developing instructional content rather than trying to make the e-learning systems easy to use for their students. And we have to be aware that an usable e-learning platform has a different meaning than an educationally efficient platform.

There are many ways to determine the usability of an e-learning application, including heuristic evaluations, usability tests, and field studies (Miller, 2005).

We also have to take into consideration the existing usability standards in the field. And we will refer to learner-centered design, iterative design and ongoing testing. The information required for the learner-centered design can be obtained through surveys, interviews or focus groups.

Some think that e-learning should take into account pedagogical, technical and organizational aspects, should be mixed with face-to-face education and should be student centered (Jochems et al, 2004).

Like in most of the service and products areas in nowadays, e-learning is focused on offering on-demand content rather than off-the-shelf content. This is strongly related with the student-centered aspect of e-learning.

A formative product, to represent a rewarding experience, should (Norman, 1993):

- be interactive and provide feedback
- have specific goals
- motivate, communicating a continuous sensation of challenge
- provide suitable tools
- avoid any factor of nuisance interrupting the learning stream

Using new technologies does not mean totally ignoring and rejecting the old traditional ones. We should try to find a suitable way to integrate the traditional strategies into e-learning. The user has to be involved in the learning process but he shouldn't feel pressure during this process.

Learning is recognized as an active process, where the learner is stimulated to cognitively manipulate the new learning material and to create cognitive links between it and prior knowledge (Ardito et al, 2004). For this approach to be effective, a task must be always included in an actual and collaborative context, to make the learner understand the motivation and the final goal of the task itself, also by facing other learners' opinions (socio-constructivist principle) (Soloway et al, 1996).

The most used methods in e-learning usability will offer a set of general rules to be followed. The problem with this approach is that these set of rules don't respect the particularity of some e-learning systems. This problem has been pointed out by several researchers already.

**Usability Testing and Learnability Testing**

Usability testing is a controlled experiment that tests how well people use a particular product (Narayan, 2007).

Criteria for a learnable course:

Is the learner motivated to finish the course? Is the course engaging?

- Do the instructional strategies interest the learner? Simply put, does the learner 'get' the theme?
- Is the instructional flow clear to the learner? Is the learner comfortable with the content?
- Is the course free of obstacles (too much audio, too much text, bugs, navigational errors and so on) that may hinder learning?
- Is the course usable?

We don't solve the usability problem if we repair all the technical errors, programming bugs, and other functionality issues. We need to also find out if the students like it, are helped by it and are comfortable by the way we present it (Andone et al, 2008).

Learnability can be divided into two broad categories: concept testing and usability testing (Narayan, 2010). For the concept testing we should ask the following relevant questions:

"Is the learner showing interest in taking the course?", "Is the learner motivated to read information? ", "Does the learner 'understand' and 'relate' to the theme used? ", "Is the learner looking for more information? ", "Does the learner feel that there is too much information? ", "Is the learner able to understand the content?" Is the learner comfortable with the language used? "

It is also important to analyze the exercises we put in our course.

- How do the learners respond to exercises?
- Do the exercises challenge them?
- Do the learners find the exercises motivating?
- Is the learner comfortable with the feedback received?

Then, we move to the usability testing part (Narayan, 2010).

Here we analyze the navigation asking "Is the learner able to find his way through the course? " or "Are the Next and Back buttons positioned at the right place? " (Narayan, 2010).

Regarding the learner interface it is important to find out if all elements (icons, buttons, and so on) on the interface are intuitive.

Finally, we look into the affordance factor and we try to find out if "Does the learner click all the clickable icons? ", "Did she click any element that was not clickable? ", "Does the learner rely on instruction text to carry out a particular action? ", "Did the learner complete all tasks on a screen before moving ahead? " (Narayan, 2010).

It is extremely important to let the learner know that we are not testing his abilities and that there is no pressure to take the test. We are testing the platform not the person.

**Case study of a learnability test**

***Scope***

Taking into consideration all the above mentioned usability factors, a learnability test was conducted on the ESIL (European Sustainable Innovation License) e-learning platform. The EU LifeLongLearning Leonardo ESIL project aims at consolidating successful training programmes for SMEs in the fields of innovation and sustainability from several EU member states (Austria, Italy, Germany, Slovenia, Estonia) as well as disseminating the method by means of a defined procedure to other member states such as Ireland, Czech Republic, and Romania (European Sustainable Innovation License (ESIL) project, http://esil.cpc.at/). The test was conducted more specifically on the Innovation Management course (Fig. 1).

***Participants***

Because the platform was in alpha release mode, we considered that ten learners were sufficient for this step. Eight male and two female learners participated in the testing process. They were students and former students with various backgrounds. Their average age was 27 years.

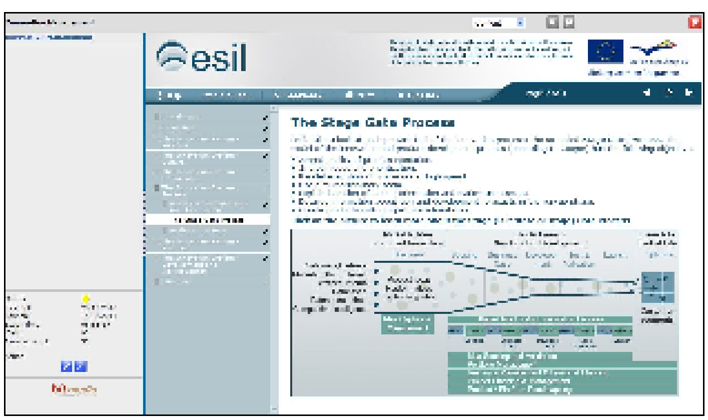


*Figure 18* **ESIL Elearning Platform - Innovation Management Course**

**Design**

The tests were conducted in the “Politehnica” University of Timisoara, Center for Distance Education. For tracking the activity of the learners, we used a video camera, a screen recording software and two observers with notebooks and pens. The observers sat slightly behind the learner and took notes.

Each learner received a list of tasks which he was supposed to perform on the platform. The learner was encouraged to voice her thoughts whenever she seemed to be having problems with performing the tasks. The observers recorded the time spent on each task, actions performed, comments made and so on.

Afterwards, the learners were asked to reflect on their interaction with the platform through a series of questions using a post-test questionnaire. We wrote down the learners’ feedback.

***The Test***

The tasks were chosen from a typical learner session on the platform:

1. Find the management course using the search field
2. Enter that course
3. Find out what the course is about
4. Choose a chapter
5. Bookmark that chapter
6. Move to the next chapter
7. Look at a term in the glossary
8. Mark the course as done
9. Find your bookmark

The post-test questionnaire contained 4 questions referring to the learning aspect of the platform:

1. What is your overall impression about the course?
2. Do you think the way the concepts were explained helped you understand the concepts better?
3. Do you think the way the interface was designed engaged you and motivated you to finish the course?
4. How would you rate the course on the basis of its look and feel?

**Results**

The first task required the learners to find the management course using the search field. 40% of the learners had a hard time finding and/or using the search field and another 20% didn’t use the search field at all because they spotted the course in the list. The average time for completing this task was 24 seconds.

The second task required the learners to enter the management course. 100% of them succeeded in finding the green arrow that allowed them to open the course, although 50% were at first inclined to click on the title of the course, which didn’t work. All of them were surprised by an unexpected pop-up which asked them if they wanted to return to the previous page. The average time for completing this task was 8 seconds.

The third task required the learners to find out what the course is about. Half of the learners successfully spotted the information on the first page of the course, while the other half searched inside the menu before finally finding it. The average time for completing this task was 29 seconds.

The fourth task required the learners to choose a chapter from the course. The success rate of this task was 100%. The average time for completing this task was 3 seconds.

The fifth task required the learners to bookmark the current chapter. Almost all of the learners (90%) succeeded in bookmarking the chapter using the bookmarking system implemented in the interface of the course. The average time for completing this task was 26 seconds.

The sixth task required the learners to move to the next chapter. Half of them used the back and forth arrows to navigate through the chapters, while the other half used the menu to accomplish the same thing. The average time for completing this task was 4 seconds.

The seventh task required the learners to look at a term in the glossary. All of them found the glossary section in the course but couldn't use it properly due to functionality bugs. The average time for completing this task was 12 seconds.

The eighth task required the learners to mark the course as done. This task had a success rate of 100%, although 40% of the learners made a considerable effort to find the "mark as done" button. The average time for completing this task was 31 seconds.

The ninth task required the learners to find the bookmark which they set in a previous task. 50% of the learners returned to the course and found the bookmark section while 40% of them found another bookmark section in the dashboard but which didn't work properly. The average time for completing this task was 32 seconds.

The post questionnaire required the learners to reflect both on the content of the course and on the platform itself.

More than half of the learners (60%) described the interface as having "too many commands", "unintuitive buttons" and "hard to find features". 30% of them described the interface as being "simple", "easy to use" and "intuitive".

Regarding the design, 40% of the learners described the interface as using "too little contrast", "dull colors" and being too "businessy". Another 30% of them described the interface as having "well-chosen colors" and displaying "quality".

More than half of the learners (70%) complained about at least one software bug encountered in the process of using the platform.

The content of the course was described by 70% of the learners as being "simple", "easy to read", "well structured", "interactive" and as having "well designed graphics".

Taking into account the overall impression about the course, the average mark given by the learners was 7 on a scale of 1 to 10.

**Discussion**

The results of the testing differ quite considerably between the interface and the content itself.

The content of the course proves to be easy to follow, well structured and interactive. The graphics seem to be well chosen and representative for the chapters they belong to. This enhances the ability of the learners to comprehend the notions taught and motivates them to finish the course.

As opposed to the content, the interface of the course would benefit from a few improvements. The biggest problems the learners faced were due to software bugs (unusable glossary, semi-functioning bookmark system, unexpected pop-up) and unintuitive, hard to find commands (enter the course, set/find bookmark, mark as done).

However, these weaknesses are related to the "extra commands" belonging to the interface of the course. The core functionality of the course, like navigation and displaying of content, seems to be bug-free and easy to use. This means that even if the interface could be improved, it doesn't hinder the learner as it is.

The results indicate that the learners would be interested in using the platform for improving their skills in various areas of interest.

**Conclusion**

E-learning has become popular in many public and private schools and a lot of organizations also adopted it for on-demand training without constraints such as distance, time and personnel.

Learnability testing is a controlled experiment that tests how efficient an e-learning platform is. Learnability testing implies both concept testing and usability testing. Concept testing assesses the interest and motivation of the learner and usability testing assesses how intuitive and bug-free the platform is.

In this paper we presented a case study of a learnability test which we conducted on the ESIL e-learning platform. The results indicated that, although it could be improved in several ways, the platform contains many examples of good pedagogy, good uses of technology and evidence of rich interactions.

We intend to extend the test with further methods and participants as the platform develops into a more complex e-learning tool.

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# ICT in education: responsible use or a fashionable practice. The impact of eTwinning action on the education process

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**Abstract**

The importance of new technologies in education is widely recognized, becoming in the last decades a fitting reason for the speech on education at all levels - curriculum and didactic practice, teacher training, development of schools, educational policies or administration of the education system. Against this background of enthusiasm that characterizes early stages of any new phenomenon, there is a risk of losing sight of key issues regarding the real impact on teaching practice, the relevance for the needs and interests of students, or usefulness of approaches for the main actors and beneficiaries of the education system. Starting from the eTwinning experience, the article is trying to bring into light the benefits of ICT integration in education, as well as several critical issues, in order to shape some solutions for improvement.

**Keywords**: education, new technologies, impact of ICT

**Introduction**

The issue of integrating new technologies in education has been long discussed and analyzed from multiple perspectives, being especially highlighted the benefits, resources and implications estimated at different levels. In the last decade, significant progress was made: provision of schools with technology, internet connection, education software development, development of support materials, and providing training for teachers. Many programs or projects aimed at promoting new technologies in education. A significant example is the eTwinning Action - part of the *Lifelong Learning Program* of the European Commission.

**eTwinning in Romania: a brief CV**

eTwinning was launched on 14 January 2005, initially to facilitate partnerships between pre-university education institutions in Europe. Subsequently, the goals of the action were consolidated and the portal www.etwinning.net became a community of schools in Europe, bringing together over 130.000 teachers.

In October 2007, Romania joined eTwinning. Teachers started to register and to create partnerships with mates from all over Europe. By July 2011, during the four years of implementation, Romanian teachers developed over 3300 school partnerships. Most of them consists of relevant and creative educational projects, motivating both students and teachers. eTwinning projects facilitated new learning experiences and teaching practices designed to motivate students, to stimulate their involvement and to develop their skills and attitudes. They have a great potential of transferability, being applicable in a new context, with different groups of students.

The quality of the work of Romanian teachers has been recognized every year. They were awarded European prizes and were invited to present their experiences in European events.

In Romania, eTwinning is implemented by the Centre for Innovation in Education – TEHNE, in partnership with the Institute for Education Sciences.

Briefly, the figures below clearly show the successful implementation of eTwinning in Romania, as well as the high level of interest of our teachers in such educational projects:

- almost half of the schools registered on the eTwinning.net portal (more than 4,000 schools registered until June 2011, according to the statistics provided by the portal);
- over 8,000 teachers registered and developed more than 3,700 school partnerships from the program (1300 being in the process of implementation);
- the European competition in 2009, 2010 and 2011 brought many prizes and recognition for our teachers;
- over 150 teachers have received the European quality labels for their projects and over 700 have received the national quality label;
- 95 teachers participated in professional development workshops organized by educational institutions in various European countries (Spain, Greece, Portugal, Germany, Italy, Finland etc.) or in the annual conferences;
- in March 2008, the annual eTwinning Conference was held in Bucharest, gathering over 400 teachers and education policy makers from Europe; the conference was opened by European Commissioner for Education, Mr. Jan Figel;
- there were prepared, printed and distributed: a guide for teachers (2009), to help them using the eTwinning portal and developing school projects, a collection of best practices (2010), promotional posters and leaflets;
- over 100 national prizes were awarded to teachers and students (promotional materials sent as a result of national campaigns or competitions);
- in 2010, there were organized two training seminars for teachers, one bringing together 50 teachers from Romania, Bulgaria and Slovakia, another 30 teachers from Romania and France;
- around 45 monthly newsletters were translated into Romanian;
- a dedicated website was created - www.etwinning.ro;
- over 200 teachers from Romania participated in online training events organized by European Schoolnet at European level;
- over 1,500 teachers participated in online professional development activities organized by the national eTwinning centre;
- during octombrie2007 - june 2011, the national eTwinning centre has developed 12 national campaigns. They have sought to stimulate the participation of teachers, to encourage projects of quality, creativity and responsibility.

The main goal of eTwinning is to facilitate communication and collaboration between schools in the European Union member countries, involving teachers and students in new learning activities: the creation of various educational products involving new technologies and cooperative development teams from different countries. In the long run, it aims at improving ability to use new technologies (both for teachers and for students), improving communication in foreign languages (basic competence in the EU - communication in at least two foreign languages), knowledge and intercultural dialogue.

**The impact of eTwinning action on the education process**

Although we could address the impact of the Action at different levels - at institutional level, at the level of teaching staff and pupils, at the level of teaching and learning, as well as the level of local community, etc. - the most important remains the teaching itself. It is clear that for teachers the membership of a European professional community is of great importance. It is also easy to understand why cooperation is so important for the school institutional development.

eTwinning is an initiative vivified by the teachers and students. It is a flexible action, without formal procedures and written agreements, but based on teachers' interest to diversify their students' learning activities, to share ideas and experiences with other European colleagues, to overcome cultural boundaries in education and to constantly renew their teaching methods.

By participating in eTwinning projects, students can communicate with colleagues from Europe, find specific items or specific cultural features, to learn using new technologies and to improve their communication skills in a foreign language. Directly or indirectly, all eTwinning projects are expected to improve communication skills of students, in the linguistic meaning of using a foreign language skills, but also in social sense, as interpersonal communication. eTwinning contribution to intercultural communication was highlighted by Professor Piet van de Craen: "*The more intense is the exchange culture, the better we will know the "other" and the more European we become*" (Van de Craen, 2008).

Knowledge of a country language paves the way for its culture, and understanding of the *other* means cultural acceptance and appreciation of diversity. Some projects have mixed foreign languages with sciences. Thus, learning a language by teaching physics, chemistry, mathematics, etc. has increased the attractiveness of lessons and pupils' motivation, activities of individual documentation have been replaced with debates and discussions of experiences made with colleagues from the partner country. eTwinning has shown through such projects that *students are eager to learn, provided they are stimulated and guided carefully* (Van de Craen, 2008).

Teachers participating in eTwinning argue that "the motivation for solving learning tasks has improved. Students expressed a strong interest to work the computer for collaborative projects. (...) ICT teaching methods have diversified, becoming more efficient and motivating not only for students and teachers participating to projects, but also for other students and teachers in school, these manifesting their desire to start working on such a project" (Gheorghe, 2008). Most Romanian students want "to use more the computer and Internet for lessons at different disciplines. 90% of them believe that people who do not have access to a computer will be disadvantaged later" (Istrate, 2008).

Analyzing virtual collaborative projects undertaken by teachers not only in Romania but also in other countries, one can easily see **the difference between the declarative and practical implications in the teaching process**. Many projects remain at an early stage of collaboration or adaptation of teaching and learning activities so that to enable collaboration among students (the same class or classes in different countries). Collaboration is reduced to presentations of schools and posting of materials in twinspaces, websites or blogs. Materials posted reflect the work of teachers, rarely of their students. But in both cases the materials tend to be results of the initiatives or individual interests and not a product of partnership, of teamwork. In terms of proposed activities in partnership, most of them regards the communication by email, videoconferencing, presentations or developing of photo albums, electronic journals, glossaries, etc. In a smaller percentage innovative activities occur such as: the involvement of students from many countries in a collaborative activity of development of a presentation of their countries, from the common elements and differentiating elements; analyzing the consequences of decisions which they adopt in the day-to-day life and discussing them in groups, taking into account the specific cultural elements; designing of scientific experiments and discussions upon observations with colleagues from other countries etc.

**Individual progress of some teachers is visible in time;** if the first project was not actually a collaborative one, the next have value the experience and diminished the shortcomings of the first stages. In many cases, however, whether a teacher has come to participate in over 20 projects, this progress is not visible. What is the cause? Based on the assumptions that there is a strong motivation for professional development and that the collaborative activity is dealt with responsibility, the only explanation is the insufficient pedagogical training to really integrate new technologies *in & for* education.

Another example is the involvement into a large number of projects, many of them having the same theme, the same activities and products. Beyond the extrinsic motivation to get as many certificates of participation as possible, what could be the benefits of such options? What should be done to determine, on the one hand, the responsible action to the benefit of pupils, and on the other hand the transition to an advanced stage of integration of new technologies in teaching practice?

**Teacher training - prerequisite for the quality of integration of new technologies in learning**

"*In education, teachers tend to accept the technology instead of adapting it to their own teaching style*" (Gheorghe, 2008). The teacher training activities should not resume to the development of computer skills and technology usage in general. This is a condition and a first stage in preparing for the integration of ICT in education, but it requires sustained teacher training activities. In the absence of pedagogical skills to design education situation by integrating new technologies as a teaching resource and not as an end in the teaching and learning, we will remain at a superficial level of exploitation of new technologies and inter-school cooperation opportunities. To implement cooperative learning strategies, it is not enough that a teacher read about it, but personally experience such learning situations. Here is the important role of the workshops for teachers organized within the eTwinning action, and also of other training activities within some programs and projects. Through the eTwinning workshops, teachers are able to experience and learn with the tools provided by the cooperative platform. These activities put them in position to become acquainted with new teaching strategies, through practical concrete examples that outline the learning process as well, not just its results.

There is a need for a pedagogical culture of collaboration (Illomaki et alii, 2003). Teachers participating in school partnerships have stated that proper use of technology has not generated the most problems, but the collaboration with other teachers, communicating in a foreign language, student involvement in group activities, integration of their project into curriculum and so on. Teachers with experience conducting inter-school partnerships based on new technologies are recommending to beginner colleagues that, according to existing resources in school, to work in small groups of students, so that each contribute to the project. They also recommend that in class to work with text, illustrations, written comments, presentations, documentation, blogs and other sites (Gheorghe, 2008).

Continuous training - often invoked as a solution - can not consistently cover the full range of teacher training needs. There is a need of strengthening and bettering the initial practical training. In this context, important steps have been achieved when departments for teacher training in some universities have integrated in their educational offers consistent teaching and learning programs through technology exploitation.

Serious approach to ICT in education, as well as the superficiality, will be perceived by students as such; they will take the models offered by their teachers, legitimated by the delivery within the school space. After implicit transmission of the superficiality, the costs for returning to the responsibility would be much bigger and the route would be much longer.

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# Involving Students in Maths eTwinning Projects

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**Abstract**

*The presentation is focused on a few ways to enhance the degree of students' involvement in projects, as well as on specific examples of activities from several eTwinning Maths projects. Due to the specific features of Maths projects and to the "arid" nature of the subject, they should have an incentive aspect, that can be achieved through the types of activities that are planned, the degree of collaboration and the tools that are used. Mathematics can thus become a "vehicle" for learning about the partners and for the mutual understanding of our cultural environment.*

**Keywords**: Mathematics, eTwinning projects, school collaboration

## Introduction

During the development of a successful school project, the teachers' role is not the same for the entire duration of the project. Once the main preconditions are entailed (a good plan, based on clear aims and targeted competences, as well as on common syllabus content, and a safe and efficient environment provided by the eTwinning tools), the focus is on the participating students. From this moment on, the teachers' task is mainly to facilitate and stimulate the students' involvement, while encouraging their independence and their responsibility for their own learning process. Students will be the main progress source of the project, because they are going to be achieving the transformation of effort into learning. New skills, experiences, knowledge will be developed as a result of their involvement throughout the project, starting from its earliest stages. Furthermore, it is important that this involvement continues even after the project is concluded.

How many times have we heard from our students the question: "Why do we have to study this?"

As opposite to the common perception of Maths as being an abstract, mechanic, repetitive and boring subject, by means of creative and imaginative projects, it can become interesting, helpful, surprising, flexible, intriguing, and fun. Students can become aware of Mathematics role in our physical and cultural environment as well as in our cultural heritage.


*Fig.1* **Alternative Approaches for Maths Activities with eTwinning Projects**

## Alternative Approaches with Etwinning

ETwinning can help teachers to significantly enhance the students' motivation due to its features: it empowers collaborative and peer-to-peer learning, as well as learning communities, benefits the students' different skills by a multiple intelligence approach and promotes a natural use of ICT. The following approaches and examples can be taken into account in order to tackle with students' involvement when implementing an eTwinning project.

**Fostering Curiosity and Creativity**

Setting as a starting point the connection between Maths and a seemingly opposite domain, such as literature, Arts, cooking, can exalt fantasy and free students' imagination. Fostering and challenging curiosity and creativity from the starting point of the project can be a good incentive and empower students' motivation. In our project *Maths in Wonderl@nd*, the starting point consisted of the Mathematical allusions in Lewis Carroll's book "Alice in Wonderland", while in *A Taste of Maths,* the challenge was to find similarities between/ ways to use Maths and/in cooking.

New types of activities can also motivate the students by letting them use the skills they had not previously had the opportunity to put to work and display.

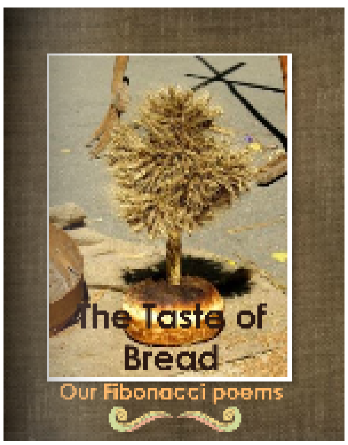


*Fig.2* **Fibonacci poems book in "A Taste of Maths"**

Videos and dramatizing, or even writing poems, can be used as learning tools and thus help make learning more effective and active. Instead of asking pupils to study topics, they can be asked to experience, experiment and create.

Following Alice in her journey, we went on "exploring the rabbit hole" by looking for more peculiar and odd mathematical objects: magic squares, the Mobius' strip, paradoxes and special numbers. The students' curiosity and investigation spirit was thus stimulated, they got used to research and analyse, to look for unusual solutions (for example in the "Egg of Columbus" episodes in our online magazine) rather than wait for ready-made knowledge.

**Emotional Focus**

Maths can be made more personal if students are aware that it has been created by the work of real people, if they learn about the stories, difficulties, and struggles of men and women who have studied it. Dramatizing and performing can bring a more personal approach, by asking students to "put themselves into the scientists' shoes" and "re-living" the important moments in their lives. In Maths in Wonderl@nd, students have learned about the history of the number PI, they have studied about Pythagoras' ideas and have "performed" the crisis of his science.

**Challenging Each Other**

Mutual challenges can make the collaboration more active and enhance the students' motivation and competition spirit. Their teamwork skills will also be stimulated. In *Maths in Wonderl@nd*, our students have challenged each other both in the blog and in the audioblog.


*Fig.3* **Loudblog**

In *My Town in Numbers*, they alternatively proposed to the other teams Math tasks connected to their own town, while in *A Taste of Maths* the tasks are related to food: cost-effective packaging, the largest area to be surrounded with a pack of spaghetti, making a fractal salad, Geometry with breadsticks etc.

***Connection to Every-Day Life***

Connecting Maths to every-day life and to our real environment gives Maths topics a purpose and a meaning.

We have tried to show how Maths are applied to other sciences, such as Biology studies, but also how one can use it in cooking, cost-effective packaging, gardening, making difficult situations simpler and, above all, getting to know more about each other. The task called ”A Visit to Bucharest” is a treasure hunt that combines Google Maps, Geometry and information about some of the most important tourist attractions in Bucharest.

**Sharing, Collaboration and Communication**

It’s important for students to feel that they have embarked in a journey with real partners, despite the virtual work environment. Project activities have to involve all or at least part of the consortium, rather than take place in parallel. A wide array of common activities can be approached, such as editing a magazine/blog together, as we did in Maths in Wonderl@nd, writing a collaborative book (using tools such as Mixbook for example, that allows shared editing), as in our Maths poems collaborative book or celebrating Maths events such as Pi Day together. Working cooperatively, even in transnational teams, not in parallel, will create a collaborative learning environment and will empower communication under different forms.

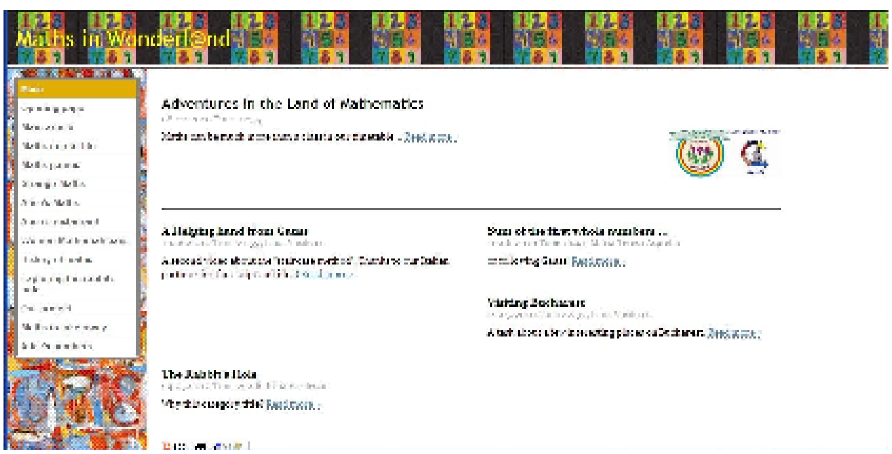


*Fig.4* **On-line Magazine**

More ideas for collaborative tasks could include learning conversations, where partners are asked to discuss the topic, share information, ask questions and/or solve problems. Part of this would also be commenting and giving feedback.  Students can create presentations or dictionaries collaboratively, by dividing the work and using a collaborative tool such as Google Docs, making comparisons, creating puzzles, quizzes, problems and games for their pairs.

Communication means dialogue and understanding. The study of Maths in a second language is not very common, therefore the tasks should not require too demanding levels of communication. On the other hand, eTwinning promotes second language empowerment by offering students and teachers occasions to use it in communicative and real contexts. Our students have enjoyed all types of communication, but their favourite were the Flashmeeting videoconferences, because they had the opportunity to be in direct contact with their partners.

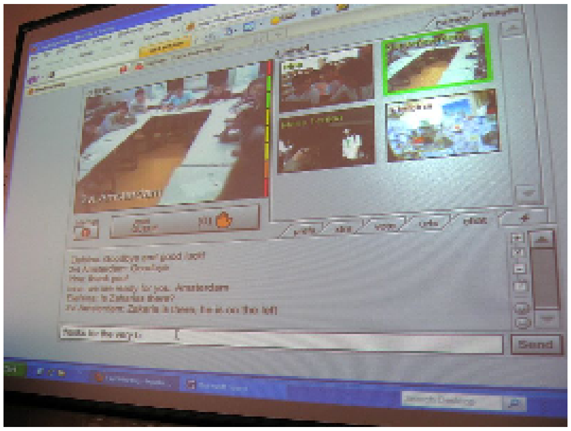

*Fig.5* **Flashmeeting**

**Gender Equality**

Gender mainstreaming is an EU priority. Studying the History of Maths and the biographies of women Mathematicians can make students aware of the contribution of women to this science and help them get rid of stereotypes related to girls' scientific skills (are girls worse than boys at Maths?) and it can also enhance girls' interest in following scientific careers. In Maths in Wonderl@nd, students had the opportunity to acknowledge how bright women have brought their contribution to the creation of the history of Maths.

**ICT Tools and New Technologies**

A characteristic of eTwinning projects is the natural, content-integrated use of ICT that empowers the collaboration by providing a safe and cooperative learning environment and allowing a wide array of communication and sharing methods such as videoconferencing, audio files, videos, blogs, images, magazines, animations, multimedia tools, according to the participants' level of expertise.

By using the tools they are familiar with, students' involvement can be enhanced. Mobile technologies allow them to study anywhere, anytime, at their own pace, using the tools they like/are familiar with: mobile technologies, podcasts, iPods and so on.

This is what we tried to do with our "iPod Maths". It was a surprise to find out that podcasts could be used for Maths as well. We used the audio blog as a new learning tool. At the same time, it was a very close way of working together, because the students could hear each other's voices. It was a bit difficult to surpass the natural teenagers' shyness as they had to express themselves in a foreign language, but finally it was possible.

**Games, Stories and Role-Playing**

Games are a very powerful tool. The partners can propose games or riddles to each other, then solve them according to their personal cultural background and compare the strategies. It's a very good method to learn divergent thinking. We played a lot of games while working in projects, from funny ones to more serious ones, from quizzes to animated games.

Playing roles is also very appealing to students; they enjoy being journalists, script-writers, actors, directors, cooks, researchers and so on. Stories can be great for younger students and they can turn a common Maths task from a boring one into an adventure. Instead of just having to find all the nets of a cube, we had to dress Mr Cube, an imaginary alien who had just arrived on Earth coming from a distant Cubic Planet where no clothes were necessary. Instead of just studying the

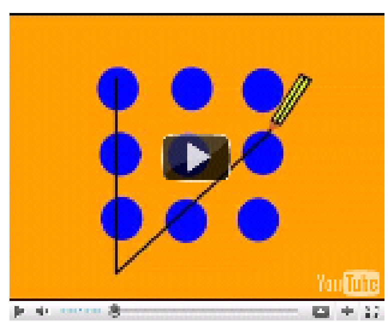

*Fig. 6* **Animation**

connection between the area and the perimeter of a rectangle, an animated character called Mr Macaroni asked us to calculate the largest surface area that can be surrounded with a pack of spaghetti.

## Conclusions

Due to the specific features of Math projects and to the “arid” nature of the subject, they should have an incentive aspect, which can be achieved through the types of activities that are planned, the degree of collaboration and the tools that are used. Mathematics can thus become a “vehicle” for learning about the partners and for the mutual understanding of the similarities and differences in our cultural environment. Moreover, it will no longer be just a rubric in the timetable, but a learner-friendly school subject.

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# Understanding (the use of) microblogging as a virtual environment for teaching and learning in academic courses

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**Abstract**

*This paper aims to understand the use of microblogging in higher education as a virtual environment for teaching, learning and research. In this way it identifies and discusses some (structural) features / characteristics of how students consume a course stream through microblogging.*

*The practical part of this study focuses on the way didactic activities associate with the microblogging platform Cirip.eu on the following topics: digital content and resources as course materials, facilitation and teaching methods used, student learning and study strategies, evaluation and assessment of experiences gained during courses, diagnosis of critical situations when using microblogging as a social virtual teaching/learning environment.*

*Based on the results of an online questionnaire and statistical analysis of the activity on the platform, our findings suggest an improvement in the teaching-learning process and an increasing quality of courses in academia with the help of the microblogging technology.*

**Keywords**: Microblogging, Social Learning Environment, Higher Education

## Introduction

In the last years, as many articles and studies have indicated, Web2.0 technologies have been used to support innovative approaches in higher education (Conole and Alevizou, 2010; Hamid, Chang and Kurnia, 2011). Blogs, microblogs, social networks, media sharing sites, social bookmarking, wikis, social aggregation, and virtual worlds are more and more used by students and teachers for communication and collaboration, for sharing resources or for building personal learning environments. As the classic learning management systems (LMS) are considered too inflexible, there are many projects/implementations of integrated platforms, in which the social functionality becomes available inside the LMS, thus speaking about LMS2.0, social LMS, Open Learning Environments or Social Learning Environments (Crosslin, 2010; Dahrendorf, 2010; Mott, 2010; JISC, 2011).

For the microblogging technology which will make the case of this article, the approach was from the perspective of integration the facilities of a LMS within social network, thus the microblogging platform becoming a social LMS.

## Cirip.eu features

Since the spring of 2008 the Romanian social media landscape has a new member through the microblogging platform Cirip.eu, developed by Timsoft, a company specialized in eLearning and mobile applications, under the coordination of the second author. The platform allows posting both text-updates in 140 characters and micro-media notes (such as audio and video clips, presentations and files) to be viewed either by anyone or by a group (public or private). These messages can be submitted/retrieved/updated through a large variety of applications and devices. Students can participate by means of either computers or mobile devices, which allow an interactive participation even outside the classroom walls (Livingston, 2010). One doesn't necessarily need an Internet connection, being possible to send and receive notes from the platform using a mobile navigator (m.cirip.ro) or via SMS.

Besides the features offered by other educational microblogging platforms, such as Edmodo or Twiducate, Cirip integrates a wide range of Web 2.0 applications and social networks organized around educational resources in order to encourage teachers and students to discover and use them, in this way they become active participants in the process of sharing, organising and generating content, which can be seen as „little OER" (Weller, 2010). Thus, Cirip allows the creation of a personal profile / portfolio including ideas, projects, research, informational resources, multimedia objects created individually or collaboratively. All users' activities are developed in a dynamic and complex manner in a continuous evaluation process by communicating with other members. Also groups and feeds monitoring are supported.

The Cirip.eu interface is available in three different language settings: Romanian, English and German, facilitating an international collaboration, around 10% of the 22000 users being foreigners.

**Cirip as a course environment (Social LMS)**

Each course on the Cirip.eu microblogging platform unfolds in a blended manner, in a private and closed group which requires the approval of the discipline coordinator. Such group is structured in observance of the general elements of a LMS:

**Public presentation part** – The *Description area***.**

**Identifying participants.** A personalized microblog provides the opportunity to set up a profile of a student with photo/avatar, name, other personal information (a description of digital identity - having a blog, with optional note importing, setting the Twitter-to-Cirip or Cirip-to-Twitter access), background, the type of the microblog and then to build up a network of other colleagues or other users / other public groups, livestreaming etc. Students can export their micro-posts as a widget on personal blogs or other sites. They can monitor sites, blogs, or activities on other social networks through RSS feeds or search feeds (using the platform specific feature).

A microblog can be seen as a Personal Learning Zone where the student can keep up to date whith university life stuff, find resources to use and learn from, discuss with peers (but also with specialists, other teachers, other Cirip users') their subjects of interests/hobbies, have fun (play week-end games or join all kind of other „informal" activities from public groups).

**A notice board for up-to-date course information** (dedicated to students and updated by teacher) contains information about the development of the course (calendar, location of sessions etc.), digital content in the form of e-books, e-papers etc. on the syllabus topics, details of pre-requisites and co-requisites, lists of bibliographic references, various announcements (for e.g. how to get help) etc. Groups have an *Announcements* section where moderators can post notes, basic teaching materials, additional resources in a variety of formats (LOM/SCORM or multimedia) and links to outside resources in libraries and on the Internet for the course activities.

**Teachers' section**: add/remove students, post announcements (also with the help of an HTML editor incorporated in the *Group news* part), send notifications to participants by email or SMS, create and conduct polls and quizzes (which can be answered online or by SMS), access internal/external search possibilities; visualizing statistics and representations of the users/groups interaction networks etc.

**Student-teacher communication area**: this is the central part of the course, containing the interaction between students and teachers, also between students. Messages can be sent and received via the web, mobile version (m.cirip.ro), through SMS, instant messaging clients (Yahoo, Jabber), e-mail, Firefox/Chrome extensions, API, desktop and other 3rd party applications; notes can also be imported from Twitter and RSS feeds. A user can embed multimedia objects in the notes, such as images (flickr, picasa albums), video clips (youtube, vimeo, dotsub), audio (deezer, blip.fm, vocaroo) and (live)video files, live-streaming (qik), presentations (slideshare, voicethread, prezi, photopeach glogster etc.), cognitive visualizations like diagrams or mindmaps (mindmeister, mindomo, spicynodes, diagrammr), files (scribd, Google docs, any online file) etc. The notes can be tagged and posted on groups or on public timeline.

**Administrative section of the platform** for activities like student registration, tracking facilities, import, export, settings, polls and/or widgets. Both the *administrative part, through classical „secretarial" activities* (enrollments are done automatically for public accounts and require approval in the case of courses hosted by closed groups), and *the quality of the methodological guidance* are ensured. The course coordinator disposes of feedback any time, through statistics, tables and graphics regarding when/how much/what and how his/her students learn, which helps him/her in case certain pedagogical remedies on the contents are needed, or in case he/she should trace other directions to follow during the learning process.

## Methodology

### *Research goals*

The generic purpose is that of analyzing the way in which didactical actions associate with the microblogging technology used as a social LMS type of course platform:

- *context and digital resources*: how the course content is presented, both through formal *Announcements* for accessing educational information, and by converting multimedia objects in 140 characters packs as materials-learning tool;
- *the teaching/learning methods used* – identifying the didactical directions suitable for the courses run on microblogging platforms, such as: teaching by questions / discourse / conversations, academic controversy, digital storytelling, micro-lectures, case studies, collaborative projects, problem based learning, teaching by collaboration, learning from events etc., by clear direct examples, within the courses developed by the author both in a formal higher education environment and an informal one (adult, continuous education);
- *students' learning and study strategies*: presenting typical learning activities and methodological suggestions for these; identifying the personal learning styles developed by students and analyzing them etc.
- *evaluation of students*: by using e-portfolios, personal learning environments, learning diaries, but also their *real experiences* during courses (either in a blended or only online manner);
- *diagnosis of critical situations (identification of risks)* when using the microblogging as a study technology.

The research question (for the overall study) is: *whether and how does microblogging succeed as an efficient and flexible social LMS?* And how the quality of the learning experience and learning outcomes could be improved.

### Research methods

The examined population consists of students in several years and forms of study, covering a variety of profiles and specializations from three universities, enrolled in formal courses held in private, closed, blended-mannered groups on the platform, during the academic year 2009-2011.

*Table 1* **Courses demographics**

| **Study level** | | | **Specialization** | | | | **Gender** | |
|---|---|---|---|---|---|---|---|---|
| Under-Graduate | Master | Post-graduate | Social | Political | Technical | Other | F | M |
| 129 | 27 | 15 | 54 | 57 | 48 | 12 | 122 | 49 |
| 171 | | | 171 | | | | 171 | |

Our research has two forms:

• *An online survey applied to students*. The survey was made up of various types of questions (open-ended ones included). We had to confine ourselves to essential questions, not only for obtaining a good response rate, but also to save the time needed for filling out the questionnaire (because it is known that long ones lead to students' giving up the completion or to superficiality from the respondent). It was delivered as an online form through a link posted on the course groups. Students could answer either online, either by mobile phone.

• *The analyze of the message corpus* relating to the courses. The resulting archives were analyzed by using quantitative and qualitative methods offered by the platform, such as various statistics (the number of participants, the most active participants, the number of links posted, the number of digital objects included in the notes, the time period, the method / device used / access etc.); tag clouds (in the course we used some specific hashtags to identify topics of interests); visualizations etc.

In order to evaluate how students consume the course stream we have built a list of primary impact elements in using the microblogging technology as social LMS:

• *Student's attention*. How many students participate (online access through web, mobile devices, 3rd party applications, Twitter or instant messaging). How often and when/from where (during the course, in the morning/evening etc.)? How many messages did they write (the frequency)? And which method they use to post (CiripFox, CiripApi etc.).

• *Shares of content*: How many links, blog posts, photos, videos, audios, comments, presentations, files etc. students shared? How many RSS feeds they follow? In how many public groups do students participated? Which is the taxonomy of the students' intentions? Did they use a specific tag? etc.

• *User-generated content created in a variety of formats*: upload of students' papers / other presentations (own), digital stories-telling etc. (Luzón, 2009).

• *Dissemination of suggested class readings*. Did students manage to identify the trending topics? How many redistributed messages to others? And within what time interval? The temporal dimension is often overlooked by teachers (Ross et al., 2010). Do they curate the content course in a personal manner?

• *Exploring notes vocabulary*. By using the platform facility for generating words clouds for microblogs/groups to analyze the vocabulary of students' notes posted in their academic group, it is important to see the relevance to the course topics and leverage the results for a better learning.

• *Peer-to-peer learning and mentoring* enable students to expose their ideas to peers and construct knowledge and understanding.

• *Mobilization among students* - expanding students' PLNs.

• *Formative assessment*. In order to obtain the students' *feedback* for identifying a number of aspects regarding the use of microblogging in their learning experience, we used Kirkpatrick's e-learning evaluation model:

- The first level „*Learner Reaction"* indicates the extent to which students liked the course and its facilitation (*How did they feel during the course?*) Filling out the questionnaire right after the course can offer important information about the relevance of the objectives, the teacher's ability to deliver the content and to maintain students' interest, the interactivity of exercises, the communication with the teacher, the value perceived etc.
- *Learning Results* measure the level of knowledge and skills / attitudes acquired by the students throughout the course (*Did students learn* anything?) In order to quantify these results, an assessment was proposed as a reflection game to students before and after the courses (i.e. the #stiu tag, „I know" in English), the testing modality being conceived within 140 characters. By analyzing the responses of all participants, the impact of the teaching can thus be determined.

– The third level „*Learning Behavior"* examines whether the students makes use of the new knowledge, both in future courses and in daily life (*Do they apply what they learnt?* Did their behavior change?). A new approach should be idealistic, at least 3-6 months after the courses in order to allow for assessing their retention degree and for empowerment evaluation.
– *Learning Results* measure the impact on the educational process resulting from student performances in a larger context (other universities, other courses, trainings at different levels etc.).

**Data analysis**

Of all the questionnaires distributed, a sample of 171 students resulted after validation. Because there are no significant differences from the point of view of gender, specialization, study level between students from the two universities, we shall not examine separately by the demographical characteristics in table 1. The most important findings are presented below.

Paradoxically, the most suspicious about the role of microblogging in educational activities are not teachers, as we might have expected, but students (replies at the question *Did I enjoy the platform?* with answers given on a 1 to 10 scale: 1=not at all, 10=very much). Thus, by analyzing their microblogs (some of them personal, some educational, seen as e-portfolios or mixed) we noticed that students responded differently to the introduction of the new technology in their curriculum and *encountered five type of learners*:

- *The optimistic* – a small part, who used the platform exceedingly (7%).
- *The fascinated* – who tried to discover the way technology itself functions (and what it is used for – 25%).
- *The hostile* – restricted himself to performing work tasks, any task being seen as an effort, a loss of time (2%);
- *The skeptical* – always wanted to have solid arguments in favor of using such a technology instead of a classical LMS, such as Moodle (2%). Most of the times we received questions like: Why do we have to do this on Cirip? Why is this a new learning environment?
- *The daring* – student who understood that microblogging stimulates didactical activities, by breaking the frameworks of a traditional e-learning education (34%).

Hence the necessity to get familiarized with the environment i.e. to acquire the working method and to possess the working skills through a *pre-instruction session (training)* in order to be able to use the microblogging platform as a LMS for disciplines other than the technical ones.

More than half of the students (56%) assessed with the maximum rating the *pedagogical usability* of the platform, 25% students accept Cirip as an environment for organizing the course preparation (for learning and accomplishing the learning objectives) and 10% think that motivation and interest for using a microblogging technology does not depend however on the computational technology itself, but on the interest in examining more thoroughly the studied discipline supported by Web2.0 technologies. Only 10% qualified negatively the platform, these being among those who used the environment only for accomplishing the course assignments.

In order to measure the skills (Trilling and Fadel, 2009) achieved by students we asked how the microblogging platform helped to acquire new knowledge and ideas. At the question *Did I learn what I needed to, and did I get some new ideas?* 55% of the students said Cirip serves learning purposes, 35% that it helps them acquire and transfer knowledge and only 10% (as a cumulative percentage) that it doesn't facilitate learning.

As for the utility of courses on a microblogging platform (*Did my students learn something during my course?*), in relation to the students' real needs, most of the students (33%) are of opinion that the activities developed are appropriate, but the development of an efficient educational act with the help of this technology implies direct experience and exercises (37%).

26% of the students consider that courses should be improved, supported by simulations and practical accommodation exercises.

Some of the investigated aspects to improve a curriculum structure based on microblogging technology was also the effectiveness of the topics presented during the courses. Thus, half of the students (43%) were satisfied with the course content while 24% were thrilled by the topics included. It is encouraging that only 5% considered the course content technology-dominated, without meeting the pedagogical objectives intended (4 students did not answer).

What we intended was not to present a definite and sterile classification of our students' learning styles, but only to find some landmarks, some useful references for developing new competences and abilities to support the already acquired ones, which should assist the student in finding his/her own learning style. Thus it seems our data indicates that a technology-rich environment leads to a bigger impact. More integrated technologies and applications, more (learning) benefits. Table 2 presents how students appreciate and have used during the courses the special features of the platform, such as embedding multimedia objects in messages, RSS feeds monitoring, advanced searches, visualizations, word clouds, statistics, polls and quizzes, and live video.

*Table 2* **Uses of Cirip features**

| **Web 2.0 applications used by students** | **No.** | **%** |
|---|---|---|
| Photos (flickr, picassa, albums, tinypic, any image or picture with a CC license) | 122 | 72% |
| Videos (youtube, vimeo, dotsub etc.) | 120 | 74% |
| Audio (blipfm, deezer, vocaroo, eOK, trilulilu, any mp3 file) | 74 | 44% |
| Presentations and files (slideshare, voicethread, photopeach, glogster, authorstream, prezi, Microsoft and Google format, Scribd, any online file etc.) | 116 | 69% |
| RSS feeds | 33 | 20% |
| Searching (users, groups, events, text etc.) | 53 | 31% |
| Tagging (word clouds, statistics, visualizations etc.) | 32 | 19% |
| Polls / Quizzes / Surveys | 61 | 36% |
| Live Video / Streaming | 48 | 28% |
| Other | 2 | 1% |

As for the utility of communication with other platform members, half of the students approve that the access to information, without the mediation or the counseling of the coordinator is benefic. Extended learning possibilities, without resorting to the discipline coordinator (by avoiding academic language as well), implies also the presence of those elements which are often overlooked when studying: the social specificity and the cultural context.

An important question for involving peers in user-content creation emphasized that the communicative element is essential. *Were students technologically savvy? Comfortable sharing information, knowledge, best practices in an open forum?* 36% of the students state they use the platform only for accomplishing the course assignments. The time spent on the platform besides performing the educational assignments is 5 percentage points lower for the students who stated they spend around one hour (18% half an hours and 14% almost an hour). By analyzing the access differences for students stating they use Cirip more than an hour (32%), we notice that the attention given to the platform comes from students who have blog (19%) and twitter (20%) accounts.

Given that the use of mobile devices has not been foreseen from the beginning in the curriculum, depending in fact on the students' financial support (not all of them can afford an Internet connection on the mobile phone for consulting educational resources or posting multimedia objects etc.), we had to limit ourselves only to using SMS in order to integrate the educational content in an e-learning environment supported by the microblogging technology.

Thus, the extent to which students are aware of the possibilities of using information/documentation, communication and collaboration on the platform with the help of mobile devices, was aimed at directly through two questions where students assess on a 1-5 scale (1=not important, 5=useful): 46% appreciate as useful monitoring via free SMS, while 19% found as not important this feature.

These initiatives could prove crucial in the context of the „4A" vision: Anywhere, Anytime, by Anyone and Anything, and for becoming aware of the key element in the future of the information society: the *ubiquity of networks*.

**Discussions**

According to R. Gagne's Nine Events of Instruction, proper teaching sequences should be followed in order to achieve the learning objectives. Table 3 contains a model with micro-based training events used by the authors, and concrete examples of activities corresponding to each event of instruction and digital strategy can be found by those interested in a spicynodes mindmap (Figure 1).

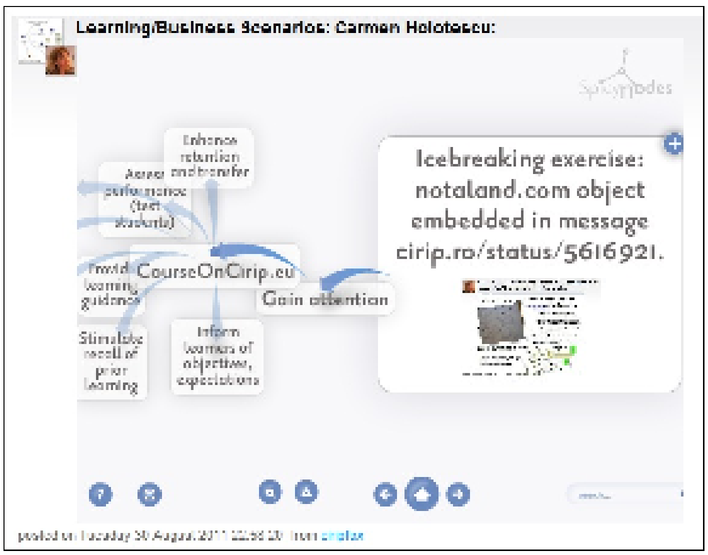


*Figure 1* **Anatomy of a microblogging course as a mindmap, source** http://www.cirip.ro/status/9312507

*Tabel 3* **Anatomy of a microblogging course**

| **Event of instruction** | **Digital strategy** |
|---|---|
| Gain attention | It is essential to gain students' interest and curiosity from the beginning. This can be achieved through audio, video, news, animations, questions etc. that will help us understand how students express their (learning) needs (Efron and Winget, 2010). |
| Inform learners of objectives, expectations | Students should be informed about the objectives, expectations, activities, what they will learn and how to get involved in the *Announcements and Materials* section, using multimedia content. |
| Stimulate recall of prior learning | Before starting the course, students are required to complete an assessment of their knowledge (questions or an activity to engage existing knowledge). At the end of the course they are asked again the same assessment, which is compared with that from the beginning. |

| | |
|---|---|
| Present stimulus material | Interactive materials with a variety of (social/Web 2.0) media. |
| Provide learning guidance | Elaborate on presented content by telling (collaborative) digital stories (in 140 characters), explaining examples and non-examples, offering analogies (Gable, 2010) |
| Elicit performance (practice students' skills and knowledge) | Obtaining performance is an important step. The teacher must find questions based on course objectives and to present them as interactive exercises. Asking questions is particularly an important strategy for generating social interaction via microblogs (Efron and Winget, 2010). |
| Provide feedback | Students should be given the correct answers and, if possible, a brief explanation to help shape their behavior to improve performance. |
| Assess performance (test students) | Results can be identified in the profile/e-portfolio of students who develop such initiatives, become self-motivated, flexible, innovative, and realistic, will perform tasks and solve problems, accepting the complexity of life, respecting the diversity of perspectives and viewpoints, and cultivating self-control and desire for lifelong learning. |
| Enhance retention and transfer | Learning content management in university for various programs of study. It provides the means to create and re-use e-content and reduce duplicate development efforts. |

What we have noticed is that the prevailing learning style was the practical one, through active experiment (learning by doing style). The fact that learning units were created through Web2.0 technologies and subsequently encapsulated as multimedia objects both in *Announcements* and as messages posted in the group, the major advantage that the acquisition of experiences occurred through participative methods and practical validations, students themselves testing the new technologies presented.

The key to success in using microblogging as a support technology is the students' motivation – as teachers to become aware of the relationship between the students, the technological environment / platform and his/her learning / education activities. We shouldn't reach the situation when students feel disconcerted.

We also encountered some *limits*:

• *Self-assessment quizzes which cannot be scored automatically* – this feature is not supported by Cirip, but self graded quizzes created with Google Docs and Flubaroo add-on can be easily embedded in messages.

• *Electronic communication* doesn't support a 1:1 private „room" (there are no private, direct messages). Users who want to communicate by private messages should create a dedicated private group with this purpose.

• *Differential access rights* for instructors and students (in a group it would be useful to provide administrative rights for more than one teacher).

• *Production of documentation and statistics* on the course in the format required for institutional administration.

**Final remarks**

Cirip acts both as a microblogging platform and a social network, that engages participatory experiences, collective learning, transform the traditional / blended course learning space in a dynamic, user-centered environment. The student is seen as a participant in the act of learning in a framework with a social structure. For instance, participation in collaborative activities and interactions with other members of the platform are factors that make learning to become a product of participation and collaboration. Figure 2 illustrates a synoptic vision of the various elements used to assist the learning process of the educable in the social environment of Cirip.

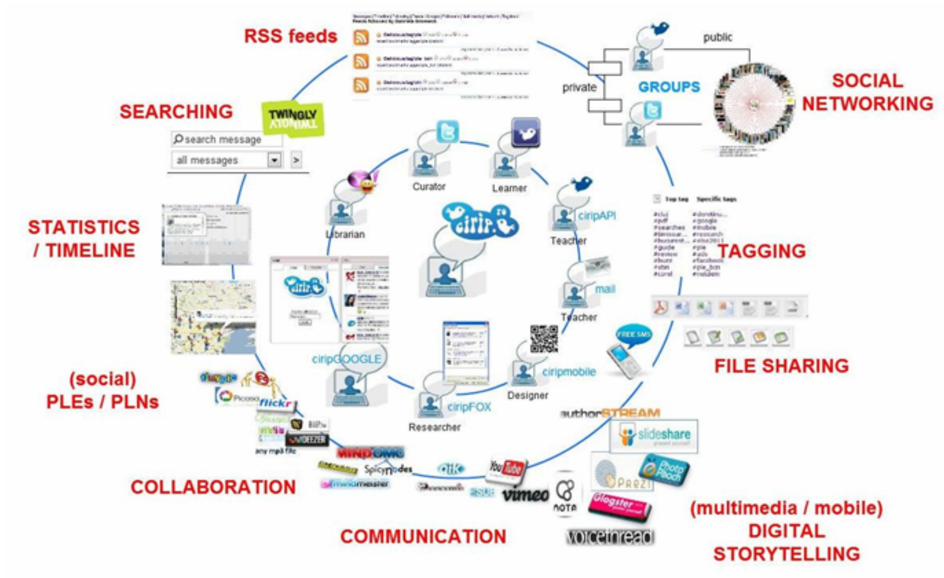


*Figure 2* **Elements of constructing social learning environments on Cirip**

At the end of the course students should know and use social media features in a context or another. But in particular we hope that at the end of a course held on a microblogging platform ubiquity of tools, services, Web2.0 applications has a profound impact on lifelong learning, allowing the establishment of true learning networks and the construction of social PLN. These are networks of people and organizations that create, support and use learning resources.

The authors view the study presented in this paper as a possible solution for developing integrated educational systems based on microblogging, covering both components, learning and evaluation, as an alternative to the institutionally hosted and supported virtual learning environments, having a user generated, activity focus that supports teaching and learning in educational settings. However, we aim at dealing with the various issues raised during the teaching-learning-evaluation process, as follows:

- A preliminary initiation of students is required (and sometimes of the teachers who haves to co-ordinate the platform) – some don't know or fail to implement correctly this technology, while others won't adapt to the new requirements (responsibilization of the teachers).
- Eliminate the effects of incertitude, as in the case of any innovation or change. One of the difficulties is the hierarchisation of knowledge (the difficulty to find and choose the relevant resources to post, to turn information into knowledge).
- Develop a student-centered qualitative model (quality characteristics, measurement indicators, evaluation criteria).
- Elaborate recommendations for applying this technology in higher education environments.

And although we refer explicitly to cirip.eu, conclusions drawn from our study are applicable (can be altered and used on) to other microblogging platforms / services.

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# The interactive teaching methods – the vectors of success in learning physics

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## Abstract

*A new quality of learning and teaching in general, is an absolute priority for education in Europe. The teachers are not only sources of information, they are also meant to lead managers and teaching so as to develop the interaction among students and training/development of key social personality traits. The students want to understand natural phenomena, to know scientific truths and to acquire knowledge to be applied in practice and for these reasons they are dissatisfied by the traditional education. The teachers and students, in most universities that have used the traditional lecture in physics courses, have revealed the limited effectiveness in both teaching and learning. In physics, the teacher must use methods to encourage discovery learning, heuristic and research methods. Dynamic and communicative teaching methods, also called interactive teaching methods, constitute the basic elements of a recently developed process to motivate learning, so that the students and future engineers develop a critical position about the taught content. Using interactive techniques and strategies, the students become more engaged in learning, retain more information, thus becoming more satisfied.*

**Keywords**: absolute priority, critical position, more satisfied

## 1. Introduction

The teachers of physics still frequently apply outdated methods of transmission, unilaterally, from source (teacher) to the receiver (student). Under this model, the source provides knowledge and the student is an absorbing container (Paladini and De Carvalho, 2008). The teachers and students, in most universities that have used the traditional lecture in physics courses, have revealed the limited effectiveness in both teaching and learning. In this course the students assume a purely passive role and their concentration disappears after 15-20 minutes (Damodharan and Rengarajan, 2011).

A new quality of learning and teaching in general, is an absolute priority for education in Europe. The innovation in the training of teachers, the creation of new teaching and assessment models, increased the quality of teaching and the classroom management becomes much more attractive and effective. An important innovation in teaching methods is occupied by the interactive learning that affects the students' personality, based on the interdependent relations established in such student-student interactions. The cultural level of communication between teacher and student and among students is much higher than with traditional approaches, the "magister dixit" type. The students gain teamwork skills, the teamwork is considered a standard in education (Todorina, 2011). By late 1990s and early 2000s, the most pedagogical researches in physics have focused on investigating the students in terms of understanding concepts, especially asking students to apply these concepts in a variety of contexts. When students have not been successful in correctly applying of concepts, the researchers concluded that students have not understood them (Rebello and Zollman, 2005).

In the U.S., a number of studies has shown that the interactive methods are much appreciated by students in learning physics and the results are much better. With the "Workshop Physics" method, the students, working under a teacher and two assistants, conducted the activities after a cycle of learning focused on five stages: prediction, observation, reflection, theory, application. As far as 1991, the assessment of the impact on students of this method showed that about two thirds of students at Dickinson College - Carlisle, Pennsylvania preferred the "workshop" method in comparison with the traditional method (Churukian, 2002). A survey on 450 students participating in introductory physics courses at North Dakota University in the spring of 2002 revealed that students do better if they understand the physical phenomena and if they report the problems to real situations in nature (Chen, 2003). The active and interactive learning has long been applied in Brazil and is considered an extremely useful and effective way of learning, but it is generally difficult to be observed in practice (Paladini and De Carvalho, 2008).

## 2. The students' responses in traditional way of learning physics

Physics is a discipline of study that has not attracted and still doesn't attract students. They tend to avoid it, since it requires too much work compared to the achievement of career opportunities. At least for developing countries, the universities offer in the field of physics only didactic and underpaid profession. Therefore, the number of high school graduates who choose physics remains low (Alarcon, 2005). Improving teacher training is essential. Unless they provide interesting classes for students, the teachers will never have positive feedback from them. The almost exclusive application of traditional methods of "chalk and talk" or just "talking" was primarily responsible for students' distancing from Physics (Alarcon, 2005). For example, the conceptual assessment of force and motion concepts (FMCE - Force and Motion Conceptual Evaluation) taught by means of traditional lectures led to the conclusion that students understand and retain only 15-20% (16% in the U.S., 18% in Sweden) of content (Bernhard et al., 2007) Solving problems is the predominant traditional approach in teaching physics. By this method, the students must learn both the descriptive and conceptual problem addressed by the physical phenomenon and also the predictive side of its development, to effectively solve problems and to logically reason. Since learning by means of logical thinking is difficult, many students are trying to memorize formulas and results (Chen, 2003). But if they do not understand the phenomena, it is unlikely that they correctly solve a physics problem.

## 3. Learning through understanding

In learning physics, the current world trend is that the specialist teachers in any country look for new ways to effectively teach this subject. In the Philippines, both teachers and students alike, consider the demonstration method to be very effective. A survey of University of Baguio Science High School in Baguio City, during July-August 2008 in which 86 fourth-year students were divided into two groups, an experimental one, where the demonstration has been used both by teachers and teacher guided students and the other – the group control, where the traditional lecture was used, was aimed at proving the superiority of demonstration by the results produced in learning physics (Saingan and Lubrica, 2008). The teachers are not only sources of information, they are also meant to lead managers and teaching so as to develop the interaction among students and training/development of key social personality traits. The teacher facilitates students, helps them in the complicated process of knowledge acquisition and skills training, which requires a constructive teacher-student interaction and communication at empathy level. He is a mediator giving the educational content through the link between students and between students and the world around them, he must be both sympathetic and objective at the same time (Todorina, 2011).

Referring to human relations of life, the physics teacher must show humor, not only because it promotes friendly relations between teachers and students, but it creates a comfort and a positive mood for both current participants and constitute an attractive introduction to a difficult course on a complicated topic (Damodharan and Rengarajan, 2011). A joint project of Bishop Grosseteste College (United Kingdom), United Nations Fund for Children and the Pedagogical Institute of

Macedonia (Johnston, Crowther, 2011) has shown that the interactive learning of physics is very effective compared with the traditional methods in which students acquire knowledge almost exclusively from textbooks which is the basis of a rigid national curriculum, which does not promote affection, empathy, develop skills, abilities, skills and attitudes throughout the acknowledging and understanding process. The students want to understand natural phenomena, to know scientific truths and to acquire knowledge to be applied in practice and for these reasons they are dissatisfied by the traditional education. In Macedonia, the Project provided the opportunity to teachers of physics to deal with clearly defined learning objectives in the areas of cognitive, affective and conative and the ability to stay away from the handbook, and to the 13-14 years old students the possibility to interact with physical phenomena and practical opportunities. The Project's results have clearly demonstrated that the interactive learning methods of physics are much more efficient than traditional ones, although the time allocated to the acquisition of knowledge is lower. The conceptual understanding of physical phenomena and the application of knowledge priority in unfamiliar contexts (Johnston, Crowther, 2011) were the main objectives of the project that have been achieved and have led to increased student motivation for physics lessons. The Project's results have demonstrated the need to extend interactive learning in other subjects and it played an important role in changing the curriculum in the UK, and have internationally highlighted the importance of learning together.

The performances are comparable with both sexes. There are studies showing that students (girls) learn by trying to understand natural phenomena, while students (boys) try to memorize the course material. In traditional approaches to learning physics, 7 out of 10 students require ongoing integration of technology, while in interactive approaches nine out of 10 students want that. The percentage of good results and very good for the group 9 / 10 "is much higher than those of the group" 7/ 10 "(Chen, 2003). A study on a sample of 150 students at Campus Norrköping, Linköping University, Sweden (project: 167/96, "Experientially based physics instruction - Using hands-on experiments and computers") that followed an introductory course in engineering physics has demonstrated that implementing the interactive demonstration method (ILD – Interactive Learning Demonstration) lead to similar results using physics laboratories equipped with the microcomputer (MBL - Microcomputer Based Laboratory). Both methods allow students to engage in the analysis of phenomena, by the "guided discovery" of the teacher. The common feature of both methods is the application of cycle: intuition-observation-explanation (Bernhard et al., 2007). The percentage of understanding and knowledge retention by ILD method reached 37% in Sweden (65% in U.S.) (Bernhard et al., 2007).

**4. The vectors of success in learning physics**

In physics, the teacher must use methods to encourage discovery learning, heuristic and research methods (Malinovschi, 2003) such as heuristic conversation, questioning, independent and systematic observation, experiment, demonstration and modeling. Interactive learning methods are applied under the same name or similar names in all countries that have adopted them.

The teachers generally accept the benefits of interactive lectures, but many of them will not engage in such lectures for several reasons. Most commonly, the teachers reported a fear of losing control when applying an interactive method. They fear that if some students actively participate and ask questions, they will not have control over other students and that can bring about disorder. The fear of not achieving all the objectives or to sacrifice a part of the content is another reason to bypass the method, plus the time, which is a "restrictive" factor, considering that the budget for teachers for one class is often insufficient for an interactive approach (Steinert and Snell, 1999).

The problem based learning is an interactive learning method widely used in mathematics and science curriculum area (Sarivan et al., 2005). Conferring interactive nature of this method, the teacher teaches students to logically and analytically think. This can be done for example by summative questions, brainstorming or graphic organizer. The discussions between students and between students and teachers focused on students' questions about the phenomenon dealt with and the consultation of materials (lecture notes, publications, audio-video) or even the Internet, normally lead to a much broader problem understanding and much better results (Chen, 2003). Basic principles of total quality management (TQM) require that every action must be customer oriented (Paladini and De Carvalho, 2008).

With schools/colleges, the client is the student, to whom everything must be done to ensure their contentedness. When applying interactive methods in the lessons, undoubtedly require more the teacher, to ensure "script, choreography and direction" of classes, while auxiliaries are essential for this teaching approach, involving an additional expense, sometimes supported by the teacher. Thus, the teacher’s motivation is low, but the students should not be disadvantaged. Dynamic and communicative teaching methods, also called interactive teaching methods, constitute the basic elements of a recently developed process to motivate learning, so that the students and future engineers develop a critical position about the taught content (Paladini and De Carvalho, 2008).

To assess the impact of physics on students, from 23 to 26 May 2011 we distributed a questionnaire to a number of 366 - 11th form students from the real profile of several high schools in the cities of Bacău, Bârlad, Vaslui and Brăila. After analyzing responses to the questions, the situation is unfavorable to a modern education, learning physics relying excessively on traditional teaching and the 59/41 obtained ratio for physical education to traditional type, confirms this fact once more, figure 1.

The share of interactive methods used in teaching physics is presented in figure 2.

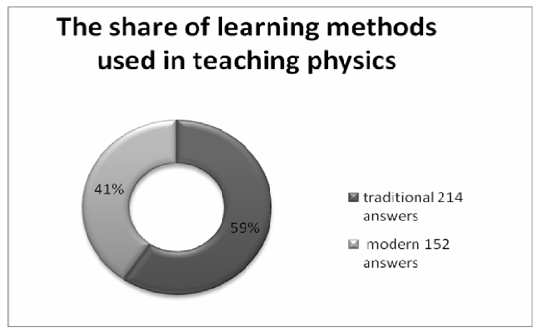


*Figure 1.* **The share of learning methods used in teaching physics**

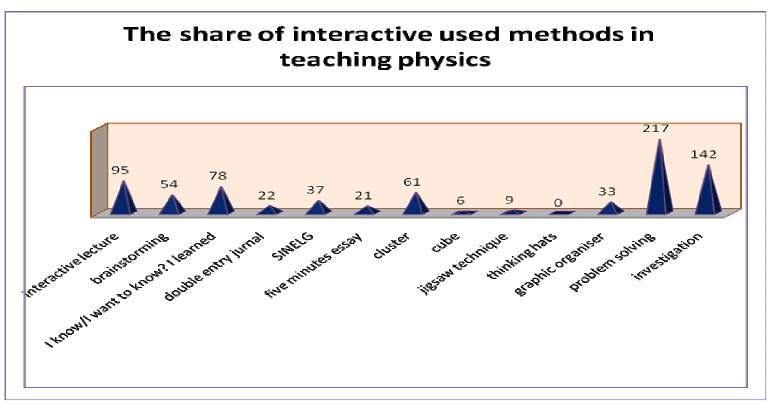


*Figure 2.* **The share of interactive methods used in teaching physics.**

**5. Two simple methods for interactive teaching physics**

Tony Buzan, in the 1960s, proposed a learning method, called "mind maps”, by which the pupils/students use only key words and images. These maps can be used by teachers to explain physics concepts in an innovative way. Due to their visual qualities and nonlinear nature, the mind maps easily promote knowledge and memory to achieve fast connections between them (Damodharan and Rengarajan, 2011). Often, the teachers use the conceptual maps in interactive teaching physics. Apparently the two methods are the same, but the differences are obvious. For example, consider teaching the X-ray properties using the two maps, figures 3, 4.

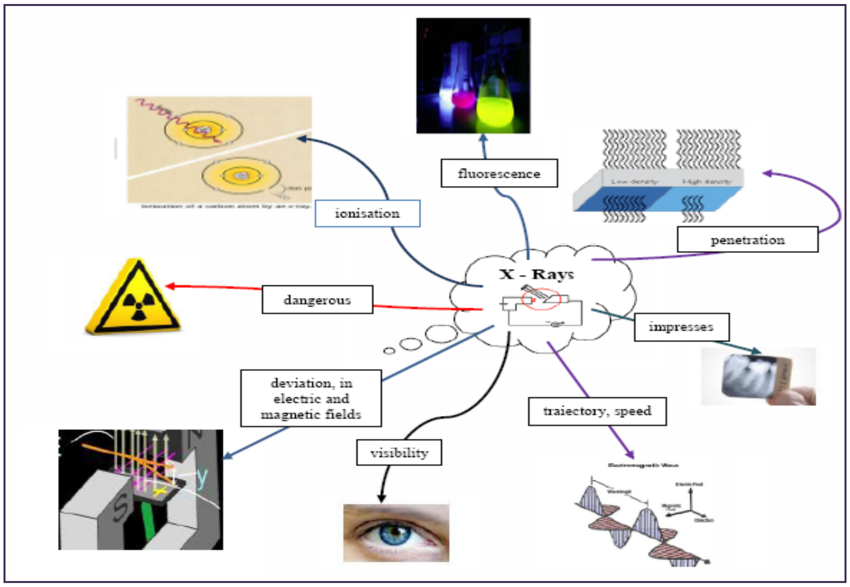


*Figure 3.* **Mind map. X – Ray properties**

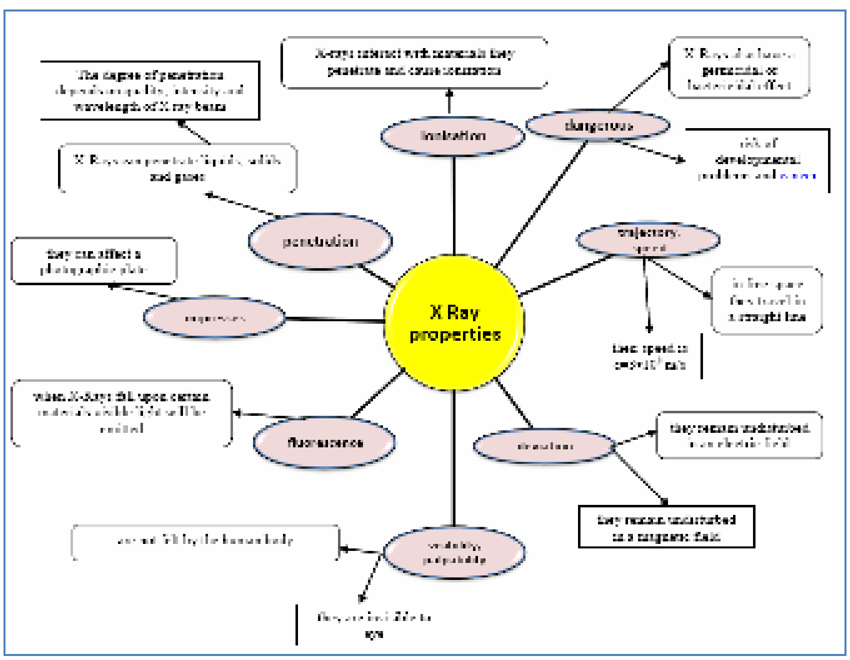


*Figure 4.* **Conceptual map. X - Ray properties.**

The question naturally arises: when should one use either of the two methods? The mind map method is better implemented in the classes with emotional and sentimental students, which are characterized by a majority share in verbal-linguistic or emotional intelligence, while the conceptual map is better implemented with classes predominantly characterized by logical-mathematical and visual-spatial intelligences. They also can be used together in the same hours for teaching the same topics, but they are addressed to different groups of students, in differentiated learning. These maps can be made by teachers, but in the same time they can be made by students in working groups. This methods can improve the performance of pupils and students in all subjects. In most cases, the students preferred the mind map.

## 6. Conclusions

Moving from a passive education into active-interactive education involves a tremendous effort for teachers especially in developing countries. Interactive learning methods must take into account each country's available resources and the cultural context of. After application of interactive methods on learning and assessment in physics, pupils' and students' performance has improved in teaching physics, while the best results are obtained at teaching physics in conceptual, computer-equipped laboratories (the percentage of understanding and assimilation can reach high values, as obtained for example in Sweden: 61%) (Bernhard et al., 2007). Using interactive techniques and strategies, the students become more engaged in learning, retain more information, thus becoming more satisfied (Steinert and Snell, 1999).

Many international organizations and networks in physical education have organized large-scale projects and activities which aimed at reinvigorating the physics, among them: PER U.S., UNESCO (which started a series of projects). In 1980, The Asian Physics Education Network (under the auspices of UNESCO) has carried out specific activities in Asia and South-East Asia (Japan, China, South Korea, Thailand, Malaysia, Philippines, Australia, Laos, Vietnam). Education under the auspices of UNESCO networks has done in Latin America, Arab countries and African countries, but the results were weaker than the Asia network. (Alarcon, 2005). Certainly, we cannot speak about an universal recipee, in increasing attractiveness towards Physics. The New technologies and ever-changing requirements of human society causes a continuously change in teaching strategies. The results will determine which of them will survive.

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# Innovative Potential of Social Networks in Blended Learning

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**Abstract**

*Foundation of e-learning environment was created in the Technical College of Yambol. The virtual learning environment (VLE) has been created using Moodle software platform and has been applied. The multimedia courses have been created in different disciplines. In order to improve the offered e-learning system, we carry out survey on the end of each year. The participants are students – one part of them attended full-time regular education; other - extramural form of education. The inspection of the opinion of students enrolled in e-learning supported courses, in the TC – Yambol, showed that 90% of students support the idea of using forums, where they can share problems, news, discussions, give assessments, ideas, literature and etc. More than 80% of students gave positive answer about the stimulus to cooperate in learning groups and to identify themselves through that group. Creation of social network and community inside of College will give new possibilities to improve the quality of furthered work in blended learning.*

**Keywords:** e-learning environment, blended learning, E-Learning 1.0, E-Learning 2.0, social network

## 1. Introduction

E-learning is a training strategy, using a wide range of technologies, tools and systems supporting knowledge and skills in time and context defined by the individual learner. E-learning comprises all forms of electronically supported learning and teaching. The information and communication systems, whether networked learning or not, serve as specific media to implement the learning process (Tavangarian et al, 2004).

The first generation of learning (really training) delivered through the web was E-Learning 1.0. It can be characterized by online course experiences. Most often these were either synchronous courses delivered using virtual classroom software or asynchronous courses (courseware) built using an authoring tool, and course content design followed a traditional training model that was development by an instructional designer. Finally, courses were typically managed through an LMS (Karrer, 2007).

Recently, more teachers and researchers pay attention to the possibilities of applying Web 2.0 technologies in education. Web 2.0 technology is applied not only in informal learning. Strategies are seeking to implement and integrated them in the formal learning process. New tools and services - blogs, micro-blogging, wiki-th, podcast programs, sharing links and resources, social networks, RSS/Atom data collection and more, encourage informal learning, joint implementation of activities and generation of content, while giving students access to a wide array of ideas (Ivanova, 2008).

## 2. Development of e-learning

### 2.1 Foundation of e-learning environment (E-Learning 1.0) and applying blended learning

Foundation of e-learning environment was created in the Technical College of Yambol. In order to improve the offered e-learning system, we carry out survey on the end of each year. The participants are students – one part of them attended full-time regular education; other - extramural form of education. A survey is conducted to identify students' opinion about learning support components in blended learning model as well as their problems in acquire knowledge's. The survey is conducted with closed and open end questions. A five-point scale is used, with categories rated from 1 (absolutely disagree) to 5 (absolutely agree).

The blended learning model is established in Technical College of Yambol and supported by e-learning on-line materials that included different courses in Informatics, Programming languages, Information technology, Common and General Chemistry, Biochemistry, Microbiology, Ecology and etc. The results of our practice show that the performance of e-learning system improving the effectiveness of the education, as well as improving the motivation among students and teachers (Pehlivanova et al, 2009).

**2.2 Students and teachers preferences and requirements about learning process**

The learning process included different types of getting experience: *formal learning* – includes hierarchically structured school system that runs from primary school through the university and organized school-like programs crated in business for technical and professional training; *informal learning* – a lifelong process whereby individuals acquire attitudes, values, skills and knowledge from daily experience; *intentional learning* – an individual aim to learn something and goes about achieving that object; *accidental learning* – happens in everyday activities an individual learn something that had not intended or expected (Pampaloni, 2009).

As a result of different project works (in the Technical College – Yambol), the foundations of a technical and informational data for distant learning process took place: virtual library with didactic materials has been created (http://tk.uni-sz.bg/edutk/) – lectures; exercises; multimedia sources; tests; glossaries; links to other web-base on-line resources etc. This system includes over 40 subjects. In the Technical College – Yambol, Moodle represents VLE design, which is well known in the academic community. The architecture of Moodle is compatible with the hardware and software of Technical College – Yambol. In many subjects students are encourage making their own research on relevant topic that is represented by the owner and after that published on the web-site of the discipline for future use and assessment by the other students. More teachers from the College start to work with the e-materials to perform their lectures and prefer on-line quizzes for the examining the students. According to the e-learning project developed to provide additional support for teachers who are delivering or preparing e-materials, the main, requires of the teachers as skill level *Intermediate*, to provide e-materials is: "to be familiar with use of on-line social networks e.g. Facebook. Have used blogs or other online services to collaborate and share information. Understand how Web 2.0 services (e.g. blogs and social networking tools) can apply in education. Use some of Web 2.0 services outside school and for personal use. Have used virtual learning environments (VLE) in schools and uploaded information to the portal" (http://www.triplescience.org.uk/elearning/).

It has been discovered that one of the strongest determinants of students' success in higher education— more important than the details of their instructors' teaching styles—was their ability to form or participate in small study groups. Students, who studied in groups, even only once a week, were more engaged in their studies, were better prepared for class, and learned significantly more than students who worked on their own (Richard, 2001). In the conducted survey we have found that the students attending blended learning still appreciate the direct communication in the group. More than 80% of students gave positive answer about the stimulus to cooperate in learning groups and to identify themselves through that group (see Fig.2).

The power of group study was provided by Uri Treisman more than twenty years ago. As a graduate student at UC-Berkeley in the late 1970s, Treisman worked on the poor performance of African-Americans and Latinos in undergraduate calculus classes. He discovered the problem was not these students' lack of motivation or inadequate preparation but rather their approach to studying. In contrast to Asian students, who, Treisman found, naturally formed "academic communities" in which they studied and learned together, African-Americans tended to separate their academic and social lives and studied completely on their own. Treisman developed a program that engaged these students in workshop-style study groups in which they collaborated on solving particularly challenging calculus problems. The program was so successful that it was adopted by many other colleges (Uri, 1992).

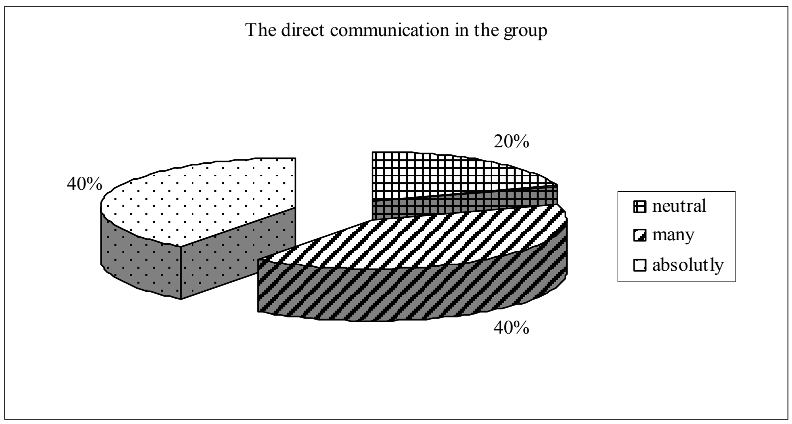


*Figure 2.* **Students prefer direct communication in the group**

The inspection of the opinion of students enrolled in e-learning supported courses, in the TC – Yambol, showed that 90% of students support the idea of using forums (fig. 3), where they can share problems, news, discussions, give assessments, ideas, literature and etc. According to students opinion the forum replace the "direct communication in the group" in some way or in this way the communication continue but in virtual space. Despite of those students doesn't attend actively created e-learning forums. They prefer to enter and use Facebook, where they created College page and dynamically exchange information.

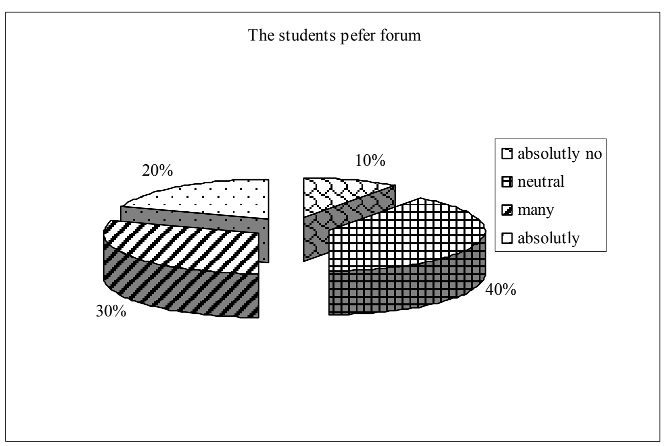


*Figure 3.* **Do students prefer forum?**

One of the main applications social networks in education is as an alternative means of communication between teachers and students and among students themselves. On the other hand create a group with different goals - from friends and supporters University faculty or to groups working on common projects. Despite that in most universities, social networks are not perceived as a means of supporting the education process (Kiryakova et al, 2011).

### 2.3 Social networks

Social networking is defined as a community of people who have similar interests, share similar values or a common profession. They are primarily web based and represent a range of different means of interaction between users and file sharing, messaging, chat, photos and videos, discussion groups, blogs.

Today we train young people for whom the virtual environment on the Internet is an integral part of their life. Global Information Network changes their attitudes to communication and communication training. Number of researchers working on the methodological problems explained that iGENERATION or Net-generation sets with their orientation to technology. Due to the fact that have grown up with information technology, the representatives of this generation thinking, seek information and learn differ differently than previous generations of learners. This new reality requires modern universities to adapt as quickly as possible to it; one of effective ways to change this is to use virtual space in the learning process (Tzokov, 2011).

As the source of information that students usually use for self-preparation high percent about 35% give the notebooks as main resource, for 31% the e-materials publish on the web-site are the main resource, 19% noticed Internet and only 15% mentioned the classic books as the main source of study the subject (fig. 4).

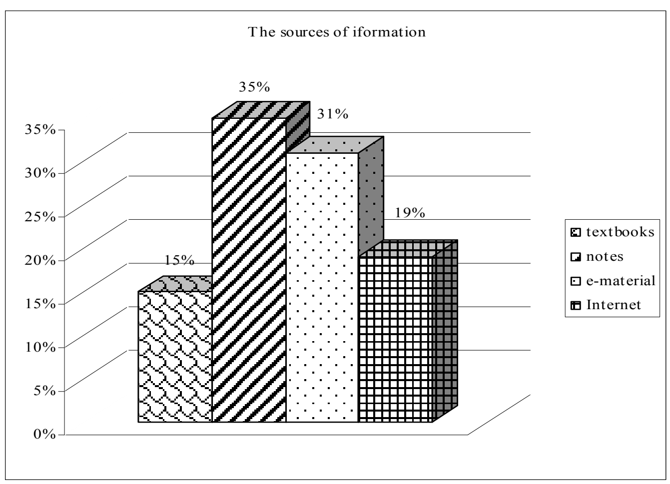


*Figure 4.* **Source of information for the students used to prepare for the exams**

Approximately 50% from students are using e-materials to prepare themselves for exam and the rest 50% prefer the classic version of notebooks and textbooks.

## 3 Conclusion

In order to satisfy the new trends and requirements for the fast oriented, flexible and suitable education our team apply efforts to develop and organize with the new approaches and technology the educational system. We expect that creating social networking and working in such environment students will develop abilities: to work in team; improve their communication abilities; share easy different information; have additional support from the group; change and share ideas and etc. Creation of social network and community inside of College will give new possibilities to improve the quality of furthered work in blended learning.

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# Jitt Approach for the Study of Magnetorezistive Materials

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**Abstract**

*Constructivist approach of science teaching uses inductive strategies in opposite with traditional deductive ones. JiTT uses a collaborative online environment combined with almost any active group learning strategy and offers to teachers the opportunity to be creative in elaborating tutorials and resources. During over thirty years of research Gregor Novak developed a Web-based, classroom-linked strategy termed JiTT (Just in Time Teaching) jointly with Andrew Gavrin, assistant professor of physics at IUPUI, and Evelyn Patterson, associate professor of physics at the United States Air Force Academy in Colorado. The Study of Magnetorezistive materials is a generous theme of study with numerous applications in techniques and a lot of experiments to be done in groups , for school or college students – a great opportunity to practice JiTT approach.*

**Keywords**: Just-in-time-teaching, constructivism, inductive learning, magnetorezistive materials.

**Constructivist approach of teaching and learning**

It is well known that in the last year students' interest for science in school decreased and the teachers tried to apply newer and newer strategies as their students learn with pleasure. A suitable solution can be constructivist strategies mostly the ones combining with ICT (Iofciu F., Miron, C., Antohe, S., 2011).

Constructivism gathers more and more ground in science teaching. Unlike traditional learning, constructivism is student centered, team working promoting and collaboration between students, limiting teacher's role to be mediator (Iofciu F., Miron, C., Antohe, S., 2010).

In constructivist prospect, learning is a social process beating out the meaning of the experience in the light of the knowledge students already have (Tobin, K., Tippins, D. 1993).

During science class the teacher offers students the possibility to express themselves, allowing for specific learning styles tendering a time for reflection. Evaluation is one of the basic roles of the constructivist teacher. To this effect, learning has to be considered integrated in the learning process, not as a recompension or a punishment when the class ends (Kahveci, A., Selahatdin, A. T., 2007).

Traditionally for science classes, mostly for physics lessons he deductive strategy is preferred. The teacher presents the content based on general principles, then uses these principles for deriving mathematic models, presents some applications of these models, then gives students as homework similar applications and finally tests their ability to solve the same exercises during exams. The question "Why?" is ignored. The only motivation for learning is that later this knowledge will be important for the future curriculum or for their career (Prince, M. J., Felder, R. M., 2006).

Constructivist approach is supposed to use inductive strategy.

**Inductive learning strategies for science teaching**

Inductive physics teaching-learning strategy is based on construction of inductive generalization during heuristic conversation, during analyzing and comparing the results of demo or frontal experiment. The teacher together with his students reaches the new knowledge based on demonstrating and analyzing experimental results (Malinovschi, V., 2003).

Inductive teaching-learning strategy includes a wide panel of specific learning student centered methods: Inquiry Based Learning, Discovering learning, Case Based learning, Project Based Learning (Iofciu, F., Miron, C., 2010), Just in Time Teaching. It is very important to specify that during teaching-learning science knowledge, empirical and theoretical strategies are tightly linked and interfering. The experiment is not being possible without an appropriate hypothesis and theory, and any theory is based on experimental data and also acknowledged by it. Induction and deduction, analysis and synthesis, absoluting and generalization are strongly linked (Malinovschi, V., 2003).

By the same token, we can't refer to pure inductive or deductive strategies; a good teacher combines them during didactic activities. To be pointed out these strategies have a strongly constructivist nature involving both team working and the opportunity to use ICT, virtual collaborative environments (Iofciu, F., Miron, C., Antohe, S., 2011a; Iofciu, F., Miron, C., Antohe, S., 2011b) and web 2.0 tools.

**JiTT**

JiTT combine ICT strategies with constructivist teaching-learning ones, offering students the opportunity to learn „just in time" (www.webphysics.iupui.edu/jitt/jitt.html). The method was developed within Physics Faculty IUPUI, US Force Academy and Davidson College. To apply this strategy he teacher has to have at hand a virtual collaborative environment (wiki, blogspot, moodle etc) to adapt to the requirements of the class. The students have to fill in an online task and transmit it to the teacher using virtual environment: e-mail, mess, skype etc. The teacher receipt and analyze the messages „just in time" and adapt the lesson based on the feedback. Students are encouraged to read the materials before the course, constantly. That means the teacher has to prepare carefully every lesson, to post online adequate materials as easy reading texts, videos, audios or links to already existing ones online around topic. The physicists developed this strategy used Java applets called *physlets* (Novak, G. M., Patterson, E.T., Garvin, A.D., Christian, W. 1999). We created a collaborative environment http://magnetorezitiv.blogspot.com/. Blogspot environment offers to the user the possibility to post information related to the topic, to update them and to communicate with the students „just in time". This is possible during evaluations and also during classes. For example, during an experimental task, students can fill in the tables with experimental data in a specific folder and the results can be send „just in time" allowing teacher to visualize and analyze them and to the groups of students to compare with others. Based on partial experimental data, or even final data, the teacher can follow the projected learning pathway, step by step, using inductive strategy.

**A constructivist approach for the study of magnetorezistive materials**

The study of magnetorezistive materials is a complex topic requiring the teacher for prior lesson's preparation. It is significant content organizing as the students can navigate easily on site. The home page is the first one created called Content allowing facile navigation through the concepts as it is shown in Figure1.


*Figure 1* - **The Home interface of blog illustrating the content organizing of the topic "The Study of Magnetorezistive Materials"**

The next pages develop each chapter in content. For a facile navigation we used hyperlinks. The content can be attached lately, in this point of task designing is important to have fixed the place will be made the postings. In the end we set apart a discussions page, but is possible to communicate "just in time" at the end of each chapter, on the topic. We posted a pre-test to evaluate the knowledge and competences students have before the beginning of the course as shown in Figure 2. The students will post their answers online according to a time limit specified by the teacher during the same class or for a next time. Based on the answers received "just in time" as *Comments* the teacher revalue lesson's design as to adapt the contents to students' needs. Teacher can also use a specific e-mail for private communication with students in the case he decided that students are not allowed to see each other's comments. Other free instruments available online are recommended: Yahoo Messenger, Google Messenger, and Skype. Hence, the classes will not be similar one to each other because of the permanent changing made „just in time".

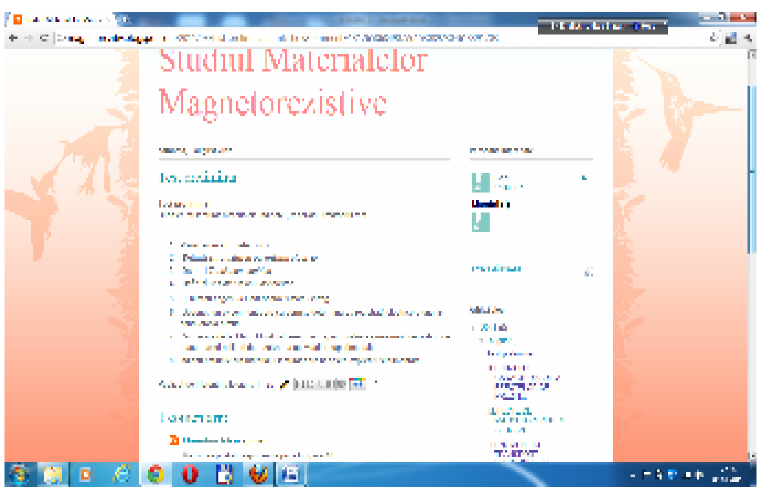


*Figure 2* - **The blog interface illustrating the test and the comments**

**Conclusions**

JiTT is an efficient strategy especially in constructivist approach of knowledge, but it is notable to consider some particular aspects for a good result. Above all, the school must have requisite equipments: computers for each student/ small group of students, internet connection available as to be possible „just in time" communication. Then, the teacher has to invest time for designing the collaborative environment, to select suitable educational resources, to organize them and post them online. Communication with students „just in time" is very important, the information received has quickly to be ordered, recorded and archived as to call them any time is needed. A special attention has to be given to group activities, to select the best learning strategies and adapting them to the students' needs.

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www.webphysics.iupui.edu/jitt/jitt.html

# Interdisciplinary approach of nanoscience using PBL method and WEB 2.0 tools

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**Abstract**

*The unprecedented development of nanosciences demands an interdisciplinary approach addressed to students in middle even primary school. "Nano" has become a buzz word used frequently connected in scientifically context: nanoparticles, nanotechnology, biomimicry etc. So, it is evident the link with integrated science fields: physics, chemistry, biology. The European project Nanoyou offers a lot of educational online resources to be used in the classroom or to be integrated in science lessons. According to the manifold to be read around the topic is recommended to use constructivist inductive strategies. Problem based Learning (PBL) is a revolutionary teaching approach, calling students'metacognition (i.e. the student's ability to analyze, reflect on, and understand his or her own cognitive and learning processes). Being a constructivist strategy of learning, PBL can be successfully used together with web 2.0 tools.*

**Keywords**: Nanosciences, Nanoyou, Constructivism, Web 2.0 tools

**Introduction**

Nanosciences are in foreground due to the technical applications to be found everywhere: gadgets, communications, electronics, and medicine. "Nano" became a buzz word connected with "small sizes", "the small world unseen", "and the micro cosmos". The word itself is a combination of nano, from the Greek "nanos" (or Latin "nanus"), meaning "Dwarf", and the word "Science."

The development of nanoscinces involves an interdisciplinary approach of scientific knowledge, involves concepts from physics, chemistry, biology, ICT. Unfortunately school curriculum do not include the study of nanosciences, but is possible, at students` demand teachers develop optional courses on this topic, or involve students in specific projects. The European project Nanoyou (www.nanoyou.eu) offer students the opportunity to learn about new applications of nanotechnology. Teachers have to find the best strategies to attract students in learning activities: to make them be part of the lesson, to work in groups, to communicate, to express themselves in scientific language to present their work using ICT and web 2.0 tools. A suitable solution may be using constructivist strategies combined with some informatics tools to be used in virtual environment.

**Constructivism approach in science education**

Constructivism is one of the most quoted educational paradigms. To be easy to understand this paradigm, we call on for Hoover`s definition of constructivist learning. Learning is active than passive if what learners encounter is inconsistent with their current understanding, their understanding can change to accommodate new experience (W. A. Hoover, 1996).

Constructivism brings in the foreground active and interactive learning and its efficiencies emphasizes when the knowledge building is realized with the purpose of assimilation by the others. The others, in this context are like mirrors reflecting what we already know, understand and transmit. This metaphor has to be permanently between the teacher and his student (asymmetric relationship) but also between the student and his teacher (symmetric relationship) (Iofciu, F., Miron, C., Antohe, S., 2011a). For science teaching the constructivist approach is one of the most desirable ways to involve students in their own knowledge building (Iofciu, F., Miron, C., Antohe, S., 2011b).

The using of ICT in science instruction involves the necessity to combine constructivist strategies with collaborative virtual environments, so in the last years increased the proliferation of computer supported collaborative learning (Koschmann, T., 1996).

**PBL**

One of the most challenging constructivist strategy is PBL (Problem Based learning). PBL has been used since 1950` and till now, it has been suffered many transformations and adaptations due to the evolution of constructivist strategies developed by our teachers. PBL is a group strategy, involving collaboration between students and also between students and teachers.

Problem-based learning is a teaching or training method characterized by the use of "real world" problems as a context for individuals to learn critical thinking and problem solving skills and acquire knowledge. It involves both knowing and doing (Lepinski, C., 2005).

There are several ways conducting PBL as long as the core concepts are followed it is a flexible method of learning driven by the author can be used directly target particular topics as well as for more general scenarios of general knowledge acquisition:

- define the problem clearly;
- explain clearly and in detail exactly what is required for the students;
- explain core concepts, statements or unknown wording;
- form groups(can be tutor-driven or student-driven);
- brainstorm and try to analyze the problem.

Ensure that is a time limit and more information than can be gathered for any one individual. These way students have to cooperate and divide the labor of evidence gathering between them:

- systematically gather evidence;
- re-gather to discuss evidence and develop strategies for remaining information needed;
- within the group developed an answer for the problem posed (Bignell, S., Parson, V., 2010).

**Web 2.0 tools in constructivist approach of science teaching**

To be able to realize science lessons using computer it is important to create a collaborative online environment. This is possible using common free web 2.0 tools: wikispaces.com, blogspot.com. Using blogspot.com teachers attain to a collaborative environment suitable for group activities. It is possible to post a requirement to be done just in time by the students in a definite time limit, to receive the answers , to have the possibility to display only selected answers (the good ones), to make remarks about the contents and evaluate students as in Figure 1.

**Interdisciplinary approach of science**

Science learning involves an interdisciplinary approach of the fields of physics, chemistry, biology, mathematics and ICT as in Figure 2.

To understand nanoscinces, it is needful that students must have knowledge from all disciplines involved. As the name shows, the natural sciences are branches of science that seek to elucidate the rules that govern the natural world by using empirical and scientific methods (http://en.wikipedia.org/wiki/Natural_science). The distinction between sciences is not very evident, so we have a lot cross-discipline fields resulted as interconnections of different fields of the studies. Physics have an integrative role; obliviously it is linked with all the other fields. Mathematics offers a good support for demonstration, as an instrument used to express the language of science. ICT is connected with all science disciplines being part of them. Today is very hard to imagine science out ICT; virtual environment offers the opportunity to communicate, to collaborate and to share knowledge and information with others.

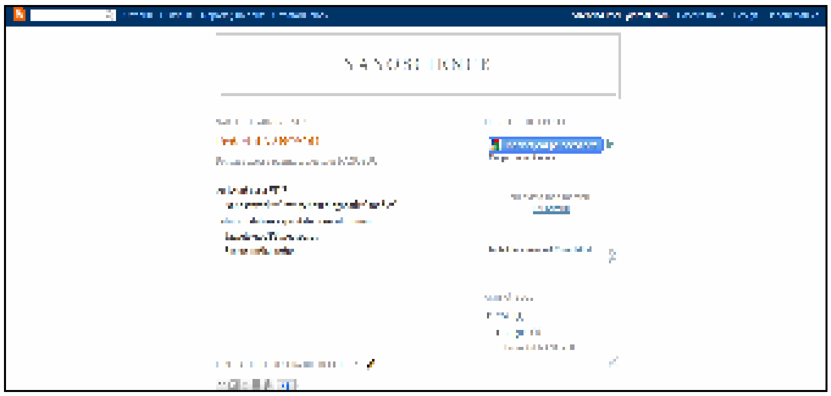

*Figure 1* - **The blogspot.com interface for the study of Nanosciences**

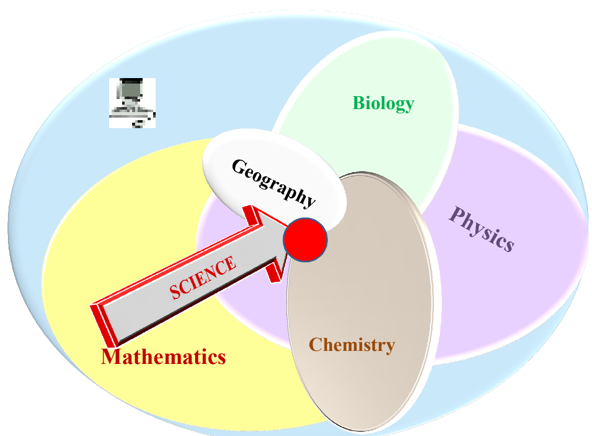


*Figure 2* - **Interdisciplinary approach of science**

**Nanoyou**

Nanoyou Project is a great opportunity to approach interdisciplinary nano sciences in a non traditional way, as to make science more attractive for our students. To introduce the concept of nanotechnologies to middle school students we designed a scheme as in Figure 3, illustrating the concept of nanotechnologies in the context of interdisciplinary approach. There are applications of nanotechnologies in medicine, energy, ICT, environment. All of these applications have become more and more present in our everyday life, so this is why is needed to give them their required attention. To explain rigorously to young students of primary or middle these advanced scientific concepts is out of question in the context of the national curricula. Because of students' desire to understand the world around them, teachers have to meet them half way and to adapt instruction strategies as to be facile to approach concepts or facts connected to advanced science concepts.

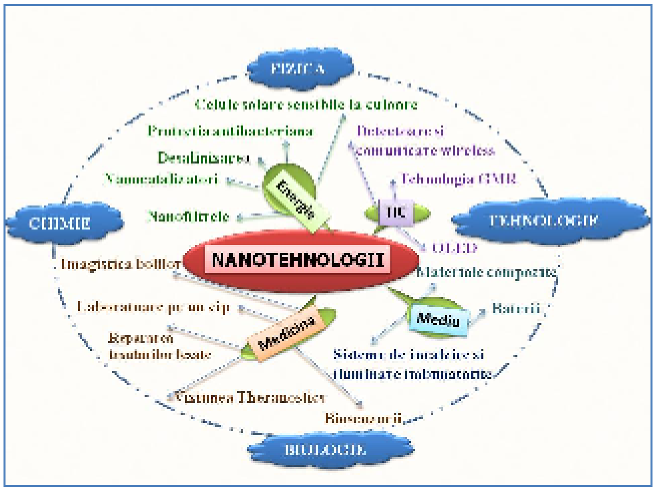


*Figure 3* - **Naotechnologies in the context of interdisciplinary approach**

We find resources for actual topics to be studied using group collaborative strategies as PBL: Antibacterial Socks, Nanosenzors Used for Medical Diagnosis, GPS Jackets, Nano-based Solar Cells, Want to Be A Superhuman, Improve Human Brain Capabilities, Revolution For The Light Bulb, Nanoparticles To Detect Food Freshness.

Students from 7$^{th}$ class, aged 13-14 years old selected “Want to Be a Superhuman”. They were randomly divided in small groups, each group having a role play to find an answer to dilemma: *Is it acceptable to use processes developed for medical treatment to enhance the human body?* as in Figure 4.

*Figure 4* **Students from 7-th grade working in small groups**

Each group represents a stakeholder: a scientist, a patient, an ethicist, a multi-millionaire, a private medical centre and a child. To be able to solve the dilemma, students needed some preliminary information about the topic. First, he teacher used the online information to introduce students to the topic. Then, the students accessed the project’s link and selected the information they need teacher to explain. There are available a large resources panel: posters, games, topics for virtual labs, resources to discuss and debate different science controversies. Using this strategy, students also develop European key competences:

- Communication in mother tongue and in foreign languages during all activities. There are a lot of resources in English to be translated, so students can use a foreign language as a tool;

- Mathematical competences and basic competences in science and technology, during hands on activities or labs;
- Learning to learn – the ability to develop a positive attitude to learning (http://www.salto-youth.net/downloads/4-17-1881/Trainer_%20Competence_study_final.pdf);
- Social and civic competences during collaborative group activities or in the context of virtual environment communication.

## Conclusions

The interdisciplinary approach of advanced science concepts in European context is facile using the learning resources offered by Nanoyou Project. A good practice solution can be using PBL together with ICT, informatics tools or online environments. All constructivist strategies allow students to develop European key competences during the learning process together with acquisition of new knowledge. Giving students a time of reflection about their work, mostly done in small groups we develop metacognition and creativity. Applied to primary or middle school students, these strategies go to incite young students to approach advanced scientific knowledge in further classes, or to desire to prefer a job in a scientific field.

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www.nanoyou.eu

# Learning pathways - a Perspective in the Physics Learning

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## Abstract

*The complexity of our days' society and the rapidly changing requests it poses to the today citizens with respect to the understanding of new technologies and their subsequent correct use require a parallel restructuring of Science, and in particular Physics, Education. In this, a fundamental role is played by teachers, to which it is assigned the difficult role of guiding the scientific cultural formation of the student. Interactive courseware aids learners to access information and tools by which they can construct personalized transitions between the information to be accessed and their own cognitive structures. The "learning pathway" is a crucial term to describe learning processes. The notion of learning pathways serves at first for a qualitative description of learning processes with a stroboscopic picture of a sequence of stable or metastable intermediate conceptions, followed by a detailed analysis of developmental conceptual changes. Learning pathways also reveal the learning trails while learners traverse any interactive environment.*

**Keywords**: learning pathway, blended learning, ICT, physics learning

## Introduction

The issue of learning efficiency was always taken into consideration and treated accordingly, specialty literature recording countless contributions. Guidelines for the 21st Century Pedagogy support the development of thinking skills in students, mathematical skills, scientific and technological, communication skills in their mother tongue and foreign languages, digital skills, entrepreneurial skills and learning skills etc. This means, as shown in Figure 1, using project-based learning, using concepts and learning through research in the spectrum of educational activities.

On the other hand, we live in a digital world. Children today grow and learn in this world. Among the expectations they have from school are the existence of multiple sources of information, multimodal communications, taking responsibility of their own learning, relevant knowledge gained in school after completion, learning in virtual communities, use of cutting-edge technologies and of their related devices in the learning process. A study performed by applying a questionnaire revealed that my students, in "Grigore Moisil" National College, in Bucharest, have computers at home and internet access in proportion of 99%, the only student without access is actually under parental punishment. Most of them spend 4-5 hours daily in front of the computer, of which 1-2 hours learning. The natural question appeared: *How can we assign a larger share of the time spent on the computer for learning- especially to motivate and increase interest for learning Physics?*

## About Blended Learning

In specialty literature there are many attempts to define the term increasingly met within the educational landscape: Blended Learning - Learning through combination of teaching strategies.

According to Caroline Gray, the term is a common approach to learning, which is based on a mixture of teaching methods, and of giving support for the skills necessary for acquiring top jobs (http://www.astd.org/LC/2006/0306_gray.htm).

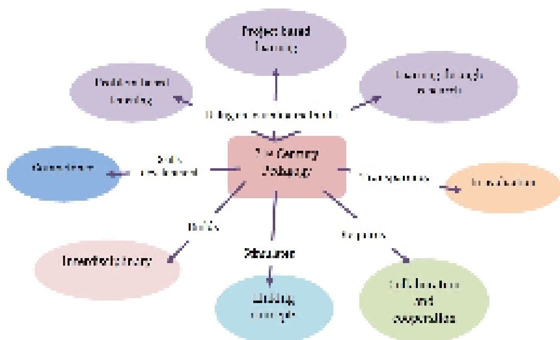

*Figure 1* - **Trends in the 21st century Pedagogy**

This learning strategy can combine:

- ➢ web-based technologies such as virtual classes, self-paced training, collaborative learning, streaming audio and video;
- ➢ different pedagogical approaches (constructivism, behaviorism, cognitivism), with the purpose of achieving optimal learning results;
- ➢ any form of technology used in the educational activity (video, CD, web, digital movie, blog, portal) with face – to – face training, led by a teacher;
- ➢ instructional technology with the current requirements of jobs in order to create a harmonious effect of learning;
- ➢ synchronous learning with the asynchronous learning;
- ➢ several types of interactive content (Bersin, J., 2008).

C. Graham shows that this requires the combination of virtual and real learning environment. He describes the interaction between face – to – face activities, characterized by synchronous human interaction and activities with the support of Information and Communications Technology, asynchronous, where educational actors operate independently (Graham, C., 2006).

In its general sense, the term Blended Learning involves the combined use of digital technologies which facilitates communication, interaction and collaborative learning with what is best in traditional learning.

The concept model of learning through combination of strategies is trying to integrate components according to the evaluation of their specific attributes, figure 2.

In the context of bringing teaching knowledge closer to scientific knowledge (Nicola, I., 1994), the school must assign a greater role to science in educational activities.

It should give students the opportunity to develop in the direction of scientific knowledge, of promoting critical thinking, of acting based on the empirical nature of science, of using scientific literature (Nuangchalerm, P., 2010).

For this reason, the teaching methods recommended in approaching the Physics

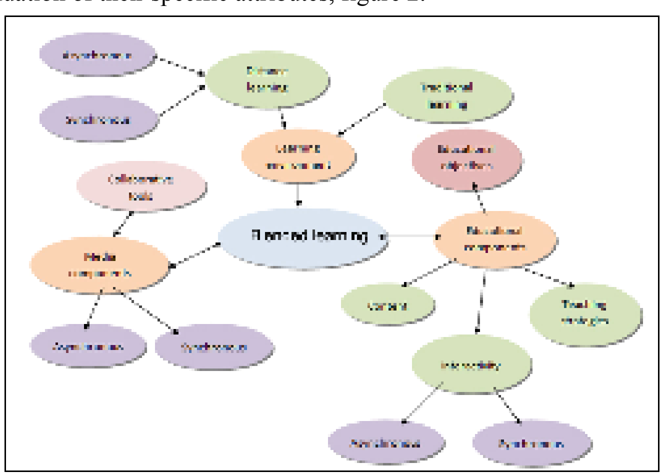

*Figure 2* - **The Blended Learning Model - Conceptual Map** (taken from http://www.slideshare.net/jtholden/developing-a-blended-learning-strategy-instructional-media-pedagogical-considerations)

lessons are the heuristics: problem-solving (Problem-based learning), discovery/ research (Inquiry-based learning), Project-based learning, by combining modeling and experiments.

The virtual term is often used to indicate a learning environment based on computer and Internet (Bopry, J., Eteläpelto, A., 2003).

Practically, in any learning environment there can be distinguished both real and virtual components. An environment based only on material components is called *real learning environment.*

According to the opinion expressed by Lavonen, Meisalo, Lattu, Leinonen and Wilusz (Lavonen, J., Meisalo, V., Lattu, M., Leinonen, L. and Wilusz, T., 2001), classrooms equipped with computers and Information and Communications Technology are called *enriched learning environments*, and is not confined to the classroom.

They believe that the library, the park in the school yard, museums, research institutes, can be part of the learning environment. At the same time the computer and ICT can offer access to virtual learning environments and/or remote access to institutions of interest (Meisalo, V., Lavonen, J., 2000).

The virtual components include resources that can hardly be used in reality. Developing and ensuring Internet access in schools made it easy to access a series of resources as virtual laboratories, regional database with useful information, educational portals etc. Virtual components also represent a communication environment widespread between educational actors. Their use creates challenges related to careful integration in the curriculum, to change in pedagogical approaches, to lessons management, to teacher training etc.

The learning path represents a structured approach which allows efficient combination of different ways of going, teaching models and learning styles. It includes innovative methods that support the autonomous learning of students, with the added value of ICT.

**Examples of learning paths for Physics lessons**

The Learning Path defines the learning elements and their sequence to achieve learning goals. This Learning Path guides the learner through a recommended sequence of lessons. The challenge for a Physics teacher and not only, is that of creating to his students intrinsic motivation. We consider that the students who participated were motivated to learn and to do experimental work, thanks to the context in which the activity took place. We will illustrate it with two examples. We created a learning path for the theme of the gravitational Pendulum, which we illustrated in the image in figure 3.

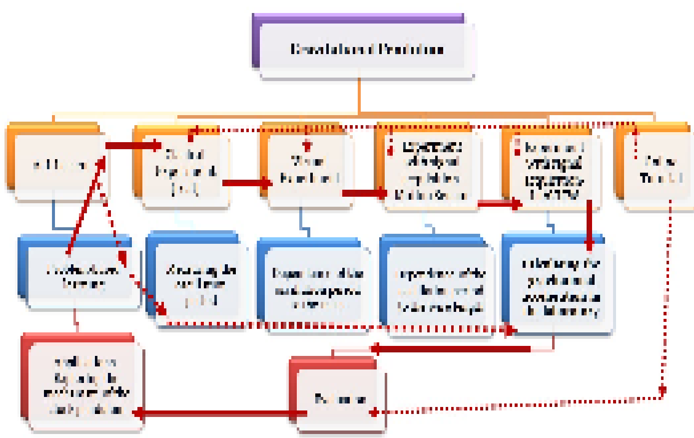

*Figure 3* - **Learning Path – Gravitational Pendulum**

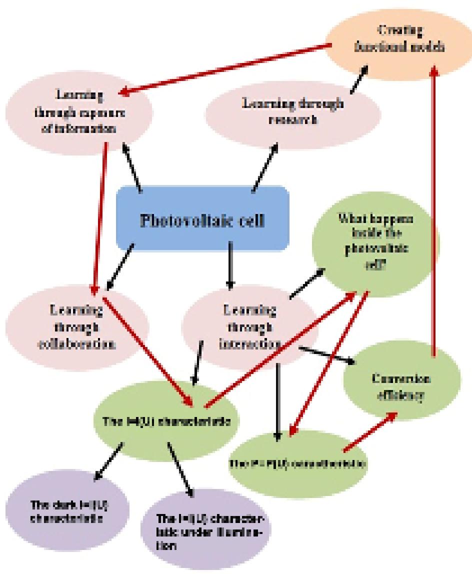


*Figure 4* - **Learning Path for the Photovoltaic cell**

The other one is shown in the figure 4 and is dedicated to the Photovoltaic cells' study.

The Physics teacher has to answer the following challenge: how the fundamentals of photovoltaic (PV) can be taught at a general level, to students who might have minimum (or even zero) background in semiconductor physics or electronics. Indeed, it is shown that PV effect mechanism can be explained in similar terms as the photochemical conversion mechanism, including photosynthesis and the dye-sensitized solar cell (Antohe, S., Ţugulea, L., Gheorghe, V., Ruxandra, V., Căplănuş, I. and L. Ion, 1996).

Students should see the effects of the light intensity and of the different light wavelengths on the PV cell and of the cell temperature. Voltage readings will be larger when more light is absorbed. Readings should be smaller when the PVC is cold, though this temperature effect may be too minor to observe on a small scale (Garabet, M., Neacşu, I., Popescu, F.F., 2010).

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# Bridging the Gap between Industry and Education: the Impact of Social Networks

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**Abstract**

*Social networks provide tools for practitioners, learners, educators, businesses, and general public to join ongoing debates, communicate, collaborate, share their interests, findings or concerns, and contribute to discussions. However, the successful use of Social Networks in an organisational setting is not a straightforward issue. Professionals face may challenges in developing social network research, ranging from how to design a social network project, details and problems that may arise during their social network data. This is why it is important that graduates and advanced undergraduates students get a jump-start on their social network skills and intellectual aspiration that would help them improve their future work performance. This paper aims to explore and analyse how Social Networks can enhance the way people work or 'do business' in the modern business world and what skills are required in order to do this effectively.*

**Keywords**: skills development; employability; industry perspectives; collaborative learning; higher education

## Introduction

Universities are expected to provide opportunities for students to develop skills and competencies which enable them to perform efficiently in the workplace of the future – a future which is ever-changing and complex. Given the variability of situations in professional settings, what are the core skills that students should develop during their studies in order to hold a better chance to be successful in their future careers? This study addresses this challenge by exploring which skills practitioners regard as crucial in their everyday life in the workplace. The aim of the study is to identify those prevalent skills and competencies that seem to pertain in the area of Business Information Systems (BIS) – an interdisciplinary domain which combines competence in both Business and IT. We recognise that different professional situations within and across disciplines are likely to value different sets of skills, hence our focus is on the critical aspects specifically relevant within the area of BIS rather than a broader set of skills across all disciplines.

The paper presents an overview of current trends and the implications they may have on transferable skills development in section 2. This is followed by the research design and data analysis in section 3. The main findings are presented in section 4 and the key implications are discussed in section 5.

## Background and literature review

***Current trends and implications on transferable skills and employability***

*Trend #1: Challenging economic situations*

The critical situation in the global economy alongside the everlasting competition for jobs and the demanding recruitment procedures have brought challenges to graduates in every discipline. This puts forward the need for strengthening the relationships between Higher Education Institutions (HEIs), society, and economy (Harvey et al. 2002). In a recently published book, McCormack suggests that "business and society need practitioners with both relevant and marketable skills. A concerted effort is needed from all stakeholders to address this. Education is at the heart of the solution" (2010, p. 65).

*Trend #2: Advances in technology*

Universities and corporate training programmes have been investing in ICT at an increasing rate during the past decades (Alavi & Leidner 2001). It has been argued that by learning through technology, students can exercise higher-order thinking skills (Alavi Wheeler & Valacich 1995) and develop their e-skills (McCormack 2010). Being critical, selective, and able to absorb all the (relevant) new knowledge co-created by individuals and groups around the world requires enduring reflection as well as technical skills which can only be triggered by integrating ICT in education (Piki 2010).

*Trend #3: Virtual teams and international projects*

Virtual collaboration is also rising. European and International funding bodies are recognizing the innovative and creative endeavours resulting from joint projects and consortia that bring together people from different countries and diverse fields. It takes a lot of skill to establish healthy working relationships in remote, mobile, or disbursed environments (Bandow 1997; Belanger & Allport 2007; Bell & Kozlowski 2002).

*Trend #4: More students moving into PG education*

Another trend is that HEIs are experiencing a growing popularity of postgraduate courses, as individuals try to boost their job prospects and increase their qualifications. As a result, the number of students who move into postgraduate education has seen a rise in recent years (Lipsett 2009). In the UK, postgraduate education is seen as the fastest-growing sector in higher education (Sastry 2004). Increasingly, people who have been working for a long time return to universities or take distance learning courses to further their knowledge, skills, and qualifications, under the pressure of more demanding jobs and also under the stimulus of a lifelong learning society (Stanescu et al. 2008).

***Research on skills and competencies within BIS***

In recent years there has been an increasing emphasis on graduate employability and vocational skills (Harvey 2003; Knight & Yorke 2003). Some studies attempt to identify the core transferable skills within a specific domain (e.g. Chalkley 2000) while other studies are more generic and attempt to identify overarching skills and competencies (e.g. Bowden et al. 2000). Research on e-skills is also on the rise (e.g. McCormack 2010). Within the domain of BIS there are a limited number of studies that have explicitly explored skills development (e.g. Jiang et al. 1998; Napier et al. 2009) and these focused on professional development rather than formal education. Hence we need further insights on the range of skills appreciated within the field of BIS.

## Research design

This empirical, exploratory study attempts to identify the core transferable skills that Business/IT practitioners consider critical in their workplace which in turn may provide a basis for the enhancement of current teaching and learning practices.

***Target group of participants***

The practitioners who participated in the study were selected in accordance with the curriculum of a Master's degree in Business Information Systems (MSc BIS) in the UK. The purpose was to capture the perspectives of those experts who work in job roles, positions, and industries which are relevant to (i) the careers that MSc BIS students are targeting and (ii) the roles and situations the program is intended to prepare them for. Essentially, the selected practitioners can be considered as potential future employers (or colleagues) of students pursuing postgraduate education in the field of BIS.

***Selection of participants***

A preliminary research was conducted by asking individuals who had recently graduated from MSc in BIS, as well as students still at university, what jobs and careers they are targeting. This yielded a broad range of careers. The most common ones included business consultancy, IT project management and business systems analysis and design. Having acquired a list of target jobs and company names a snowballing interview technique was used to identify professionals that could participate in our study. The basic idea of this technique is to define the population inductively, by letting participants to nominate each other (Miles and Huberman, 1994).

***Research method***

In total, 31 in-depth, semi-structured interviews were conducted with practitioners from ten countries in Europe, Asia, Africa, and America working in areas such as Business Consultancy, IT Consultancy, IT Project Management, Research and Development, Banking, and Telecommunications amongst others (Table 1). The majority of interviews were carried out in person while some were conducted via desktop teleconferencing using Skype®. Each interview lasted between thirty minutes and one and a half hours. The interviews were audio-recorded with the permission of the participants and under the declaration that their identities and those of their employers would not be revealed.

***Data analysis***

NVivo® was used for qualitative data analysis. The coding phase involved identifying key phrases and themes in the respondents' references to skills, competencies, behaviors, and performance-related attributes which they perceive as critical in their everyday working lives and the specific skills that they expect graduates to be able to demonstrate. Cultural differences in terms of perceptions on skills requirements were beyond the scope of our analysis for a number of reasons. Firstly, although we interviewed people from ten different countries, their job location did not always represent their nationality. Secondly, students are increasingly targeting international jobs. Therefore, we focused on identifying the most prominent skills across job roles, sectors, and countries. We looked for those themes that tended to re-appear in the interviews and those that most of the informants concentrated on.

| Location | Job Description / Role | Industry / Sector |
|---|---|---|
| **United Kingdom** | 1. IT Programme Manager | IT Services / Business Consultancy |
| | 2. Freelance Consultant / Trainer | Business Consultancy |
| | 3. Program Manager (Marketing) | Technology Devices & Services |
| | 4. Project Manager (Communications) | Investment Banking |
| | 5. Information Security Consultant | Audit / Consulting |
| | 6. Consultant (Audio-Visual) | Infrastructure Design |
| | 7. Principal Consultant (Audio-Visual) | Infrastructure Design |
| | 8. Managing Consultant (Communications) | Infrastructure Design |

| | | |
|---|---|---|
| | 9. Principal Consultant (IT) | Infrastructure Design |
| | 10. Principal Consultant (Sustainability) | Infrastructure Design |
| | 11. Manager (IT Department) | Car Rental |
| | 12. Lead Software Engineer | Car Rental |
| | 13. Informatics Management Graduate | Health Sector |
| | 14. IT Project Manager / Call centre manager | Health Insurance |
| | 15. Technical Director | IT / Software Development |
| | 16. Technical Staff (Computer Support) | Education |
| **Cyprus** | 17. IT Project Manager / Software Engineer | R&D in Telecommunications |
| | 18. Network Engineer | Internet Service Provider |
| **Romania** | 19. IT Project Manager | R&D / Software Development |
| | 20. Software Developer | R&D / Software Development |
| | 21. Executive Director (IT department) | Public Sector |
| | 22. Software Test Engineer | IT / Software Development |
| | 23. General Manager / Business Consultant | IT Consultancy |
| **Pakistan** | 24. SAP Consultant (Sales and Distribution) | Industrial Chemicals |
| **China** | 25. Management Trainee | Banking |
| **Bangladesh** | 26. Manager (Sales and Marketing) | Real Estate Sector |
| **Saudi Arabia** | 27. Production and Training Services | Investment Banking |
| | 28. Information Systems Analyst | Cement Production Company |
| **Nigeria** | 29. Business Analyst / IT Support | Banking |
| **Malawi** | 30. IT Business Analyst | Banking / Application Service Provider |
| **Canada** | 31. System Administrator | Telecommunications |

*Table 1*: **Participant Demographics (N = 31)**

## Findings

A recurrent theme that emerged in the interviews we conducted was that graduates are expected to have a ‘portfolio of skills’ and be able to utilize them depending on the situation. The five categories of transferable skills and qualities we elicited include ‘Hybrid Management’, ‘Communication’, ‘Team skills’, ‘Flexibility’, and ‘Engagement’.

### *Hybrid Management skills*

For individuals working in a context which spreads across the silos of individual disciplines and organizational divisions being able to adopt in a chameleonic way is vital.

Practitioners recognized the need for graduates to be able to see a holistic view of what they are involved in:

“*You want to see if they get a feel for how technology affects people’s lives and changes business, and that they have an insight beyond merely the technical.*” (IT Consultant)

A few participants also acknowledged that an important skill that graduates lack is commercial awareness.

### *Communication skills*

All participants perceived communication skills as central and they all discussed some aspect of communication. This ranged from being confident to communicate, to exhibiting good verbal and presentation skills, to writing high-quality reports and communicating in a visual way, and having the ability to persuade others.

Communication emerged as the most prominent skill across all participants. The different views on what communication entails suggest how important it is for graduates to be able to communicate in various ways and formats in order to get their message across, promote their ideas, or articulate what the client wants, all of which are routine tasks in the modern workplace. Another lateral perspective highlighted by the participants concerned the foreign language skills. Language skills are considered crucial in extending graduates' access to knowledge and, consequently, for helping them to succeed professionally in the midst of internationalization.

***Team skills (collaboration, coordination, cooperation, negotiation)***

Effective teamwork depends on a number of factors, including the team dynamics, the project manager's leadership skills, and the individual members' commitment. Most importantly however it depends on team skills. Some of the participants focused on coordination and project management skills, while others emphasized the importance of negotiation skills.

Those participants working in diverse teams highlighted the significance of building a collaborative spirit in the team and being willing to share information:

"*You would like to see somebody who is enthusiastic, not just about the techie stuff but also about passing that on and explaining it to other people and working together in a team. That's the collaborative element*." (IT Consultant)

***Flexibility***

Progressively more graduates move between multiple roles (and industries) and fewer pursue a job for life. Therefore it is essential to have the ability to adapt quickly and transfer their knowledge and capabilities in diverse contexts in order to cope with the changes and complexities involved. As one of the interviewees said, flexibility means that graduates need "to be able to work in their own time frames, capable of working in the office, at home, wherever" (IT Consultant). Flexibility was also articulated by some participants as the ability to be open-minded and proactive, "the ability to learn quickly" (System Administrator) and "be able to manage, even when you don't know the answer" (General Manager).

***Engagement***

Many respondents talked about the need for more engaged graduates who are involved, proactive and keen to take initiatives. They explained that when individuals are intellectually curious, committed, and have a genuine interest in what they do, they are driven to improve themselves, explore, and learn more.

Successful graduates are those who can demonstrate self-determination and active engagement with their job. Graduates need to be keen to initiate interesting projects and demonstrate their readiness and enthusiasm for lifelong learning. Having a strong interest in what they do can drive individuals to continuously look for new trends and ask interesting questions. This triggers higher intellectual engagement and involves finding relevant information, evaluating it, and combining it in innovative ways for problem solving.

**Discussion**

The skill categories identified during data analysis are by no means exhaustive. The aim of the study was to shed light on the key trends and transferable skills that emerge as important from an industry perspective. These trends have a number of implications for HEIs and can help educators in curriculum design.

***Implications for practice***

By examining the perspectives of industry professionals it became clear that they expect graduates to demonstrate proficiency in communication and social skills. Surprisingly they also reported that the skills that new recruits lack the most include their ability to communicate their ideas clearly, take initiatives, and work effectively in teams. This has implications for instructional design.

Due to its nature, collaborative learning is expected to provide better learning outcomes and increased student involvement compared to individualistic learning practices. Numerous studies have reported the benefits of collaborative learning in higher education (Alavi 1994; Dillenbourg 1999; Grabinger et al. 2007; Piki 2010).

The study also raises some issues about the connections that need to be established between formal education and the 'world of work'. Blackwell et al (2000) suggest that work experience can contribute to superior educational standards in higher education and to the development of a flexible, highly-skilled and enterprising labour force. Educators and programme coordinators need to re-orient education towards the needs of the economy (Harvey et al. 2002).

**Conclusion**

The trends described in this paper illuminate the need for developing closer links between the world of work and the world of education. Despite recent efforts in bridging this gap, in many cases employers are not fully satisfied with new recruits, a fact which signifies that industry and education sectors do not speak to each other – or that they simply do not speak the same language. The study contributes to our understanding of the core skills and competencies graduates need to demonstrate when the real business work unravels around them. Our findings confirm the importance of key skills suggested in the literature (especially communication and collaboration) while also illuminating new perspectives on competences that seem to be crucial in BIS-related jobs (such as hybrid management, being adaptable, and actively engaged). These findings provide a sound foundation for future research into transferable skills and the implications they may have on both the role of educators and their students' employability.

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# An Overview of the Most Important Aspects Related to Quality Assurance in Computer Supported Collaborative E-Learning

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**Abstract**

*Collaborative learning is defined by Dillenbourg as a situation in which two or more people learn or attempt to learn something together (Dillenbourg, 1999). Information technology has developed to a stage where any organization of higher education can no longer ignore. In fact, information technology has become part of everyday life for teachers and students. The use of information technology in an E-Learning environment, in order to mediate and support interaction, tasks, knowledge acquisition and finally the educational process itself has lead to a new concept called Computer Supported Collaborative Learning. Customers (students) expectations are high, therefore, quality assurance should lies in any activities of higher education organizations. This paper is presenting the most important aspects related to quality assurance in Computer Supported Collaborative E-Learning environments, as well as is presenting an overview of the quality importance in such learning environments, the quality role, the main quality elements, and some of the trends and perspectives at European level as resulted from available studies.*

**Keywords**: Collaborative E-Learning, E-Learning, Quality Assurance

**Introduction**

The explosion of Information and Communication (ICT) since the 1990s has brought about profound changes in the way society is organized and functions. With all these changes that affect the way we live and work, it is not surprising that learning has not escaped the phenomenon. While distance education and learning is not new the possibilities of ICT have generated potential uses and means of organization that enhance and accelerate the distance learning process (Eschenlohr et al, Qual E-learning Project, 2004).

Learning supported by computers is very much in vogue today as more and more organizations have adopted different E-Learning programs for various purposes (education, training, instruction etc.). The concept itself has been defined in many ways and developed on various directions. We are talking today about computer based learning or computer based training or computer supported collaborative E-Learning or even about technology enhanced learning.

Regardless the E-Learning services approach adopted by a higher organization, in the current higher education environment and taking in discussion the proliferation of E-Learning providers, it is inevitable for higher education organizations to demonstrate the quality of their educational programs in a manner that is sufficient intelligible to their direct clients (the students) as well as to their indirect clients (state and private business sectors).

**Computer Supported Collaborative E-Learning (CSCEL)**

Collaborative learning has been defined as a situation in which two or more people learn or attempt to learn something together (Dillenbourg, 1999; Wikipedia, accessed August 2011).

Unlike individual learning, people engaged in collaborative learning capitalize on one another's resources and skills, asking one another for information, evaluating one another's ideas, monitoring one another's work, etc. (Chiu, 2000; Chiu, 2008; Wikipedia, accessed August 2011). More specifically, collaborative learning is based on the model that knowledge can be created within a population where members actively interact by sharing experiences and take on asymmetry roles (Mitnik et al, 2009; Wikipedia, accessed August 2011).

Put differently, collaborative learning refers to methodologies and environments in which learners engage in a common task where each individual depends on and is accountable to each other. These include both face-to-face conversations (Chiu, 2008; Wikipedia, accessed August 2011) and computer discussions (online forums, chat rooms, etc.) (Chen and Chew, 2008; Wikipedia, accessed August 2011). Methods for examining collaborative learning processes include conversation analysis and statistical discourse analysis (Chiu and Khoo, 2005; Wikipedia, accessed August 2011).

Often, collaborative learning is used as an umbrella term for a variety of approaches in education that involve joint intellectual effort by students or students and teachers (Smith and MacGregor, 1992; Wikipedia, accessed August 2011). Thus, collaborative learning is commonly illustrated when groups of students work together to search for understanding, meaning, or solutions or to create an artifact or product of their learning. Further, collaborative learning redefines traditional student-teacher relationship in the classroom which results in controversy over whether this paradigm is more beneficial than harmful (Chiu, 2004; Harding-Smith, 1993; Wikipedia, accessed August 2011). Collaborative learning activities can include collaborative writing, group projects, joint problem solving, debates, study teams, and other activities. The approach is closely related to cooperative learning.

Computer-Supported Collaborative E-Learning (CSCEL) is a relatively new educational paradigm within collaborative learning which uses technology in a learning environment to help mediate and support group interactions in a collaborative learning context (Mitnik et al, 2009; Chen and Chew, 2008; Wikipedia, accessed August 2011). CSCEL systems use technology to control and monitor interactions, to regulate tasks, rules, and roles, and to mediate the acquisition of new knowledge (Mitnik et al, 2009; Wikipedia, accessed August 2011). Researchers and practitioners in several fields, including cognitive sciences, sociology, computer engineering have begun to investigate CSCEL, thus, it constitutes a new trans-disciplinary field (Wikipedia, accessed August 2011).

CSCEL is a pedagogical approach wherein learning takes place via social interaction using a computer or through the Internet. This kind of learning is characterized by the sharing and construction of knowledge among participants using technology as their primary means of communication or as a common resource (Stahl et al, 2006; Wikipedia, accessed August 2011). CSCEL can be implemented in online and classroom learning environments and can take place synchronously or asynchronously.

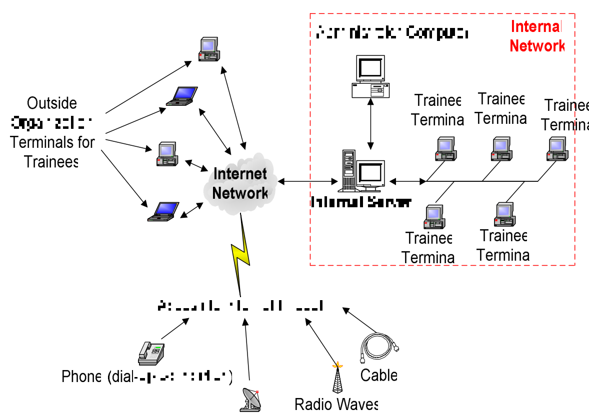


*Figure 1.* **General schematic model for CSCEL (Dobre, 2011)**

In figure 1 the author is presenting a general schematic model for CSCEL, showing the interaction between teachers-students-technology.

Lambropoulos et al have proposed a pedagogical model (figure 2) for E-Learning design with applicability in CSCEL, the model being scripted in six distinct phases, considering as well the activities before and after de e-course (Lambropoulos et al, 2011).

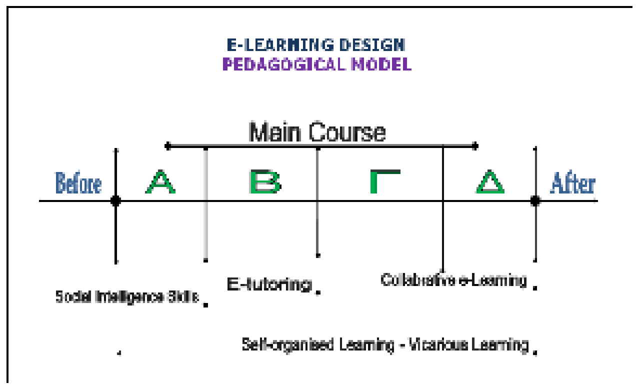


*Figure 2.* **The Pedagogical Model for E-learning design** *(*Lambropoulos et al, 2011*)*

Figure 2 suggests the need for different teaching and learning styles. The teacher adopts initially an instructional approach and move to the role of orchestrating the activities. The student considers adapting to four different learning styles occurring simultaneously, instructional, collaborative and self-directed and vicarious learning. The teacher role is a combination of expert, observer, intervener and overall conductor. In this way there is a matching of organisation and knowledge convergence (Lambropoulos et al, 2011).

**Quality Assurance and CSCEL**

The Quality Assurance Agency from UK describes quality assurance as "the means through which an institution ensures and confirms that the conditions are in place for students to achieve the standards set by it or by another awarding body" (QAA, 2004; Evidence Net & PBWorks, accessed August 2011).

Other researchers (Auvinen and Peltonen, 2004) consider that the quality in education can be defined from at least three points of view: from a technological, an economic or a pedagogical perspective. The pedagogical approach focuses on enhancing the processes of learning and the interaction between the learner and the learning environment (Auvinen and Peltonen, 2004).

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Regarding quality in education, three different dimensions were distinguished by Auvinen and Peltonen:

- different understandings of quality within a stakeholder group;
- the perspectives of different stakeholder groups (e.g. students, teachers, institutions, employers of graduates, governments);
- different standards of quality can be applied to measure achievement at different levels of education (schools and universities have different objectives).

The European dimension of E-Learning adds even more complexity to this question. Different educational systems, learning cultures, learner preferences and other national or regional characteristics have developed different standards of quality management and quality assurance (Auvinen and Peltonen, 2004). However, the researcher's opinions are different from the viewpoint of having or not having a unique valid concept of quality in learning and consequently a single uniform approach. For sure, a solution will be identified and implemented.

Beside these differences in approaching or not a unique quality assurance system remains the final goal: clients' satisfaction. High level of clients' satisfaction will prove the effectiveness of a specific learning system. Looking to CSCEL and quality assurance requirements, the three principles of effective online pedagogy postulated by Pelz could be applied to CSCEL as well. The Pelz's principles are (Pelz, 2004; Auvinen and Peltonen, 2004):

- *Let the students do (most of) the work*. The more time students spend effectively engaged in content, the more of that content they learn. This is the constructivistic view of learning;
- *Interactivity is the heart and soul of effective asynchronous learning*. This is the most important element that E-Learning can contribute to effective communication;
- *Strive for presence.* Recent research in the field of E-Learning suggests that discussion responses that add value to a discussion fall into one or more of three categories: social presence, cognitive presence, or teaching presence. This concerns both the teacher and the students.

There is a growing consensus that high quality teaching is not just about high quality presentation of the content or just about high quality teaching skills. High quality teaching is fundamentally about offering a context in which high quality learning is possible and is encouraged (Auvinen and Peltonen, 2004; Martens & Prosser, 1998). The focus should be on the process rather than on the outcomes (Auvinen and Peltonen, 2004).

Two main directions have been adopted by the higher education organizations in the past years, one called *quality assurance* and another one called *quality enhancement*. Researchers, specialists, higher education organizations, associations, agencies etc., have sustained a direction or another. According to Mellar and Jara, the complex institutional context in which are located the E-Learning environments, impact on the application of the quality assurance mechanism and also, the trend is to move from a quality assurance approach to quality enhancement one (Mellar and Jara, 2009).

The quality of CSCEL has been measured through key performance indicators and standard process measurements. According to Auvinen and Peltonen, the economic approach treats the learner like a customer. But this view opposes the pedagogical learner concept. A learning process is not something that is delivered to a learner by an E-Learning provider but rather a process of co-production between the learner and the learning arrangement (Auvinen and Peltonen, 2004).

Zhao suggests a framework that provides ways of measuring and enhancing the quality of online higher education (Zhao, 2003; Auvinen and Peltonen, 2004), as follows:

- *Course effectiveness*. Even the most dazzling technology has no value unless it supports content that meets the needs of learners;
- *Adequacy of access in terms of technological infrastructure.* Shortcomings in technology and access seem to cause most of the problems faced by online students;
- *Student satisfaction.* Student satisfaction concerns satisfaction with course quality, with instructor interaction and peer collaboration, and with support services. Both asynchronous and synchronous interactions between students and instructors and amongst students are pivotal in virtual classrooms and online learning. Studies show that timely feedback and mentor support are vital to learning success from the point of view of instructors as well as peers;

- *Academic satisfaction.* Academic satisfaction means that teaching staff find online teaching effective and professionally rewarding. In many respects, teaching online is not the same as conventional face-to-face teaching in terms of changes to pedagogy and intensive adoption of ICT in teaching.

Quality Assurance Agency for Higher Education (QAA), European Quality Observatory (EQO), NCC Education and many other professional bodies have published during the past decade important studies showing an proving the importance of quality assurance in online environments. Is sufficient to mention here the EQO study “Quality in e-learning” (Ehlers et al, 2005), a study looking to reveal the current and future challenges of quality and standardisation of E-Learning in Europe. One of the EQO study result was the development of a standardised process model which was developed to act as a reference model for comparing and describing process-orientated quality concepts (Ehlers et al, 2005). Figure 3 shows the seven processes and all component sub-processes of the model proposed by the authors of the EQO study (Ehlers et al, 2005).

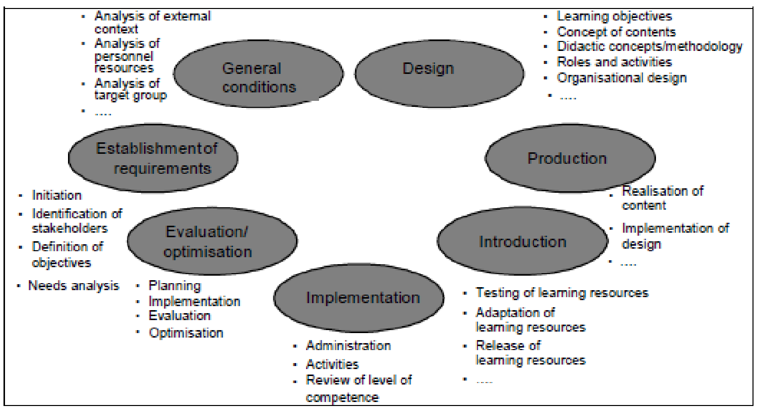


*Figure 3.* **Processes and sub-processes of the reference framework for the description of quality approaches (Ehlers et al, 2005)**

**Conclusions**

The author considers that the higher education organizations need to prove a high commitment to quality measurement for CSCEL environments in order to assure all their clients about the educational process success. Such engagement can be driven through self-assessments carried out by each department from a higher organization as well as through an overall self-assessment at organization level. The higher education organizations will continue to move ahead in reference to CSCEL delivery but also they need to focus from strategically viewpoint on the enhancement of their quality management systems and the author considers that the Ehlers et al model could be considered for CSCEL as well. Nevertheless, concerns in terms of CSCEL efficiency have been reported but as soon as will be identified appropriate quality methods close to the particular characteristics of educational process and as soon as these methods will be implemented properly the concerns will disappear.

One very important condition will be not to neglect the quality of the educational process. The author is considering future research work of the quality assurance/enhancement in CSCEL as the quality is playing a key role in the success of CSCEL.

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# Evaluation of Student's Knowledge – An Overview of the Testing and Assessment Tools for E-Assessment

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**Abstract**

*Modern educational process at all levels requires the use of information technology devices for all component processes, teaching, learning, assessment, feedback collection and analysis etc. Higher education is probably the leading level in creating and providing new options for an effective educational process. E-learning, today widely used and available in many organizations, has become one of the biggest and very important challenge for teachers, students, and supporting teams. Any E-learning program has to have an assessment component available in any phase/stage of the teaching – learning process. Such component is called often E-assessment and is involving the use of information technology tools, primarily computers, to assess student's knowledge. The extent of teaching and learning can be measured through steps of assessment and feedback. An assessment can help in certification and provide feedback to teachers. It can also provide a basis for evaluation of the different pedagogical methods and materials used in teaching and learning (Nazir and Iqbal, 2007). This paper is presenting an overview of some of the testing and assessment tools used for E-assessment in order to provide a view of the present developments in this domain looking to provide support as better as possible to any administrator/user of such assessment solutions.*

**Keywords**: E-assessment, E-learning, E-assessment tools

## Introduction

All over the world, the number of higher education organizations which embracing E-learning programs is increasing every year. Consequently, the number of teachers involved and students enrolled in these programs is rapidly rising. Therefore, the higher education organizations are looking into strategic plans for implementing the E-learning programs in the most effective ways. The information and communication technologies products available today to support E-learning programs are used at a large scale by all organizations and by all parties involved. For instance, Bennett considers that technology is an essential component of the modern educational system (Bennett, 2002).

The most common product used is the computer in all his forms of existence: work stations, lap tops, servers etc. For decades the use of computers in assisting E-learning programs has been a research topic for many experts in this domain and many studies, solutions, new ideas were issued and promoted within organizations involved in such educational programs.

An area which has not been left unexplored is the student's knowledge assessment. The traditional assessments tools (i.e., classroom written tests, oral exams etc.) have been approached differently and have been transferred into computer environments.

In general, according to its purpose the assessment process is approached using different strategies. The two main basic types of these strategies are formative and summative assessment

(Al-Smadi and Gütl, 2008). Formative assessment is part of the learning process and is used to provide feedback to both, students and teachers, in order to guide their efforts toward achieving the goals of the learning process. The summative assessment is performed at the end of a specific learning activity and is used to evaluate the student's progress and also to classify them based on the results obtained (Bransford et al, 2000; Al-Smadi and Gütl, 2008). Other researchers (Nazir and Iqbal, 2007; Reed, 2006) take into consideration apart the above two main basic types several another types of assessment such us: diagnostic assessment, adaptive assessments, forward-looking assessment, self assessment, and performance-base assessment.

Regardless the type of assessment used, the assessment process itself involves the use of tools for testing and assessing the student's knowledge. The type of tools used is directly linked to the learning objectives. The learning objectives have been classified in Bloom's Taxonomy on six levels as follows: knowledge, comprehension, application, analysis, synthesis and evaluation (Bloom, 1956). Following Bloom's Taxonomy, the consequence will be that various types of assessment tools should be used to assess the different objectives levels. Bloom's Taxonomy is applicable not only for traditional testing and assessing tools but also for E-assessment testing and assessing tools.

**E-assessment Concept, and History**

***E-assessment Concept Definition***

The E-assessment as a concept has been defined by different researchers and specialists and is difficult to choose the best or most accurate definition. However, the author has selected definitions available from resources accessible for the large public as follows:

a. *From Wikipedia, the free encyclopedia*: "In its broadest sense, e-assessment is the use of information technology for any assessment-related activity. This definition embraces a wide range of student activity ranging from use of a word processor to on-screen testing." (Wikipedia, accessed August 2011);
b. *From Callan and Clayton*: E-assessment is a broadly-based concept that covers a wide range of activities where technology is used in the designing and delivery of assessments. It also includes the processes of reporting, storing and transferring data associated with assessments (Callan and Clayton, 2010);
c. *From Joint Information System Committee (JISC)*: e-Assessment is the end-to-end electronic assessment process where ICT is used for the presentation of assessment activity, and the recording of responses. This includes the end-to-end assessment process from the perspective of learners, tutors, learning establishments, awarding bodies and regulators, and the general public (JISC, 2007).

All above definition have as common reference the use of information technology. From all tools offered by information technology the computers are the primary ones used for E-assessment. Based on the computer used the E-assessment has been distinguished as Computer Assisted Assessment and Computer Based Assessment.

Computer Based Assessment can be understood as interaction between the student and computer during the assessment process, the test delivery and feedback provision being done by the computer (Al-Smadi and Gütl, 2008).

Computer Assisted Assessment is more general and it covers the whole process of E-assessment, involving test marking, analysis and reporting (Charman and Elms, 1998; Al-Smadi and Gütl, 2008).

***E-assessment Brief Historical Milestones***

According to Wooley, one of the earliest attempts to use computers for supporting educational and assessment process was the project called *Programmed Logic for Automatic Teaching Operations*

*(PLATO)*, a project started in 1960 at the University of Illinois, USA (Wooley, 1994). Later, in 1967, has been started another project called Time-Shared, Interactive, Compure-Controlled, Information Television (TICCIT), this project being considered the second large-scale project for using computers to support the educational and assessment process (Hayes, 1999).

Apart of the above attempts to use computers in educational and assessment process another one, quite important and addressing specifically the assessment supported by computers was the *Automatic Grader* program development (Hollingsworth, 1960; Al-Smadi and Gütl, 2008). In 1965, Forsythe and Wirth have presented another system for assessing automatically the programming exercises written in Algol. The system was used by students attending the numerical analysis course at the University of Standford to assess their programming exercises (Forsythe and Wirth, 1965; Al-Smadi and Gütl, 2008).

According to Reiser, in early 60's the formative evaluation was used to assess the instructional materials before they were issued in their final form (Reiser, 2001). The progress recorded by information technology starting within 1980 when the micro computers have effectively exploded had a huge impact on assessment practices (Reiser, 2001; Al-Smadi and Gütl, 2008). Other fields such as mathematics and chemistry have adopted the E-Assessment (Rottmann and Hudson, 1983; Myers, 1986; Al-Smadi and Gütl, 2008).

Starting within 1990, the World Wide Web appearance has changed definitively the ways how educational and assessment processes have been approached. Researchers have identified new resources and new opportunities for improvement the earlier E-Assessment programs as well as new programs have been developed. Specialized companies have launched on the market automatic programs for E-assessment with large applicability and in parallel, the higher education organizations all around the world have designed their own programs. As an example, Blackboard Inc. is one of these companies, having a huge impact on this domain. Today, Blackboard software is used by over 3700 educational institutions in more than 60 countries (Wikipedia, accessed August 2011).

Systems such as QUIZIT (Tinoco et al, 1997), WebCT (www.webCT.com, accessed August 2011), ASSYST (Jackson and Usher, 1997), and PILOT (Bridgeman et al, 2000) are also examples of web-based systems with ability of online testing and grading (Al-Smadi and Gütl, 2008). A most recent example is the system proposed by Lei which is a web-based assessment system that applies Bloom's Taxonomy to evaluate the outcomes of students and the instructional practices used by educators, in real time (Lei, 2006; Al-Smadi and Gütl, 2008). In 2007, Guetl is introducing a system called e-Examiner deemed to be a tool to support the assessment process by generating automatically test items for open-ended responses, marking students' short free texts answers and providing feedback (Guetl, 2007; Al-Smadi and Gütl, 2008). The history of E-assessment can also refer to the use of computers to automatically assess the students' programming assignments (Douce at el, 2005; Al-Smadi and Gütl, 2008).

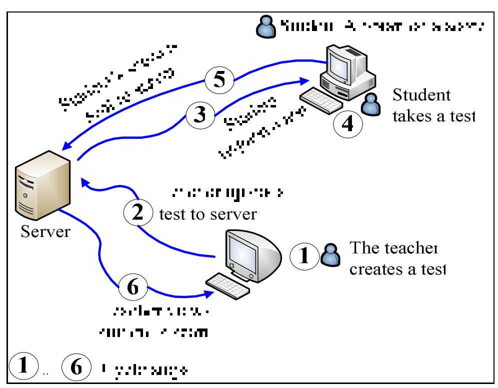

*Figure 1.* **Testing and assessment tools working common cycle based on Horton and Horton common cycle (Horton and Horton, 2003)**

### Testing and assessment tools for E-assessment

Tests and other assessments measure the effectiveness of learning. Students rely on tests to gauge their progress in a course. Teachers and course authors may use test scores to assign subsequent learning activities or just to measure effectiveness of E-learning (Horton and Horton, 2003). Testing and assessment tools for E-assessment are used mainly in computer environments but their future is wide opened being influenced by the progresses recorded in information and communication tools development. The tests used by teachers to assess the student's knowledge even is just one part of a course is still a very important one. Usually, the tests are attached to courses and vary in the way how they work.

According to Horton and Horton, the way how the tests work most follow a common cycle of developing, conducting and reporting tests (Horton and Horton, 2003). In figure 1 the author has represented the common cycle based on Horton and Horton ones. The process usually starts when the author uses the testing tool to create a test (step 1). The teacher defines the test by specifying questions and answers. After that, the teacher uploads the test to a server (step 2). From the server the student sends a request for a test (step 3). After request approved the student takes the test (step 4). The score obtained by the student is reported and sent to the server (step 5). The cycle is finalized in step 6 when the teacher views the score obtained by the student (Horton and Horton, 2003).

Some of the most used tools used are the following (www.i4learn.co.uk, accessed August 2011):

a. *Button Selection*: for Multiple choice - multiple response - matrix selection - true/false;
b. *Check-box/Radio-button Selection*: for checkbox array - multiple-multiple choice/response - correlation half matrix selection - multiple true/false;
c. *Move object (drag and drop)*: for diagram labeling, diagram building, cloze, extended matching item, classification, sequencing and sequences within classes;
d. *Hot spot*: for selection on graphics, identification of areas on photographs / diagrams / maps / forms etc.;
e. *Clickable graphic object*: graphic objects may be made clickable and scored in the same way as for multiple choice/response although we normally create this sort of interaction using our hotspot template which has enhanced functionality for scoring;
f. *Drop-down lists*: for extended / multiple matching item with optional common or multiple lists;
g. *Free text and numeric entry*: for automatically scoring user input and for creating forms to receive short answers for manual marking or information gathering;
h. *Draw line, arrow or curve*: for graphical applications including overlays on photographs and diagrams;
i. *Sliders on scale*: any number of sliders in any orientation. Can be linked to graphical output (e.g. dials and gauges);
j. *Multiple interaction templates*: for use where more than type of interaction is required concurrently to satisfy the requirements of a question;
k. *Bespoke simulations*: we can build scored simulations of real life and laboratory environments into the system as required and have experience in the development of virtual microscopes and virtual experiments where the user is scored not only on their end result but also on how they achieved it;
l. *Calculator and Hint buttons*: calculators and hints can be made available for all question types;
m. *Feedback*: feedback to the user may optionally be displayed either as an immediate response to a user action either at the end of the question.

Often the best results occur when is used a tool for testing and assessment especially designed to create and administer tests. Some of the testing and assessment tools are self-contained products, some are add-ons for other products, and some are Web-based services (Horton and Horton, 2003). Below, the author will present briefly some of the tools considered most popular today.

According to Horton and Horton, the best-known testing and assessment tool is *Perception* available from Questionmark Company. Perception is available in two versions, one for Windows which allows users to create, offer and administer assessments using a Windows application, a database, and a local area network and a second version for Web applications which includes the same computer-based applications as well as a server component that allows the users to create, edit, offer, and administer tests from anywhere using a Web browser (Horton and Horton, 2003).

Another option is represented by *CourseBuilder for Dreamweaver* from Macromedia Company. CourseBuilder is a free extension for Macromedia Dreamweaver. Once installed in Dreamweaver, just simply drag a question to the Web page and replace the placeholders with the unique content. Coursebuilder includes a number of questions types including drag-and-drop, single choice, multiple-choice, true-false, text-entry, and exploratory exercises. By setting an option, the user can track students' scores and send them directly to an AICC-compliant learning management system such us Lotus LearningSpace, or save the information in a database (Horton and Horton, 2003). *Quiz Rocket*, developed by LearningWare let the user to create five different question types and surveys and then upload them to a server as Flash files. The questions can be aggregate into sets using its Web-based administration utility. Also, has an option to receive e-mail notification and summary scores (Horton and Horton, 2003). *HostedTest*, from HostedTest.com, allows users to create and edit questions, combine them into tests, and administer students using a Web browser. Question types include multiple-choice, one-choice, short-answer, and long-answer (Horton and Horton, 2003).

Of course, the list with available resources can continue (i.e. *Test Generator* from Fain & Company, *TestLinc* from Mentergy, *Unit-Exam.Com* from Unit-Exam.Com, *Brainbench* from Brainbench, *ExamsOnline.com* from ExamsOnline.com, *Vue Testing Services* from VUE etc.) (Horton and Horton, 2003).

The range of options available on the market is very large and, probably, in the future will be even larger. The author has presented above only few milestones from E-assessment history and some of the most known systems in use to date. There are more companies and systems and is up to each organization which one will be employed for their needs.

**Conclusions**

Our life has been influenced by a revolution in the field of information technology and communication. As a result, peoples' mentality has changed significantly in the recent years. Consequently, educational and assessment processes have become affected and educationalists have also started redesigning educational systems itself (Prensky, 2001). Brown and Smith have captured in their conclusion to their researches the final aim of the students' assessment: "Nothing that we do to, or for, our students is more important than our assessment of their work and the feedback we give them on it. The results of our assessment influence our students for the rest of their lives and careers – fine if we get it right, but unthinkable if we get it wrong." (Race et al, 2005).

In this paper, the author tried to outline several important aspects related to E-assessment and to the tools in use to date for students' testing and assessment. Without considering the subject completed explored, future work will include an extended overview of the topic as the E-assessment is considered at present a viable solution to the challenges faced by higher education organizations.

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http://www.i4learn.co.uk/content.asp?sub=subsub&subsubid=30
http://www.questionmark.com
http://www.webCT.com

# Disambiguation of bright fringe notion through teaching Moiré patterns

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## Abstract

*Acquisition of scientific knowledge - as justified true belief - involves perception, learning, communication, association and reasoning. Learning physics - as well as scientific research - have as a first step a nuanced and clear understanding of the used concepts. The separation of similar observed situations that occurs for different reason is a challenge for both teacher and student. The paper aims disambiguation of different meanings of bright fringe notion. Appearance and observation of Moiré patterns are presented and explained. Different situation concerning appeared Moiré patterns are modeled using computer.*

**Keywords**: Learning model, Conceptual knowledge, Moiré pattern, Bright fringes

**Introduction**

Remembering, understanding and applying are, in a natural succession, the first three goals encompassed in a statement of educational objectives (Bloom, 1956; Anderson and Krathwohl, 2001). To accomplish these objectives, the student must be able to recall previous information, to comprehend the meaning of new problems, and to use concepts in a new situation. This includes the recognition of specific facts, procedural patterns, and concepts that serve in the development of intellectual abilities and skills (Anohina, 2005; Etkina and all, 2008).

For various reasons, this is not always easy. As Feynman noted, “Trying to understand the way nature works involves a most terrible test of human reasoning ability. It involves subtle trickery, beautiful tightropes of logic on which one has to walk in order not to make a mistake in predicting what will happen” (Feynman, 2005).

During the preparation of the Romanian team for the IPhO, we have found there are problems in understanding the exact meaning of the notion of bright fringe. In college education, optical fringes are introduced in connection with interference and diffraction patterns. This can not be an « a posteriori » knowledge because fringes patterns probably observed by student in their daily experiences are Moiré patterns – a topic not studied in college.

The purpose of the article is presenting a suitable model of the appearance of Moiré fringes. The apparent complication increases the chance of developing a learner model appropriate to gifted students that allows a complete understanding of the bright fringes nature. The shown model is supported by the possibilities provided by computer modeled graphics.

Also, we will briefly present some results obtained by the users of the proposed model. The original contribution of the article is the construction of a student model that permits indubitable distinction between different types of bright fringes whether observed in daily life or in specific laboratory experiences.

**Moiré patterns**

A Moiré pattern is a pattern created when overlaying two grids having slightly different mesh sizes, or when the grids are overlaid at a small angle (Amidor, 2007). An example is the overlap of two pieces of the same fabric of fine silk or even cotton or synthetic fibers. The similarity of the spacing of individual threads which is, however, not perfect spacing, creates characteristic patterns, "ripples", when the layers are seen together in transparency. Moiré pattern can be seen while driving a car when looking through two lines of snow fences slightly inclined in respect to each other. Moiré patterns are often byproducts of the digital imaging, as undesired artifact of images in television or computer graphics. As example, a notoriously undesired situation in a TV show is the presence of a guest wearing a tie with thin, horizontal stripes. Generally speaking, superposition of two optical patterns of lines creates a real and visible pattern of roughly parallel dark and light bands, the Moiré pattern, superimposed on the lines.

***Moiré patterns of parallel and inclined grids***

The simplest Moiré pattern can be observed when a transparency comprising a grid (periodically repeated opaque parallel narrow strips) overlaps onto a paper sheet comprising also a grid. The image appearing through the superposition of the grids outlines periodically repeating dark and bright parallel bands called Moiré pattern as in the Figure 1.

Bright areas of the superposed image correspond to the zones where the lines of the two grids overlap. The dark areas of the superposition image, forming black Moiré bands, correspond to the places where the dark strips of a grid overlaps with the white space between the strips of the other grid that is to the place where the two grids are interleaved. A heuristic model of apparition of Moiré pattern is schematically suggested in the figure 1 b: if fingers overlap, then light passes and fails to pass if fingers are entwined.

The period of a grid is the space between the axes of parallel bands .In the following, the base sheet will be named as "base" and the transparency will be named as "revealing layer". We denote the period of the 'base" as $b$ and the period of the "revealing layer" as $r$ , as in Figure 2.

In the appeared Moiré image, the distance $m$ between two consecutive bright or dark strips is called period of pattern. If b> r, then the number of base periods, $b$ , entering into a period of Moiré pattern, $m$ , is with one fewer than the number of revelator periods entering in $m$ . That is

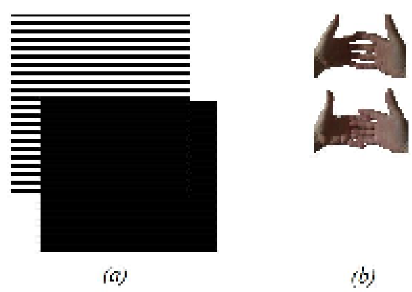



*Figure 1* **a) Moiré pattern. b) A heuristic model of apparition of dark and bright zones**

$$[1] \quad m/b = (m/r) - 1$$

so that

$$[2] \quad m = b \cdot r / (|b - r|)$$

When the difference between periods of the two grids is very small, then $m$ is much larger than the periods of the two grids.

Concluding, the superposition of two layers comprising grids of parallel strips forms an optical image with parallel Moiré bands with a magnified period. The closer the period of the two grid (i.e. the smaller the difference of the periods of grids $|b - r|$ ) the bigger the period of Moiré pattern. Moving one of the networks with a period, one obtains a shift of a fringe of Moiré bands pattern. During a mutual displacement of grids, Moiré image speed is much higher than the relative speed of the networks.

When the two superposed grids are inclined to each other, bright bands appear again in places where the two networks strips overlap. The image of the two mutually rotated grids and of bright Moiré bands (due to overlapping of strips) is shown in Figure 3.

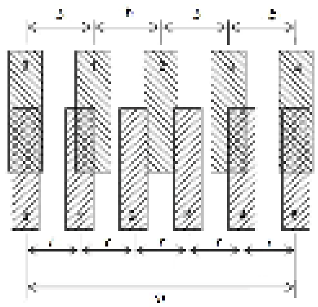


*Figure 2* **The connection between periods of the two networks and period of Moiré bands. In the presented situation, bright bands appear at the ends and a dark band in the center**

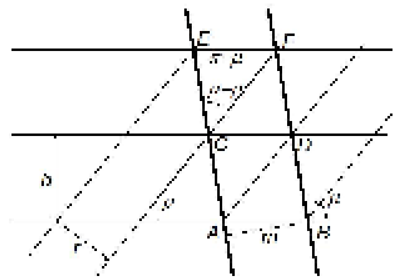


*Figure 3.* **Tilted overlapped grids (lines EF, CD, AB and respectively lines FC, AD), and bright Moiré bands (lines EA and FB)**

As in the figure 3, $CF \cdot \sin\rho = b$, $EF \cdot \sin\rho = r$, $EF \cdot \sin\mu = m$, $CE \cdot \sin\mu = b$, that means that the period of Moiré bands has the expression

[3] $m = r \cdot (\sin\mu/\sin\rho)$

In the expression $\rho$ is the angle of the grids and $\mu$ is the angle between base and Moiré bands.

Applying sinus theorem in $\Delta EFC$ obtains

[4] $$\frac{r}{\sin(\mu-\rho)\cdot\sin\rho} = \frac{b}{\sin\mu\cdot\sin\rho} = \frac{EC}{\sin\rho}$$

and consequently

[5] $$\mu = arctg\left(\frac{b\cdot\sin\rho}{b\cdot\cos\rho - r}\right)$$

If base and revelator are identical, $b = r$, then

[6] $\mu = (\pi + \rho)/2$

and

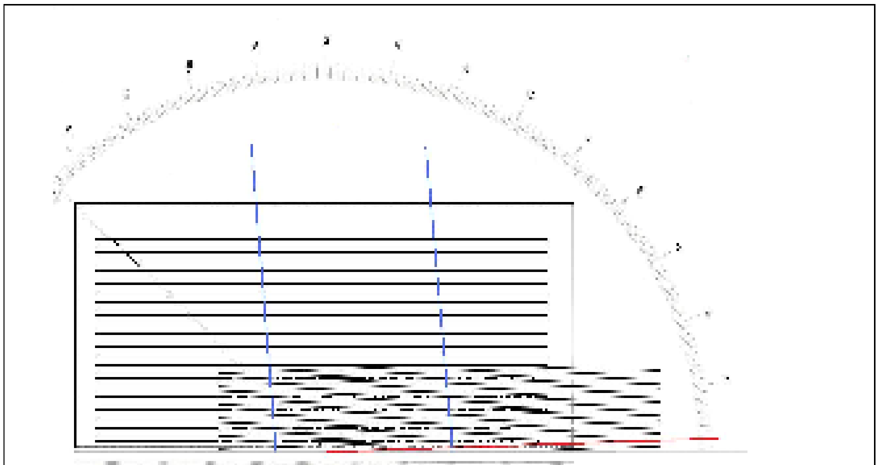
[7] $$m = \frac{r}{2\sin(\rho/2)}$$

If the angle between grids is $\rho < 60°$, then the period of appeared Moiré pattern $m$ is greater than grids common period $b$. Also, for $\rho < \pi$, results $\mu > \rho$ and consequently the speed of variation of Moiré band’s slope is greater then the speed of variation of revelator's strips slope.

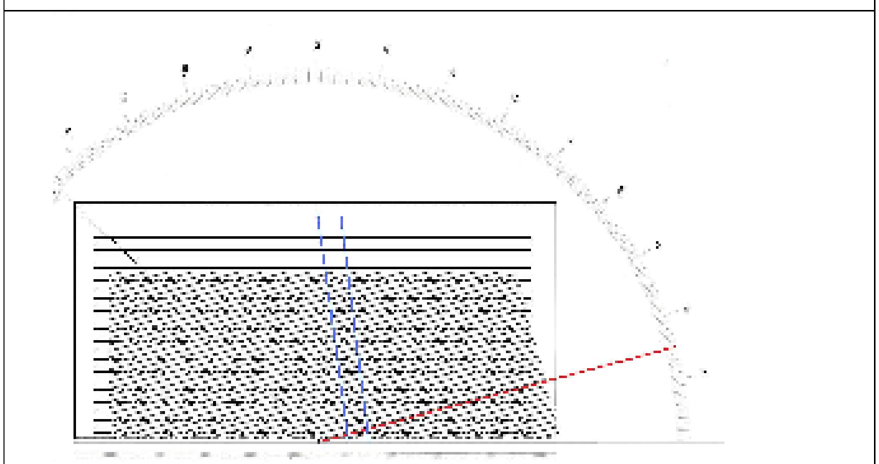
**About application**

The content presented in paper was made available to members of Romanian team for IPhO. Students were also instructed about the possibilities provided by computer aided graphics (Ryan and all, 2000). Assessing the results by considering how students approach the problems of optics, it can be concluded that new knowledge helps to clarify all issues relating to the appearance of bright fringes. The results presented in the images that follow are evidence of this.

Figure 4 shows two examples of Moiré pattern constructed by a member of the team for networks tilted with different angles.



(a)



(cb

*Figure 4.* Moiré patterns for tilted grids: a) $2°$ b) $15°$

Students have built many images such as those presented in Figure 4 and also animated images similar with those reported in the literature (http://upload.wikimedia.org/wikipedia/commons/b/bb/Moire02.gif). Using computer graphics capabilities, students has inclined grids each other and studied geometric characteristics of appearing images. Model checking has been done in different ways. In figure 5 is presented the determination of the common period of the grids by applying the relationship [7]. Value obtained by students is appropriate.

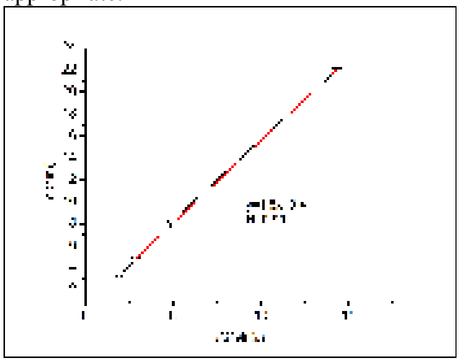


*Figure 5* **Determination of the common period of the grids as slope of line**
$$m = f\left(1/(2\sin(\rho/2)\right)$$

A subject in Physics Preolimpic Romania - Hungary Contest 2011 was based on knowledge of Moiré fringes; students were interested in scientific and practical applications of Moiré fringes as they were presented in literature (Stanley, 2007; Nishijima and Oster, 1964).

**Conclusions**

We assumed the task to provide stimulus that will motivate our students to search information about bright fringes using different ways and in different places as well as to facilitate the learning process.

New information is helpful for disambiguation of bright fringe notion improves the quality of learning model and consequently the student performance in physics even in international competition. Using computer-aided graphics capabilities, students were able to practically verify the acquired knowledge. Article content was used as a tool for understanding the facts of everyday life or significant scientific and technical applications.

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http://upload.wikimedia.org/wikipedia/commons/b/bb/Moire02.gif

# Positiveness of Web-based site for General and Inorganic Chemistry in Blended Learning

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**Abstract**

*The virtual learning environment (VLE) in the Technical College of Yambol has been created using Moodle software platform and has been applied. In order to improve the quality of student training, this year start a project "Introducing Interactive Teaching Methods in Inorganic Chemistry and Investigation the Effect on the Quality of Knowledge". The project has the aim: to create e-learning data base of General and Inorganic Chemistry; to apply new interactive devices during lecture activities; innovative possibilities for self preparation of students as well as new assessments of acquire knowledge of students.*

*The inspection of the opinion of students enrolled in e-learning supported courses, in the TC – Yambol, showed that 80% of students support the idea of blended learning supported by Web-based e-learning materials, they found e-learning more interesting. Approximately 80% of students gave positive answer about the e-quizzes for self preparation, followed by 70% for video materials and the same range of 70% for lecture presentations. We expect that through the creation of new approaches for teaching and self preparation will give novel possibilities to improve the quality of education furthered in the College.*

**Keywords:** e-learning environment, blended learning, multimedia courses, self preparation, quality of education

## 1. Introduction

The key to education is to find ways to have both ordinary information and natural memory work together (King, 2011).

The use of ICT for learning-teaching-assessment, have some potential benefits (Vlada M. at all 2009): *With regard to teachers*, facilitation of learning objectives; facilitation of teacher's activity; the modernization of the educational process is not seen by teachers as an important argument for using ICT in designing, teaching and assessment activities; *With regard to students*, classes in the computer laboratory are useful because they facilitate students' understanding; development of computer use skills; the new technologies attracting and motivating students for higher achievement; *With regard to the organization* of the education process, the benefits of ICT are in connection with active, participative learning, as well as with cooperative learning; the contribution of ICT to individual or personalized learning is surprisingly ranked last, although the majority of educational applications are more suitable for individual learning.

The use of ICT can support the learning process and enhance communication. It facilitates the transformation from the classical teacher-centered process characterized by teacher-to-student communication flow, separated working forms, guided tutorials and closed experiments to a flexible student-centered learning process in which the student constructs his or her knowledge using different sources (Brouwer, 2006).

In order to satisfy the new trends and requirements for the fast oriented, flexible and suitable education in the Technical College of Yambol are applying efforts to develop and organize educational system with the new approaches and technology.

**2. Development Web-based e-learning materials for General and Inorganic Chemistry**

Interactive Websites provide standards-based cross curricular web resources designed to enhance online learning opportunities. In order to improve the quality of student training, this year start the project "Introducing Interactive Teaching Methods in Inorganic Chemistry and Investigate the Effect on the Quality of Knowledge".

The project has the aim to create supported e-learning data base of General and Inorganic Chemistry; to apply new interactive devices during lecture activities; as well as new assessments of acquire knowledge of students; given possibilities of new ways of self preparation of students.

**2.1 Applying blended learning of General and Inorganic Chemistry in Technical College – Yambol**

As a result of the project work, the informational data for distant learning process on General and Inorganic Chemistry took place: virtual library with didactic materials has been created (http://tk.uni-sz.bg/edutk) – lectures; exercises; multimedia sources; tests; glossaries; links to other web-base on-line resources etc. Moodle represents VLE design, which is well known in the academic community. The architecture of Moodle is compatible with the hardware and software of Technical College–Yambol (figure 1).

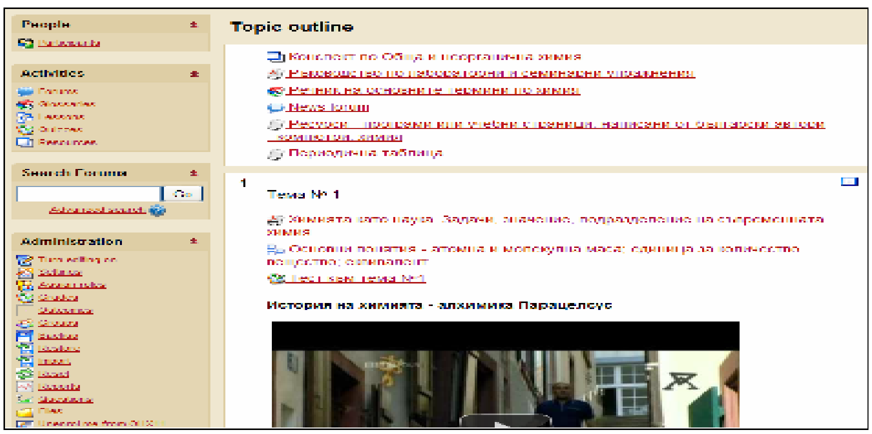


*Figure 1* **Interactive Website for learning General and Inorganic Chemistry**

It is not only the e-Learning that made things better, but many believe blended approach would produce even better results. The term blended learning is used to describe a learning situation that combines several delivery methods with the goal of providing the most efficient and effective instruction experience by such combination (Williams, 2003; Williams, Bland & Christie, 2008).

Blended learning tries to provide a common platform for traditional learning aspects with possible combinations from virtual learning technologies. In Technical College of Yambol study of General and Inorganic Chemistry is included as compulsory discipline. Each week students have lectures (3 academic hours), laboratory exercises (2 academic hours) and stechiometry resolving problems in seminary lessons (2 academic hours). With the new project work, the didactic materials has been created on the field of General and Inorganic Chemistry (http://tk.uni-sz.bg/edutk): virtual library with – lectures; exercises; multimedia sources; movies; presentations; tests; glossaries; links to other web-base on-line resources etc. Many Higher-Education institutions have adopted the use of virtual learning environments and incorporate e-learning into their traditional teaching mechanisms as part of a blended-learning approach (Charlesworth & Vician, 2003; O'Connor &McDonnell, 2005; McDonnell & O'Connor, 2005; Lovatt et al. 2007; Evans, 2008).

The web-based support of blended learning give opportunity students to be encouraged making their own research on relevant topic that is represented by the owner and after that published on the web-site of the discipline for future use or assessment by the other students. More teachers from the College start to work with the e-materials to perform their lectures and prefer on-line quizzes for the examining the students. In the course of General and Inorganic Chemistry to each new topic relative test have been created (figure 1).

In order to improve the offered blended learning and supported e-learning system, we carry out survey on the end of each year. The participants are students – one part of them attended full-time regular education; other - extramural form of education. A survey is conducted to identify students' opinion about learning support components in blended learning model as well as their problems in acquire knowledge's. The survey is conducted with closed and open end questions. A five-point scale is used, with categories rated from 1 (*absolutely disagree*) to 5 (*absolutely agree*).

**2.2 The positiveness of interactive lessons**

ICT applications supporting varying learning styles (Hamilton & O'Duffy 2009):

- *Visual* – learning by seeing. Modern ICT supports visual learning with high quality graphics, animations, simulations and visualizations. Abstract concepts are brought to life and effectively explained. Digital photography and video enhances learning and provide rich presentation. Teachers can present concepts and ideas using rich visual media, capturing the learner's attention. Interactive whiteboards bring this visualization alive for the whole classroom.
- *Auditory*- learning by hearing. Auditory learners learn most effectively through dialogue and listening. ICT based learning supports simultaneous, audio, visual and text-based learning. High quality sound and editing capability enables deeper learning and creative presentations.
- *Kinaesthetic*- learning by doing. ICT can truly come into its own for the kinaesthetic learner providing engaging activities to draw the student back into the learning process. Computer based activities have been proven to have significant positive impact on confidence levels, attendance rates and drop-out levels, particularly among this group of students. Kinaesthetic learners benefit from using devices that involve touch, like mice and joysticks, or a Tablet PC, which enables users to write or draw onto a computer using a pen. Advances in gaming technology and policies that support the use of this technology will enhance the student's numeracy, literacy, logic skills and self-confidence.

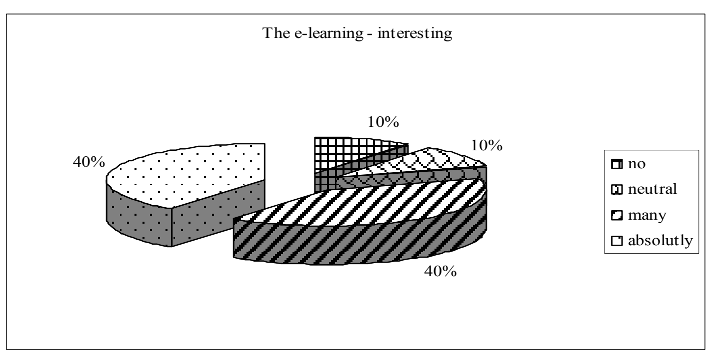

*Figure 2* **E- learning is more interesting than ordinary**

Blended learning combines multiple

delivery media that are designed to complement each other and promote learning behaviour (Singh, 2003). In order effectively to accommodate, support, and promote the knowledge production process, instructors need to select appropriate learning models and strategies (Dabbagh, 2007).

All that new potential that offer the Web-base learning make the E-learning more attractive and appealing to students. Approximately 80% of students are agreeing that E-learning is more attractive and interesting than ordinary one (see figure 2).

Approximately 50% from students are using e-materials to prepare themselves for exam and the rest 50% prefer the classic version of notebooks and textbooks. Nevertheless, 70% from the students give answer that the created Web-based data resources are useful for their self-preparation for exams (figure 3).

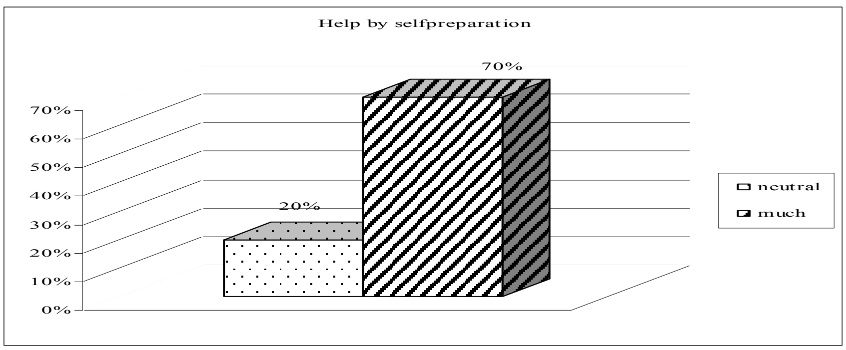


*Figure 3* **Is it Web-based data and on-line resources helps for preparation to exam?**

Particularly, the Multimedia tools have an important impact for the teaching – learning process could be successfully integrated as Multimedia activities in school work, home-work and in distance learning, respectively. The audio – video tools make an interactive lesson, the students haven't time to bore, and they wake up the interest in a nice manner. It isn't must insisted, the modern tools must be combination with the traditional tools for a dynamical lesson, not monotone. It is danger that the students "sleep" in the class (Bostan & Antohe, 2009).

The survey showed that students prefer on the first place solving e-quizzes, approximately 80%, for self preparation. Roughly 70% of students use presentations, which they knew from attending the lectures, and also in range of 70% prefer available video material on the topic of study (figure 4).

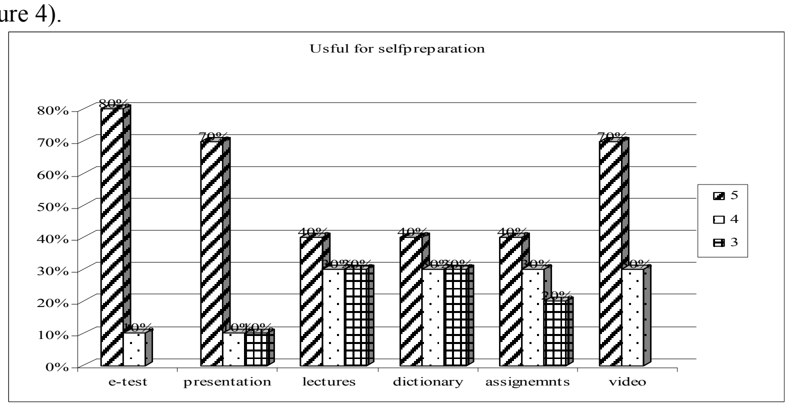


*Figure 4* **Students assessment of usefulness of web-based information for self preparation for the exams**

The results completely corresponded to the Information Processing Model explained by Mike King (King, 2011). Lessons that are multi-media integrated allowing the learner to experience numerous impacts on sensory memory. These multiple sensory impacts will theoretically provide larger amounts of images and sound transfers to occur as they are retained in for longer periods of time in short-term memory. The key is not only impacting short-term memory but also in the design of having the learner to construct schemas through higher order complex task. Making quizzes involve kinetic learning style and solving a complex task that engage working memory. Working memory is the active process of using the information from the lesson as it is moved from short-term memory to long-term retention (King, 2011).

It was found that the learners who accessed resources (mainly self-test quizzes and notes) performed better in the summative exam than those who did not and this was interpreted to show that students who were motivated to use all available resources did better in their examination (Lovatt et al., 2007) .

### 2.3 On-line exercise – results and consequences

The online self-study quizzes as online self-directed learning to construct knowledge and skills are often one of a series of measures implemented to support first year undergraduate chemistry students and to scaffold their learning (Lovatt et al., 2007). Several other authors have described a coordinated approach undertaken that involves online support, quizzes and/or assessment as a central feature of the blended learning that offer (O’Connor &McDonnell, 2005; Charlesworth & Vician, 2003).

Most of the institutional electronic learning platforms (*Blackboard, Moodle and Sakai*) offer online assessment tools. The on-line exercise results are very useful tool for the improvement of the furthered work of the lecturer. The Moodle provide simple statistic that offered to the teacher observation how the students cope with the different parts of study material (figure 5).

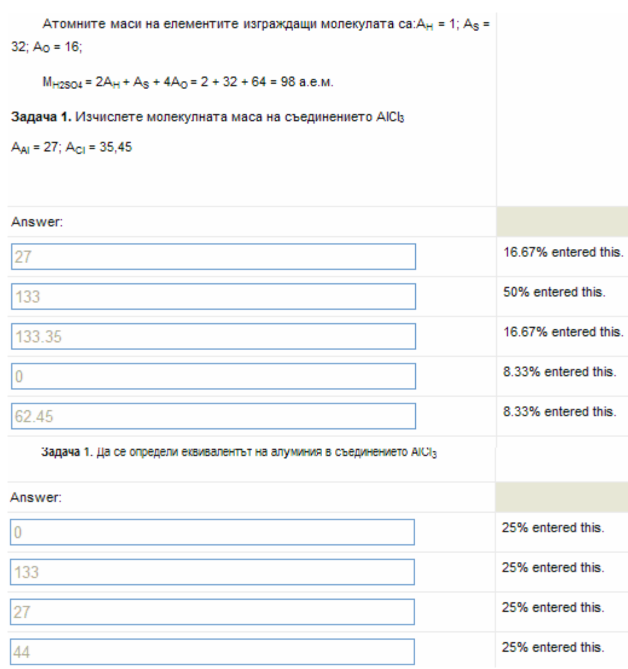


*Figure 5* **On-line exercises – results**

For example on the question “Calculate the molecular weight of the $AlCl_3$”, 66,67% of students gave the right answer but on the question “Calculate the Equivalent of $AlCl_3$”, there are only 25% correct answers. In this way very easy and fast the tutor knows where to emphasis, to have more exercises and to find additional approaches to deal with the learners. Williams et al. (2008) report using a blended learning approach to teaching inorganic chemistry. Study packs were prepared based on lecture notes and included learning activities. Paper copies were made available and they were also accessible on the Blackboard VLE, as was a formative online assessment quiz for each study pack. Evaluation showed that student achievement and satisfaction increased and the authors were of the opinion that this was attributable in some part to the variety and extra support provided by blended learning. It has been shown that students appreciate the flexibility and easy access to learning materials and that this approach results in an improvement in their confidence in relation to the subject. In addition, an improvement in exam success rates was observed when a VLE and several other changes in teaching methods were introduced in Dublin Institute of Technology, Ireland (McDonnell & O’Connor, 2005).

## 3 Conclusion

The positive effect of web-based technology used to support and assess learning in Chemistry at third level has been present in this paper. A very broad range of applications can be used, applying ICT tools, including learning activities such as simulations of laboratory equipment, 3-D animations for visualization at a molecular level, cross-disciplinary online collaboration, variety of online assessment methods and etc. The positive effect of blended learning is that students appreciated the flexibility that the system allowed and, as a result of the online tests and tutor communication tools, they reported having less anxiety about exams and improved confidence and perceived learning. The expecting results of the project work is that through implementation of new approaches for teaching and self preparation of students will give novel possibilities to improve the quality of education furthered in the College.

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# Blended Learning and Applying New Tools and Services of E-learning Support

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**Abstract**

*Due to combining the blended learning program with practical work on institutional e-learning projects, strengths and weaknesses of different online technologies and learning methods have been examined. There are differences between traditional e-learning system and E-Learning 2.0 training, which appear in the recent time, responsive to the needs of learners, technologically supported by Web 2.0 applications. Wherein the principles of "promoting individual creativity", together with the principle of "use of collective intelligence" are most often applied. As a further strategy we planed to enlarge the capacity of blended learning process by applying on-line activities and training methods supported by E-Learning 2.0 tools. Introducing also new subjects to out data-base and expansion of the data-base by creation the new compulsory disciplines courses. Creation of social network and community inside of College as well as applying wiki – activities will play more attention to furthered work.*

**Keywords:** E-Learning 1.0, E-Learning 2.0, blended learning, Web 2.0 applications, wiki – activities

## 1. Introduction

The latest evolution of the Internet, the so-called Web 2.0, has blurred the line between producers and consumers of content and has shifted attention from access to information toward access to other people. New kinds of online resources – such as social networking sites, blogs, wikis, and virtual communities – have allowed people with common interests to meet, share ideas, and collaborate in innovative ways. Indeed, the Web 2.0 is creating a new kind of participatory medium that is ideal for supporting multiple modes of teach (Brown & Adler, 2008).

## 2. Development of e-learning

### 2.1. Foundation of E-Learning 1.0 and applying blended learning

The blended learning model is established in Technical College of Yambol and supported by e-learning on-line materials that included different courses in Informatics, Programming languages, Information technology, Common and General Chemistry, Biochemistry, Microbiology, Ecology and etc.

The results show that the performance of e-learning system improving the effectiveness of the education, as well as improving the motivation among students and teachers (Pehlivanova et al., 2009).

### 2.2 Comparison between E-Learning 1.0 and E-Learning 2.0

The second phase of e-learning, based on Web 2.0 technology is called e-learning 2.0, the comparison between the main features of the two stages e-learning are shown in table 1 (Ivanova, 2008).

*Table 1* **Features eLearning 1.0 and eLearning 2.0**

| **eLearning 1.0** | **eLearning 2.0** |
|---|---|
| Training in Web environment - student consumed and transmits information | Training in Web platform - the student has written and co - create, share, combine, used in different contexts, distributed content and knowledge |
| Management systems training - require installation, administration and maintenance | Free hosted systems for eLearning 2.0, start pages, social networks, services and tools |
| The courses are designed for groups | The effect of "long tail" and the effect of "snowflakes" affect the definition of individually tailored training |
| Still much of the management of the training are not oriented to services | Freely available and easy to use services - to encourage participation, the effect of "social networking" - the value of Web 2.0 services increases when are used by more people |
| Taxonomy - the course is indexed by an expert, educational resource are created top-down, one way | Organization of links to resources through participation in networks (Folksonomy - sharing links) - categorization of learning resources, working cooperatively, bottom-up, multidirectional |
| Personal pages - static presentation of information | Social software - the effect of "using the power of the crowd" - to encourage participation |
| Ultra information on static pages | RSS, mash-up services enable the student organization dynamic accurate and specific teaching resources - to encourage individual expression of creativity |
| The software product is ready, used only in its final version | Software as a Service - forever in beta version, innovation enabled the learner, which can be a software developer |
| The components of a system are strongly defined and coordinated | The system allows the assembly of components, which can be implemented flexibly, personalized and adaptive learning |
| All rights reserved | Some rights reserved - students can combine and reuse resources from different sites |
| CD, web-based content | Web content is accessible through different devices and can be delivered through various methods, such as podcasting |
| Web-based applications, often with "thin" client desktop applications | Web-based applications with "rich" user interface |

Like many important concepts, Web 2.0 doesn't have a hard boundary, but rather, a gravitational core. The visualization of Web 2.0 is given on figure 1, as a set of principles and practices that tie together a veritable solar system of sites that demonstrate some or all of those principles, at a varying distance from that core (O'Reilly, 2005).

The term E-Learning 2.0 (Karrer, 2006; 2007) for CSCL (Computer-supported collaborative learning) systems came about during the emergence of Web 2.0 (Downes, 2005).

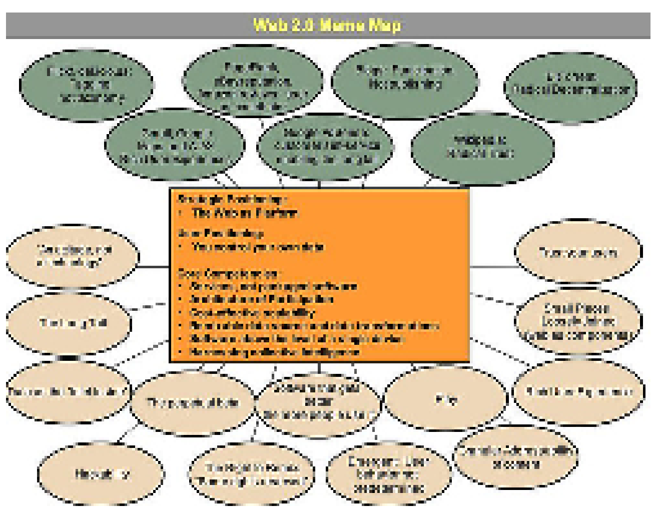


*Figure 1* **Visualization of Web 2.0 ( O'Reilly, 2005)**

From an E-Learning 2.0 perspective, conventional e-learning systems were based on instructional packets, which were delivered to students using assignments. Assignments were evaluated by the teacher. In contrast, the new e-learning places increased emphasis on social learning and use of social software such as blogs, wikis, podcasts and virtual worlds such as Second Life (Redecker, 2009). This phenomenon has also been referred to as Long Tail Learning (Karrer, 2008).

### 2.3 Main Moodle set of teaching-learning resources and activities components of E-Learning 2.0

Moodle has an important set of teaching-learning resources and activities. It is particularly useful to define groups and work in virtual spaces. According to some authors the most useful tools in this course have been (Donoso et al. 2010):

- Internal e-mail
- Generation of Web Pages
- Insertion of several kinds of documents and files
- Advanced file upload
- Online activities
- Questionnaires
- Generation of Wikis

*Wikis – Wiki* is unusual mechanisms of communication in that it allows the organization of contributions to be edited in addition to the content itself. Like many simple concepts, "open editing" has some profound and subtle effects on Wiki usage. Wiki is a piece of server software that allows users to freely create and edit Web page content using any Web browser. Wiki supports hyperlinks and has simple text syntax for creating new pages and crosslinks between internal pages on the fly (http://www.wiki.org/wiki.cgi?WhatIsWiki).

Wikis offer a powerful yet flexible collaborative communication tool for developing content-specific Web sites. Because wikis grow and evolve as a direct result of people adding material to the site, they can address a variety of pedagogical needs - student involvement, group activities, and so on. Since wikis reside on the Internet, students can access and participate from any location, provided they have Internet access. From an instructional technology perspective, wikis allow faculty and students to engage in collaborative activities that might not be possible in a classroom. Their flexibility will encourage broader adoption - by both students and faculty (fig. 2).

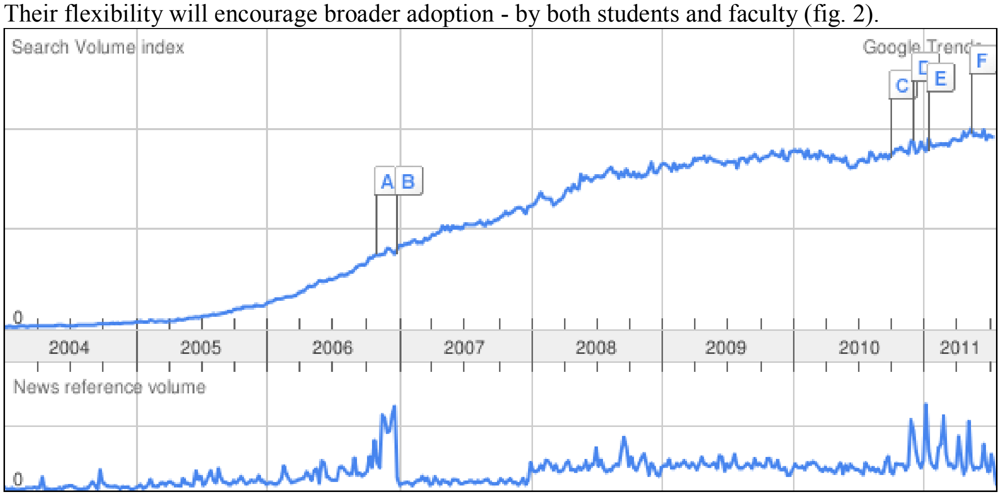


*Figure 2* **Trends of wiki technology from 2004 to 2009 provided by (www.google.com)**

There are creative wiki's practices by which students can include group lecture notes, group project management or brainstorming (Nedeva & Nedev, 2010).

Usually, lecture notes are a solitary activity, but one person can easily miss an important point during a lecture through daydreaming or trying to understand a prior point. Students may also have difficulty deciding what information is important and what is elaboration or example. **Creating a wiki for group lecture notes after a lecture** gives students a chance to combine all their notes. Those that missed information can get it from their peers. The group can also decide what information is critical and give it proper emphasis. Group lecture notes could be done with the entire class, if it is small enough, or with small working groups. Groups can also compare notes for further discussion and refinement.

The most straightforward use of a wiki is as a **tool for group collaboration for creating group projects.** A teacher assigning a group project can give students a place to work by creating a wiki with the group mode enabled. This will give each group their own space to record research, to develop outlines and to create the final product. The teacher may create a submission date on which to turn off editing capabilities for students so that he or she can grade the final projects. Afterwards, the teacher may enable visible groups so that everyone can see each other's work.

**Brainstorming is a non-judgmental group creative process** in which group members are encouraged to give voice to any ideas they personally consider relevant to the group exercise. In a face-to-face meeting, a brainstorming facilitator will usually stand in front of a big piece of paper and elicit ideas from the participants in the room. A teacher can create an online version of this process by setting up a wiki for the entire class or for smaller student groups and asking people to submit ideas around a brainstorming topic. People can add ideas as they occur and link to other pages for elaboration.

**A teacher might assign** his or her class the task of contributing to Wikipedia, Wikiversity, or to another wiki on the Web, on any class topic, perhaps by assigning students to groups (or making it a class project if the class is small enough and the topic broad enough) and challenging them to collaboratively create an article they would feel confident posting to a public-information space. Students will use the course wiki to create drafts of the article they will eventually publish to the community at the end of the semester.

Filters allow for the automatic transformation of entered text into different, often more complex forms. For example the titles of resources can automatically become hyperlinks that take you to the relevant resource, URLs pointing to mp3 files can become Flash controls embedded in the web page that let you pause and rewind the audio. The possibilities are endless and there are a number of standard filters included with Moodle and many more specialized filters available from the Moodle.org.

### 2.4 Systems for distributing E-Learning 2.0

E-Learning 2.0, by contrast to e-learning systems not based on CSCL (*Computer-supported collaborative learning*), assumes that knowledge (as meaning and understanding) is socially constructed. **Computer-supported collaborative learning** (CSCL) is a pedagogical approach wherein learning takes place via social interaction using a computer or through the Internet. This kind of learning is characterized by the sharing and construction of knowledge among participants using technology as their primary means of communication or as a common resource (Stahl et al., 2006). CSCL can be implemented in online and classroom learning environments and can take place synchronously or asynchronously. In E-Learning 2.0, learning takes place through conversations about content and grounded interaction about problems and actions. Advocates of social learning claim that one of the best ways to learn something is to teach it to others (Brown & Adler, 2008).

Such systems are, for example:

- *EctoLearning* (www.ectolearning.com) - **EctoLearning** is a social, collaborative, online learning environment that directly addresses the needs of the modern learning environment by making the new communication skills and competencies for content creation and sharing central to the classroom experience. **EctoLearning** is also a full Learning Management System (LMS) with attendance tracking, grade book, and a sophisticated assessment engine including the use of rubrics based evaluations;
- *Edu 2.0* (www.edu20.org) - This platform is an easy-to-use, free cloud-hosted LMS+, with nothing to download or install. It includes a comprehensive set of LMS features as well as Facebook-like news feeds and social networking. **Edu 2.0** differs from systems such as Moodle and Blackboard. There are several important differences. First of all, Edu 2.0 is web-hosted and free; you don't have to download any software or manage your own servers. Second, section "*Resource*" allows you to graphically browse thousands of community-contributed resources by topic; you can even upload your own resources. Third, Edu 2.0 unique personalized learning system allows students to study at their own pace and track their progress against a chosen curriculum. Finally, "*Community*" section allows teachers and students to network and collaborate with other members that share the same educational interests;
- eLearningCommunity 2.0 (www.elearningcommunity.com);
- LearnHub (http://learnhub.com/);
- LectureShare (www.lectureshare.com) and other.

## 3. Conclusion

There are differences between traditional e-learning system and E-Learning 2.0 training, responsive to the needs of learners, technologically supported by Web 2.0 applications. Wherein the principles of "promoting individual creativity", together with the principle of "use of collective intelligence" are most often applied. As Downs points out, "Web space has changed - from the environment in which information is transmitted and consumed into a platform where content is created, shared, mixed, used in different contexts, distributed" (Downes, 2005).

In order to satisfy the new trends and requirements for the fast oriented, flexible and suitable education our team apply efforts to develop and organize with the new approaches and technology the educational system. Creation of social network and community inside of College as well as applying wiki – activities will play more attention to furthered work.

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# Increasing the quality of e-learning by improving the testing system

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**Abstract**

*The basis for this article is the experience gained by the lecturers from Technical College-Yambol while using the virtual educational tool eDuTK. The test results of the students were analyzed in order to show the quality, efficacy and adaptability of the tests and to improve the efficiency of the marking systems for the tests taken by the students. The statistical Rasch Models were used in this article, together with articles from referenced authors, who have contributed to the development of the theory and improvement of the results in practice in this specific area. Results and conclusions are stated.*

**Keywords:** e-learning, test quality, Rasch models and Measurement, MOODLE.

## 1. Introduction

An important component of the e-learning systems turns out to be the methods for testing and marking the studied university material and knowledge gained. One of the possibilities to measure this is by evaluating the quality of the given test itself, based on test's efficiency in correctly evaluating the level of preparedness of the students which are taking it.

An important advantage of the testing system in use at Technical College – Yambol is the possibility for statistical evaluation of the test results, which allows not only to correctly grade the students' results, but also to assess the quality of the tested material. The virtual learning environment at Technical College – Yambol (eDuTK) is based on MOODLE (Modular Object Oriented Dynamic Learning Environment).

## 2. Material and Methods

The results of the statistical analysis of the test taken for the "Programming and computer skills – part I" college course were evaluated and are presented in this article.

The test results of 118 students, which all took the same test, were analysed. The goal of this analysis is to improve the quality, adequacy and efficacy of the test itself, so that the test precisely shows the level of preparedness of the students taking the course. The methods of analysis used are based on the test theory presented by different authors [1,4,5].

By using eDuTK, which is based on MOODLE, we can successfully apply the assessment tools that are part of this virtual environment. With these assessment tools we can evaluate the indicators for test quality in accordance to the one item parameter Rasch Model. The test, before being used for grading the students, is provided for self-testing as a means for self-appraisal of the level of preparedness. After analysis of the test results changes can be made to the test itself, when necessary, before using it for officially testing the students on the course material.

**3. Results and Discussion**

The application of the testing system in e-learning is a substantial and crucial part of the quality of education. In the 21st century there are three primary requirements for the testing methods: adaptability, quality and efficacy [6].

The adaptability of the test methods gives priority to the personality of the student and the necessity for the establishment of test systems and methods that are capable of discriminating between the individual requirements of the lecturers providing the exam/test. There is a new type of educational test with a growing level of difficulty that are being established, in which the level of test difficulty is based on the results of the previous exams/tests.

The quality of the test methods is connected to the advantages of the sustainability and high-speed work of the hardware and software means of education and to the quality of the separate tasks in the test; nonetheless it is dependent on the reliability and validity of the test results.

The efficacy of the methods predisposes lowering of the cost ratio for attaining the desirable results.

The different tasks/ questions in a test should respond to the following requirements [8]:

- short description;
- being technologically correct;
- right format;
- correctness of the content;
- logical content;
- uniformity of the grading of the right answers;
- specific place for marking the answers;
- correct placement of the task/ question on the test;
- uniformity of the test instructions;
- adequacy of the instructions based on the format and the content of the test.

The first part of the above mentioned requirements is dependent on the lecturer, who is preparing the test. After statistically analysing the test results it becomes obvious how well he managed to fulfil the first part of the requirements. The second part of the requirements is fulfilled using the virtual educational environment eDuTK, since their fulfilment is part of the system used for the test preparation.

Based on the requirements for test preparation, the lecturer should always posses multiple choices for question to choose from, which in the virtual educational environment eDuTK is maintained by the establishment of a data base of questions, in multiple categories, which are randomly assigned to a test thanks to a criteria provided by the lecturer himself. This way each student is given a different test version, but each test version is the same in its level of difficulty and content of material.

The well-known Rasch Measurement (RM) model, which is also implemented in our work, has many advantages that make it suitable for our research project [2]:

- this methods assures the validity of the results by using fit statistics, diagnostics information, and person-item map in order to compare the difficulty level of the tasks with the level of preparedness of the test-takers;

- it provides information about the reliability of the calculations by calculating the standard deviation, assessing the tasks parameters and the test-takers' parameters using an uniform scale;

- it provides the possibility to assess the levels of preparedness of the persons tested, independent of the level of difficulty of the task in questions' data base;

- evaluates the parameters for the level of the task difficulty, independent of the level of preparedness of the test takers;

- it presents the parameters for the tested and for the task to be fulfilled in the same axis on the scale, which helps for the better interpretation of the data using different criteria;
- it focuses on the specific tasks and the results accomplished, instead of the basic statics behind the test/questions/tasks itself and the test takers;
- it gives the opportunity to compare the results of the test takers, resulting from parallel versions of the test, which is by itself evaluating the knowledge gained on the same topic/subject.

Rasch Measurement (RM) is a probabilistic model that uses 'logit' as the measurement unit, transforms this original data and raw scores into ratio data hence a linear correlation. The most simple and strict explanation for RM – this is a method for transformation of the final test results and an interval scale for the natural logarithms. The most important part in this definition is the process of transformation of the test results into the scale of natural logarithms, after which the assessment is done [9].

Using the Item Analysis of eDuTK we obtain the following results:

- Q# - shows the question id number, icon type and a preview popup window link that has an edit link embedded in it;
- Question Text - the question
- Answer text - each answer
- Partial credit - how much credit was given by teacher for each answer
- R counts - how many selected the answer and the total attempts
- % R - the percentage that selected that answer
- Facility Index (% Correct) - the overall difficulty of the question
- Standard Deviation (SD) - measure of variation of selected answers
- DI & DC columns - Question effectiveness measures

Other statistical indicators of the Rasch Measurement, beside the above mentioned models were used for the test results analysis in Technical College - Yambol. The following statistical characteristics of the test were also calculated:

Index Easy (IE) and Index Difficulties (ID):

[1] $IE_{(i)} = \overline{X_{(i)}} / X_{\max};$

[2] $ID_{(i)} = 1 - \overline{X_{(i)}} / X_{\max};$

where $\overline{X}_{(i)}$ - is the mean of the grades for all tested persons, which have completed the i-th tesr;

$X_{\max}$ - the maximal grade for the i-th test.

The calculated $ID_{(i)}$ values are provided in the graph (Figure 1.).

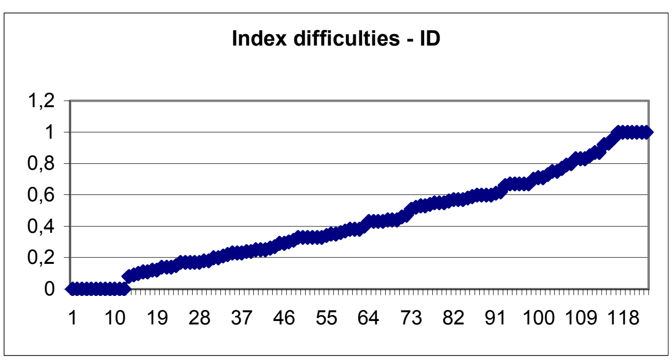


*Figure 1.* **Index Difficulties of the tests results**

One can conclude, by taking into account the analysis of the results, that questions of different difficulty level are not evenly distributed in the test. Besides there are a few questions with the highest level of difficulty present and also a few with the lowest difficulty level that need to be excluded from the test questions' data base.

The standard deviation (dispersion) is equal to Yk (i)/Xmax(i), where Yk(i) is the number of points earned by the κ-th test taker of the i-th test, and Xmax is the maximum number of points that could be gathered for the i-th test. The index characterizes the distribution of the points, which have been gathered for a particular test version. If all of the tested students reply in the same manner, the distribution of the answers, characteristic for this parameter, will be equal to zero. If that is the case this question is not suitable to be used and needs to be replaced.

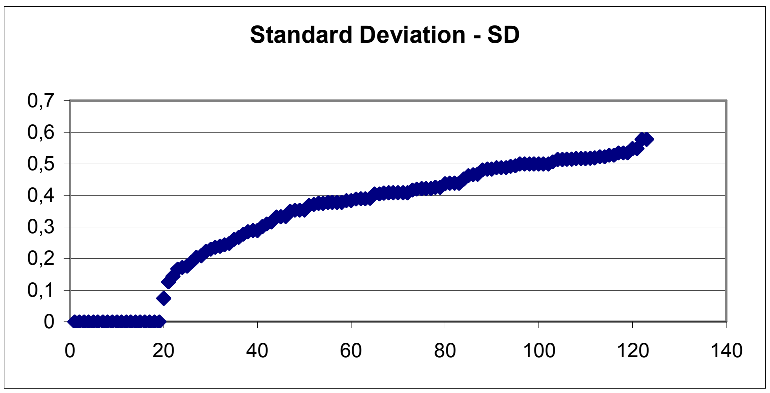


*Figure 2.* **Standard Deviation of the tests results**

From the graph it can be seen that of the questions in this particular test have a SD bigger than 0.3, which in accordance to test theory is a good indicator for these questions (Figure 2.). The question, whose SD is smaller, need to be removed from the data base.

The correlation (differentiation) KD coefficient is the coefficient of correlation of the answers given by the test takers, and the results of the test as a whole. This calculation is done using the following formula:

[3] $KD(i) = \sum(x \cdot y) / (N \cdot \sigma x \cdot \sigma y)$,

where x – standard deviation of the points received by the students for a specific question;
y – standard deviation of the points received by the students for the test as a whole;
N – total number of answered for the test;
σx – standard deviation of the set of points gathered by the student for the specific test;
σy – standard deviation of the set of points gathered for the specific test as a whole.

This coefficient gives a value between -1 and +1 inclusive, and is a tool to distribute the students taking the specific test into two groups – the ones that did well, and the ones that did poor. The plus values correspond to the tasks that separate the well-doing students from the poorly-doing ones; the negative values correspond to a question, to which the poorly-prepared students responded better that the well-prepared students. Such a result shows that the test cannot separate the well-prepared from the poorly-prepared ones, and thus this calculation is not adequate as an assessment tool for the level of preparedness.

**4. Conclusion**

From analysis that we conducted on the test done for the “Programming and computer skills – part I” course we can make the following conclusions:

1. The mandatory test features are without a doubt considered and acknowledged during the test preparation;
2. At first the test is provided to the students as a self-assessment tool in order to analyze the test’s quality and the level of difficulty of the questions in it;
3. The possibility for a multiple versions of a single test is provided thanks to the database containing a large pool of possible questions;
4. Multiple choice answers are preferred, and not questions with a single-correct answer, with eDuTK we have the choice of 7 different types of questions (in the matter of answering them);
5. The questions, in the database of questions, are divided in different categories based on a specific topic on one hand, and on the other hand they are sub-divided into at least two levels of difficulty. While choosing test questions during the test preparation, the lecturer randomly selects questions from each sub-category with a different level of difficulty.

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# A method of determining the static web pages that unbalance the complexity of the web application

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**Abstract**
*In this paper the complexity of the static web pages will be used to define the notion of* $\varepsilon$ *-balanced web application. Using this notion a method to determine the static web pages that unbalance the web application from the point of view of its complexity will be described.*

**Key words**: Web Page, Web Application, HTML, Complexity, HTree, RHTree

**1. Introduction**
In the second section the method of calculating the complexity of a static web page will be presented.

With the aid of this notion we will introduce in the third section, the relative and absolute complexity of a web application depending on the static web pages that it contains. In the fourth section a method to determine the static web pages that unbalance the web application from the point of view of its complexity will be presented. The method used for static web pages, created using HTML can be expanded to other components that can be part of a web application, using calculus techniques of a complexity specific to the language used to create them.

The introduction of the unbalancing notion has led to the expansion of the use of complex static web pages (other applications of this notion will be presented in [1], [3], [4] and [5]).

**2. Complexity of the static web pages**
To define the complexity of a static web page the notions [1] and [2] will be used.
HTML code of a web page can be shaped in an arborescent structure called for short HTree. The process of building this tree is the following:
-The root is associated with the tag `<BODY>`
-The vertices of the others are built sequentially searching the HTML code, associating a node to each tag.
The process of building the tree ends with the tag `<\BODY>`. Details about the process of building this tree can be found in [1], [2] or [4].

The HTree associated with an HTML code can be simplified using two rules:
*Rule 1.*
If i and j are two adjacent nodes in the HTree, satisfying the following conditions:
IntDegree(i) = OutDegree(i) = IntDegree(j) = OutDegree(j) then i and j can be merged into a single node.

*Rule 2.*
If i and j are two nodes with the same parent in the HTree, satisfying the conditions:

OutDegree(i)= OutDegree(j)= 0, then i and j can be merged into a single node.

In rule 1 and 2, OutDegree(i) is the number of vertices (i, j) and IntDegree(i) is the number of vertices (j, i) from the HTree.

By merging the nodes in the HTree, a new tree is obtained that is called reduced HTree, in a nutshell RHTree.
Having constructed the two trees, the complexity of the HTML code, recorded as p, can be measured using the following notions: relative nesting complexity (notated with RC(p)) and absolute nesting complexity (notated with AC(p)).
The defining method is as following:

$$RC(p) = N_{RHTree} / N_{HTree}$$

$$AC(p) = RC(p) \cdot N_{HTree} = N_{RHTree}$$

Where: $N_{HTree}$ represents the number of nodes of the HTree and $N_{RHTree}$ the number of nodes of the RHTree.

*Observation 1.*
For any static web page p, we have $0 < RC(p) \leq 1$.

*Observation 2.*
For any static web page p, we have RC(p) = 1, if the HTree is the same as the RHTree.

*Exemple 1.*
We consider the static web page p with the source code:

```
<HTML>
<HEAD>
<TITLE>WORDCUP2010, win gr. A,B,C
</TITLE>
</HEAD>
1: <BODY>
2: <B>Winner Group A,B,C</B>
3: <BR>
4: <TABLE>
5:  <TR> Uruguay
  </TR>
6:  <TR> Argentina
  </TR>
7:  <TR> USA
  </TR>
</TABLE>
</BODY>
</HTML>
```

The HTree of the static web page p is the following tree:

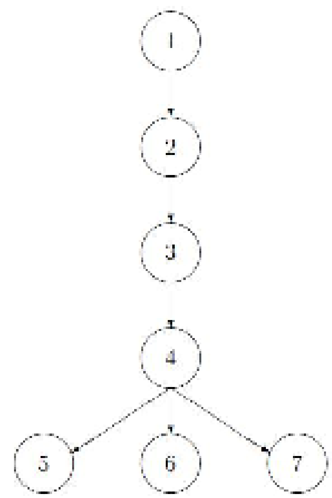

*Figure 1*

In order to build the RHTree we have to merge the nodes 2 and 3, using rule 1 and nodes 5, 6, 7, using rule 2.
Thus:

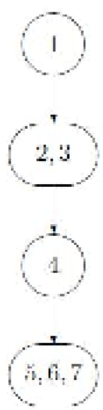

*Figure 2*

We obtain:
RC(p) = 0.428
AP(p) = 3.

**3. The complexity of a web application from the point of view of the static web pages it contains**

In the following section a web page application made up from the web static pages $p_1, p_2, ..., p_n$ will be considered.
The relative mean of the complexity of the structure of the web application we defined as:

$$RM = \frac{1}{n}\sum_{i=1}^{n} RC(p_i)$$

The absolute mean of the complexity of the structure of the web application we defined as:

$$AM = \frac{1}{n}\sum_{i=1}^{n} AC(p_i)$$

Applications of this notion will be presented in [1], [2], [4] and [5].

**4. A method to determine the static web pages that unbalance the web application from the point of view of its complexity**

In this section the relative arithmetic mean RM will be used to determine the complexity of a web application.

*Definition 4.1*
Let $\varepsilon > 0$. A web application formed with the static web pages $p_1, p_2, \ldots, p_n$ is named $\varepsilon$ -balanced if:
$| RM\text{-}RC(pi) | \leq \varepsilon$, for every $i \in \{1, 2, ..., n\}$.

*Definition 4.2*
Let $\varepsilon > 0$ and a web application WA formed with the static web pages $p_1, p_2, \ldots, p_n$. We say that a static web page pi, $i \in \{1, 2, ..., n\}$ unbalances WA if:
$| RM\text{-}RC(pi) | > \varepsilon$.

From the point of view of the construction of a web application and the type of its usage, it is recommended that this is $\varepsilon$ -balanced for an $\varepsilon < 1$ chosen as little as possible.
In the case of the existence of static web pages that unbalance the web application these have to be modified in order to obtain the balance of the application. The adjustment of these static web pages implies:

I) The transfer of data from one page to another static web page;
II) The removal of data from a static web page;
III) Add new data to a static web page.

The identification of static web pages that unbalance a static web application implies:
-The calculation of the relative complexity of each static web page;
-The calculation of relative mean of the complexity of a web application;
-The identification of static web pages that produce $\varepsilon$-unbalancing of the web application, using a value as little as possible for $\varepsilon$.

An algorithm that $\varepsilon$ -balances a static web application is presented below:
**Input dates:**
$\varepsilon$
n (numbers of static web pages)
$RC_i$, i=1,2,…,n (relative nesting complexity for pages $p_1, p_2, ..., p_n$).

RM ← $(RC_1+RC_2+...+RC_n)/n$
*repeat*
i ← 0
Search the $i \in \{1,2,...,n\}$, with $| RM\text{-}RC(p_i) | > \varepsilon$ and $| RM\text{-}RC(p_i) |$ is the largest.
If $i \neq 0$ and and is used for adjustment I) or II), then recalculate the static web pages to change RC and recalculate RM
If $i \neq 0$ and and is used for adjustment III), then recalculate the static web pages to change RC, add new components to the vector RC and recalculate RM
until i=0 (i.e. static web application is $\varepsilon$ -balanced)

## 5. Conclusions and future work
The use of notions from the below sections to build the web applications leads to the possibility of identifying the static web pages that can be redesigned in the view of their uniformity from the point of view of their complexity. In the future, I am planning to build a complex integrated application, that will use the programs mentioned above and a check on more web applications to realize a analysis of its usefulness.

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# Adobe Flash Professional - an important contribution to increasing the quality and performance of the Romanian education

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**Abstract**

*The most important objective of the Romanian education system is increasing the quality and the performance. This can be achieved if change the thinking and the action manner of all those involved in education. So, the young people which living in a computerized society should have theoretical knowledge and practical and IT skills in the field in which they want to practice in the future. Therefore, in the class are increasingly using the interactive lessons made on the computer. This paper presents the causes which led to use the computer and the Adobe Flash Professional programme in the lessons, how I achieved and implemented this application in the lesson and the implications of its implementation in the classroom.*

**Keywords**: Adobe Flash Professional, Computer, Education, Quality

## 1. Introduction

The mirage of the electricity has sparked the people's imagination since antiquity. In the time of Thales from Miletus was noticed that some substances if are rubbed having other materials can attract light bodies. Understanding these phenomena was much expected but when electricity was understood the progress was astonishing. Today almost nothing can be done without "electricity." That's why I chose this topic to achieve an application using Adobe Flash Professional, to allow the secondary school students to learn theoretical concepts and evaluate their own knowledge in an interactive, attractive and creative manner. Also, the application making links with other disciplines.

The paper is structured in five parts. The second part presents some of the things that must change, in the Romanian education system, for to increase the students' interest in the physics study. The third part presents the application which was made in Adobe Flash Professional. The fourth part presents a didactical experiment designed to verify if the application made, used in the class, was beneficially for the educational process. The last part is for conclusions.

## 2. Ways to increase students' interest in physics studies

Lately, the interest in studying physics has dropped considerably. It appears that most students learn physics because this is needed at the future job. This means that, the students consider the physics is a necessity not necessarily a passion. Very few students consider that physics can provide: security of the life and development of the society. Therefore, to increase the students' interest in the study should:

- to change the style of teaching and of evaluation
- to address the inter-and trans-disciplinary subjects for to know the physics applications in all fields

- to focus on understanding the phenomena, not on memorizing the formulas or on solving the difficult problems
- to actively involve the students in the lessons
- to focus in the learning on developing the creative ideas and on finding the connections between the facts, the phenomena and the everyday life
- to emphasize the positive developments of the students
- to focus on the culture, on the tradition, on the achievements of our predecessors
- to give enough time working and thinking for to give all students the opportunity to find an answer
- to take into account the learning style of each student
- to encourage both the collaboration and the individual learning
- to use textbooks and didactical materials attractive, tailored the level of the understanding of the students
- to use a scientific language correctly but also accessible for the students
- to focus not only on intellectual development but on the development of practical skills and on the education for life, on all what generates interest and knowledge
- to use the IT technology and the adequately didactical methods for to make physics more attractive and easier to understand

Training and learning with IT technology provides the students: interactivity, multimedia environment, open environment, synchronous and asynchronous communication environment, independence of the equipment, the distance and the time.

**3. How to use it technology and the modern teaching methods in the class?**

To study "Electrifying of the objects" have created an application with Adobe Flash Professional. It contains a movie clip that has four times: home page, theoretical concepts, measurement and a part of mathematics and history about the pyramids. The fourth time was later added to create a disciplinary lesson.

Go to one of these moments is by means of four buttons. The buttons is determined by the code written in Action Script.

Home page includes the project title, author, and a mouse button that allows you to view data on OVER Thales of Miletus, the first person who asked questions about the nature of the universe and gave answers that did not take into account the gods and demons.

The second moment also contains a movie clip with several Key Frames. The first frame presents some basic theoretical concepts about the atom, molecule, electric charge, electrical load quantification principle and the principle of conservation of electric charge. To do it use a Scroll Pane and an animated movie clip. It is also conducted an interactive environment where students are and what an electroscope that was first built in 1705 by Hauskebee. It consists of two threads of straw hanging side by side at the bottom of a metal bar. Today straw wires were replaced with gold leaf. At the other end of the rod is fixed to a sphere. The lower end of the rod is locked in a glass container to prevent air currents foils. For making were used more buttons and movie clips. Achieving this framework did not require writing instruction. The next frame shows the image and identifying school electroscope its component parts. Were used for making buttons but there was no need for writing code instructions.

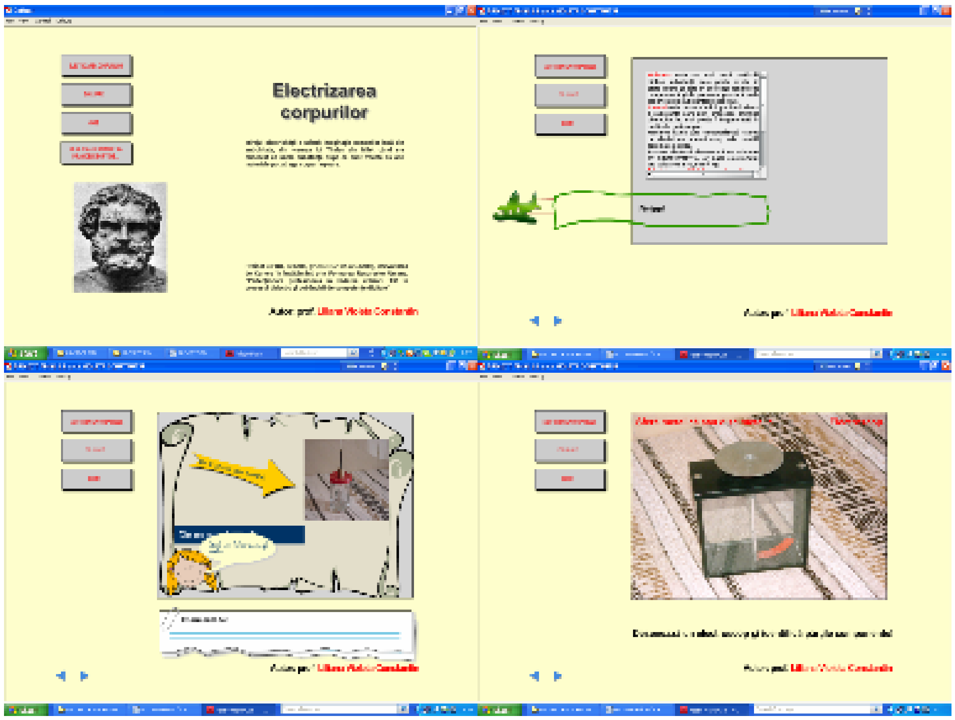


*Figure 19* – **Teaching and learning sequence made in Flash**

Also movies are inserted which allow students to adjust to laboratory equipment and how to do real experiments. The student can construct a sensitive instrument used to detect electric charge using a glass, plastic lid, a nail, a cork, thin pieces of foil and wire. Movies must be inserted in format .flv. To achieve this conversion I used AVS Video Converter 6. The next frame contains several sequences that allow us to understand how static friction is achieved by contact and influence. This simulation includes two navigation buttons that work because of instructions written in Action Script. Another framework is one in which students learn that the same sign electric charges repel and attract the opposite sign. As the name of positive charge (+) and negative charge (-) was given by Benjamin Franklin are presented via a button some biographical data about it. Not require writing instruction. This highlights the fact that Adobe Flash Professional is easy to use. Moving from one frame to another is also done through buttons.

The third moment for self-evaluation (assessment) also contains a movie clip with several Key Frames. The first frame-work have more combo boxes which give the possibility of the student to chose from a list the correct answer. A button allows the student to verify the answer thru activation of a movie clips which warn him if he is wrong or correct. The application allows the student to find the correct answer. The next frame-work is similar but the student has more options from where to chose the correct answer, and the animated movie clips are different in according with the answer.

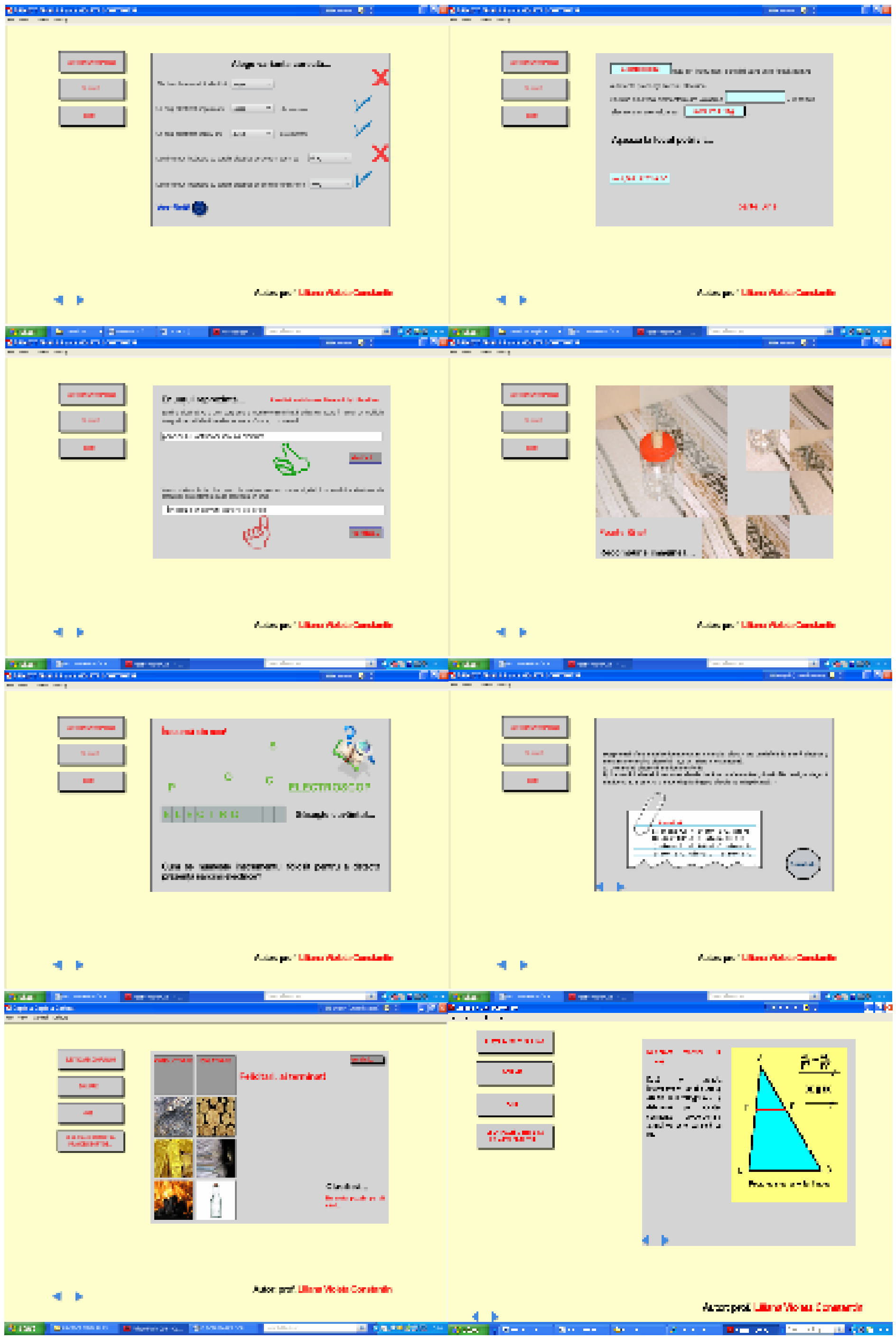

*Figure 2* - **Self-evaluating sequence made in Flash.**

Another type a self evaluation is an incomplete text that student must complete. The student drags the word in the empty space of the text. If he found the correct answer he is congratulated if not he is advice to try again. The message is a dynamic text. For realizing this frame-work it has been created movie clips which represent words and movie clips that represent their positions in text. It has been used the drag&drop technique. This is relation among abstracts objects. In the next frame-work it has been used Input text and buttons. The student writes the answer and verify after that if the answer is correct or not. A movie clip show him if the answer is good or wrong. The student must be informed about the characters used in the application because the Flash different the lower case from upper case. The next frame-work is organized in the form of puzzle game. The student watch the pieces, the result must be the image of the lab equipment (the experimental device used for obtaining the image of an object thru lens). The technique used here is drag&drop. The same drag&drop technique has been used here. The students get a question. The answer is obtained forming a word with the letters they have. The verification is realized using button of the mouse OVER which show the answer thru messages. It follow a set of problems which the student introduces the answer and after that he makes the verification. The last problem does not require writing the response. The student solves the problem in the notebook and verifies the answer after that. The student can remember the basic notions passing with the mouse on the colours words. Classification of substances into two categories: conductors and insulators can be done easily using drag & drop technique throughout.

The next moment have a movie clip that contains six frames. The first frame shows both the reciprocal theorem of Thales and Thales's theorem and how it calculated the height of the pyramid of Cheops. This provides a link with ancient history and studied math pyramid. The second frame shows the definition of the pyramid in geometry and structure. The third frame shows a video that shows the structure of the pyramid. The fourth frame allows viewing the formulas for calculating area and volume of the pyramid. The fifth section presents the framework and the last frame pyramid is a film made in Egypt, the pyramid of Cheops. The transition from one frame to another was achieved by means of buttons. This section has raised no particular problems in terms of code instructions. To be more attractive and can attach music project.

As to develop their theoretical knowledge, students must achieve a puzzle. As to develop their practical skills, students must build an electroscope.

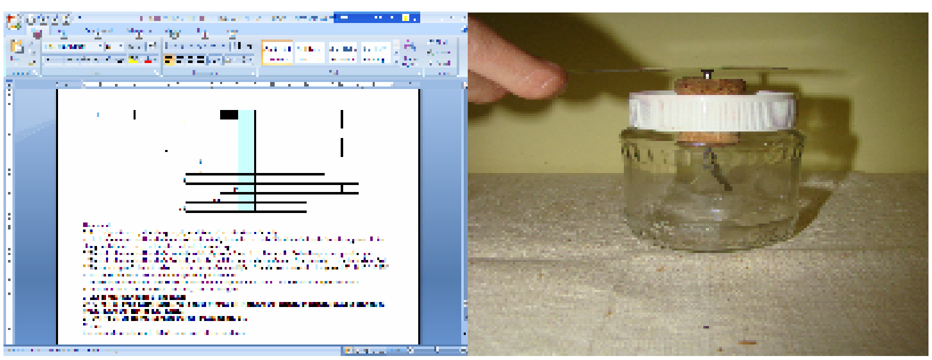

*Figure 3* – **A puzzle and an electroscope made by students**

### 4. What results we obtained using the IT technology and the modern teaching methods in the class?

To supplement information on the use of modern IT technology and physics lessons, we organized a psychological and pedagogical experiment with high school classes of students. Experimental hypotheses:

• Lack of interest for studying physics in high school students due to teacher resistance to change traditional teaching and assessment methods

• Negative aspects of students' attitudes towards the use of modern methods in the classroom is due to ignorance or incomplete knowledge of these methods or the IT basics

• The meaning of the pupils' attitude is also based on the degree and how their participation in achieving the lesson, showing students' attitudes tend to be friendly, positive energy when they are involved in the lesson and to be negative when the lesson is directed by teacher

• Student opinion is influenced by the methods used

For making the experiment were selected two groups of students of class VIII. The experimental group was a high school classroom, and the control group (control) was the same class level and the same profile, chosen on the basis of similarities as large as the experimental level and composition class. The experiment took place in three stages:

• The initial stage or pre-experimental: Selected the two groups (classes) and experimental control on the level and composition homogeneity criterion. There were marks received by students before the experimental period.

• Experimental Stage: The experimental group changed methods of teaching evaluation. The control group was not made any changes in teaching methods is evaluation.

• The final stage or post-experimental: There were marks received by students of two classes after the experiment.

Experimental results:

*Table 2* **Experiment results**

| Mark obtained | Number of students who scored that (class of witness) Pre-experiment | Number of students who scored that (class of witness) Post-experiment | Number of students who scored that (class of experiment) Pre-experiment | Number of students who scored that (class of experiment) Post-experiment |
|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 |
| 2 | 0 | 0 | 0 | 0 |
| 3 | 1 | 1 | 1 | 0 |
| 4 | 2 | 2 | 3 | 1 |
| 5 | 3 | 4 | 3 | 1 |
| 6 | 6 | 6 | 5 | 2 |
| 7 | 5 | 5 | 5 | 3 |
| 8 | 5 | 3 | 4 | 5 |
| 9 | 1 | 2 | 2 | 6 |
| 10 | 2 | 2 | 2 | 7 |
| | Class average 6,64 | Class average 6,56 | Class average 6,60 | Class average 8,24 |

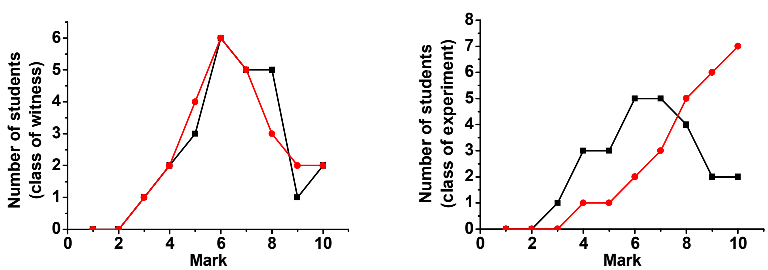


*Figure 4* – **Experiment results**

It is noted that the class of Gauss experiment turns into a curve in the form of J. The failure cannot be eliminated, however. Some students continue to maintain the status of weak students. However, a rather high percentage of students located in the median strip Gauss curve tend to evolve, by enrolling in the good category. It diminishes the phenomenon and mediocrity can say that 80% of students a class are able to learn the material in the programs, if properties are provided with homework time and a distinguished teaching assistance. Working Group on the practical implementation of an electroscope improved relations between students. It also has improved relationships between students and teacher. He noticed a change in students' cognitive and emotional behaviour, emotional behaviour they are having with mobilizing role, more dynamic, and learning techniques have changed. "We went through the grind of learning, memory, sound understanding, creativity, problem-solving. Students have been sensitized and are willing to actively participate at study of the nature processes or phenomena. They appreciate the value of practical knowledge and skills acquired. Cognitive networks are restored, new ideas are incorporated into a cognitive structure are rearranged knowledge already acquired. New ideas are created on the land of the cognitive models existing. You can make connections with other disciplines. Student behaviour is consistent and predictable. The student results from control class are recorded in Gauss curve, but are weaker than those of students from class experiment. The main causes of poor results of students may be anatomical and physiological causes, social causes, or causes of pedagogical family. Must be reorganized:

- the educational process,
- the curriculum design,
- the teacher-student relations and the efforts submitted in formal, non-formal and informal pedagogical and curricular activity counselling,
- the culture of family and of local communities,
- the nature and the extent of their involvement in school life

At the root of poor results are associated with several causes, not all of which have the same weight and persistence.

**Conclusions**

It can be said that the application made with Adobe Flash Professional is beneficially both for the students and for the educational process.

In conclusion, for to achieve a quality education must be educated the creative spirit of students and of teachers must change the teachers thinking and working style of classroom, crystallized in the centuries of traditional education, too little concerned about the student's personality. This ensures the transition from a "school for all" to a "school for everyone" from the focus on content to focusing on student needs and interests.

**Acknowledgements**

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# The interactive conceptual maps – a step towards performance

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## Abstract

*With the aid of the conceptual maps, the new ideas are tied by the existing cognitive models. Thus the student organizes the personal experience, establishes relationships between different concepts, identify areas of their application. Using the interactive concept maps on take into account each student's learning style: auditory, visual or practical, so the performance can be achieved more often. This paper presents how to make and to use at the class of the interactive conceptual maps. It also highlights the advantages and the disadvantages of using graphical organizers in physics lessons.*

**Keywords**: Computer, Conceptual map, Education, Interactivity

## 1. Introduction

A conceptual map has been described for the first time by the psycho pedagogue Joseph Novak in 1977. "The conceptual maps reflect the cognitive networks and the emotional networks formatted during the lifetime regarding special notions" Horst Siebert. With the help of these the cognitive networks are rebound, new ideas are included the cognitive structure, the old knowledge are rearranged. New ideas are growing in field of pre-existent cognitive models. The conceptual maps are presented as a visual technique of the informational structure that describes the way which the concept of a domain interact. A solid learning of the new concepts depends on the existing concepts in the mind of the student and the relations that will be establish among them. To be more clear, the new notion take meaning when pre-existent notions are present that make possible the absorption of the new one. The conceptual maps give a major importance in connecting and interconnecting the concepts (very essential in learning process). The essence of knowledge depends by the structure of knowledge. With other words doesn't matter how much but how strong (the relations among notions and knowledge that are establish-the solidity of the cognitive network). Performance depends on how the student organizes their experience, ideas, integrated structures and their applicability. Using concept maps active and conscious student learns. J. Novak and D. Gowin described the logic of the conceptual map by defining three key terms: concept, statement and learning. The affirmations make the connections among concepts; they must be straight, complete in the same time and accessible; the act of learning implies that conduct of active construction of the new affirmations. Formally, the conceptual map is graphic with junctions and arrows. The knots are representing the concepts (the important terms) from the respective learning unit. The arrows are representing the relation between two concepts; the indication from the line of the arrow show the way how two concepts relates (the bound between). The combination between two conceptual knots including the indication from the arrow constitutes a logical affirmation. The basic element of the conceptual map and the smallest unit use for judge the validity of the relation expressed between two notions. So, conceptual maps are important aspects of the conceptual system posed by students in a certain area.

So modern education develops a methodology based on action, on the interactive methods that require mechanisms of thought, of intelligence, of imagination and of creativity. Therefore, conceptual maps should be interactive. The purpose of this paper is to present how to make and use in the class the conceptual interactive maps and analyze advantages and disadvantages of using graphic organizers in physics lessons.

The paper is structured in four parts. In the second part entitled "Study of mechanical oscillations with the aid of the interactive conceptual map" shows how to achieve a conceptual interactive map and the softwares used. In the third part were presents the test applied to students, the scores obtained by them and some conclusions which can be drawn from the analysis and interpretation of results. The last part is for conclusions and highlights the advantages and disadvantages of using interactive conceptual maps in education.

## 2. Study of mechanical oscillations with the aid of the interactive conceptual map

Oscillations are an important part of the physics behind many practical applications so I chose this topic for achieving the interactive conceptual map.

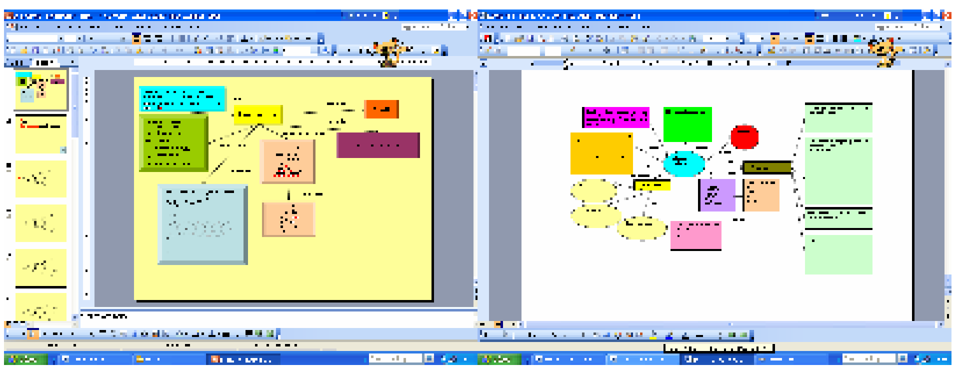

*Figure 1* **The interactive conceptual map and the incomplete conceptual map**

Interactive conceptual map is achieved in Power Point. Interactivity is provided by the action buttons. They allow switching to other applications or components of the conceptual map.

Study of oscillations can be achieved using Lab View. The scope of using Lab View in the study of the mechanical oscillations is to graphic model the composition of parallel and perpendicular harmonic oscillations. This subject is difficult to understand through the analytical representation. Students can see in the real time the changes at the amplitudes of the oscillation resulting when was changed the amplitudes, the initial phases or the frequencies of the oscillations components.

In case of compose the parallel oscillations to obtain graphical representation of oscillations components were used the following equations:

[1] $y_1 = A_1 * \sin(2 * \pi * F_1 + f_{01})$

[2] $y_2 = A_2 * \sin(2 * \pi * F_2 + f_{02})$

The initial phases introduced in degrees must be converted to radians.

[3] $\varphi(rad) = \varphi(grd) * \pi / 180^0$

The equation of the resulting oscillation allowed the graphically representation.

[4]

$$y_r = (\frac{A_1 + A_2}{2}) * \sin(\pi * (F_1 + F_2) * t + \frac{f_{01} + f_{02}}{2}) * \cos(\pi * (F_1 - F_2) * t + \frac{f_{01} - f_{02}}{2}) + (\frac{A_1 - A_2}{2}) * \sin(\pi * (F_1 - F_2) * t + \frac{f_{01} - f_{02}}{2}) * \cos(\pi * (F_1 + F_2) * t + \frac{f_{01} + f_{02}}{2})$$

If case of the beatings the amplitude of the resulting oscillation is calculated using the relationship:

[5] $$A_r = 2 * A_1 * abs(\cos(\pi * t * (F_1 - F_2) + \frac{f_{02} - f_{01}}{2})$$

where they took into account that $A_1 = A_2$.

The resultant frequency is calculated using the formula: $F_r = F_1 + F_2$ and the resultant initial phase: $f_{0r} = \frac{f_{01} + f_{02}}{2}$, so that the elongation of the resultant oscillation equation is:

[6] $$y_r = A_r * \sin(2 * \pi * F_r * t + f_{0r})$$

In the case in which was composed the perpendicular oscillations allow easy introduction of the amplitude values, of the frequency and of the initial phase (no change in radians) and obtaining the direct sinusoidal form for each oscillation component. Lissajous figures are obtained for different frequency oscillations. They represent the trajectory of the material point that the form of curves consisting of several branches. In the case in which the oscillation frequency components form a rational report, the trajectory is stable and closed.

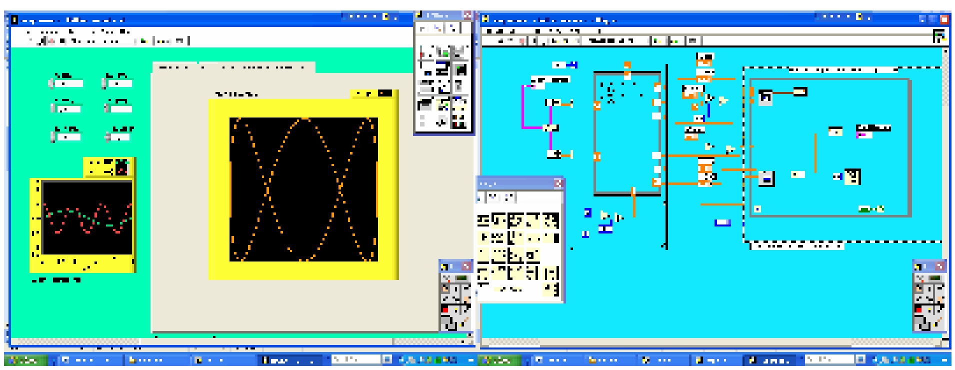

*Figure 2* **The panel and the diagram in case of compose the perpendicular oscillations**

The computer allows the realization of experiments therefore practically impossible due to: lack of teaching materials, the inadequate equipping of the school laboratories or the exposure to the danger of the students and of the teachers. While performing real experiments is extremely useful because as the Chinese saying goes, "a picture replaces 1000 words", their preparation and implementation consume the time and the didactical materials.

At the study of the gravitational pendulum, students have at their dispositions one pendulum at which can change the length. For different lengths of the gravitational pendulum can calculate the oscillation period (the students count the number of oscillations made in a period of the time). Also, they can make graph from the period of the gravitational pendulum depending on the length of suspension wire. They learn to work in Excel to make graphs and to calculate the measurement errors.

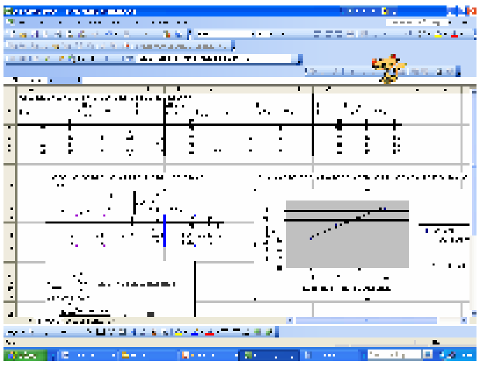

*Figure 3* **The study of the gravitational pendulum**

The elastic pendulum brings back its students in Lab View programming environment. Entering the elasticity constant k value, the mass of the object m, the amplitude of the oscillation, the initial phase Φ and the damping factor b, students can see the elongation of the elastic pendulum. Also students can see what happens in the transition from the damped motion or the aperiodic movement at the critical damping.

*Figure 4* **The panel and the diagram for study the elastic pendulum**

It is already proven that the Foucault pendulum reconfirms the Earth's rotation through crushing measured at the poles and bulging measured at the equator. The experience with the public was first made in 1851 under the dome of the Pantheon in Paris using an object with the mass m = 28 kg suspended from a wire with length L = 70m. Attachment of the upper end of the wire allowed swinging the pendulum in any direction. The period of the Foucault pendulum was T = 17s. At ground level, directly below point of the suspension and around him, was built a metal circle with radius R = 3m in which was put sand. A metal peak of the object suspended scratches the sand at each oscillation. For small oscillations the movement of the object was made in the horizontal plane of the place. It was found that in an hour the pendulum changed the oscillation plane by an angle α = 110. A full circle was made in 32 hours. At an oscillation, the plan has moved with 3mm, measured on the circumference of the sand circle. Students may find that in the early of the nineteenth century, a Romanian scientist conducted an experiment with the Foucault pendulum in Bucharest under the dome Atheneum. The experiment was the capital attraction for several months. George Potra wrote about this demonstration in "History of Bucharest".

Using the application which was put available, the students can see the Foucault's experiment, can learn more about this and view the trajectory of the pendulum. Students can calculate the rotation period of the horizontal plan anywhere in the world using the formula: $T_z$ = 24h/sinφ where φ is the latitude.

*Table 1* **φ(grd) and Tz(h)**

| φ(grd) | $T_z$(h) |
|---|---|
| 10 | 138,21 |
| 20 | 70,17 |
| 30 | 48 |
| 40 | 37,34 |
| 50 | 31,33 |
| 60 | 27,71 |
| 70 | 25,54 |
| 80 | 24,37 |
| 90 | 24 |

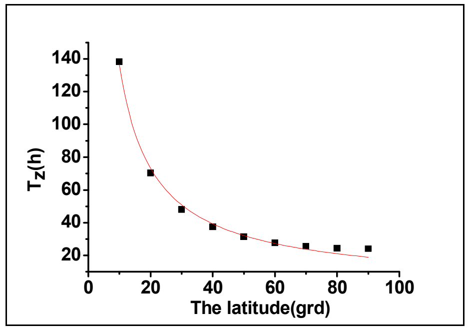


*Figure 5* **$T_z$=f(φ)**

The informatics system (application) MathCAD is a product of Mathsoft, specializing in mathematical problem solving, either numerically or symbolically. It was first introduced in 1986 on MS-DOS. MathCAD was conceived and originally written by Allen Razdow. Using the simulation carried out in MathCAD students can determine the wire length of the pendulum. The pendulum makes 25 complete rotations in 50s. T = 2s therefore in Romania to the latitude φ = 450, the wire length of the pendulum used in the MathCAD application should be l = 0.9225 m.

[7] $$T = 2\pi\sqrt{\frac{l}{g}}(1+\frac{\varphi^2}{16})$$

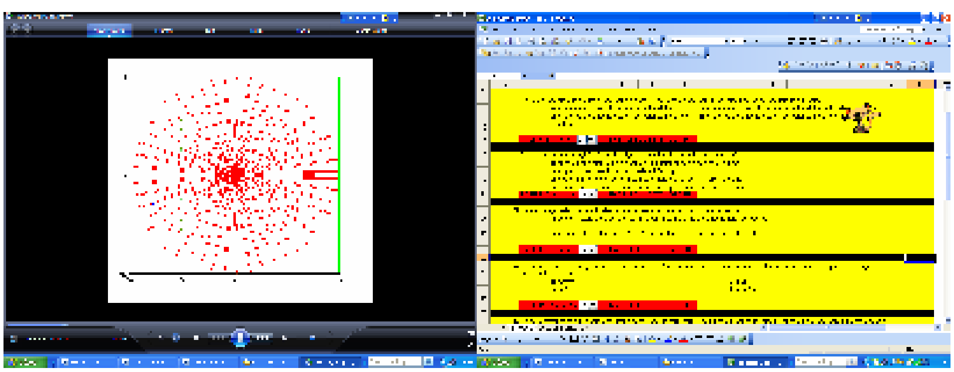

*Figure 6* **The MathCAD application and the test made in Excel**

The way in achieving the conceptual maps could dictate by teacher or chosen by student. So the teacher can impose what concepts to be used and to indicate the bound between concepts. The student task will be that to complete the empty spaces from the map structure. The student can choose alone the concepts and to establish the relations between them. The cognitive demands by the free chose are bigger then by dictation one.

For self-evaluation of the students' knowledge, they had completed an incomplete conceptual map. The incomplete conceptual map focuses on dialogue, on negotiation processes. Thus, the student was involved in decisions on the educational process. He can add new branches at the conceptual map. Lesson becomes a dynamic process, which conforms to the needs, the desires and the possibilities of the students. So, is encouraged the students participation at the build of the lesson, is stimulated the creativity and the intrinsic motivation for learning. Also, they had at disposition a crossword puzzle, a worksheet and a test made in Excel.

### 3. The efficiency of using interactive conceptual map in the lesson

The students solved a test with objective, semi objective and subjective items for see which was the efficiency of using this interactive conceptual map in the lesson.

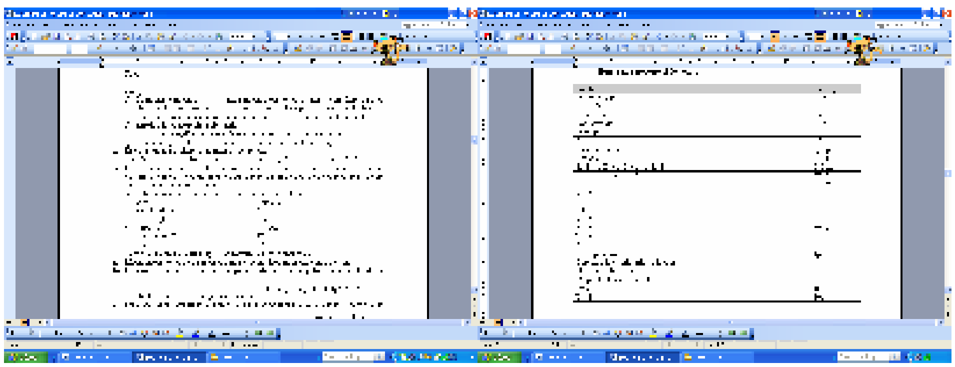

*Figure 7* **The test**

The test was accompanied by a scale for correction and scoring. It was found that only one student scored was below 5 and 3 students was scored 10. Percentage of promotion is 96% (24 of 25 students tested was promoted), the average grade is: 7.52.

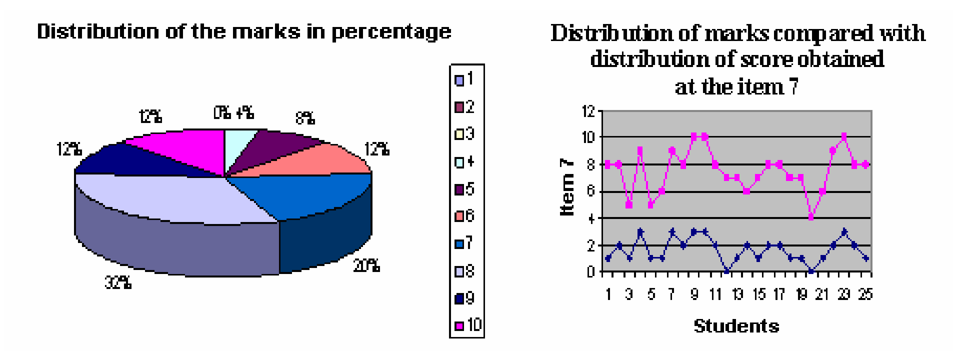


*Figure 8* **Distribution of the marks in percentage**

By the analysis of scores obtained by students on items found that the distribution of scores from the subject 7 which involved solving a complex problem is closest to the distribution of marks. This shows that if the item is more complex and requires higher level skills, the marks obtained enable a better classification of the students. The items which require lower level skills not enable a classification of the students. Also, at item 8 where the focus is on the correct scientific ideas, on the fluency and on the clarity of expression and on the originality and creativity, most students have very good score. In the essays made by students was put great emphasis on applications of the oscillations in everyday life. They were referring to the applications from the interactive conceptual map used and to other new applications that were studied by their own effort. Also, they showed that the physics can assure the daily livelihood of people, the life's security and develops the cognitive and psychomotor skills. From the test applied at students was observed that using the interactive conceptual maps, can achieved the performance in many more cases.

## 4. Conclusions

It was found that conceptual interactive maps allow: organizing the knowledge in the mind of students, creating the links between the concepts and between different applications, development of theoretical and practical knowledge, facilitating understanding of materials, evaluating of the performance , stimulating of critique and of creative thinking, motivating the learning process, promoting the positive attitudes, adapting to the level of understanding and to learning style of each student, working individually and in groups, encouraging students to ask as many questions for to limit constraints and factors that cause frustration, stimulating the communication by organizing discussions and debates, activating of the students by requiring them to work with concepts, objects for their reconsideration and issuance of new ideas, cultivating cognitive independence, spontaneity and autonomy of learning, fostering the spirit of constructive criticism, argumentation and the ability to search for alternatives , promoting access to knowledge by stimulating of reflection, by their attitude for learning, mobilizing of the psychomotor functions for study with the computer, overcoming objectives of curriculum subjects. Yet, the conceptual maps have some disadvantages. The disadvantages of the conceptual maps are: the allocation of time, a high level of standardization, rigor and order that student must follow.

So, is observed that using the modern methods for teaching, learning and evaluating, the physics becomes more attractive and easier to understand. Students are eager to study and to become responsible persons able to integrate into the society! Therefore, I consider that the use of graphic organizers in the lesson is beneficial to the educational process!

## Acknowledgements

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# Collaborative E-Learning Model

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**Abstract**

*In this paper we will present a model for an e-learning system. We propose a collaborative system because in our days collaboration became a very important tool and not just a theory. Our approach is oriented towards the interaction between teachers and students. We intend to focus our research on providing a system that encourages the collaboration between students and teachers in order to provide better study environment.*

*The article will present our approach, the design of an e-learning model and how such a system will work.*

**Keywords**: E-learning, Collaboration, Design

## 1. Introduction

In our days there are a lot of possibilities to study. Unfortunately, few of them provide opportunity to brake time and distance barriers. Not every student has the possibility to follow a school on a strict program basis. This is why we consider e-learning a great opportunity to allow every person to follow any school he wants.

Most e-learning systems are provided by universities, but their courses are not 100% Internet based. Even more, there are a lot of courses on the internet, but one could never know if the one he chooses is the best for him and his needs.

Thus, we propose an e-learning model that will satisfy the majority of those who are interested in studying from distance, using appropriate e-learning systems.

Our system will gather and provide e-courses from prestigious universities. Famous teachers and researchers will guaranty the validity and accuracy of the information provided by the course; thereby, people interested in our system will have more faith and trust in the virtual school.

Thus, the system will fully integrate a collaborative process model between teachers, students, universities, and economical environment in order to deliver a solution that will provide answer to any stakeholder's specific needs.

## 2. E-learning, Collaboration, E-collaboration

Derek Stockley defines e-learning as the delivery of a learning, training or education program by electronic means. E-learning involves the use of a computer or electronic device (e.g. a mobile phone) in some way to provide training, educational, or learning material.

The speedy century we live in demands new e-learning systems as people seem to be more than busy. Time is insufficient but the need to learn more, to develop knowledge is a key factor to success.

The impact of e-learning platforms is largely due to media technologies used to achieve them. The benefits of their use are represented by consumption reduction, the possibility of adapting programs which are customized to accommodate with rapid change and new knowledge in various fields, expanded opportunities for interdisciplinary education and, not least, significant reduction of educational costs (Ţolea Enikö Elisabeta, Costin Aurelian Răzvan, 2010).

E-learning requires a computer and a network to enable transfer of skills and knowledge. E-learning refers to all forms of electronically supported learning and teaching systems, which have a procedural character and aim to the construction of knowledge. E-Learning systems reference to individual experience, practice and knowledge of the learner. Information and communication systems, whether networked or not, serve as specific media to implement the learning process (Tavangarian D. et al, 2008).

Michael Schrage said in his book “Shared minds” that “…collaboration is the process of shared creation”. This is the most concrete explication of its meaning.

Collaboration uses the C-Three (cooperation, coordination, and communication) as a set of tools to achieve its goal but it should not be confused with these terms. As you will see later in this article, the proposed system uses specific tools of the 3C's to implement a fully collaborative procedure, permanently encouraging creativity and shared procedures.

In our perception, collaborative project e-learning systems have to include the following:

a) tools for the 3C’s (Communication, Coordination, Cooperation);
b) a precise work flow management;
c) and document management functionalities.

Communication refers to the way people interact, how they share ideas and understand each other. Therefore, the e-learning system should provide all the existing tools to enable users' communication:

a) Face to Face communication;
b) Video Conferencing tools;
c) Audio Conferencing tools;
d) Telephone;
e) Net Radio;
f) Chat/ Instant Messaging;
g) E-mail.

The main issue about communication is that even if someone is listening and interfering they may not be collaborating because everyone has he‘s own ideas and way of understanding things. Thus, we have to provide specific coordination procedures in a way in which we still encourage creativity and, in the same time, we implement standard communication rules to discourage disputes.

Coordination is all about balance and symmetry. Coordination is a framework used to ensure coordination between central office and field units. It is used to achieve efficiency. (Leo Denise, 2005)

Cooperation is very important in a group, in organizations and even between humans. If we refer specifically to an organization where a collaborative system is integrated, cooperation is the key of success as it can be seen in Figure 1.

In today’s business world there is a saying: “time is money”. E-collaboration has another perspective on this issue. IT specialists came with a solution to reduce costs inner an organization. This solution is the groupware, which is a compilation of breaking space borders, going behind time limits and nevertheless saving money (Costin Aurelian Răzvan, Ţolea Enikö Elisabeta, 2010).

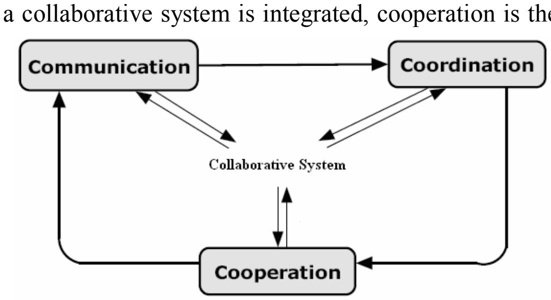


*Figure 1.* **3C vs Collaboration model**
(Hugo Fuks and Alberto Raposo, 2008)

### 3. Proposed model's structure

Nowadays, there is a new multidisciplinary field called Computer Supported Cooperative Work (CSCW) which studies the opportunity and the way systems that support collaborative working should be implied.

CSCW is a design-oriented academic field bringing together social psychologists, sociologists, and computer scientists, among others [wikipeadia].

Our project aims to create a collaborative e-learning model in which those who want to learn shall have the opportunity to do it. The main idea of our project is trust. We want the users to trust our courses and teachers.

Collaborative learning is a situation in which two or more people learn or attempt to learn something together (Dillenbourg P., 1999). E-collaborative e-learning is the situation in which this process takes place in a network. “Collaborative learning” is an umbrella term for a variety of educational approaches involving joint intellectual effort by students, or students and teachers together (Barbara Leigh Smith and Jean T. MacGregor).

First of all we want to create an agreement with prestigious universities, in order to have the support for our courses. Once established this agreement, and created the collaboration with teachers we can go further with our project.

After that, we create a website which will provide the needed information for students. Students will have the possibility to choose what course they want to take, and also choose whom courses will follow. Below you can see the workflow of this project and its architecture.

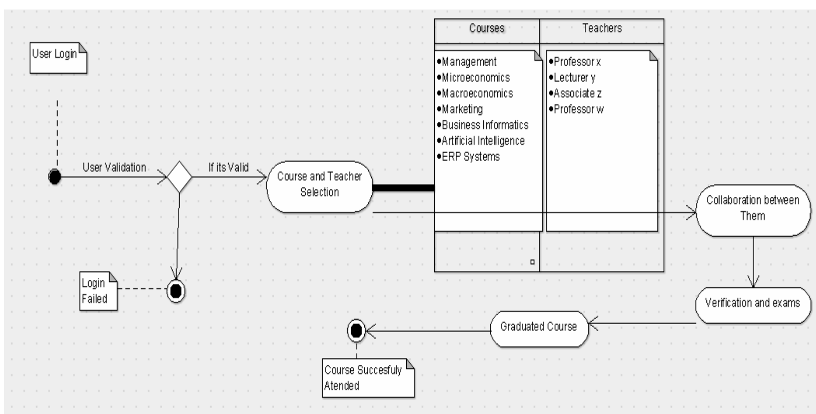


*Figure 2.* **Workflow**

As it can be seen in Figure 2, in order to provide all the information described above we need a database (DB). The database will include in its structure all the information necessary for running the system in optimal conditions.

After the analysis phase of the project we concluded that the portal should include the following:

• Advanced Search Engine by category here we talk about courses and their correspondent teachers;

• The target audience of the portal is not limited to Romania and Romanian speakers. It is recommendable for information to be translated in several international languages such as English, French, German, Italian, and Spanish and in other languages according to the requirements.

For reasons of simplicity and ergonomics in implementing the database and application development, we will insert a column in the tables relating to specific languages. The database was designed so as to be easily maintained and changed;

• Account and password for each user;
• Discussion forum for various problems;

The proposed system has a simple architecture. On one hand we have a database that provides information. On the other hand we have the user interface that communicates with the database. (Fig.3). It is essential for us to capture all information created by the collaboration between users and save it in the same database. Thus, content management is a must for our project.

The user interface provides collaborative system's specific tools. Users have at their disposal all tools they need for a fully collaborative learning system. But collaboration is not just about these tools. It implies several things as well: common goal, predefined process rules, individual roles, shared responsibility, shared risks, creativity, and common vision. Therefore we think that teachers or another named user to be granted with human coordination rights. It is the human coordinator responsibility to assure that everybody is aware and follows the imposed rules and follows the imposed common goal, which in our case is learning. The human coordinator is the one who compiles the working rules, provide a role for each user, and supervise users' communication and cooperation processes, by describing and imposing a specific standard for how these processes will take place. We have chosen this flexible approach as we consider that every course should be approached in a unique way. Creativity must not be obstructed by standards and rules so human interference is a must for such a system.

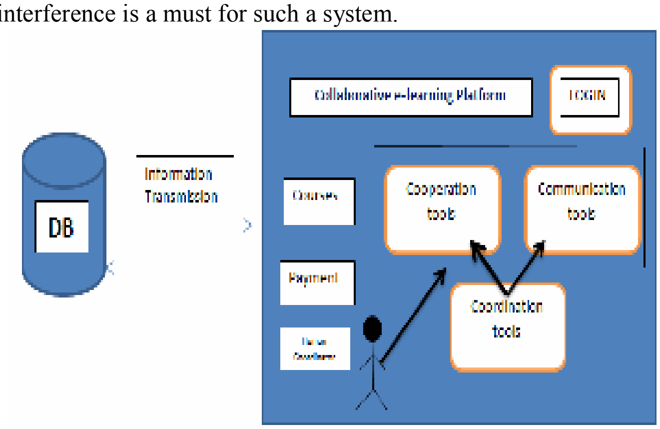


*Figure 3*. **Prototype**

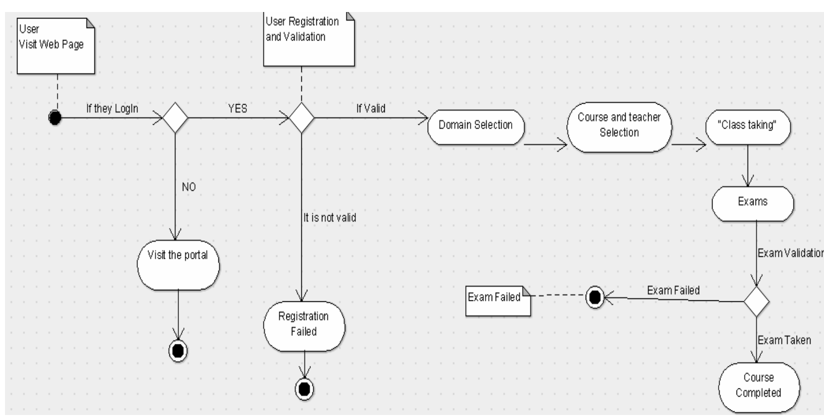


*Figure 4*. **System Scroll**

The portal is built upon a solid structured database which contains validated and precise information. The database contains information about: the academic curricula, e-learning domains, professors and their courses, information about the users, exam models, and user rankings and opinions. The databases' architecture is represented in Figure 5:

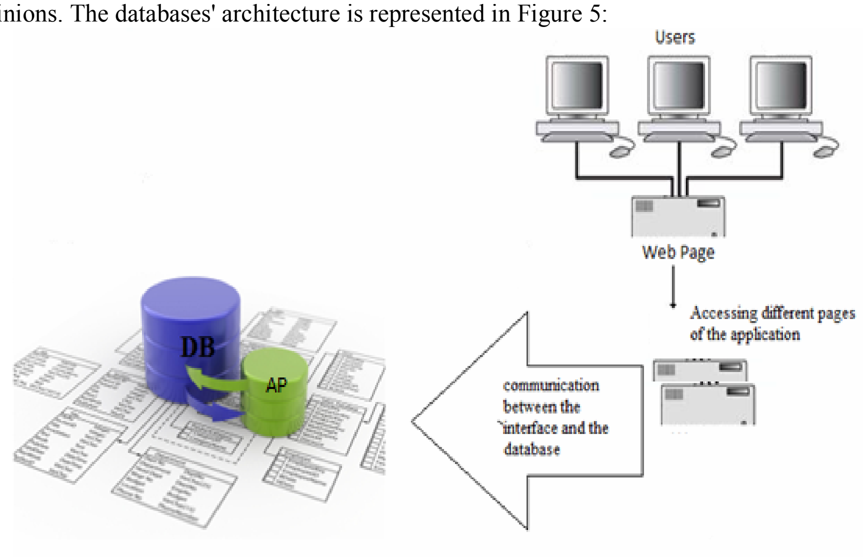


*Figure 5.* **Application Structure- Communication between the users-interface and database**
(adapted after http://www.sintactic.ro/solutii/baze-de-date.html)

## 4. Conclusions

As shown, e-collaboration is not just about communicating and information-exchange. Groupware could assure a way of successful studying program in a dynamic era and environment. Therefore, we strongly believe, e-collaboration will develop into a main tool in the future for developing e-learning systems.

With the fast development of the area of collaborative networks, showing in a diversity of application domains, theoreticians say that it is becoming crucial to systematize and consolidate the knowledge in this area.

Through e-learning students can learn, breaking the space barriers. It has been shown that e-learning increases knowledge retention factor by 50 per cent against teacher-led trainings. The impact of internet on our life is increasing, and we think that our project will contribute to the development of e-learning.

Our system provides a successful platform for encouraging students to learn from distance. Once students gain trust and collaborate between them, and with their teachers, we are convinced that they will have all the things needed to learn new things and in the same time to finish a school.

## Acknowledgments

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# A Metamodel for Manipulating Business Knowledge Within a Data Warehouse

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**Abstract**.

*In today's business environment, large companies struggle with a considerable number of information systems, from operational and transaction-oriented ones to analytical data processing systems, which creates an "informational chaos" from the metadata management point of view. Efficient metadata management is the key to improved performance for the data systems involved, as well as for the technical and business users who employ them. Although a multitude of data and information exists within the business intelligence systems (i.e. the data warehouse environment), business users who lack technical skills are deprived of "basic" knowledge of the data they are analysing, albeit this information lies in the technical metadata. This article presents a simple metamodel that integrates technical and business metadata, which can be used as a map for navigating through the data warehouse's metadata repository. The generic metamodel can be used as a basis for developing data warehouses or data marts, as its extended version guides them through the business metadata information and technical metadata lineage. A case study on a reinsurance data warehouse - a loss management data mart, will prove the validity and usefulness of the metamodel.*

**Keywords**: Analytical processing, Metadata Management, Business Metadata, Metamodel, Data Mart

## 1. Introduction

Given today's multitude of choices, from Online Transactional Processing (OLTP) and Online Analytical Processing (OLAP) systems to various other types of information and data sources, integrating data is a quite complex task. But the need for data integration is crucial, because without its data a company cannot survive. There are many tools available on the market nowadays, and companies need to search for the one who better fits their informational needs and enables them to properly and usefully exploit their data. Although one might get to a certain level of data integration, a very important aspect is taking care of metadata, the context of the integrated data.

Metadata represents and essential factor in understanding the meaning of the data analyzed, as it provides a context for the data and concentrates the totality of information and knowledge of the actual data of an enterprise, capturing general and specific characteristics of the enterprise. Most of the metadata is stored in a metadata repository and it is described by a metamodel, the conceptual schema of the repository, which specifies the existing metadata elements and the relationships between them.

This article presents a simple metamodel designed to integrate various types of metadata and serve as a map to navigate through the data warehouse's metadata repository, being structured as it follows: the first section will cover a brief literature review, the second section will introduce the problem statement and some general notions about metadata and its importance in the data warehouse environment, followed in the third section by the metamodel design and a validating example of the loss management data mart. The last section will be covered by conclusions.

**2. Literature Review**

The issue of metadata integration and management is very much addressed in the literature, but not as much has been written about integrating the semantics of data (i.e. the business metadata, the organization's knowledge) in the data warehouse.

(Golfarelli et al, 1998) presents a comprehensive conceptual data warehouse design technique for multdimensional data, but doesn't explicitly address the integration of semantic metadata and the interdependencies between multidimensional structures and the unstructured or partly-structured business concepts which reside within every organization.

There is a high interest in the research world regarding data quality in data warehousing environments, as various metadata models have been proposed in the attempt to eliminate these issues. (Gomes et al, 2007) describe a metamodel as an extension to the Common Warehouse Metamodel (CWM) toward data quality. Data quality can be specified by means of rules on values and rules on structures and the authors provide modeling guides for storing formal specifications of data quality rules. In (Calvanese et al, 1998a; 2001b), the authors provide a comprehensive metadata model formalism to support source integration in the data warehouse design process. They start from the premises that a data warehouse is a set of materialized views over the operation information sources of the organization, designed to provide support for data analysis and management decisions, and present a technique for declaratively specifying suitable reconciliation correspondences of data from different sources.

In (Ralaivao et al, 2007), the authors argue that metadata and domain-related knowledge are essential in the processing of complex data in data warehouses, and adress this issue by proposing an XML-based architecture framework which integrates knowledge as metadata in these environments.

(Stöhr et al, 1999) describe a uniform and integrative model for data warehouse metadata and accentuate the importance of defining interdependencies between technical and semantic metadata. We follow this model in our paper, as we attempt to extend it and apply it to a case study on a loss management data mart.

**3. Metadata in the Data Warehouse**

According to (Hay, 2006), metadata is the data that describes the structure of an organization's use of information, and which describe the system it used to manage that information. He states that metadata doesn't just define data, instead it offers a broader view of the enterprise, describing how the data, activities and people are understood by it (how this data is represented in a structured manner, who can access the data and why, where the data is stored and the processes involved in its retrieval and manipulation, as well as the motivation and business rules which provide semantics to the data).

***3.1. Importance of Metadata***

Metadata's importance in the information systems is undeniable, especially since the number and complexity of these systems continues to increase over the years. When there are only a few systems that a certain organization works with and sufficient people who are familiar with them, metadata is not all that important and its management does not represent a priority. Metadata becomes essential though, when organizations reach a higher number of systems and staff involved in their handling, as it is able to offer in some cases a map of the system landscape. The different types of metadata defined in the literature target all kinds of data users and become a tool for system and data understanding. Metadata ensures the premises and documentation of specific system development processes (analysis, design, implementation), representing, in some cases, a guide for technical and also non-technical users. At the lowest level, metadata translates table and column information from a data warehouse into meaningful business terms, unlocking valuable information stored within the data warehouse and serving as an intuitive map to guide business users in building reports and constructing analyses (MicroStrategy Inc., 2010).

### *3.2. Technical Metadata vs. Business Metadata*

Metadata can originate from various different source systems (operational and analytical environments, data dictionaries and flat files, etc.), and can also be the result of extraction, transformation and load processes. Gathering metadata represents a task just as difficult as the data integration itself. The literature exposes two main types of metadata, according to the user's point of view: technical metadata and business metadata.

From a technical perspective, metadata is seen as structured information used by automated processes (Brand et al, 2003). Technical metadata is generated and used by the IT systems, and it includes all the details on all the layers of the system, both at physical and logical levels. It is also a representation of the ETL process. It stores data mapping and transformations from source systems to the data warehouse and is mostly used by data warehouse developers. The definition of technical metadata is usually more complex than the business metadata and it sometimes involves multiple dependencies.

Business metadata is the type of metadata which stores business definitions of the data; it contains high-level definitions of all fields present in the data warehouse, information about cubes, aggregates, datamarts, etc., and is mainly addressed to and used by the data warehouse users, data managers, testers, analysts and many others. Business metadata describes the content of the systems in a non-technical way, so that business users and other users that are not familiar with technical descriptions understand their content. It mainly focuses on making technical metadata understandable and usable by the business community, providing explanations, mappings, road maps, and translations of the technical solutions and the business needs (Allen et al, 2005).

### *3.3. Metadata Management*

In a modern view, metadata management has to be able to integrate the "islands" of data from within an enterprise, describe the origin and context information of this data, and make this information available for the end user. Activities of metadata management include the development of metadata models, used to define the content of metadata in a certain context, the development of metadata repositories used to organize the metadata defined in the model, etc.

Metadata management has a very important role in ensuring the proper functioning of the enterprises' activities, especially in the four areas where it is commonly deployed: design, where metadata is used to model business processes, to create data models and help in the development of applications; operation activities, where metadata defines provides definitions of the exploited information; management activities, through careful metadata management of business intelligence data, and also in governance activities, where metadata helps identify enterprise data assets to be governed within an organization.

Building the enterprise metadata repository, which integrates both technical and business metadata, can be a very complex task. The main reason behind this metadata repository is that it can provide an enterprise-wide centralized metadata management tool, essential for the data warehouse administration, maintenance and usage. This implies the necessity of a repository to manage metadata, i.e. information about the structure, content and interdependencies of data warehouse components (Stöhr et al, 1999).

**4. The Metamodel**

A metamodel represents the conceptual schema of the metadata repository, which specifies the existing metadata elements and the relationships between them. A metamodel has to be extensible, so that users can define their own application specific elements whenever the application requirements change.

In (Terpeluk Moss et al, 2003), the authors define a logical metamodel as a data model that indicated objects, the relationships between the objects, and the cardinality and optional character of the relationships. A logical metamodel built for a metadata repository differs from a logical data model built for a business application in terms of the nature of objects that resides in the models. In the logical metamodel we have objects that represent metadata (entities, attributes, definitions, domains, tables, columns, and indexes, etc.), whereas in the logical data model we have objects of the business data (customer, product, account, location, etc.).

The metamodel presented in this paper offers a representation for modeling technical and business metadata as well as integrating them in a common repository model by means of shared generic classes. We use Universal Data Model (UML) classes for metamodel representation, since it is the most commonly used modeling language. Our metamodel is based on a standard presented by the Business Rule Group in (Anderson-Healy et al, 2000) and extended further by David C. Hay in (Hay, 2006).

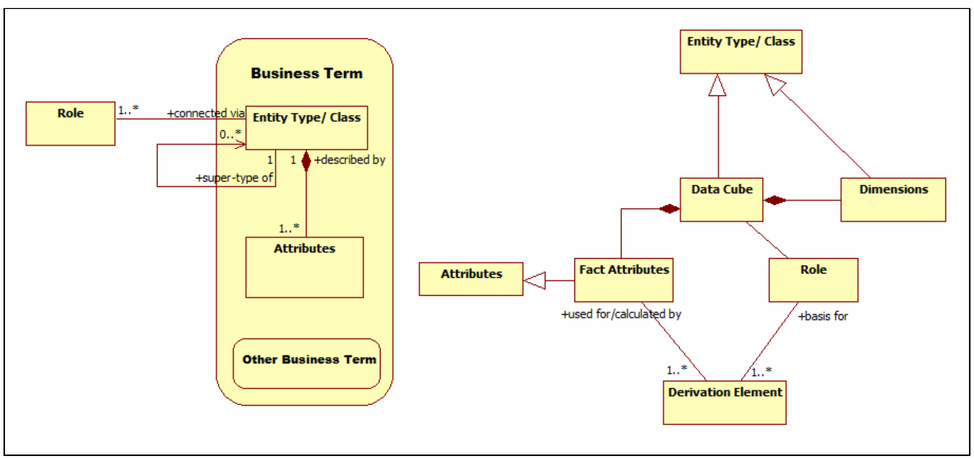


*Figure 20.* **Generic Metamodel Classes**

Business knowledge has to be defined in the context of the designed metamodel and the multi-dimensional data model (i.e. the loss management data mart). We particularize the sense of business knowledge in this paper and use it's signification to portray the broad sense of business rules. There are four business rules categories defined by The Business Rule Group: business terms and facts (structural assertions), constraints (action assertions), and derivations. **Error! Reference source not found.** presents the generic metamodel and classes used to describe the business metadata use in a multi-dimensional data model. A business term definition is a business rule itself, therefore defining a term consists of establishing a category of business rule. The facts are used to link the enterprise terms (e.g. natural language sentences, relationships, and attributes, etc.). The constraints on the enterprise data are made to express constraints on the enterprise's behavior. Derivations are business rules that define how knowledge in one form may be transformed into other form of knowledge.

The business semantics can be partially represented by business metadata, which provides a business-oriented description of the data warehouse content and a formal representation of the analysis requirement (Stöhr et al, 1999; Inmon et al, 2008). Business metadata represents concepts and subject areas at a high level of abstraction, business entities and transactions at the medium level, and business terms at the lowest abstraction level (Mhashilka et al, 2009).

Figure 2 presents the generic metamodel for the multidimensional data model of a data mart. Regarding the generic metamodel, the Business Concept Entity can be seen as any business fact and business related event, derived from business processes, which ensures semantics for the data warehouse's data. The Mappings Entity provides the connection between business concepts and their technical representation within the Data Mart, representing in fact the data movement dependencies. It has as source the Business Concept and as target the Dimensions of the Data Mart's Data Cube. Dimensions represent the basis of the integration process of external information. Mappings use transformations (Transformation Entity) to relate to the attributes of the Data Cube (a Data Mart contains one or more Data Cubes). The derived attributes of the Data Cube's Fact Table can be the result of an aggregation process (Aggregation Entity) or a direct transformation (Non-Aggregation Entity), which actually passes on the original values.

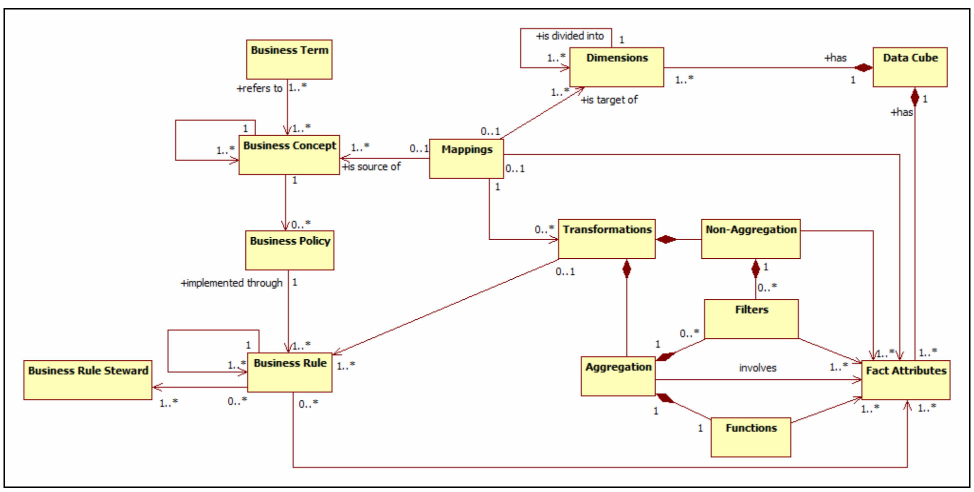


*Figure 21.* **Metamodel of a DataMart**

The Business Concept is supported by the organization's Business Policy. The policies are implemented through Business Rules, which relate also to the Transformation Entity and the Data Cube's attributes. Business rules are used within the organization's decision-making process and always defined by and in care of data stewards; rules stewardship describes the persons/organizations responsible for them and provide traceability features. Business rules/business metadata represent in fact constraints on a business, more precisely a statement that defines or constraints data about an enterprise (Hay et al, 1995). (Jennings, 2004) defines business rules as the logic applied to calculate of derive a business-related valued, which describe why data appears the way it does. In the database environment, business rules refer to domain, table and column constraints, and referential integrity; the information systems environment sees them as structural and behavioural rules: validations, derivations, actions/events, and presentation rules.

In order to validate the presented metamodel we present an example of a query on the respective data loss management Data Mart in the reinsurance business area. The Data Mart, which is seen as a subset of a larger Data Warehouse, contains three major Data Cubes, one of which will be covered in our example (due to lack of space, the Data Mart schema will not be portrayed in this paper). The Loss Management Data Cube holds information about the amounts and numbers of Loss Claims filed by the re-insured organizations, around several dimensions (Category and Class of Loss, Cause of Loss and Reason for Change, Status of Loss and Consequence, Peril and of course Company Codes and Date-Time Dimension).

A user of the Data Mart's information (be it technical or business user) could be interested in knowing the total value of loss claims caused by Hurricane Katrina in the first three months after it's happening, only for USA-based reinsurance companies. The information regarding this business query, which can be seen as a particularized Business Concept, can be found in the Fact Table under *claims_amount* attribute and dimensions: Peril (attribute *peril_name = Storm*), Cause of Loss (attribute *cause_description = Flood*), Date-Time (attribute *date = August 29, 2005 – date = November 29, 2005*), and Company Codes (attribute *country = USA*). Through Mappings this business event is connected to the Dimensions and Fact Attributes entities. An aggregation type transformation is applied on the values of each individual claim that matches the selection parameters and the total value of loss claims is obtained in the *claims_amount* attribute. The function used for aggregation purposes is summation and the filters correspond to the attributes involved, in this case each individual claim value.

The metamodel guides the user through the mapping and transformation processes behind a query result against the presented multidimensional model. It represents a useful schema for the non-technical users, as it helps them understand where the data is coming from and how it is processed.

## 5. Conclusions

The metamodel presented in this paper intends to offer business users an overview of the metadata repository, describing the steps followed by the data in its transformation, before ending up in a query result. It uses generic meta-modeling classes, such as Entity, Mapping, and Transformation for representing technical and semantic metadata. Specializations of these generic classes, such as Business Policy, Business Rule, Data Cube, Dimensions, Fact Attribute, Business Concept, Mappings, Aggregation, Filters and Functions, are used to represent the multi-dimensional data model. In our case, the semantic metadata is reduced to the notion of structured metadata, already existent in a database or in other structured form in the organization's environment. By enforcing the existence of business rules, an organization can validate its data's accuracy. A real-world example of a business query against the presented Data Mart proves the validity and usefulness of this metamodel, which is able to guide the non-technical users through data lineage and transformation into its final presentation form.

## Acknowledgments

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# Application of Interactive Devices and Virtual lab in Chemistry Learning

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**Abstract**

*This paper presents an educational project ("Introducing Interactive Teaching Methods in Inorganic Chemistry and Investigation the Effect on the Quality of Knowledge") of blended learning in the studies of "Food Technology" in Technical College of Yambol. The blended learning model is established and supported by e-learning on-line materials. The multimedia courses, lessons and e-quizzes have been created. Moodle platform is used for the management of on-line educational process.*

*We propose the innovative devices that can be apply in Chemistry lessons and by integrated audio – video tools, specific programs and interactive whiteboards, virtual labs to create simulations of chemistry experiments and solving different problems.*

**Keywords:** blended learning, high education, e-learning environment, whiteboards, Virtual Chemistry Lab

## 1. Introduction

Last years blended learning is widespread in universities and other similar higher educational institutions (Dziuban et al., 2004; Macdonald, 2006; Ticheler, 2009; Donoso et al., 2010). New learning and teaching models that take advance of the new online environments and personal computers are emergent. Innovative pedagogical models appear that change the emphasis from teaching-centered to student-centered in learning paradigms and new theories of learning (social constructivism and brain-based learning).

The social constructivist theory of learning, which originated with Vygotsky (1962), claims that learning centres on social interaction and shared tasks in which individuals build their learning by interacting with the environment, particularly teachers and fellow students (Beetham, 2002). A number of authors point out that interactive, collaborative learners can be well-supported in a web-based environment and remark that asynchronous online communication encourages significant peer interaction to take place (Roberts, 1995; McMahon, 1997; Oliver, 2001).

Several authors have discussed the use of VLEs in higher Chemistry education (Chin, 2003; Charlesworth & Vician, 2003; McDonnell & O'Connor, 2005; Brouwer & McDonnell, 2009; Donoso et al., 2010). Chin (2003) has produced guidelines for using VLEs. Charlesworth and Vician (2003) described their introduction of a Web CT VLE to attempt to improve motivation and learning on a first year chemistry programme.

Examples of innovative approaches that use educational technology to support active learning in chemistry lectures, tutorials and laboratory sessions are considered.

## 2. Materials and methods

This paper presents an educational project of blended learning suitable for the subject General and Inorganic Chemistry in the studies of "Food Technology" in Technical College of Yambol. The blended learning model is established and supported by e-learning on-line materials that included different courses. Moodle platform is used for the management of on-line educational process. This year start a project “Introducing Interactive Teaching Methods in Inorganic Chemistry and Investigation the Effect on the Quality of Knowledge”. The project seeks to build up an innovative style of teaching Chemistry upon the good practices of face-to-face teaching methodologies and resources of fully ICT-learning environment.

In Technical College of Yambol study of General and Inorganic Chemistry is included as compulsory discipline. Each week students have lectures (3 academic hours), laboratory exercises (2 academic hours) and stechiometry resolving problems in seminary lessons (2 academic hours). With the new project work, the didactic materials has been created on the field of General and Inorganic Chemistry (http://tk.uni-sz.bg/edutk): virtual library with – lectures; exercises; multimedia sources; movies; presentations; tests; glossaries; links to other web-base on-line resources etc.

## 1. Challenges of teach and study Chemistry

Chemistry is challenging to learners because a chemist needs to think on several levels: The *observational* level (macro level), the *molecular* level (sub-micro level) and the *symbolic* and *process* level (Johnstone, 1982). This can lead to misconceptions which are often very difficult to overcome and can even prevent any further learning.

In cognitive psychology, there is one memory system, but it is normally divided into three functions for storage (Anderson, 2000): sensory, short-term (often called *working*), and long-term (often called *permanent*). *The sensory memory* retains an exact copy of what is seen or heard (visual and auditory). It only lasts for a few seconds; while some theorize it last only 300 milliseconds. It has unlimited capacity. *Short-Term Memory (STM)* – the selective attention determines what information moves from *sensory memory* to *short-term memory*. STM is most often stored as sounds, especially in recalling words, but may be stored as images. It works basically the same as a computer's RAM (Random Access Memory) in that it provides a working space for short computations and then transfers it to other parts of the memory system or discards it. It is thought to be about seven bits in length, that is, we normally remember seven items. STM is vulnerable to interruption or interference. *Long-Term Memory* - is relatively permanent storage. Information is stored on the basis of meaning and importance (figure 1).

To design lessons that affect deeper roots of retention there is a need in the understanding of the Information Processing Model (figure 1) and how learning occurs when information is transferred from sensory memory to short-term memory into long-term memory. This understanding of the process of learning helps lesson designers’ impact higher retention rates among learners. Long – term memory or retention of information can be affected through lesson design (King, 2011).

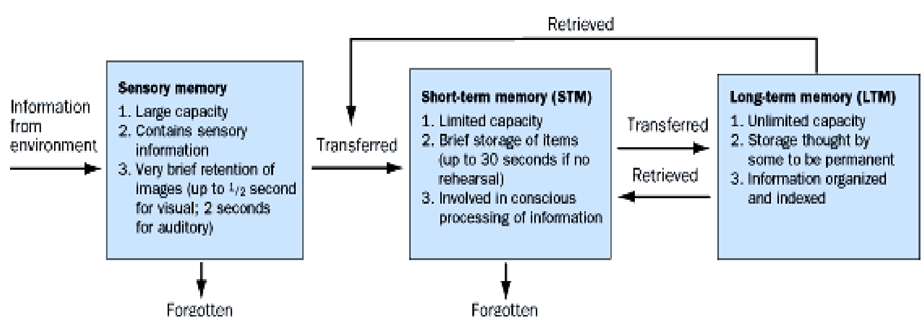


*Figure 1* **Information Processing Model (Three Box Model): Three Interacting Memory Systems** (http://cla.calpoly.edu/~cslem/101/7-C.html#Sensory Memory intro)

### 3.1 Virtual Chemistry Lab

The purpose of this program is to create a virtual chemistry laboratory to help students who study chemistry for the first year and for their teachers. The on-line recourse of the Virtual Chemistry Lab is http://chemistry.dortikum.net/bg/news/ in Bulgarian language and http://chemistry.dortikum.net/en/news/ in English. It has an easy-to-use interface, a help file, a manual and is completely free.

Using this program, students acquire basic skills and knowledge for work in a laboratory without the risk of incidents in a real laboratory. Users have the option to check their skills and knowledge in an unconventional and entertaining way. As far as its further development is concerned, the program has the option for updating its database of the elements and their compounds. The program can also be updated over the Internet, which helps to constantly keep its database up-to-date. What's more, teachers can manually add more substances and reactions and thus enrich the students' experience.

Virtual Laboratory of Chemistry has (figure 2):

- *a way to visually conduct experiments with different substances, a model- and analysis-oriented view of the current reaction;*
- *an "assistant" to simplify the work with the program, valuable encyclopedic information regarding the elements;*
- *a glossary;*
- *self-test facilities;*
- *interactive lab exercises;*
- *a sophisticated unit converter;*
- *a lab log;*
- *a built-in calculator;*
- *an equation editor;*
- *a help file;*
- *an attractive interface and many other features.*

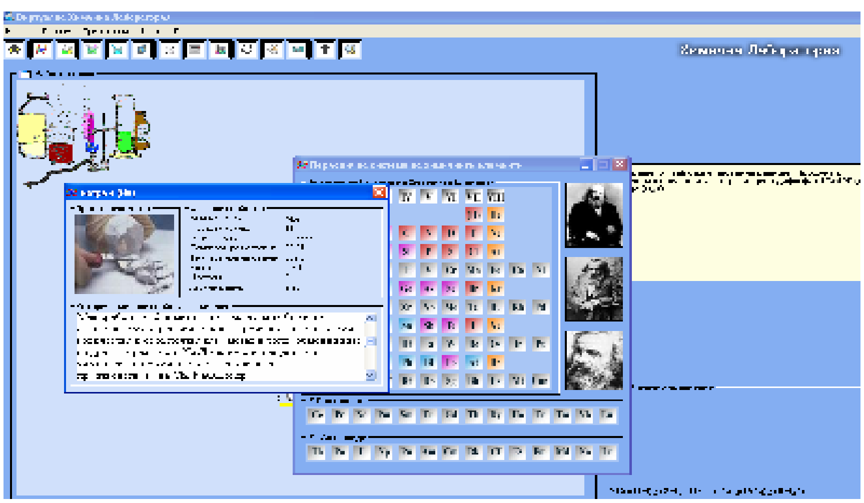

*Figure 2* **Virtual Chemistry Lab**

A chemistry project without the periodic table of elements is nothing. There are two variants of the table – normal and unfolded (figure 2). They differ in nothing except the location of the elements. To satisfy the students' curiosity, there are included information about every element – physical attributes, history, interesting facts, a photo of the element and others.

Apart from the periodic table of the elements, there are also several other reference tools included – the solubility table, Oxidizing and Relative activity of some of the substances.

When students first encounter with the chemical terminology, they find it hard to remember it without constantly using it. This will no longer be a problem as the program has a built-in glossary of the most widely used terminology. It's a wonderful way to recollect the meaning of any unknown term at any time.

The most interesting thing for some of the students and most of the teachers is the self-test feature of the program. There are several tests – the first is the standard one – several answers and only one of them is the right one. After the test is completed, a mark is generated depending on the number of the right answers. This is a good way for teachers to check students' knowledge. The questions in the test can be modified in the administrative panel. Another tool of examination is the equation editor. It can help the teacher to check the students' skills of solving chemical equations. The last but not least important method for examination is using simple lab experiments. A reaction is visualized onscreen and the student is asked a question regarding the reaction. Seeing the changes on the screen, the student has to consider what he sees and answer correctly.

The students learn about some of the most widely-spread elements, compounds and reactions, they also learn how to solve equations and different problems like the mass and so on. In this case they need to use different units and convert them. The program incorporates an extremely useful unit converter and it can convert all kinds of units. Another useful tool is the calculator which helps the students to calculate any sum they encounter with.

### 3.2 Web-based resources

With the new project work, the didactic materials have been created on the field of General and Inorganic Chemistry and publish as on-line resources at http://tk.uni-sz.bg/edutk. It included: virtual library with – lectures; exercises; multimedia sources; movies; presentations; tests; glossaries; links to other web-base on-line resources etc.

The Computer Assisted Learning stimulates the visual hearing memory and transposes the students in the middle of physical phenomena. The realism of dynamical pictures, the video joined with the sound and the motion, the possibility to recreate the physical reality with digital technique make the didactics movies the most important teaching tools (Bostan & Antohe 2009). On the web-site of General and Inorganic Chemistry movies from chemistry history and lab experiments are linked and available as on-line resource.

Provision of a range of online learning materials, activities and self-tests with instant feedback allows learners to determine how well they understand and can apply material introduced in their lectures (Adams, Byers, Cole & Ruddick, 2003; O'Connor & McDonnell, 2005). Online self-study quizzes with instant and detailed feedback are very useful, allowing first year students at Dublin Institute of Technology, Ireland, to determine how well they understand and can apply the topics they are being taught (O'Connor & McDonnell, 2005). This type of support has been found very useful for teaching chemistry to large groups of first year undergraduates, particularly those who have not studied chemistry at secondary level (Brouwer & McDonnell, 2009).

### 3.3 Interactive Whiteboard

The interactive devices give opportunities for the lecturers in the universities for better visualization of the learning contents (figure 2, 3, 4). The visualization of the educational material gives a better possibility of perception of the educational contents and more time for discussions. This kind of innovative education increases attendance and engage the students in more active and deeper learning of the educational material. It is undoubted fact that the visual memory is many time powerful and it allows a man easier and quicker learns the material.

Visualization of chemical structures and reactions on a molecular level is introduced to develop a deeper understanding of chemistry in learners. Computer animations, simulations and 3-D molecular modelling can be used to improve learning and understanding of chemistry, not only by students at the beginning of their study, but throughout (figure 3).

Interactive whiteboards allow teachers to record their instruction and publish on-line the material for review by students at a later time. This can be a very effective for students who benefit from repetition, who need to see the material presented again, for students who are absent from school, for struggling learners, and for review for examinations (figure 4).

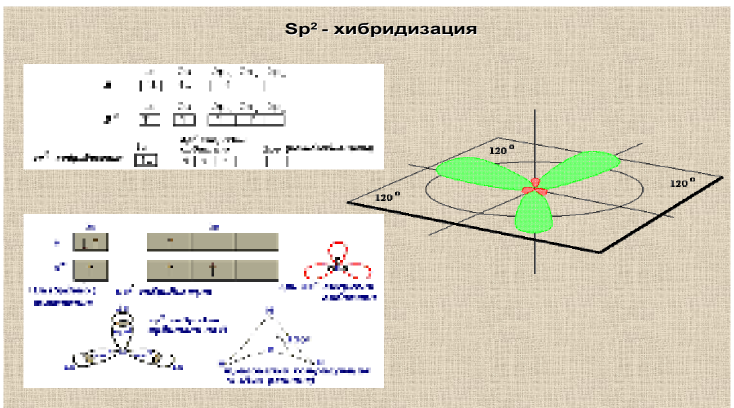


*Figure 3* **Visualization of sp$^2$-hybride orbitales**

A good explanation by the lecturer is not enough to achieve deep learning by students. The learners need to be actively involved (Stanley & Porter, 2002). With the implementation of interactive whiteboard that goals easy can be achieved. The main ways of use interactive whiteboards in the study process are: save lessons to present to students who were absent; create video files and posted to the server or web; present presentations created by student or teacher; digital storytelling; brainstorming; take notes directly into PowerPoint presentations; video movies; reinforce skills by using on-line interactive web sites; diagramming activities; teaching steps of solving the problems, etc. (figure 4).

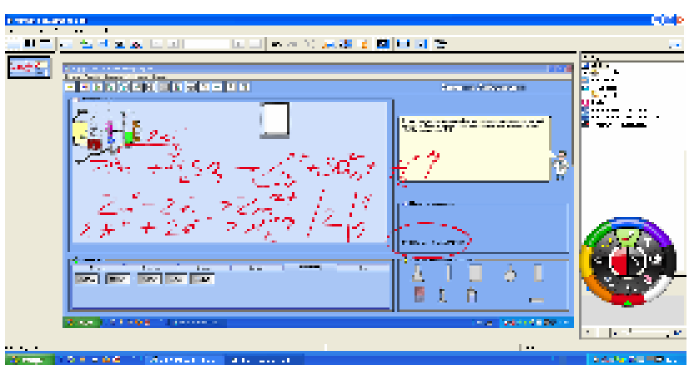

*Figure 4* **Explanation of the reaction – using ChemLab and IWB**

During a lecture, incorporation of online methods can be achieved by using simulations, animations and computer-generated molecular models to demonstrate and explain difficult concepts. All that methods are easy implementing using IWBs. Group discussions, an exchange of opinion with a neighboring student as well as asking questions, solving on-line quizzes in class through IWBs, are common methods employed to make lectures active and interactive.

## 4 Conclusion

It has been recently proposed that the best practices for teaching chemistry designed and developed must be shared. Teachers explaining chemistry education techniques and current technologies (an associated DVD and website) would be used to ensure effective and timely dissemination (Greenbowe, 2008).

Working on projects and share the information about innovative devices and their implementation in the teaching and learning process is beneficial, worth it and have to be encouraged.

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# On line course for warping technology

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## Abstract

*The overall objective of this paper is to contribute to modernization of learning technology by designing and implementing a knitted computer-assisted course. The course is applied to the knitting laboratory of Faculty of Textile Knitwear, Leather and Industrial Management of Iasi. The content is modularized and structured as a site. The materials provided are designed as virtual learning environments, as modern methods of computer-assisted learning, allowing students to access course online or offline. The students have work with the following interactive tools: schematic drawings color interactive areas to obtain additional technical information, interactive buttons causing the opening of windows that contain representative pictures and texts, e-learning tests and self-assessment at the end of each theme, animation that showing the operation of assembly mechanisms.*

**Keywords**: e-learning, module course, quiz, warping technology

## 1. Introduction

The paper presents the result of the design and implementation activities of some multimedia working resources used for the technological study of the warping operation.

In the knitting industry this operation is destined to the activity of yarn preparation for wrap knitting machines. The technological study of the warping operation is made during the laboratory activities of the "Knitting technology fundamentals" subject (discipline). This subject (discipline) is part of the third year curriculum of the Knitting and Clothing Technology specialization at the Faculty of Textile – Leather and Industrial Management of Iaşi.

On the basis of a critical analysis of the technological study of the warping operation that was realized so far in the knitting lab with the help of some traditional learning resources, the following working conditions and difficulties have been revealed (Table 1):

On the basis of the conclusions drawn from Table 1 the authors have decided to supplement the traditional learning resources (books, treaties, courses, reference books) with multimedia learning resources (course modules and computer assisted labs) for learning the warping technology.

*Table 1*. **A critical analysis of the technological study of the warping operation**

| Working conditions | Working difficulties |
|---|---|
| The knitting lab of the faculty does not have a warping machine. | Form the technological point of view, a warping machine occupies a large space. |
| The running of a warping machine is very expensive. | A public education institution cannot afford such an investment. |
| A warping machine uses a big quantity of expensive yarns. It also needs specialized personnel. | A public education does not have the necessary budget for purchasing the yarns and paying a specialist. |

| | |
|---|---|
| The usage of some warping machines on a small scale is a working alternative for lab works. | A small scale warping machine does not reproduce the industrial working conditions. |
| The factories that have warping machines are located at large distances from Iași (Paşcani, Bucureşti, Cluj-Napoca). | It is difficult to finance study trips at great distances from the training centre for the students and the teaching staff. |
| The warping operation can be studied during the practical training at the knitting companies that have a wrap knitting technology. | In a practice centre in the knitting companies can be trained only a few students. Therefore, the addressability is reduced. |
| The warping, as a technological operation, can be seen by the students during the study trips when they are organized by the faculty. | The study trip supposes a short visit to the company without completely reaching the learning objectives. |

**2. Considerations regarding the usage of multimedia learning resources for the technological study of the industrial warping machine.**

For the technological study of the warping operation, the following types of multimedia learning resources have been designed and obtained: graphic interactive flash animations, sets of colored images, charts, photographs, AVI-type videos, scripts and electronic tests of different types.

These visual elements can be used for different reasons:

- to complete and illustrate an explanatory text (e.g.: construction and functioning of an industrial warping machine);
- to complete, in different ways, the graphic elements that are part of an explanation (drawings, schemata and illustrations);
- in order to show something that actually occurs (functioning of different mechanisms units of the industrial warping machine).

An illustration that is attached to an explanation offers much additional information. The connection between words and images is much more likely to make people understand the phenomena and to remember more easily the words that are connected to an image. People can remember images better than words. That is way the authors of multimedia learning resources should carefully study the image, underline correctly the details, write essential notes about the image and delineate appropriately an explanatory drawing.

For a better explanation of the construction and functioning of an industrial warping machine, the charts and simplified graphic elements are recommended to be used. These can reveal some construction details that cannot be clearly rendered in a photograph. The one who creates the image should focus on the key-elements of the warping machine. For instance, when the industrial warping machine scheme it is presented, we have to focus on the schematically representation (that is easy to understand) of the following components: the bobbin creel, the warp yarns distribution devices, yarn brake, automatic stop-motion devices in case of faults, threads oilier, ionization device for the surrounding atmosphere, warp winding mechanism on sectional beams etc. (Figure 1).

The videos are often used in order to indicate a mechanical process, or to demonstrate how something can be done. These are usually watched while one listens to a recorded explanatory commentary, if there is one. The videos repeatedly show images that can be seen in reality in the workshops of a factory where the warping process is completed where the students are not present.

The animations indicate a simplified and slower version of a process. It is advised to be connected to a photograph or a video of the process or, even better, with a real thing. When the video or the animation has an explanatory commentary, it is better to replay the video or the animation with the sound off or with disconnected earphones in order to remember the description of what is happening.

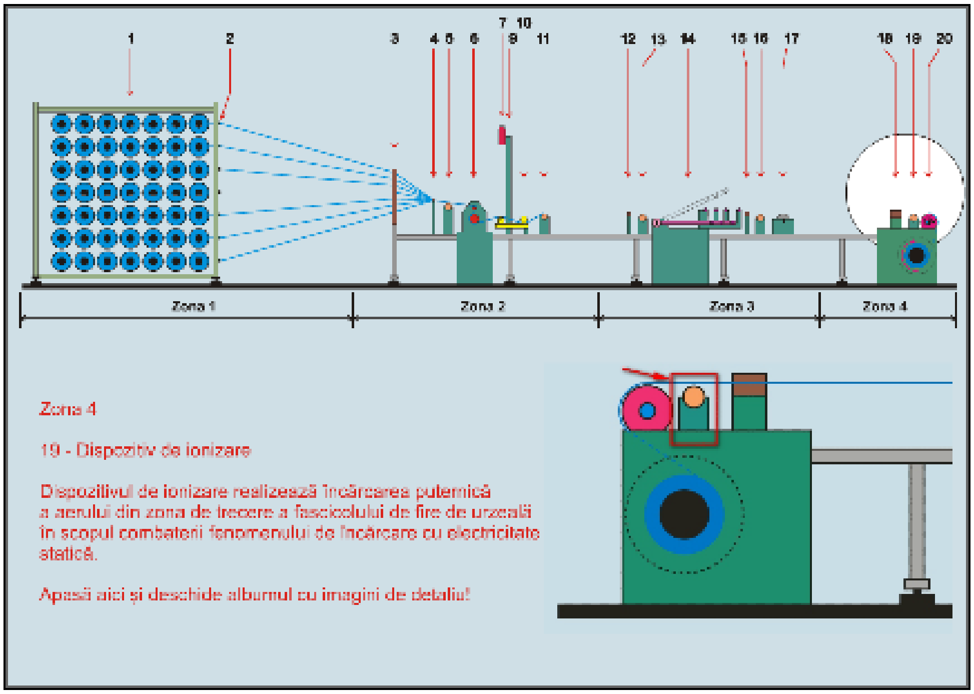


*Figure 1.* **Screen capture of the interactive drawing of an industrial warping machine**

In conclusion, the photographs illustrate, the graphics and the animations explain, and the videos and the animations demonstrate. But it must not be forgotten the connection with the additional text. These course and lab modules offer the comfort of being able to study on a certain date and place of our choice, depending on the time and space availability.

These multimedia resources are used during the lab work of the subject “Knitting technology fundamentals” and solve the following themes:

- acquiring knowledge about construction, characteristics and destination of industrial warping machine for obtaining sectional bobbins by the sectional warping method;
- acquiring knowledge about the purposes of the warping operation: obtaining sectional bobbins with a specific warp structure (number of threads, pass mode, warp length), leveling and equalization of the tension on the length and width of the warp, improving the threads processing by lubrication and antistatic treatment;
- testing and self-testing of students regarding the learning level of the textile warping technology.

The results have already been applied and they have had the following impact:

- stronger motivation of the students for studying a traditional domain in a non-traditional manner;
- improvement of their grades;
- improvement and development of the students’ abilities to use computer-assisted programs;
- possibility to continue the work outside the time scheduled in the syllabus;
- higher efficiency in lab work progress and possibility to learn complex things in a shorter time and with lower effort.

### 3. Methods used

The graphic part was achieved by means of Corel Draw 14, interactive animations with Corel RAVE 3 and Adobe Flash CS3, while the electronic tests have been achieved using Hot Potatoes 6 program. All working resources have been included in a lesson module in HTML format. The course structure has been edited as a XML file with the help of XML Marker application and it was converted into a HTML interactive lesson with the help of ModulEst application. The contents have been introduced into a lesson with the help of Adobe Dreamweaver CS 4 application.

### 4. Results obtained

To support the learning process and the self-assessment of the learning progress, the following computer-assisted working resources have been designed:

- an interactive flash program for presenting the general structure of an industrial sectional warping machine;
- an interactive flash program for identifying and defining construction elements of an industrial sectional warping machine;
- a succession of presentation and description scripts with text and images for the following elements: bobbin creel, the warp yarns distribution devices, control device and yarn brake, automatic stop-motion devices in case of faults, lubrication device, ionization device, warp winding mechanism on sectional beams;
- a video that presents the working mode of an industrial sectional warping machine (Figure 3);
- a learning test and a self-assessment test in HTML format (Figure 4).

For designing the application of presentation of the general structure of a warping machine several requirements have been taken into account (Figure 1).

First of all, the drawing that was realized is colored and it clearly reveals the appurtenance of different component units to a certain group of mechanisms. There are also used simplified graphic elements that reveal very clearly certain construction details and technological functions that cannot be rendered in a photograph.

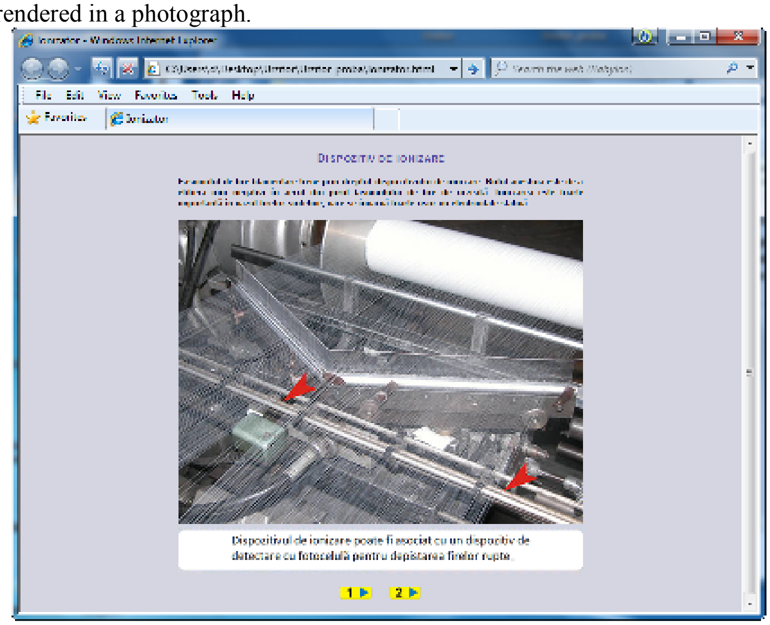


*Figure 2.* **Screen capture of a presentation script with the elements of an industrial warping machine**

Each element from the scheme is associated to a number. This has a shape of interactive button which causes different actions when pressed.

In the learning stage, the student presses, at his choice, a certain button and thereby he opens a text window with that indicates the unit's name, its function and a series of technical and functional characteristics.

In the self-assessment stage, the student can verify if he has correctly acquired the knowledge about the construction and characteristics of warping machines. For this stage, the lesson module disposes of an electronic test of image association.

*Figure 3.* **Screen capture of a video about the functioning of an industrial warping machine**
[KD-1000 Warping Machine]

The student can choose to use a script associated with an element from the drawing. A script is a program attached to a HTML document or one that can be directly built-in. The scripts offer a mean of extending HTML documents in extremely active and interactive ways.

The script is executed on the computer where the learning module is loaded when the link from the main program is activated by pressing.

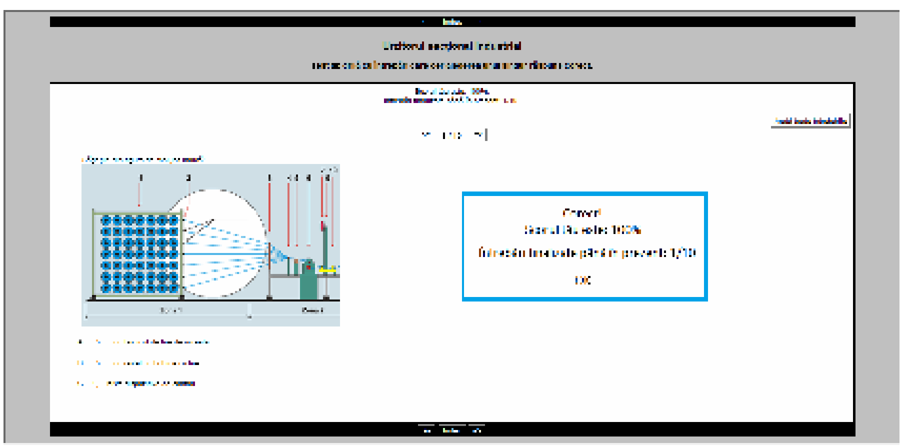

*Figure 4.* **Screen capture of an electronic assessment test**

When launched, the script opens a window that contains an album with detailed photographs of the warping machine.

The navigation within the photo-album is done using certain interactive buttons. Each photo has a title and an area with an explanatory text.

The page opens outside the main program and can be handled on the screen with the help of mouse pointer. This allows the simultaneous visualization of the main drawing and of the images from the window opened by the script.

**5. Conclusions**

All interactive applications have been designed so that students are able to reach the operational objectives indicated in the lab work. These are in conformity with the lab works' content and successfully complete the traditional working resources of the lab.

The designed multimedia lessons are useful for the student who, by repetition, will reach the objectives of the work, and also for the teacher who disposes of programmed training resources and electronic resources for student evaluation.

These resources favor the application of the student-centered learning concept.

These interactive lessons are used in the lab for supplementing the real working resources with the simulated ones. For this purpose, the lab disposes of a number of 8 working places equipped with computers with multimedia features. The students can also download the application from the site of the subject or they can open the applications and work online.

The tests for each lesson are used for continuous and final evaluation of the students. These tests have a fixed period for answering and they show permanently the result of the test. If a wrong answer is chosen, the learning and assessment tests are programmed to display observations and additional suggestions in order to get over obstacles connected to the solutions.

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# Training in a virtual learning environment in the theoretical module - a factor for development of "responsible" driver

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## Abstract

*The global goal for drivers training in Europe implies development of "responsible driver". On the basis of new pedagogical approaches are offered models of learning through social experience, feels and in virtual learning environments. In 2011year were inquired and interviewed 104 persons, head examiners for a driving license in all areas of the country. The questionnaire includes 5 components (notion of "responsible driver", safety driving, social skills of the driver and ecological driving, skills to evaluate their own actions) with specific indicators.*

*Good Practices in the preparation of drivers in the theoretical module are described and are given recommendations for more effective use of virtual learning environment in "blended learning".*

**Keywords:** situated learning, computer simulation, virtual learning environment, car-driving training

## Introduction

Changing trends in world development, the introduction of modern information and communication technologies, access to huge volumes of information and the ability to communicate in cyberspace requires changes in education. Despite technological advances, developing and introducing new pedagogical concepts difficult to overcome the classical form of education.

From a pedagogical point of view has to change the use of new technologies. The teacher supports the learner's activity so that he should seek to find the necessary facts to conduct independent research on an issue and take appropriate (in context) solutions for the situation.

In connection with the development of economy and statistics on victims of road accidents has formed a global strategic goal for the training of drivers in Europe. There are new models that will provide a learning environment that will include candidate drivers in joint activities that will be implemented using a virtual learning environment and practical training. The focus is on developing knowledge, skills, competencies and behaviours. Responsible driver should be motivated to improve traffic safety, to be social and friendly to other, who involved in traffic, to protect the environment and have a real idea of their behaviour in traffic.

## Theoretical Treatment

The studies, analysis of the results and proposals are based on constructivism as a philosophical and psychological basis of learning, reflecting the idea of personality-oriented approach. We associate with opinion that learning is "active cognitive process in which students create new ideas and concepts based on previously acquired knowledge and facts. The learner selects and processes information raises hypotheses relying on their own thoughts and position of the problem ... The teacher and students are involved in the process of active dialogue."(Полат, 2006) This approach to education change student behaviour due to the practical application of conclusions learned from the analysis of personal experience. Students comment on the facts, make a critical analysis, found useful and important, apply these lessons.

Learning by own attempt and experiences include: expertise and experience, analysis (reflection and rationalization on experience), generalization and application. In this educational technology are develop skills for making grounded decisions, taking responsibility for the consequences, initiative, independence, ability to cope with complex situations and anticipate and prevent risks. The interaction of teacher and student is dialogue, which is built on a problem related to real life familiar situations. We emphasize that knowledge is formed individually in terms of social cooperation with the other of the group and instructor, according to their interpretation in terms of learning situations close to reality.

R. Richey identified as important factors for teaching and learning: the student experience, control and interpretation of learner focused on the authentic environment and contextual factors. (R. Richey, 1997)

According to teachers should be guided by the following basic rules to implement interactive, dialogue learning, based on personal experiences of students: encourage initiative, cooperation and leadership, creating information as a result of independent cognitive activity, to organize thorough discussion, to stimulate the search for causes and consequences of actions, to promote independence and self-analysis, to emphasize the relationship of curriculum and practice and career development. (J. Brooks, M. Brooks, 1999; R. Yager, 1991)

We accept that these factors and formulate rules can be successfully applied in the training of drivers in terms of "mixed" training.

**Research and results**

In 2011 during the periodically/recurrent training of examiners for a license to drive in the country were interviewed 104 persons. All examinations are men except one woman. They are representatives of all areas of the country. The questionnaires include 5 components (notion of "responsible leader", safety driving, social skills of drivers, and environmental driving, skills to evaluate their own actions) with specific indicators.

In analyzing the survey results are grouped into 4 groups according to their professional experience as examiners. The first group (17 persons) have experience of 0-5 years, in the second - from 6 to 10 years (32 people) in the third-from 11 to 20 years (37) and the fourth - with over 20 years experience (3). Were conducted interviews for educational technology and the possibilities of blending classical forms with modern methods, including virtual learning environments. Demographic data show that the majority part of individuals has many years of experience as drivers, instructors and examiners. This allows them to express their profound opinion, taking into account the different social positions and roles that are performed.

The survey data show that 78.85% of the respondents associate “responsible” driver with his ability to predict risk, 75.96% - with non-aggressive, protective driving style and 67.30 % - with the ability to adequately respond to risky situations and incident (respondents indicated more than one answer).

In interviews conducted during training, examiners take the view that improving the quality and effectiveness of the training of drivers is necessary to change the pedagogical concepts and approaches in basic and supplementary training.

In our opinion and according to respondents changes in regulations on compulsory regular training in Road safety in courses for drivers and equipment of classrooms with computers and Internet connections are a prerequisite to work in blended and virtual learning environments and use interactive methods. Our observations and opinions of the respondents indicate that the introduction of new technological tools, but in terms of the classical model of education does not conduct to expected results.

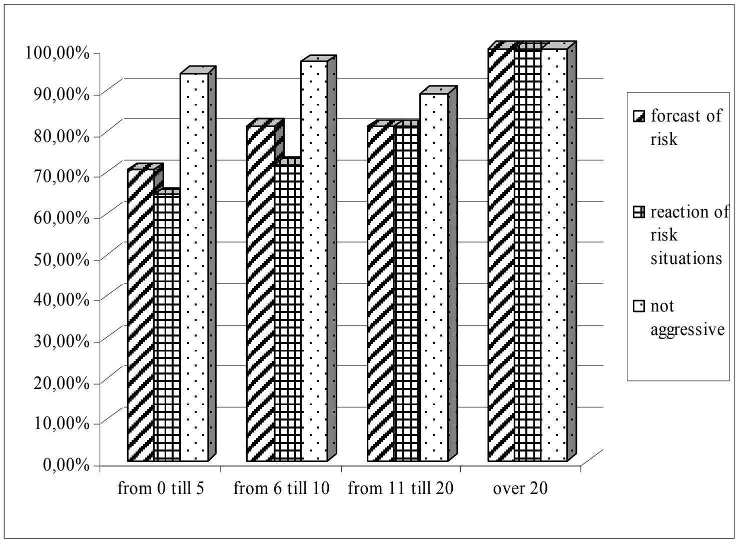


*Fig.1.* **Understanding the "responsible leader" according to examiners (grouped by professional experience).**

Guidelines for changing the interaction between teacher and student are related to idea of learning through attempt and social experience, more independent action and driving practice, considering with individual student needs, developing intuition and the formation of social responsibility. Virtual learning environment is particularly expedient for implementation of multilevel models of driver training, blended learning where the teacher is in the role of expert, moderator, role model, not only source of information.

The training in Road safety can used capabilities of modern technology within a blended learning for the development of safe driving behaviour (ability to predict risk, decision making, defensive driving), eco-driving, communication skills, assessment and self-assessment.

Preparation of drivers is characterized by features of adult learning which groups are heterogeneous in their composition. Students are different in age, gender, level of education, motivation and attitude to learning, values and social status. This determines the variety of pace, learning styles that require flexibility, differentiation and individualization in work of the teacher.

Although most teachers possess and use contemporary technical equipment and multimedia products in their work, the nature of activities is aimed at the formation of knowledge, skills and habits, but primarily reproductive in nature and in typical traffic situations. The repetition of key concepts, identify ways of signaling the importance of road signs and markings can't provoke student's interest because of the weak connection with the actual movement of the road. Considering limited number of specific driving situations included in the examination tests.

Internet connection and sufficient individual places of work in the education offices make it possible to change the nature of driver training. Successfully are using developed materials that include existing regulations, a textbook for the driver, tests for self-preparation and variants of the examination tests in electronic versions.

It is especially important to develop skills in risk assessment. In some European countries such computerized test is still provided in applying for training, in others - in training before the exam or as part of the exam to acquire a license.

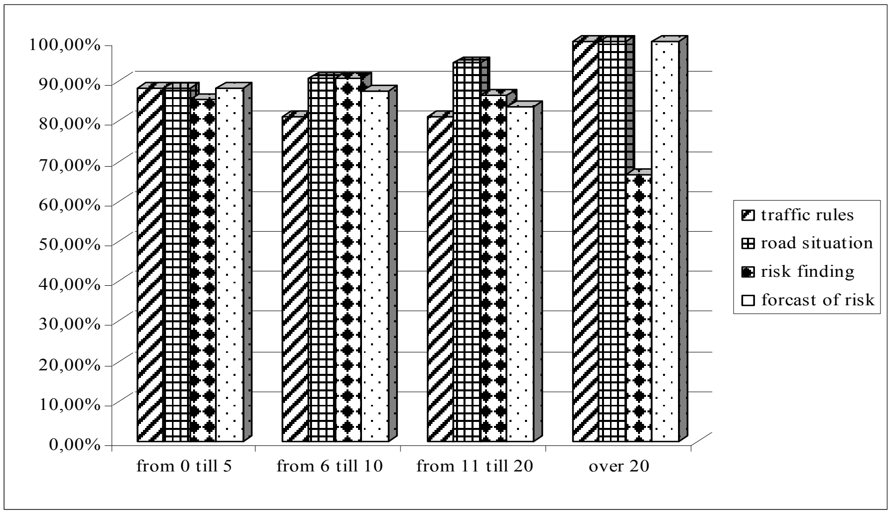


*Fig.2.* **Basic skills for safe driving, according to examiners**

Virtual learning environment allows using audio and video materials. Videos and animations present real situations with different participant in the traffic and choice of response (decision) of several variants. Animated situations illustrate the consequences of the decision and the behaviour of the learner. This approximates to the actual conditions of traffic and develops skills for adequate assessment and behaviour in a safe environment. Virtual learning environment imitate the appearance of a real dangerous situation in which the learner in a deficit of time analyzing the situation, decide and carry out complex actions in accordance with specific conditions. The ability to predict identifies not only with observation, resourcefulness and prudence.

Objectivity of decisions and actions depend more on concentration, degree of preparation and other personal qualities. To avoid the feeling of uncertainty, students work in small groups of 2-3 persons. At the beginning of training is giving enough time for analysis of the transport situation and proposals for decision. It is advisable to avoid the requirement for only one correct solution. Teachers have to put "open" questions where the answer choices are consistent with the state, the degree of preparedness and confidence of the candidate and his individual characteristics.

Through analysis and simulation of different traffic cases students develop skills to predict the probabilities of obstacles to the movement. There are big the opportunities changing the role and assessment of the situation from the position of other participants of traffic. The same video can be viewed in advance under the guidance of the teacher's from the position of driver, pedestrian, traffic policeman, passenger in the car.

Blended learning in a virtual environment and through interactive methods (role playing games) develops skills to assess their own behaviour and actions of other participants of traffic. By visualizing the different situations on a particular route or crossing will develop skills to interact with others and defensive style of driving which is an essential characterization of “responsible” drivers.

Modern ICT contribute to overcoming the template and standard in driver behaviour because they allow to be tested different routes of movement in terms of the city and outside of the location, heavy traffic, etc.. This will avoid the risk of distraction of attention and observation, because the route is a traditional and familiar, but the traffic situation is different every time.

The use of virtual learning environments in blended learning allows drivers to debate and discuss the curriculum "eye to eye", providing case studies, learning problems or incidents in which students work independently outside of class. This allows for a deeper understanding and long-demand solutions that develop skills in analysis, synthesis, criticism and increases the autonomy of students.

Gradually putting problems can vary in scope of problems, complexity, and group or individually problem solving by reducing the time for resolve and approach to real conditions. This pedagogical technology develops skills for search and selection of information, independent thinking, problem solving and adducing arguments, critical thinking. (Klooster) In subsequent sessions in the classroom is well the student to give reasons in the presence of instructor and group for his decision, setting out the arguments, the way and means to solve the problem. So, they see different approaches and style of thinking and behaviour, comparing his work with that of others, which develop critical skills to assess road transport situation.

Training “eye to eye”, combined with virtual learning space reveals some personal psychological characteristics of students (attention, depth, breadth and flexibility of thinking, skills of analysis, synthesis, comparison, and memory). Teacher acquires idea about the attitude of students to certain situations and driving style that would be shown in independent driving later.

In our opinion the research and discussions with teachers and experts-examiners, during basic training should be increased use of computerized tests to assess the risk involved risk situations. (Sujata, M et al, 2007)

On the basis of indicators identified by Donovan (Donovan, 1996), we offer video materials to include speeding, do not observance of distance, incorrect positioning in traffic lane, incorrectly reverses, does not comply with the mandatory sign "STOP"and others. In these videos required response time must be consistent with real-time. The larger number of errors in these typical situations and the more delayed reactions in virtual learning environment suppose the greater risk in independent driving. After solving these computerized situations it is desirable to discussion in the classroom in which to compare and analyze different positions, reactions and behaviour. Consensus and justify the effectiveness of driving behaviour in specific conditions and environment contribute to changing attitudes of students and advantages of safe driving.

Blended learning allows for the formulation and development of skills for self- analysis and self-assessment in the theoretical module. In the initial stage of basic education teacher may assigned to solve a particular version of the test to 2-3 students to overcome stress, lack of self-confidence and uncertainty that would give the wrong answer and will not deal. The combination of questions can be asked on topics from the curriculum chosen by the student or teacher. Tests for self-preparation and self-assessment during the training were developed in different ways.

In one, after marking a response is received as feedback on its correctness. For easily perceiving this is visualization in different colours (green - correct answer in red - wrong) and additional symbols. This option is recommended for the initial stages of training when it isn’t taken much of the curriculum and students formed the necessary pedagogical and technical skills in a virtual learning environment. Students with better motivation, autonomy and learning skills can solve unified tests in which responses display misspelled answers after work.

Based on the experience of different European countries and in our opinion is a better version of tests on road safety for drivers to be modified to include questions from the official statistics on road accidents, social consequences and relationships to other participants in traffic. Thus apart from the absorption, reflection and transmission of knowledge close to their real situation, will seek emotional impact area and awareness of risk, responsibilities of aggressive driving and incidents.

We believe the change in the structuring of tests in which the questions and cases to be given at least 3 responses that will reduce the likelihood of a random selection of the correct answer. It is the wording of the questions requires not only the reproduction of knowledge, but also a feeling that is addressed to each student, to be directed to the emotional sphere and requires expression of attitude.

**Conclusions and recommendations**

- To prepare and be involved in basic and continuing education computerized tests to assess risk situations involving risk driving and investigation of aggressive driving style.
- To use the potential of "blended learning" and virtual learning environment for learning by doing, attempt and social experience.
- During ongoing training of instructors to consider new pedagogical approaches and opportunities for practical application.

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# The potential of informal learning in the formal context

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**Abstract**

*Formal and informal learning seem to be opposing forms of education, but both can live together in harmony through new information and communication technologies. Advantages and disadvantages of formal and informal learning consists in that each entails the transmission of specific skills and knowledge. Research objective is to study the differences between formal and informal in order to streamline their complementary learning process. Thus, as a pedagogical tool, the webblog served as a motivational factor in learning. Design research was conducted during the school year 2010-2011, the second semester, the lot of subjects represented by the 9$^{th}$ grade students of the Normal School Vasile Lupu from Iasy, at Physics discipline. To ensure a comparable basis of objective data, the method used mainly pedagogical experiment and to fulfil this were selected two groups: a control group and an experimental group, observing the changes made by using the blog by students in the learning process, namely the main coordinates of learning: motivation, ability to achieve the purpose for learning, also the interest, effort, tension, learning environment stimulation. Were involved two instruments, Intrinsic Motivation Scale, Student Motivation Towards Science Learning and also focus groups with students to see their perception about learning. By final statistical checking of the data, the results were statistical corelated.*

**Keywords**: Informal learning, Webblog, Motivation, Formal learning, Learning stimulation.

## 1. Introduction

We see more and more emphasis on concerns from the focus on formal structure, institutionalized education, to the broader learning process.

In this paper we tried to illustrate the increasing role of informal learning in the optimizing of the learning process. Informal learning must have a continuous dialogue with the formal one, in order to ensure cyclic coding, better understanding of the tacit knowledge produced during collaboration and promote the introduction of formal knowledge in informal settings, so repeat the formal-informal continuous exchange can determine the development of a dynamic knowledge.

By using new information and communication technologies, we can stimulate curiosity of young students, enabling informal learning processes, which can be monitored and partially integrated through a proper education in the traditional classroom programs. Learning systems can be designed to support a variety of teaching methods and styles of learning (Kozma, 1991). One of the most important distinction is between formal and informal learning, formal learning is usually described as learning that is managed by an authority (eg. school or university), while informal learning can be managed by students themselves (Coombs and Ahmed 1974, Smith, 1999; McGiveney 1999).

Some learning situations involve participants using a variety of different roles (Arrigo, Giuseppe et al. 2007), and each role can be considered separately (eg.: a student in the classroom may face an activity formal learning, while another faces an informal activity).

Use of e-learning gives educators the ability to manage and organize learning activities. However, with the rapid advance of information technology, learning is no longer limited to a specific location, could be "beyond the classroom", which means that learning takes place anywhere, anytime (Ramey-Gassert 1997, Bentley 1998).

Informal learning has a significant role in learning (Ramey-Gassert 1997) and "Informal learning should no longer be regarded as an inferior form of learning whose main objective is to act as a precursor to formal learning '(Coffield, 2000).

In general, the process includes elements of learning and the spectrum of formal, non-formal learning and informal learning (Cook and Smith, 2004), in terms of environmental characteristics and context (Jeffs and Smith, 1990). For example, if we consider the environment, we could say that formal education happens in schools (Smith, 1999) and informal learning happens outside schools (Coombs and Ahmed. 1974, McGiveney 1999).

What is needed is a framework for understanding how these perspectives combine to highlight the fact complementarity of the two types of learning, formal and informal learning in the learning process more efficient.

**2. Materials and methods**

This experimental study is part of PhD research. Thus, research was conducted during the 2010-2011 school year, the second semester, including students of two classes by the 9th grade students, high school classes, counting a total of 60 students from the Normal School Vasile Lupu, from Iasy, with the prior agreement of the school manager, which provided the teacher conducting research through the physical discipline. To ensure the experimental objective were selected two classes, one control and one experimental, to the physical discipline.

**2.1. Hypotheses of the research**

Using traditional methods, which is complementary to blog stimulating influence student learning.
Approached learning strategy**,** influence student motivation in the sense that virtual methods (blog) complementary to the classical result a high intrinsic motivation**.**

**2.2 Defining variables**

Independent variable is defined by a learning strategy addressed, namely the classical method and method of use accompanied the blog.

As dependent variables we have three: intrinsic motivation, perception and the stimulating learning environment.

**2.3 Description of the instruments**

In this study we used a motivation questionnaire, Students Motivation Toward Science Learning (SMTSL) The SMTSL combines theory used to develop the Motivated Strategies for Learning Questionnaire (MSLQ), and the Multidimensional Motivation Instrument (MMI). The MSLQ was designed specifically for college students and measures student motivation and learning strategies (Pintrich et. al, 1991). The MMI addresses the relationship between learning environment and motivation (Uguroglu et al, 1981).

The second instrument used was intrinsic Motivation Inventory (IMI). The intrinsic Motivation Inventory (IMI) is a multidimensional measurement device Intended to Assess Participants' experience related to the target subject in laboratory experiments activity. It has Been Used in Several experiments related to intrinsic Motivation and self-regulation (eg, Ryan, 1982; Ryan, Mims & Koestner, 1983; Plant & Ryan, 1985; Ryan, Connell, & Plant, 1990, Ryan, Koestner & So , 1991; So Eghrari, Patrick, & Leone, 1994).The instrument assesses participants' interest/enjoyment, perceived competence, effort, value/usefulness, felt pressure and tension, and perceived choice while performing a given activity, thus yielding six subscale scores. Recently, a seventh subscale has been added to tap the experiences of relatedness, although the validity of this subscale has yet to be established. The interest/enjoyment subscale is considered the self-report measure of intrinsic motivation; thus, although the overall questionnaire is called the Intrinsic Motivation Inventory, it is only the one subscale that assesses intrinsic motivation, per se.

Also, were conducted focus groups with students from both classes, the control and the experimental and they were processed by means of qualitative analysis. It was developed a protocol for the questions would be addressed during the focus-group students. These were recorded, asking them to, prior approval students.

**2.4 Procedures of research**.

The research was carried out directly on the reality of school, seeking to ensure, first, an experimental basis. For this purpose we used mainly pedagogical experiment method.

Two classes were chosen with a relatively homogeneous preparation. We want that to these classes to teach the same teacher. It was agreed to be the class of control and experimental, through Mrs. teacher, who proposed that students will make their first blogs to be part of the experimental class. Thus was created a blog to physical discipline, the experimental class in which teacher and students have access to post homework or questions about the ambiguities of knowledge taught. In this blog post homework or teacher directions for lessons taught information and explanations to the questions students also came along. Also, each student has created a blog, or they can used the same blog, that already had, although it was not for physical discipline. Numerous data obtained were correlated and unified with the methods such as direct observation systematic organization of the survey questionnaire based on written application of the scale of intrinsic motivation, focus groups with students who were subjected to experimental method. The processing of data and results of the procedures we used statistical method, namely SPSS and qualitative analysis method for focus groups.

The control class teaching similar lessons went normally, ensuring the same information content and using teaching methods and those who felt it would be better to raise the conduct of the lesson to a high degree master teacher, competitive with the assumed will be achieved by introducing new information and communication technologies in the experimental lessons. For example, graders experiment could resolve their issues and along the book but the blog could use the blog to ask various topics to get to school, and pupils in the control lacking access to a personal blog could achieve all duties to physical discipline, only during working hours, work through the book just demands and to maintain motivation in learning, were used as the main learning e-portfolio and class webblogul experimental and control class, the portfolio in paper format with the same requirements as other students and topics that users fully webblogul. In determining the effectiveness of information and communication technologies both in terms of facilitating the understanding of material taught and as that of facilitating learning conceptual method has been used mainly pedagogical experiment. Thus, we initiated an experimental situation, with a focus on those lessons include teaching and learning of knowledge about phenomena not accessible or inaccessible by nature, but only.

At the end of the semester, the students were exposed to the study, questionnaires were applied and held focus groups at different times of course. All students have applied to written instruments, face to face or online. The focus groups were attended by students from both classes, and they were selected in groups of 10 pupils, by teacher, so the focus group was attended by about every 20 pupils from each class. Focus groups were held in the park of high school, not being bothered by anyone and also ensuring a natural, casual students.

**3. Results**

To verify the first hypothesis was used Oneway ANOVA, Independent Sample T Test and have obtained the following values: t (58) = 1, 294, p = 0, 20 (insignificant) t (58) = 4.147, p <0.001 (significant). To highlight the differences, render and the average values of the two groups as follows: for the stimulating environment, M1 (for the control group) = 1, 28 and M2 (Experimental group) = 1, 72, and for intrinsic motivation: M1 = 2, 58, M2 = 2, 77. Students from the experimental group, that class has been used blog led to a significantly higher intrinsic motivation, and the control group, where there used to blog. They were actively involved in learning, showing greater interest in the tasks to physical discipline.

To verify the second hypothesis, we used Oneway ANOVA, Independent Sample T Test, trying to observe differences in terms of student learning motivation, for the two groups, control and experimental. Thus, the averages of the two groups are: M1 (blog) = 2, 87 and M2 (no blog) = 2, 77, and p <0, 001 (significantly); group blog where he used to determine differences intrinsic motivation in a significant way, unlike the group where he used only traditional methods.

To see the subjects perception in terms of learning, a focus groups were conducted. They were were held after a protocol of questions, with groups of 10 students in total are 20 students from contro, group and 20 students from experimental group. Interviews were recorded with the consent of pupils and their answers were then transcribed. Each focus group took approximately one hour duration. For the interpretation of student responses, was used as the content analysis technique. Thus were established categories, taken out of the interview guide, topics for each student and specifications for both class and for the experimental control, thus making comparison. Table. 1 will clearly play as defined categories and themes.

*Table no. 1* **Content analysis of the focus group questions**

| Category | Theme | Specification (examples |
|---|---|---|
| Learning in relation to use of the blog, that blog without using | Attractiveness / Novelty | "I thought again what I did in physics this semester. I have not done so. " "I want to continue in this way in the future." "It was attractive, we can use videos to illustrate the idea that". |
| | "The possibility of using the same methods in the future: blog, that only the classical method of learning. | "We want to continue, but we also want to have other means that we use, for example to have in class or Internet-connected computer to have blogs, as were other classmates' |
| "Strategies used. | Accessibility | "Very accessible. Unlike colleagues who were not able to use the blog, the new seemed easier from this point of view. " "If I blog, I could solve and subject to physical but to do other things that were not for physics, but I blog" |
| | | |

| | | |
|---|---|---|
| | The level of understanding. | "Yes, I understand better. What was clear in my class blog at home because I could clarify and send links, images, videos " "Retin better, using pictures or movies" "I liked to do portfolios, but it was nice to be able to come and other meansde exemplu power point, or do the work to which we can attach a video or power point " |
| | Collaboration | "We liked that we could collaborate. I had fears that we have to group " "It was interesting that we could send comments, blog and so we further stimulus" |
| difficulties encountered | Effort | "I found it very easy to blog, compared to colleagues from other classes that the portfolio had to write on paper or computer to transcribe" "It was hard at first I did not know very well I post, but then I liked and I found it quite easy" |
| | Tenssion | "I could not do our homework in our pace when we had time and could" |
| | Tehnical/physicaldiff iculties | "was harder for some of us, because we did not have internet access in the home tam sis, but I went to school lab, we can post on the blog and we did " "It was not difficult, but if we could put either a power point or electronic portfolio and post a picture or a movie, it was easier and more beautiful." |

After analyzing specifications, frequent answers to follow that fit the theme, namely the number of words that expressed the theme idea.

Data in Table no. 2, exact percentages will show us the answers.

*Tabel no:2* **The frequency of students responses**

| | Group blog | Whithout blog |
|---|---|---|
| Atractivity / novelty | 42 | 35 |
| Possibility to use in future | 50 | 40 |
| Accesibility | 65 | 44 |
| The level of understanding | 60 | 54 |
| Colaboration | 53 | 48 |
| effort: high or small | Small effort: 15<br>High effort: 5 | Small effort : 10<br>High effort: 5 |
| tension | 5 | 7 |
| Difficulties | Tehnical:4 | Tehnical/ physical: 4 |

Thus, the differences are not huge, but the answers grade students who used only traditional methods for learning, seems to see the regret of not having tried them virtual learning how they parandu them the simplest and certainly attractive.

**4. Discussion**

By using new information and communication tehnologies is now possible to stimulate students'curiosity, activating informal learning processes, which can be monitored and partially integrated through education, teachers in the traditional classroom programs in addition, the relationship between formal and informal learning activities, the teacher plays a crucial role in selecting the material to be included in the class, he became a facilitator.

Teachers should use the e-learning platform and adapted to provide students with interesting and diverse educational content to create a pleasant learning environment. It is necessary to use these instruments to provide informal learning for all students, including students of average ability to accomplish tasks and improve educational attainment.

Teachers should use informal processes in combination with formal processes in creatively to develop students' motivation, the main element in effective learning.

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# Context based Expert Finding in Online Communities

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**Abstract**

*Nowadays, online communities are one of the most popular collaborative environments in the Internet where people are free to express their opinions. These communities provide facilities for knowledge sharing in which, people can share their experience with each other. The main problem regarding to the knowledge sharing on online communities is the wide range of information on them without any mechanism to determine their validity. So, for knowledge seekers, it is important to recognize the expertise of each member based on contexts to find the best answers among all replies to his question. Although, lots of researches have been conducted so far to determine the level of people's expertise, none of them has had context based approach to the problem.*

*In this research a novel method based on social network analysis is proposed to find the experts in different contexts. For evaluation process of the proposed method, Metafilter Forum was chosen and the data has been processed in several steps. First, data were extracted, transformed and loaded to data base by ETL operations. Then, experts on different contexts were found by applying the proposed method on the processed data. Finally, accuracy of the method was calculated and compared with other methods.*

**Keywords**: Expert finding, Online communities, Link analysis, Wordnet

## 1. Introduction

Nowadays the Internet plays an important role in people's learning and education. Email was one of the first communication tools on the internet that enabled people to communicate and exchange knowledge. Nowadays because of the development of computer science and the appearance of new technologies like Web2, new applications like Wiki, Blog, Micro Blog, Social Bookmark Services, Social Network, Sharing File and Video system and Online Forum have been appeared. Some of these applications like Online Forums, Wikis, Social Networks and Blogs play an important role in sharing knowledge between users and eLearning (TuncaySevindik et al, 2010). For example in the research which was carried out with (Mazman and Usluel, 2010), in addition to Facebook social networks capabilities in the field of distance learning, its advantages in comparison with some eLearning tools like Moodle have been mentioned.

Generally online forums are the areas where different kinds of people are free to express their ideas by posting questions and answers on them. Some of the online forums' attributes like ease of use, usefulness, social influence and ease of communication have caused them to be welcomed by many internet users and become the most popular and useful web applications. People are helping each other in these forums because of many reasons like reputation-enhancement benefits, direct learning benefits, expected reciprocity and altruism. Today's usage of online forums in the field of distance learning is very necessary and useful. Some of these online communities like java online forum are dedicated to java programming language, so java computer programmers from all over the world can share their knowledge by answering others' questions. Some others like Yahoo Answers consist of wide range of different topics.

Because of the extensive amount of shared knowledge in online forums, the need to have a mechanism in order to determine the degree of the values of the presented answers is necessary so that the researcher will be able to realize the correct answers among all the answers. Most of the online forums have a mechanism to determine users' popularity which is usually shown with duke stars. For example in java online forum, users have duke stars that determine their knowledge. The higher number of her duke stars is, the more level of knowledge she has. The problem with this method is that its correctness depends on the correctness of user's evaluation. Also duke stars could not represent the field of people's knowledge. For example, one person is an expert in mobile programming but he does not know anything about servlet programming. Therefore, nearly in all online forums an automatic method to determine people's knowledge based on contexts is required.

In this research a novel method based on social network analysis is proposed to find the experts in different contexts. The Metafilter online forum has been chosen to test and evaluate proposed method. This online forum has different categories where people can post and comment on different topics. Furthermore, questions have some assigned tags which are related to the context of the question. Also the best answer among all answers for each resolved question in Metafilter Forum was chosen by the user whom asked that question.

This paper is organized as following. In section 2, the most related works are mentioned. In section 3, a novel approach for expert finding in online communities is introduced. Then in section 4, our methodology containing a step by step explanation of its stages has been presented. Also, accuracy of the proposed method was calculated and compared with other methods and at last, our study is rounded off with a conclusion in Section 6.

## 2. Prior Works

Expert finding problem has been one of the most top issues for researchers from 15 years ago. In the past, most researches in the field of expert finding had been conducted on organizations, but now they are being done on the Internet. So far, knowledge sharing environments like online communities are helpful tool for distance learning in terms of sharing knowledge and establishing relations between members.

If expert finding systems want to be a good expert recommender in online communities, they should find appropriate persons for asked questions. Most current expert finding systems employ information retrieval methods to find experts through electronic resources. In these systems, by calculating feature vector for every member's activities, the level of member's expertise will be obtained and used to recommend appropriate questions to each one. Results of these techniques are usually expressed as a non-rated list of people whom are extracted by using feature vector. By employing this method, experts will be determined, but their level of knowledge will be left unknown. Furthermore, information retrieval methods have some other deficiencies for expert finding (Littlepage and Mueller, 1997).

Ranking graph based algorithms such as PageRank and HITS were used with content analysis techniques in order to define the level of expert's knowledge. This work had been carried out as a research project to rank transferred emails between IBM's employees based on emails' subject. They discovered using graph based algorithms can have better results in comparison with content analysis techniques. Anyway, their research had some drawbacks such as the size of their network was too small which could not show the characteristics of knowledge relations in real online communities (Campbell et al, 2003).

In 2007, Ackerman with his team's members conducted their researches for finding experts on sun java forum. They pre-processed extracted posts from sun java forum in order to create members' social networks. Then they employed six expertise ranking algorithms on this network. With the help of simulation, they studied the effects of different network structures on the performance of their proposed algorithm. Then they had found some structural features which could affect the performance of expertise ranking algorithms (Zhang et al, 2007).

Social network analysis techniques were employed to study the structure of question and answer news systems. It was found that people's interactions patterns are affected by their interests. Visualization techniques were developed to study different interactions patterns in groups of Usenet. These visualization techniques are helpful to understand the whole picture of online interactions environments (Turner et al, 2005).

In another research, a new model was proposed to find the best answers in Yahoo Answers (YA). YA is an active social world with a great diversity of knowledge and opinion being exchanged which can be used as a tool for knowledge sharing. Different categories of this forum were analyzed properly and then categorized based on content properties and interactions patterns which exist among people. While interactions in some categories resemble expertise sharing forums, others incorporate discussion, everyday advice, and support. With such a diversity of categories in which people can participate, they found that some users focus narrowly on specific topics while others participate across categories. They found that lower entropy correlates with higher rating answers. Also by combining user attributes with answer characteristics, they could predict which answer will be chosen as a best answer (Adamic et al, 2008).

SNPageRank was proposed using PageRank-like algorithm to find influential people on Friendfeed. Friendfeed is one of the most active social networks on the Internet, which has high volume of shared knowledge with variety of different subjects. A star schema data warehouse was designed in order to store high volume of data and reduce processing time. Results were compared to the experts' opinions utilizing spearman's correlation function (Kardan et al, 2011).

As mentioned in previous section, depending on selected context, people could have different level of knowledge. So SNPageRank algorithm along with other mentioned methods, could not distinguish expertise in terms of different contexts.

**3. Context based Expert Finding Algorithm (CEF)**

In order to determine experts in each field, a new algorithm called CEF was presented. In this method some changes have been made on the PageRank algorithm (Page et al, 1998) so that it could be used to determine experts in online forums. In PageRank algorithm the nods are the web pages which are connected to each other by links existing between the pages. In CEF algorithm, instead of the web pages, the nods are the members of the forum and the communication between them is maintained by the posted questions and answers. In order to explain this algorithm, a simple example from an online forum with 5 members is presented in figure 1.

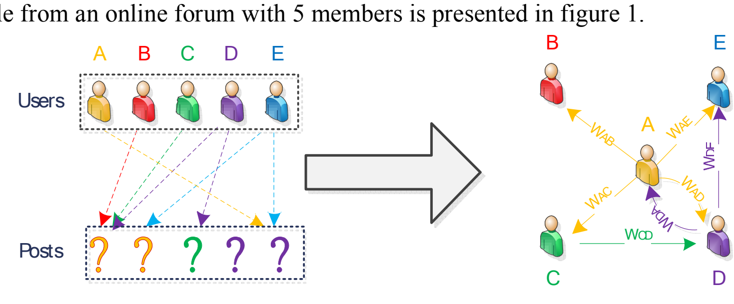


*Figure 22:* **A Simple Forum**

On the left side of the Figure 1, the members with their sent posts are illustrated. Each person's questions are shown with that person's color. In Figure 1, an arrow from person B to one of the person A's question shows that the person B answered the A's question. Based on the sent questions and replies between the people, the members' social network that was called Community expertise network (CEN) by Akerman is depicted (Zhang et al, 2007). It indicates what expertise exists within an online community, as well as how it is distributed in practice. In CEN an edge is drawn from the user making the initial post to everyone who replied to him. The CEN of our example is shown on the right side of the Figure 1. When a person answers another person's question, it indicates that the replier has superior expertise on the subject than the asker. The steps of CEF algorithm are described below:

### 3.1.Computing the Weight of the Edges

At first, the weight of each edge in CEN is computed. The weight of each edge is computed based on the number of answers and the level of communication between them and their specific field of study. Imagine in the mentioned example, we are going to identify the experts in the field of the Internet. So the edges of the CEN should be weighed according to internet topic. The weight of each edge is the sum of the amount of relationship between the posts and the Internet. In order to determine the amount of relationship between a post and the Internet, the distance between the tags of that post and the Internet is computed and then the average distances is considered as the amount of relationship between the post and the Internet. The distance between each tag and related specific field is computed by using distance function OSS that uses the WordNet dictionary (Schickel-Zuber and Faltings, 2007). This function gets two concepts as input and returns a floating point between zero and one by using anthology of WordNet. The closer each return's digit to zero, the more similar the two concepts are. In order to compute the weight of each edge the formula 1 is used.

[1] $$W_{AB} = \sum_{p=1}^{N_{AB}} \left( \frac{\sum_{t=1}^{N_p} (1 - \text{Distance}(T_t, C))}{N_p} \right)$$

In formula 1, $N_{AB}$ is the number of B's answer to A's questions, *Np* is the number of tags of post *P*, *C* is the related specific field, *T* is a symbol for tag and distance is the OSS distance Function that is used to calculate distance between context *C* and tag *T*. after computing the weight of edges, the CEN adjacency matrix is shown in the table 1.

*Table1* **Adjacency Matrix for the Simple CEN**

| | **A** | **B** | **C** | **D** | **E** |
|---|---|---|---|---|---|
| A | 0 | $W_{AB}$ | $W_{AC}$ | $W_{AD}$ | $W_{AE}$ |
| B | 0 | 0 | 0 | 0 | 0 |
| C | 0 | 0 | 0 | $W_{CD}$ | 0 |
| D | $W_{AD}$ | 0 | 0 | 0 | $W_{DE}$ |
| E | 0 | 0 | 0 | 0 | 0 |

### 3.2. Transition Probability Matrix

In order to build transition probability matrix, at first we use Adjacency matrix. If there is a row without a number except zero in Adjacency matrix, all of its components are put in *1/N* in which *N* is the number of members in online forum (e.g. *N* is 5 here). In this example the rows B and E do not have number except zero. Then, the amount of each cell is computed by using the formula 2 for other rows.

[2] $$\frac{W_{ij}}{\sum_{Z=0}^{Z=N} W_{iZ}}$$

In formula 2, $W_{ij}$ is the weight of the link between $i$ and $j$ which was computed previously. By employing formula 2, the average weight of each link is computed according to the other links of that person. After making the mentioned changes on the adjacency matrix, we multiple 1-$\alpha$ by all the table cells. The amount of $\alpha$ is the probable of teleport operation. In teleport, surfer can jump into each node in the graph. The destination of teleport operation is selected randomly.

If the number of the existing nods in the graph is equal to $N$, then the teleport operation will transfer the surfer to any node (even the present node) with the probability of $1/N$. In this procedure, If a node doesn't have any output link, then the teleport action will be done, otherwise it will be done by probability of $\alpha$ in which $\alpha$ is between 0 and 1 (usually 0.1). Finally the amount of $a/N$ will be added to all cells.

### 3.3. Expert Finding

In this part by employing PageRank calculation, the experts in the field of $C$ are determined. In order to do the calculation, location probability vector that shows the probability of the existence of the surfer in each node, is employed. Suppose at first, we are in node A. So the location probability vector equals to $X_0 = (1, 0, 0, 0, 0)$. The location probability vector X1 is obtained by multiplying location probability vector X0 by transition probability matrix.

The location probability vector X2 also is obtained by multiplying the $X_1$ by transition probability matrix, and the other location probability vectors are computed in the same way. This calculation is continued until the result of multiplication between location probability vectors and transition probability matrix is reached to a constant amount. It means $X_z = X_{z+1} = X_{z+2} = \ldots$.

## 4. Methodology

In Figure 2, the architecture of proposed system for finding experts in online communities is illustrated. Therefore, we split this section according to the stages of proposed architecture.

### 4.1. Crawler

First of all, the user's data from the Metafilter forum are extracted using the crawler and then they are stored into text format files. To do that, we write special crawler in C# language according to structural characteristics of Metafilter forum.

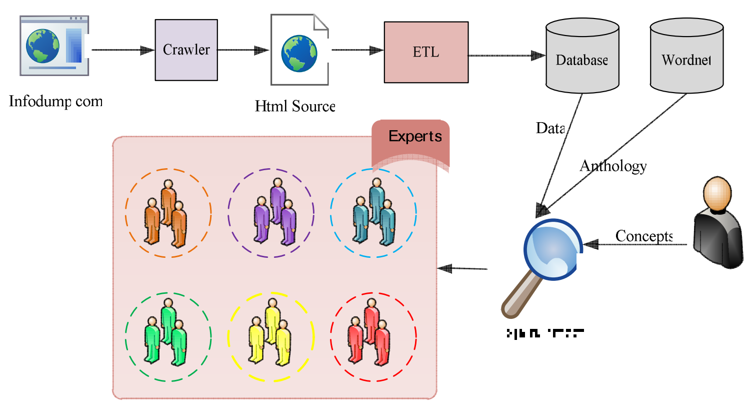


*Figure 23* **Proposed Architecture for Context based Expert Finding**

### 4.2. ETL

Before the data could be used, they should be stored in a well formed structure in order to make queries possible on the data. The required data are extracted from text files by using regular expressions in C# language and then the proper data are separated and after doing pre-processing and cleansing operations, are loaded to designed database.

After loading data into database, the following cleaning phases will be done on the data.

- All users, whom the count of their questions along with their answers is below 20, will be deleted from database.
- All the questions without any replies will be deleted.
- All the questions without any assigned tags to them will be deleted.

The statistical information about Metafilter forum after doing above cleaning phases on data is displayed in table 2.

*Table 2* **The Statistical Information of Metafilter Forum after cleaning operations**

| Number of all users | Number of all questions | Number of all answers | Average number of questions for each user | Average number of answers for each user | Average number of answers for each question |
|---|---|---|---|---|---|
| 15502 | 165702 | 2400864 | 12 | 160 | 13 |

### 4.3. Expert Finder

In this stage, by employing CEP method on cleaned data, experts in specified context will be determined. CEP shows the level of each user's expertise by a number between 0 and 1. The higher this number is, the more level of knowledge user has. As mentioned in section 1, the best answer for each resolved question in Metafilter forum was chosen by the user whom asked that question. By having the result of CEP algorithm we can know who has enough knowledge to answer each question. Thus we can calculate the accuracy of expert finding methods by employing formula 3.

[3] $$Accuracy = \frac{N_1}{N_1+N_2}$$

In formula 3, $N_1$ is the number of asked questions which expert finder method could find the best answerer for them and $N_2$ is the number of questions which expert finder method could not find the best answerer for them. In figure 3, the accuracy of proposed method for each context is illustrated. Also, other expert finding methods which were described completely by Akerman (Zhang et al, 2007) were employed in order to compare the accuracy of CEP with them.

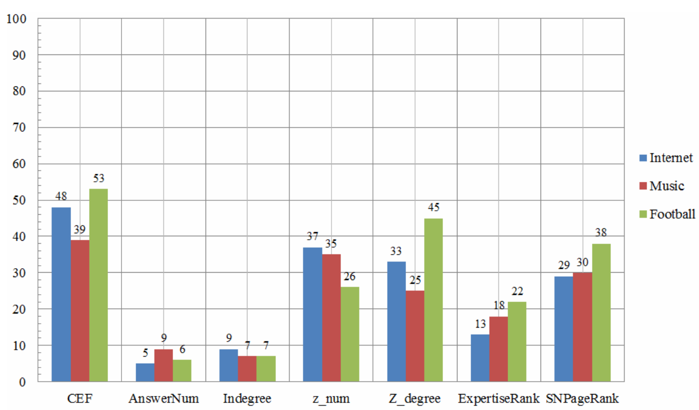


*Figure 24* **The Accuracy of Various Algorithms**

To do that, we chose three different contexts which they were Internet, football and music. Then for each context, we selected 100 related resolved questions randomly as a test data. The best answerer is found by employing each mentioned algorithms in figure 3, separately, for all questions in test data. As was shown in figure 3, CEP method gained higher accuracy in comparison with other methods in all three contexts.

## 5. Conclusion

In this paper, a novel model was proposed for expert finding on online communities. After doing a comprehensive research about expert finding, a new architecture for expert finding in online communities based on context was introduced in this research. We wrote a crawler program to crawl data from Metafilter forum. And also a database was designed to store Metafilter data after doing cleaning operations on them. Then a new ranking algorithm -named CEP- had proposed to determine the expertise level of users in a specific context by employing social network analysis techniques and Wordnet dictionary. In this algorithm, unlike prior ranking algorithms, the connections between nodes are weighted. Finally, the results of comparing our novel model with other ranking algorithms shows that CEP gained higher accuracy in comparison with some well-known prior algorithms, in order to find the best answerer for each asked question.

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# Making Use of Educational Computer Games in Modern Teaching and Assessment Models, Methods, and Practices

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## Abstract

*In order to transform the student into an active person which, guided by teachers, discovers and scrutinizes new knowledge territories, there are new teaching strategies in agreement with the student's learning manners. This paper stands up as an argument for a broadening of the assessment methods used in the science teaching process. The main goal of the authors is to emphasize ways of achieving learning excellence by usage of modern educational means. This bold aim can be reached by using educational computer games in the teaching-learning-assessing process. We focus upon the advantages of this method taking as example such an educational game.*

**Keywords**: Educational computer game, Elementary particles, Higgs Boson

## 1. Motivation

Throughout our career we could not help noticing that students love computer games. So, what does the juxtaposition of the words "game" and "elementary particles" makes you think of?

Primarily, it is about a pleasant, interactive, playful activity, a hands-on way of teaching, meant to harmoniously shape and develop the student's personality. He or she discovers the pleasure of searching and finding new things to subsequently use further on. These successive inquiries, when conducted into a scientific environment, become more and more interesting but also difficult, thus the satisfaction getting even more rewarding.

Secondly, we have in mind the elementary particles physics and nuclear interactions, which describe the laws governing our universe (Gell-Mann, 1995). In the last few decades there has been an ongoing struggle to develop this field and make new discoveries. Sadly, the textbooks do not reflect, not even superficially, these efforts.

## 2. Introduction

Hands-on training has always been considered an essential part of experience in the Physics teaching-assessment process. The recent teaching-assessing research papers have introduced ideas and stimulated thinking on various alternatives to the traditional didactic lectures and repetitive "cook-book" practices (Torretti, 1989). Obviously the effective management of educational change is crucial, but there was overall a willingness to explore the possibilities, despite cultural and traditional barriers to change. For some, too, such new approaches represent significant threats to the authority of the teacher, but many warmly embraced the ideas and debated a variety of strategies that would assist students to control their own learning (Newhouse, 2007).

The method clearly reflects a commitment to a student-centered approach and represents one form of active learning. Students faced with a problem presented to them in a group situation must work together to identify the issues and find a resolution to the problem that is presented to them.

The integration of the PC in the Physics education opens new perspectives and allows achieving outstanding performances (Moraru et al, 2011).

As any good teacher knows, all students do not learn in the same way. In addition, it is common for a class of students to be at a variety of levels in any particular subject. Teachers need to use different teaching methods in order to reach all students effectively. A variety of teaching strategies, knowledge of student levels, and an implementation of which strategies are best for particular students can help teachers to know which teaching methods will be most effective for their class.

The first step to choosing a teaching method is to assess the students. This assessment can be formal or informal. Formal assessments include standardized tests, tests from the textbook or curriculum being used, or teacher-created tests. These assessments can give you an idea of the previous instruction that the students have received as well as their academic level (Cohen, 1988). The students in your class may have undergone various teaching methods and quality of instruction in previous years. There are many, many teaching methods. If the teacher finds the best teaching method for a particular group of students, the students are likely to learn more quickly and be more engaged. In addition, using a variety of teaching methods will keep children from being bored, and help them encounter the information in new and exciting way. In an active and interactive teaching and learning process, the student is no longer a passive receiver of knowledge processed and spread by the teacher. Contrarily, the student becomes an active person which, guided by teachers, discover and scrutinize new knowledge territories. The main goal in an active and interactive teaching learning process must be to help the students to discover the pleasure of inquiry and learning, which leads to increase confidence in their forces. The usage of modern technologies and educational software is a must of the modern educational process (AAAS, 1993). Students, teachers, schools and parents can all benefit from accurate knowledge of a child's skills early in that child's educational career. However, traditional assessments of skills are labour intensive and can invoke anxiety in the children. This project tested the idea that computerized assessment games might work as a support tool for teachers, providing useful information about children whilst avoiding almost all the problems associated with traditional testing.

Handling, applying and evaluating the educational games method, allows the students to be able to:

- manipulate numerical and other data;
- use information to identify patterns, report trends, draw inferences and report conclusions;
- present reasoned explanations for phenomena, patterns and relationships;
- make predictions and put forward hypotheses;
- apply knowledge, including principles, to novel situations;
- evaluate information and hypotheses.

These assessment objectives cannot be precisely specified in the syllabus content because questions testing such skills may be based on information that is unfamiliar to the candidate. In answering such questions, candidates are required to use principles and concepts that are within the syllabus and apply them in a logical, reasoned or deductive manner to a novel situation (Cohen, 1988).

## 3. Objectives

The main objectives of the educational game project are:

- supporting students hands-on learning of science;
- delivering hands-on activity resources to educators;
- offering online training on the design process to educator;
- learning more about Physics in an unconventional way;
- pointing out of anchor-knowledge necessary in the teaching of new concepts, and training of the students in the area of conceptual and operational structures constructions;
- integrating the achieved knowledge and intellectual strategies into a derived general scientific frame;
- uncovering areas of special need that may be difficult to identify without special assessment;
- exploring how multi-sensory needs may be accommodated within a game assessment framework (AAAS, 1998).

## 4. Description of the Game

Games designed for individual assessment of high school students, such as “You too can search for the Higgs Boson”, can provide invaluable additional information to help teachers and students learn more about this modern but difficult Physics subject.

This is a 3-levels computer game.

### 4.1. The First Level

The first level introduces basic concepts regarding the elementary particles, such as:

- atom,
- nucleus,
- electron,
- proton,
- neutron,
- quark,

and so on (http://www2.slac.stanford.edu/vvc/cosmicrays/cratmos.html).

At this level, the student will accumulate information and coins. The coins can be transformed in energy, and used at the next level to buy hints, answers, or different goodies (useful information for the next levels, and so on).

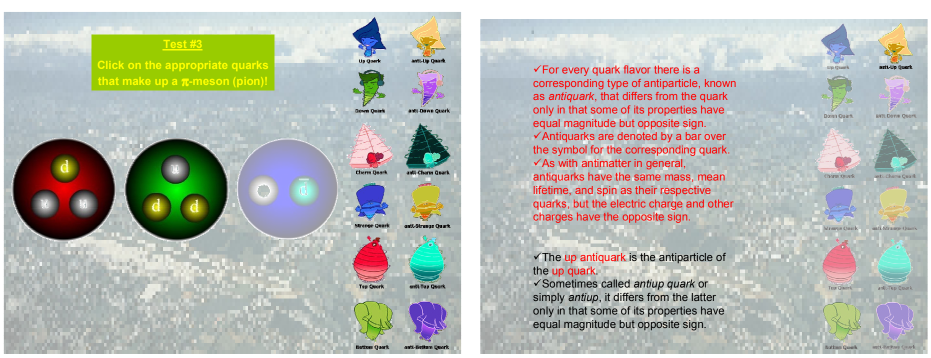


*Figure 1.* **Two screenshots taken from the “You Too Can Search For the Higgs Boson” educational software**

### 4.2. The Second Level

The second level treats rather simply things regarding:

- detectors,

• accelerators,
• components assembling.

There are simulations involving notions regarding the movement of charged particles in electric and magnetic fields.

Also, by drag-and-dropping, the student will assemble particle accelerators: LINAC, Syncroton, and Cyclotron (http://web.mit.edu/8.13/www/JLExperiments/JLExp14.pdf).

**4.3. The Third Level**

The third level provides a virtual tour of the CERN.

• At the end, the student will find out what energy does the Higgs boson have and whether he or she managed to discover it or has to start the game all over again.

• When the final energy is converted into mass, if the student gets a value between 124 and 200 GeV/c2, he or she will receive the message: “Congratulations! You found the Higgs Boson”.

• If the energy is lesser than the first value, the message will be: “Sorry! Keep searching!”

**5. Conclusions**

The enhancement of student-student and student-teacher communication skills will raise the interest of the partners in education. This way, the lesson focused on the student becomes reality, the student, as well as the teacher, being interested in the outcome of the didactic activities (AAAS, 1993). A modern teaching process must give the students many quality and modern resources, including educational games. We have always had the desire to offer more than usual text book can offer, to go beyond what one studies at school in some subjects, to combine fields. These applications give us this opportunity! On the one hand, this educational game can be used very well in classes, to improve the lessons. One the other hand, it invites the students to find out more by individual study, exploring the interactive lessons and taking the challenges.

We argue for a paradigm shift because the traditional teaching methods cannot deal appropriately with the avalanche of new knowledge and with the accentuated dispersion of the activity domains and jobs. We are not pleading for a rebuttal of the traditional teaching methods, especially in the first years of school, when the personal touch of the educator remains of most importance, but we strongly believe that the usage of modern technologies and educational software is a must of the educational process, an addition to the classical methods, appealing to the individual character of each student (Stoica et al, 2010).

Well-designed games can allow students to be assessed without them being aware of that, thereby avoiding the anxiety that traditional testing can induce.

Game-based assessments can provide information on possible hearing issues, colour blindness, and emotional recognition which may not necessarily be picked up in class until some way down the line. They can also provide information about how children perform on various cognitive skills as well as higher-level skills like literacy and numeracy (Moraru et al, 2010).

**6. Still to Come in the Future**

In order to make this educational game as inclusive as possible, and further assess its accuracy and validity, the following step is planned for the future.

It will be useful and interesting to have it reviewed by a group of teachers and students. Subsequently, their observations and suggestions will be implemented in the final version of the program.

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# Representing Human Resource Knowledge in RDF

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**Abstract**

*Companies give increasing importance to employees and their needs. Lately the organizations are trying to create different spaces to relax for employees and to offer them the opportunity to participate in various leisure activities, individual or group (fitness, football, outdoor activities etc). In a knowledge based society, this attitude is natural as employees are the main actors in the harmonious development of the company. However, in many cases, the knowledge held by employees is not put to use properly. This is due to the fact that on many occasions, the management is not aware of the capabilities and skills that the employees possess. In the same time, the needs of the employees are hard to discover. Our solution, wants to solve these problems by representing the relevant data about each employees in RDF (Resource Description Framework). Some of these data will be taken from the company's relational database, some data can be added directly in RDF, and also we are trying to make use of the social networks, which are used by employees, to extract some relevant data, like the history of employment or hobbies, which can be useful in different situations.*

**Keywords**: RDF, human resource management, social network, relational model

## 1. Introduction

Human resource management is a complex activity, which can have a major contribution in the success of a company. Therefore we consider that the employees needs present a significant importance in the current economy. Lately an increasing number of organizations are trying to create different spaces for employees' relaxation and to offer them the opportunity to participate in various leisure activities, individual or group (fitness, football, outdoor activities etc). This attitude is natural due to the relationships that exist between the human capital and firm performance. All the elements involved in the production, research and technological process, depend on the activity of human capital. However, in many cases, the knowledge held by employees is not put to use properly. This is due to the fact that on many occasions, the management is not aware of the capabilities and skills that the employees possess. In the same time, the needs of the employees are hard to discover.

Our proposed model, wants to solve these problems by collecting the relevant data about each employee and representing this data in RDF (Resource Description Framework). The multitude source of data existing in the current knowledge based society leads to the need to collect data from various disparate sources. In our specific case, human resources, some of these data will be taken from the company's relational database, some data can be added directly in RDF, and also we are trying to make use of the social networks, which are used by employees, to extract some relevant data, like the history of employment or hobbies, which can be useful in different situations.

In this document in section 2 will be presented the problem context and statement, which contains a brief introduction in human resource field and the advantages that has in practice the

RDF representation of human resources knowledge. In section 3 will be introduced the design details for the proposed model, followed by the presentation of some implementation details. And then in the following sections the evaluation and final conclusions of this paper.

## 2. Problem Context and Statement

### 2.1. Context

We agree the idea expressed by Cappelli and Singh, presented in (Wright *et al.,* 2001) related to strategic human resource management, that "certain business strategy demands a unique set of behaviors and attitudes from employees and certain human resource policies produce a unique set of responses from employees". Therefore we consider that in the current environment, characterized by rapid change, the companies have to encourage the development of employees in order to obtain the desired organizational performance.

RDF is a knowledge representation framework, developed by Word Wide Web Consortium (W3C) and underlying the Semantic Web paradigm, which offers the possibility to represent knowledge "in a very meaningful way". The RDF idea is based on triples. Every triple has a subject, predicate and object, leading to the possibility of expressing knowledge in a format close to natural language (Berners *et. al,* 2001) (Russell, 2011). One of the justifications of the RDF usage may be the fact that this format simplify the aggregation of data from different sources and also simplify the exchange of data with other systems (Pollock, 2009).

A lot of research papers about RDF representation were found. For example, in (Berners *et al.*, 2001) and (Klein, 2001) is presented the RDF format from a theoretical point of view. The study presented in (Vdovjak and Houben, 2001) treats approximately the same theme like us, RDF architecture for semantic integration of heterogeneous information sources. This paper argues for a semantically unified interface for querying heterogeneous information sources, while our approach make use of data retrieved in social networks and existing relational databases.

Regarding the translation of data from the relational database into RDF our approach is closest to that described in (Bizer et al., 2005) that highlights the applicability of Semantic Web technologies in the recruitment process for a job, starting from a relational database, using a mapping file, exactly like our solution does. But, in addition our model proposes the use of some data extracted from a social network, Facebook.

As for related works in the social network field, some adequate examples are presented in (Russell, 2011). These examples represent the starting point for the process of extracting data from a social network, which is employed in our work.

Our proposed model is different from those just mentioned, not because introduces some novel particular ideas, but because the combination of the technologies of extracting data from different sources and aggregate them in RDF.

### 2.2. Statement

To get maximum performance from employees they must be satisfied by professional position they occupy, the tasks assigned to them, professional and personal development opportunities, recognition, work environment, entertainment activities offered by company, etc. This can be accomplished only if the company holds the appropriate information about personnel. Even if an organization has access to all this information the process of aggregating and organizing this huge amount of information is a major challenge. Our solution tries to meet this challenge by representing the collected data from various sources in RDF format.

Our approach provides a model based on RDF which relies on the relational model and also on social network data. That's because the sources of collected data relevant to our human resource model, are the existing relational databases and the data existing in the social network.

The relational models, at the moment of writing, are the most popular data repositories, and are used by the most applications. They represent a mature technology, a very efficient way for storing large data sets where the model does not change and can be predicted. A major limitation of the relational databases is represented by their rigid schema, after the definition of the relationships between tables this are difficult to be changed, and in real life, change is inevitable. In our model this limitation is exceeded by the usage of RDF format, which is based on a extensible schema, offering the opportunity of incremental enlargement of the initial scheme. RDF repositories also offer portability and easy integration with other data sources, like the data extracted from the social networks (Segaran et al., 2009) (Pollock, 2009).

A social network can be defined as a web service that allow people to construct a profile within a bounded system, articulate a list of other users with whom they share a connection and view and traverse their list of connections and those made by others within the system (Boyd and Ellison, 2007).

Since their apparition, social networks, like Facebook, Twiter, MySpace, LinkedIn, Foursquare are continuously increase their number of users. Gradually, social networks become a daily activity for a significant number of people. Including, American president Barack Obama is active on Facebook, Twitter, LinkedIn and Foursquare to keep the public informed (Site1).

In our approach the extraction of data from social network plays an important role, because in order to keep the employees satisfied, a company needs essential information about their personnel, like interests, favorite sport, or even job history and often this information are published by the users on social networks.

Using RDF representation has several benefits. RDF format may represent the basis for communication between people and/or between software agents, and this can be an opportunity which can be exploited in the future by integrating the model we proposed in an application. Also, RDF can represent and organize the knowledge base of a company; in our particular case, the obtained RDF repository can provide enough support for an appropriate human resource management, because RDF format provides knowledge maintenance and interoperability between applications.

## 3. Design Details

Since our proposed model is based on collecting and representing the knowledge held by a company about each employee, our work is focused first on translating the relevant data available in existing relational database into RDF representation, then in adding more data, through simply RDF triples, very close to natural language, and at the end, on the process of extracting relevant data from the social network Facebook. A graphical visualization of the process can be seen in Figure 1.

As can be seen in Figure 1, the relational database is mapped in a RDF repository through a mapping file, which is written in RDF, using the N3 (Notation3) syntax. The mapping file is implemented in D2RQ language using D2R server. The D2RQ mapping language is a declarative mapping language that describes the relationships between a RDF repository and a relational data model. The D2RQ server is an instrument for publishing the relational databases on the Semantic Web. It provides query capabilities on this content with the SPARQL language. The D2RQ server includes the SPARQL protocol, an endpoint at the relational database (Bizer, 2004).

Some useful data which will be translated from the relational model to our RDF repository consists primarily of employees' identification data, such as name, year of birth, address, etc.

In RDF the subject, predicate and object are known as RDF triples, and they have the form of absolute URLs (Uniform Resource Locator) representing real-world concepts. The triples may be added simply to RDF file with the use of a normal text editor tool.

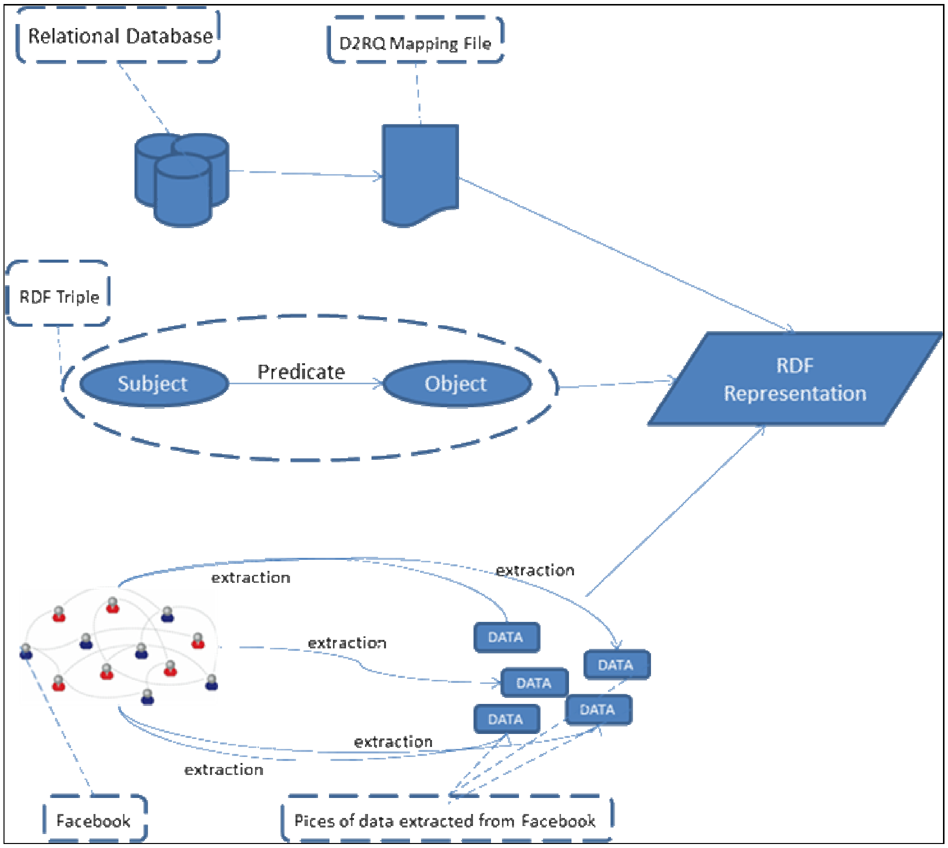


*Figure 25.* **Proposed Model**

Related to the social network Facebook, our model extracts the needed data through the Facebook Graph API, which more precisely, enables the read of Facebook data. Facebook network is based on a social graph which is composed of people and the connections they have to everything they care about. The data returned by Facebook are in JSON format, which are then processed by Python (site2).

## 4. Implementation Details

Usually any organization has a computer system, which often contains basic information about employees, and which generally is based on relational model. Our model has as starting point this assumption, and maps the desired data in RDF repository. This is done by D2R Server and D2RQ language. The mapping process of the relational database into RDF uses mainly ClassMap and PropertyBridges. A ClassMap is a class or group of similar classes, and each ClassMap has a set of PropertyBridges, which specifies how to create instances of properties.

For mapping a table *Employees* into a RDF class *Employee*, we use a URI pattern, which is created using the class name, in combination with the columns FirstName and LastName:

```
map:Employees a d2rq:ClassMap;
    d2rq:dataStorage map:database;
    d2rq:uriPattern
"Employee/@@Employees.FirstName@@@@Employees.LastName@@";
    d2rq:class :Employee;
```

To create the property hasPosition directly from the database is used the following N3 syntax:

```
map:hasPosition a d2rq:PropertyBridge;
    d2rq:belongsToClassMap map:Employees;
    d2rq:property :hasPosition;
    d2rq:column "Employees.Position";
```

The D2R server processes the mapping file and transforms the database records into RDF triples. For a table record, which has in the column FirstName, *Ionescu,* in the column LastName, *Adrian* and in the Position column, the value *SAP Developer,* the output of D2R server in N3 serialization is:

```
<http://localhost:2020/Employee/IonescuAdrian>
      a :Employee ;
      hasPosition "SAP Developer" ;
      .
```

Facebook can contain different information about users: information about education, current job, job history, favorite activities or different interests. For the company, this kind of information can be useful. For example work history, more exactly the history of positions can help the management in distribution of employees on projects, or the clustering of the users, employees of company, based on common interests or favorite activities with the aim of organizing a teambuilding.

In order to extract data from Facebook through the Graph API, provided by Facebook to developers, the Python language is used. A preparation process is needed before Python can access the data provided by the social network. Any application that uses data from Facebook, have to respect the users privacy. So, the Graph API allows access to all public information about an object. For example, the first name, last name of a user represents public information, and we do not need special authorization to access this data. The access to additional information about a user requires special permission, an access token, for the Facebook user (site2).

If the company wants to extract employees interests, probably because is planning to organize a teambuilding and wants to know the interests of their personnel, the code in Python, resolves the question (after the import of adequate libraries - like Facebook, JSON, etc) Before access the interests the necessary permissions are obtained for user_work_history to access the employers name, this representing a condition to select only the company employees; user_interests to be able to retrieve the employees interests.

```
user_ids = []
while True:
      results = gapi.request('search', {
                              'q': Q,
                              'type': 'user',
                              })
      if not results['data']:
```

```
            break
      ids = [user['id'] for user in results['data'] if
user['employer'].lower().find.(testCompany) > -1]
      if len(ids) = = 0:
            break
      user_ids += ids
if not user_ids:
      print 'No users permitted the access or no users are
employees'
      sys.exit()
groups = gapi.get_objects(user_ids, metadata = 1)
for u in users:
      user = users[u]
      conn =
urllib2.urlopen(user['metadata']['connections']['interests'])
      try:
            interests = json.loads(conn.read())['data']
            finally:
                  conn.close()
            print user['name'], interests['name']
```

**5. Evaluation**

*Strengths*:

- Our proposed model offers the advantage of data collection automatically from a relational database, through a mapping file, implemented in D2RQ language. In this way the company can make use of existing data, and is not wasting time with data collection and with the transcription of this data into RDF. Also, an important amount of relevant data can be found on social networks, including Facebook, and our model makes use of this data.

*Opportunities:*

- The model obtained for representing knowledge related to human resources may be integrated in a system for further processing the collected data. Also, this model represents a cheap solution for integrating the data from various sources.

*Threats:*

- Our solution for representing knowledge is based partially on collecting various data from Facebook, and the companies may be skeptical regarding the use of such data. Although the process of extracting non-public data takes place only with the agreement of the social network user, people often give their consent for the processing of these data, and then complain that their privacy is invaded.

**6. Conclusions**

Company success depends majorly on employees’ performance. A maximum performance can be obtained from employees, if they are satisfied, and for this the company needs an adequate model for representing and collecting the data related to personnel.

The major objective of this work was the collection and representation of knowledge held by the company about each employee. Heterogeneity of data sources that are available to companies, are difficult to integrate and the integration represent a real challenge. The model we proposed in this paper is based on RDF representation, in order to facilitate future integration with other data sources.

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# Computer Skills Analysis in National Curricular Documents

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**Abstract**

*Computer skills even though necessary in education in the informational society are nevertheless little mentioned in the projected curriculum and even less so in the accomplished curriculum. Although our research is very wide and aims at the development of these skills in both students and teacher, in regulatory, curricular documents as well as in didactic activities. The micro-research presented in the current article focuses on the analysis of computer skills in curricular documents (master plan, school curricula) valid between 2000 and 2005 and on capturing the evolution/modifications per school discipline/ curricular area/ school year. The focus on this type of skills was monitored based on the structure of compulsory curricula and the conclusions had in view a focus on objectives (master objectives and benchmarks), specific learning activities, contents, methodological suggestions etc. within this category of skills that is so much discussed about and so little put in practice in the Romanian education system.*

**Keywords**: computer skills, curricular documents analysis, national curriculum

**1. Introduction – specialized skills necessary in education in an informational society**

In our research a first step was accomplishing an analysis of the national curriculum (master plan, school curricula etc.) aiming to highlight the correlations between ICT/Internet and the elements of the teaching process (objectives, contents, teaching resources, evaluation methods), the initial and continuous training programs of teachers and school mangers.

In this analysis we sought to highlight computer and Internet usage skills and abilities for both students and teachers as the activities carried out within our research have particularly involved their use.

The purpose of the analysis was to capture the level of computer and Internet usage abilities required by compulsory national curricular documents but also the capacity and willingness to exercise them in educational practice.

Curricular analysis preceded the other stages of our research which consisted of the analysis of Internet used as educational tool, observation of teaching activities and assessment of students' performance.

**2. Research Methodology**

**2. 1 Analysis of competences in the national school curriculum**

Curricular analysis was carried out in two stages:

- Analysis of the education master plan in which we seek to highlight the importance of ICT/Internet use in the learning process (as an independent subject);
- Analysis of school curricula (valid between 2000 and 2005) for the subjects studied in grades I to XII (vocational branch only).

**2.2 Analysis of master plan (national curriculum)**

The analysis of the functional structure master plan in the school years 2000 – 2002 as compared to that of 2003 – 2005 denotes that for the “Technologies” curricular area we have as part of the fundamental acquisition cycle and the development cycle subjects like “Practical skills” (grades I to IV) and “Technology Education” (grades V to VIII) and as part of the observation and orientation cycle there is “Informational technology”, “Informatics” and “Computer Aided Training”.

Thus we notice that although the need for computer skill training is evident from the first years of schooling the specific subjects in the core curriculum to develop these skills are not included in the curricular document. An immediate explanation may be the lack of adequate equipping of primary or secondary schools and/or the lack of training in information technology and communications for the teachers.

At the same time we notice that or the curricular area “Technologies” the number of hours for grades I to VIII (1-2 hours) has not changed whereas for ninth grade two compulsory hours were added instead of the previously one hour per week for the subject “Information technology”. This is also due to the effort of equipping the high schools with computer networks and Internet connectivity as well as the existence of specialized teachers.

Ninth grade being a year of study with emphasis on skill development for consolidation and further specialization further explains the emphasis on acquiring skills and competencies in new technologies.

From the analysis of curricula does not directly and clearly appear the concern for the formation of computer skills because only the subjects and allocated number of hours are indicated there, therefore curricular documents indicating the concern for developing such skills are rather considered the school curricula in which the intent and even the concrete learning activities and methodological suggestions are specified concerning the development and practice of Internet use in various subjects.

**3. Discussion. Considerations about our Investigation Findings**

**3.1 Analysis of school curricula**

During our analysis we watched how computer and the Internet occur in the structure of school curricula at the level of framework objectives, benchmarks, learning activities, contents, methodological suggestions etc. for the subjects studied in grades I to XII.

From the analysis performed for the primary education for school years 2000 – 2002 and 2003 – 2005 no references are found in relation to computer and Internet use for any subject in particular. This can be explained as a specific focus of this level of education on the knowledge transfer and training of general culture. Even if the common core curriculum in its formal written explicit form does not reflect concerns in the field of computer and Internet use, teachers can resort to the number of hours dedicated to optional subjects to be used for “Information technology” starting with first grade for which the Ministry of Education and Research proposed an optional curriculum.

For fifth to eighth grade we notice that in the curricula made and applied starting from the 2001 – 2002 school year we find direct references to the use of information and communications technologies, computer and Internet to computer skills training for subjects such as Physics, Chemistry, Mathematics and technology Education through suggested learning activities as per the table below:

| Subject | Grade | Content-related skills required by ICT |
|---|---|---|
| Physics | VI | • *Monitoring the use of aids in achieving laboratory essays (graph paper, computer etc.);* |
| Physics | VII | • *Monitoring the use of aids in achieving laboratory essays (graph paper, media arts, computer etc.);* |
| Physics | VIII | • *Use of modern editing, copying, some multimedia elements (drawings, photographs etc.);* |
| Mathematics | VII | • *Calculations using the computer (pocket calculator, PC, etc.) and learning algorithms, systematically putting out errors due to rounding;* |
| Mathematics | VIII | • *Calculations using the computer (pocket calculator, PC, etc.) and learning algorithms, systematically putting out errors due to rounding;;*<br>• *Use of software to learn mathematics; Internet surfing.* |
| Chemistry | VII | • *Interpreting information through computers, films and slides.* |
| Technology education | V-VIII | • *Practical activities for the use of software.*<br>• *Practical activities for computer and software use. Use of text editor, worksheets, databases applications, Internet for activities encountered in other subjects;*<br>• *Practical activities for computer and software use;*<br>• *Discussions over the articles of copyright law and their significance;*<br>• *Gathering information from magazines, collections, CDs, Internet, sending a fax, email etc.* |
| Biology | V-VIII | • *Exercises to use albums, atlases, encyclopedias, collections of dedicated texts, Internet; exercises to use information sources: atlases, albums, magazines, databases, videos, Internet; use and development of educational software.* |

**Competences required by ICT use in school curricula**

From the curricular analysis of the school curricula for the fifth to eighth grades we notice the presence of suggestions for learning activities only for the disciplines in the curricular areas "Mathematics and sciences" and "Technologies". These take into consideration the use of computer and Internet as well as educational software.

Such suggestions can be observed mainly for the seventh and eighth grades and less for the end of the development cycle (fifth and sixth grade). At the same time we notice there is no direct reference to ICT in formulating the framework objectives and less often so in the benchmarks (Technology Education for sixth to eighth grades).

We find Internet as a teaching tool that fits harmoniously in all the educational resources offered.

In ninth to twelfth grades, for 2001-2002 school year there are *methodological suggestions* referring to the use of computers for subjects within the curricular area "Mathematics and Natural Sciences" while the needs of the information society are addressed by explicit formulations in the curricular modifications of the 2003-2005 school years. One can notice the Physics emerges as a special concern for the practice of ICT use skills through the detailed formulations of methodological orientations:

The use of ICT in teaching Physics aims essentially at the following objectives:

*A. Increase in the efficiency of learning activities*

*Therefore ICT is used for:*

- ***Shaping physical phenomena and operation of devices****. In all possible cases the phenomena and devices will be first introduced in the laboratory or studied by direct observations in nature or in practice respectively.*
- ***Experimenting in virtual labs.*** *Virtual labs constitute alternative or complementary resources in the experimental study of physical phenomena. The use of virtual labs is recommended in the following situations:*
  - *Creating the experiment in the virtual lab follows the actual experiment and allows the students to have control over a greater number of factors influencing the studied phenomenon;*
  - *The existing resources do not allow the actual creation of the experiments necessary for the understanding of studied phenomena;*
  - *The experiment in the virtual lab facilitates the understanding of the studied phenomenon by children with motor deficiencies who cannot create the actual experiment with a different kind of support;*
  - *The actual creation of the experiment endangers the health of the students.*
- ***Processing experimental data.*** *Data obtained from observations n nature or by creating experiments can be processed according to the intended purpose by the use of specific computer programs. Processing experimental data can include calculus, graphical representations etc. time allocated to simple operations can be thus dedicated to learning activities that involve superior cognitive processes. At the same time, by computer processing experimental data students learn to exercise their competences in the field of ICT in various learning contexts.*

*B. Developing communication and individual study competences (to learn how to learn) within the context of the subject*

*ICT offers students a diversity of concrete ways supporting the development of communication and individual study in the context of the school subject. Thus, ICT can be used for:*

- ***Collecting information.*** *According to the existing resources teachers must encourage students to resort to a large variety of information sources, including Internet, multimedia encyclopedias and electronic documents. In this way students learn to select and synthesize information acquired in compliance to the intended purpose and develop the capacity to critically appreciate the accuracy and correctness of information acquired from different sources.*
- ***Presenting information.*** *According to the possibilities at hand teachers must encourage students to present the results of various investigations in electronic format – in attractive formats, with high impact, easy to understand and easy to transmit via electronic communication media.*
- ***Document editing.*** *When it is possible, students can be required to edit the essays of lab work and projects. It is recommended that the editing of these documents be made at least partly under teacher guidance. By this guided editing students can review, modify and assess their work, critically reflecting over the quality of the results as they progress.*

Although concerns are detailed and complexly defined in the methodological suggestions, in terms of computer and Internet use competences there are no explicit references found in the contents lists or in the learning activities examples, leaving at teachers' discretion the choice of appropriate teaching strategies to motivate students to develop computer skills. This task is made more difficult for the teacher as their personal level of proficiency in ICT field is poor.

In **Biology**, tenth grade, we find as a methodological suggestion *the use of AEL program for the study of computer aided biological phenomena,* in **Chemistry** *the use of Internet and other* *information means to assess consequences of chemical processes and the action of chemical products on self and environment,* in foreign languages it is suggested *the use of tables, schemata, dictionaries and other types of papers for reference, other types of information sources, including Internet,* exercises of writing personal/official correspondence (messages, letters, emails, greetings), in **History** it is specified that *the integration of new informational technologies in the teaching-learning process (including Internet) becomes essential given the multiplication of information and communication sources,* and in **Psychology** it is suggested that *the use of computers, of ICT and Internet resources in teaching activities as modern instruction means*.

For the subjects in the curricular area **Technologies** we mention that all competences necessary for training in view of the efficient use of new informational technologies are covered. The methodological suggestions as well as the learning activities include curricular and cross-curricular aspects.

***Natural sciences specialization – sciences***

- *Processing experimental data, simulation and event control, graphical representation of experimental data,*
- *Using databases for underlining events in time,*
- *Using specific applications.*

***Social sciences specialization – humanities***

- *Documenting and creating specific documents: questionnaires, interviews, tests, letters of intent and request for proposal, offers, statistical data processing and graphical representations.*

***Technological high school - resources***

- *Creating specific documents: fabrication receipts, analysis bulletins for raw materials and finished products, inventories for raw materials and auxiliary materials, manufacturing reports, inventory sheets for finished products, specific consumption reports, inventories for raw products and materials, monthly, quarterly and yearly reports regarding consumption of raw materials and products, partial and total balance reports, databases regarding the useful and harmful microorganisms specific to the field, as well as microorganisms causing fermentations, sampling, analysis and processing and interpretation of data from specific databases, etc.*

***Technological high school - services***

- *Creating specific documents: request for proposal, queries, commercial letters, minutes, administration reports, syntheses for economic activities, etc.*
- *Applications created using worksheets for calculating costs and revenues, for determining the profit and tax revenue, VAT tax, etc.*
- *Using applications for projects reflecting the knowledge of economical notions acquired by the student in specialty classes.*

***Technological high school - technical***

- *Using applications for projects reflecting technical knowledge acquired by the student in specialty classes,*
- *Applications created using worksheets to calculate the amount of materials used, to track measurements, technical factsheets and some statistical calculations.*

*The chosen work tasks can belong both to the technical field (industrial field) and the field of monitoring environment conditions (ecology), services (public transportation, electrical energy distributions) or habitat computerization.*

## 5. Conclusions and future directions for research

Following the curricular analysis one can notice the non-unitary character of school curricula by the fact that they lack consistency in following up the development of competences and skills in the filed of ICT at every level of education, for every school subject; also there are no subjects that aim at exercising computer skills at the level of the core curriculum or the differentiated curriculum. We notice the use of ICT and Internet is defective and episodic over the length of compulsory education, it is sporadic for the majority of curricular areas but predominant in curricular areas like "Mathematics and sciences" and "Technologies" generating an imbalance at high school level based on the profile.

Analyzing curricula for ninth to twelfth grade we find that regarding the use of new informational technologies and Internet there is no mention at the level of framework objectives, actual learning activities or contents but only in the methodological suggestions.

Remarkable is the fact that whereas in **Technologies** curricular area ICT s used for developing computer skills, with real life examples, the use of ICT in other school subjects is intended to facilitate the learning process and development of other skills by transfers and correlations in real life situations in social contexts useful to professional integration.

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# From Managed Learning Environment to Personal Learning Environment

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**Abstract**

*Personal Learning Environment (PLE) is an innovative tendency to use the modern information and communications technology, I&CT in the (self-) learning processes of any level, but especially in formal university education and postgraduate open remote continuous lifelong, including informal and non-formal learning. The development barriers of PLE's are significant, firstly, due to the lack of a clear vision of what PLE is and what it should do. The paper summarizes the concept of PLE and related technologies.*

**Keywords:** Knowledge-based society (KBS), Open distance learning (ODL), Managed Learning Environment (MLE), ePortfolio, PLE, Web-2.0, IC&T.

## 1. eLearning concept evolution towards Personal Learning Environment

Modern information society based on the knowledge (**KBS - Knowledge-Based Society**), toward which most developed countries aspire, can be determined *as the society, in which fundamental aim of Labor majority of members, basic resources and the driving force of progress is information and knowledge, but in the quality of the labor tool - information and communication technologies.*

In the **KBS** the decisive factor for social differentiation becomes knowledge, not property. At the same time, knowledge is becoming the main product, the training becomes continuous, throughout the life people are forced to make self-perfection without stopping the basic activities, resisting with familiar, local and workplace constraints.

In the **KBS**, there is a need for highly qualified specialists, who do not just possess specific professional knowledge, skills and capacities, but are capable to solve problems in new situations and are ready to meet the social requirements the content of which can be only supposed. Therefore, in the contemporary conditions, to obtain additional knowledge in various domains becomes essential and continuous. Thus, the idea of continuous training KBS becomes topical and is based on the fact that modern specialist upgrades his/her qualification during all the life.

Digital educational content, organized in accordance with the model of modern theories of electronic learning *eLearning*, *(eL)* can be delivered whether online completely or in combination with traditional forms, including evening, Sundays schools, etc. Currently appeared a new form of learning called *Blended Learning (bL),*which combines traditional learning with the happy benefits of *eLearning* and *Open Distance Learning* continue throughout life *(ODL)* formal and informal or non-formal, setting up new educational environments. These are the following: *Virtual Learning Environments*, (*VLE)* – systems designed to support teaching and learning in virtual learning networks, *Managed Learning Environments, (MLE),* the emphasis is on management.

Most companies specialize in the development of *Learning Management System*, *(LMS)* and digital content *Learning Content Management System, (LCMS)*. Support and management of eLearning is possible thanks to many *proprietary platforms*, such as *AEL Siveco*, *HyperMethod*, *Prometeus* etc. and various open platforms – *Free Open Source Software, FOSS*, such as *Moodle*, *Ilias*, *Claroline*, *Dokeos* etc. These types of software have become almost ubiquitous in any educational institution. Currently a series of standards and general specifications for *LMS, LCMS, MLE and VLE* are developed. The most important of these are ADL SCORM *(Sharable Content Object Reference Model*) and the project IMS: *IMS Abstract Framework, IMS/CP, IMS/DRI, IMS/MD, IMS/LD, IMS/SS IMS/DC*. SCORM is the most popular standard for eLearning, which is a specification that includes methods of construction and packaging of distributed learning courses. There are also widespread and IEEE standards: *IEEE LTSA, IEEE LOM, IEEE LOM XML for SD*.

So, having appeared around the 1980's as a radical idea concept of **eLearning** has become one of the most important trends of reforming the national educational systems. Its effectiveness should be demonstrated today in conditions of edification of the global information society based on knowledge. Contemporary educational system must ensure the integration of various means of knowledge of the world and also raise the cultural potential of conscious human actions, of interpreting, and wide knowledge of the outside world in the conditions of globalization.

Achieving this desideratum and providing freedom of thinking is possible only by *presenting the possibility of self-training and of self-realization* through open learning throughout life, by developing new training program in accordance with individuals' subjective possibilities. A basic tendency which attracted attention of a great number of analysts in solving this problem *is changeable nature of the Internet* users, caused by the I&CT challenges and KBS needs. Internet users prefer random access *"on demand"* to the mass media, expected to be in free *connection, free of charge, unlimited* with their friends, and they are able to create their own media or to download it from someone, for instance, purchase of electronic books, online course, CD, etc. In education, *these necessity became a manifest,* and resulting systems are called systems "focused on learner/student" (learner-centered) and platforms respective of support - *Personal Learning Environment*. PLE is much more than a simply adaptation of the font size, background colors, the stage of education, discipline, etc. allowing the introduction *of complete control of the educational process by the learner.* That is exactly the essence of PLE concept.

PLE term was first used on November 4, 2004 *at the session of the Conference of Personal Learning Environment* JISC/CETIS 2004. Till then the concept that met many of the characteristics of PLE was ePortfolio [6].

*Thanks to its flexibility, there is no accepted definition for PLE's*. Some suggest that the principles of PLE's can be presented in software tools, while other suggest that it is more like a concept than a particular tool. Some say that these are connections that create Personal Learning Environments itself; others name PLE as a tool to content creation, content storage, communication, identity management protocol, etc. Various points of view of the PLE's reflecting the early age of the concept and diversity of practical applications of read/write Web itself.

After one observation submitted by George Siemens [2], PLE represents rather a concept than a product. "It is unfortunate tendency especially in our sector to take a concept (PLE's, ePortfolio) and to try to materialize as a product". *PLE is a collection of Web-based tools, distributed free and often focused around a blog, joined together and adding content using RSS and HTML simple sites scripts* [5].

Graham Attwell defines PLE as an idea which integrates lifelong learning, including formal and informal learning, learning styles, new approaches of evaluation, cognitive tools [1]. More than that, PLE is inspired by the success of the *"annexation"* of new technologies and social software, now found and widely used practically anywhere.

According to Ron Lubensky, PLE represents an individual facility to access, collect, configure and manipulate digital objects of his learning experience, being in continuous development [3]. This definition captures the following important points that appear to be common for all points of view today:

1. PLE is *effectively controlled by the individual,* consequently, it is disconnected from the institutional portals such as universities, *Virtual Learning Environment* (*VLE)*, work places, *Learning Management Systems (LMS)*, for which submitted objectives are as a response to the institutions requirements.
2. Objects which are operated in/through PLE including digital resources and references with which individuals want to use them at present and probably to plan in the future. The resources include not only the static text and multimedia but also the dynamic services and their objects, like instant messaging, online forums and conversation Weblog. Since an *ePortfolio* contains real properties, with the purpose of reflection, evaluation or self-assessment, PLE includes a wider warehouse, which also includes links and comments for the all three purposes.
3. The primary purpose of a PLE for an individual is to bring all the disparate objects, but important for learning, under a single operating ceiling. The hypothesis is that there are many objects, their organization requires time and it is easy to forget or to lose. PLE's are intended to simplify the management of these objects by creating meaning through aggregation, that links and labels metadata (eg. objectives, comments, keywords).
4. A PLE is integrated with digital services for which the person is currently subscribed. These could be University's VLE, LMS's at the workplace or collection of so-called Web 2.0 services like social sites or photo sharing.

PLE includes different learning experiences for which an individual is subscribed to the lifelong learning. As the Figure suggests, presented by the reference [3], the PLE is located at the intersection between VLE, Web 2.0 and the extended view of ePortofolio.

Students can start to operate their PLE hanging VLE's from their school. In the Universities students could be connected to the university's VLE. At the beginning of professional practice an individual can link their PLE with learning at the workplace and other facilities for professional development. During all this time, the person would like to make a selective reference at Web 2.0 services, which prove to be useful to enable personal development and one of the learning.

## 2. Web 2.0 + eLearning = eLearning 2.0

The term **"Web 2.0"** refers to the second generation of Web development and design that is intended to facilitate communication, exchange of reliable information, interoperability, as well as collaboration on the Web. Web 2.0 is not a product but is a marketing term. Examples of labeled applications Web2.0 would be: *Gmail*, *Flickr, Del.icio.us*, *Digg*, *Remember the Milk*, *Basecampand* and many others, some of which are explained below. Web2.0 uses to a maximum the power of communities, being strongly supported by this community, concentrated around these applications.

In the Web 2.0 is told technically about *JavaScript and XML (AJAX), RSS and Web services*, some of which are explained below. All of these offer developers a platform for which it can build sufficiently powerful Web applications and enough complex, remotely accessible.

The Web 2.0 concepts lead to the development and evolution of Web-based communities, hosting of services and applications, such as *social networks, video-sharing sites, wikis, blogs, and folksonomies*, some of which are explained below. These tools *allow all to become publishers*.

Web 2.0 tools in education gain popularity and, consequently, appear eLearning version 2.0, a change that demonstrates way in which *Read-Write Web* can improve education.

**eLearning 2.0** combines the use of tools and Web services such as *blogs, wikis* and other social software to support the content creation. *Chat groups, discussions groups, communities and social networks* are just some of Web 2.0 tools used in eLearning 2.0 (to see the figure **„eLearning 2.0 in the modern learning process"** presented in the reference [8]).

Universities and the educational centers use eLearning 2.0 tools and solutions to improve the traditional system of learning. This type of complementarily, mutual learning, if properly managed, offers a great potential to expand the range of learning activities. The relationship *pupil/student-ideas-content* is not limited by interactions with their teachers as they interact with colleagues in the discovery, exploration and clarification of knowledge. ELearning 2.0 involves subjects in a proactive learning environment, such as PLE. [8].

ELearning 2.0 gives the possibility to learn informally, continuously, collaboratively by creating our personal learning environments PLE composed of the following components:

- Blog/blogs in which we write reflections about what we learn, find, projects on which we are working, comments relating to other blogs, interesting resources;
- RSS's blogs/sites that we seek and follow them and the aggregators/RSSreaders for their management;
- Collections of resources built with an *collaboratively bookmark system*, such as *del.icio.us*. Various wikis;
- Social networks (including based on the content such as *Flickr, Slide Share, YouTube* etc.). Virtual Worlds - Second Life, gaming; Communication systems - various *Messengers, Skype discussion forums*, etc.;
- Social aggregators to manage all the accounts.

**Wiki** in the Hawaiian language ”*Wiki wiki*” means *”very quickly”* in the context refers to the speed of creating and updating documents, projects, etc., generally located on the Web.

**Blog** is an English word derived from the term *Web + log* (journal on the Internet), Web publication, accessible to the general public that contains the personal articles, with periodic or continuous update.

Wikipedia defines the **ePortfolio** as a set of electronic information (personal profile, collection of achievements, etc.), and the people and organizations that have access to this information.

**Elgg**, *www.elgg.net* is a social network framework that offers the necessary functionality needed to allow to run its own social networking site. Physique is a system with the ePortfolio facilities, Weblog, networking, tagging. To run the Elgg you need a Web server and a certain quantity of technical knowledge or access to the system administrator.

**Skype** is free software that allows users to make chat, just phone calls and /or video over the Internet, using techniques such Voice over IP (VoIP).

**Podcasting** is a method of files distributing in multimedia format (audio/video) through content syndication through Web feeds, RSS and ATOM. Files can be downloaded and played on mobile devices that support the format in which they were created. A podcast author is usually called podcaster.

**Twitter** is a free microblogging social network (short message less than 200 characters) posted on its own page, but which arrive at those who "follow" because of belonging to the network. **Facebook** is one of the most successful social networking sites (social networks) today.

**YouTube** is a website that allows uploading/viewing of video content and the social software application, with educational nature.

**Social aggregators** allow aggregation of all resources from a personal learning environment.

## 3. Instrumental technologies/platforms related to PLE

Open Distance Learning (*ODL*) technologies include:

- Unimedia technologies (TV, DVD);
- Multimedia technologies (educational software);
- Internet-based Technologies (eLearning eTesting, eTraining, eCouching etc.).

From technical point of view, *PLE represents the integration P-P-P* (Peer-to-Peer-to-Peer) *a number of the Web 2.0 technologies* such as *Blogs, Wikis, RSS feeds, Twitter, Facebook* etc.

around those that learn independently (to see the figure **„Offered services and the tools used by the PLE”** presented at the reference http://www.flickr.com/photos/francescesteve/3039956497/in/gallery-ianinsheffield-72157622646048331/).

**P-P-P** (Peer-to-Peer-to-Peer) is one type of computer networks and network technology, where all nodes are “peer to peer”, each having the role of master of resources is responsible for those resources and providing access to them according to good will. Technology known especially for its role in downloading of films, music and software is used on a wide range of more and more by the companies as an expensive way to provide the content to customers. PPP involves multilateral relations, unlike the PP, which plays bilateral relationships.

At the same time, a PLE may or may not intersect with the institutional LMS or VLE and individuals could integrate the components of an institutional LMS in learning environments which they build for themselves. A typical PLE, for example, could incorporate blogs, where the people trained to comment on what they learn, and may reflect their posts removed from the Web information sites such as YouTube, Skype or RSS feeds from news agencies, etc.

**A Web feed** (RSS) is a data format for its contents and the summary of Web content together with links to the full content of the source of information and other metadata from the Internet, updated frequently (http://ro.wikipedia.org).

Web feeds provide this information as an XML file. In addition to facilitating syndication, Web feeds allow loyal readers to be informed about every update of the content on these Web pages by using special software called *aggregator* (*feed reader*).

The types of content, delivered through a web feed are typically extracted or simple links to the Web pages where the content originates. Web feeds are used by many Web sites, blogs and podcasts manufacturers. Often sites have feeds generally known, but the smallest have adopted this technology. Some sites even allow users to choose between formatted RSS feeds or Atom formatted, others offer only RSS feeds or only Atom.

Programs that use RSS are available for different operating systems. The part of client is designed as standalone programs or extensions to existing programs such as browsers. Microsoft Internet Explorer, Mozilla Firefox, Google Chrome, Safari and Opera have integrated RSS feeds support.

**RSS** – is a family of Web feed formats (*RSS stream, or RSS channel*), specified in XML and used for Web syndication. RSS is used for news, blogs, and podcasting. Abbreviation is used to refer to the following standards: Really Simple Syndication (RSS 2.0); Rich Site Summary (RSS 0.91, RSS 1.0); RDF Site Summary (RSS 0.9 and 1.0).

**Syndication of the information** represents one of the biggest advantages generated by social software in terms of efficiency. Using RSS technology user chooses exactly what information to receive and this news is "delivered" to a few seconds after its posting on the Web. This will be informed quickly, conveniently and effortlessly with the data that do not need to search/track alone.

**Atom** like is based on XML format and is predestined for the aggregation of the information firstly of Web sites. It is also used in blogs, but still can be used for regular Web publications.

*RSS represents a format that is more popular than the Atom feeds*. Increasing the popularity of RSS is conditioned by the development of infrastructure - software, services, forums and more. Some experts propose to unify the two formats. Other experts consider that the unification of these formats does not make sense because the simple users are not interested which format is better, they are interested that aggregator program should maintain all formats.

**Single Sign-On** is a technology that ensures the users transition from a division of the portal into another without the need for a repeated identification. For example, if there are several independent divisions *(forums, chats, blogs, etc.)* on the Web portal, then performing the authentication procedure in one of the services, the person automatically obtain access to the other, making it exempt from rewriting authentication of data related to him.

**OpenID** represents a decentralized system that allows user to use a single account for the authentication on different sites, portals, blogs and forums that are not related with each other. The sites that have logotypes maintain OpenID, placed near the password input field on the homepage. There are multiple OpenID providers, which presents hosting OpenID URL.

**4. Final conclusions**

The year 2004 marked the appearance of open-source **Elgg** social platform, appreciated as a first implementation of PLE, which incorporates a *social network, blogs, resources, RSS, tags, OpenID, podcasts*.

In 2006, the **Open Academic** project proposed integration in a learning virtual environment of open source products **Moodle** - already integrated in previous projects with **LAMS** and **Elgg, Drupal, Elgg, OpenID, MediaWiki**.

Among the first who specified features for PLE is Scott Wilson [X], a researcher at Cetis, who published on his blog on January 25, 2005 **Future VLE** diagram.

Wilson opposes flexibility of PLE to virtual learning environments - VLE, which limits the spatial and temporal access to resources, but also to the community of learning often means expensive implementation of standards *(Learning Objects directories)*. Ideally, personal learning environment of the participants should be used/rich/integrated in learning environments of courses/trainings online/blended learning in which we participate.

PLE includes grant support to educate for:

- Setting the own learning purposes;
- Managing own learning processes and content;
- Communication with other participants in the learning process and learning achieving of the objectives.

Social software, collaboration platforms integrated with traditional eLearning systems promotes a new style of student-centered learning. Tools for the creation of virtual communities of students and content publishing stimulate a more open learning, focused principally on necessities and interests of students and based on principles of self-training and self-control.

PLE represents a crossing from the way in which trained people consume information by independent channels to a model in which they *assimilate a connection from increasingly array of resources that selects and organizes them*.

It is worth to mention the following advantages of PLE:

- Recognition of the individual role in organizing their educational process that takes place in different contexts and situations, not supplied by one supplier of education;
- Integration of formal and informal learning episodes into a unique experience and use of social networks that can overcome institutional boundaries and use network protocols;
- Expansion of the access to modern educational technologies for all those wishing to organize own learning process;
- Facilitation of different learning styles.

PLEs are yet at the starting level of development, the barriers are significant, and it's not the least because of the lack of a clear vision on what a PLE is and what one should do. Why the popularization of PLE is topical and important.

Basically, the success of PLE will depend on the ease with which they can be implemented and used by pupils/students/trainees of interoperability and confidence provided that both the training and institutional administrators have that security.

Like any change of paradigm, the biggest obstacle to the technological revolution is situated in the political and commercial inertia. Many commentators believe that the change can be held through the effort. The reality is, however, that any change requires significant efforts. KBS is a new type of society, composed of individuals with other needs, exigencies and opportunities to learn, work and distraction. PLE does not come to substitute by itself VLE, MLE, LMS etc. PLE tends to integrate the opportunities to offer to those willing to learn the greater opportunities, freedom, and responsibility for their own development and performance.

PLE concept does not insist on a specific model, on the contrary, it involves its continuous development by the addition of new functionalities and modifying existing ones. But the orientation towards the open source software guarantees the freedom to develop such a system.

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# Physics experiments with Yenka software

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**Abstract**

*Over the last two decades, information technologies and the Internet have been transforming the way students learn. In this context, the audio - video tools have an important impact for the teaching - learning process of Physics. The Computer Assisted Instruction stimulates the visual and hearing memory and transposes the students in the midst of the Phenomena. The paper is important because it presents modern means used in teaching/ learning physics in class and in the laboratory - supplementing traditional teaching process with simulations/ computer modelling, experimental data processing and graphics obtained through specialized software. I present paper the achievement of a physics experiment on laboratory that will be filled with computer simulation. Software modelling experiments in real time, such as Yenka contribute to a better understanding of physics phenomena. I propose an outline of the lesson plan and illustrate how the teacher can by integrating multimedia educational resources on instruction at various stages of learning units.*

**Keywords**: Interactive Physics, new teaching method, Computer Assisted Instruction, modelling on computer.

## 1. Introduction

Computer has revolutionized how people find other people, and many students now look for teachers on the Internet. Politicians at European level have recognized that education and training are essential to the development and success of knowledge society. A transdisciplinary vision of education requires long life education and the computer revolution transforming learning in leisure and recreation in learning. The new interactive aids of teaching/ learning emphasize the role of technology-enhanced environments in science learning: such environments allow learners to observe and explore scientific phenomena interactively on the computer. The multimedia educational resources have an important impact on the teaching-learning process of Physics. The Computer Assisted Instruction stimulates visual and hearing memory and transposes the students in the middle of the Phenomena and completes their knowledge. Teaching/learning physics has evolved from traditional transposing methods - demonstrations on the black board and laboratory experiences - to computer modelling or e-learning platforms that facilitate a distance teaching/learning.

In schools, information technology and communication can be more than just a means of education; can become a concept to make radical changes in education. Its potential to improve the quality and standards of performance of participants in the educational process is significant. The class isn't made with chalk on the black board and traditional means; in the interactive class, we will corroborate diverse teaching means, so traditional to modern tools. It is better that the teacher stimulate the students. The teaching will be better if they "play" than a discourse, in which we present the new information (UNESCO, (1983); Popa, (2005)).

The computer can become a tool for all those who wish to find in him a friend and the mysteries will turn into knowledge. This tool is equally useful to student and teacher. Computer used in class aims to develop skills related to communication, procurement, presentation and transmission of information in forms as varied. The Yenka program allows simulation of experiments that cannot be completed in class, completion of laboratory experiments, to realize animated graphics, contributing in this way to develop skills to organize specific information and use it to produce new knowledge.

Physics is par excellence an experimental object, but many of the phenomena are too fast to be studied and understood fully, or it cannot be done in a laboratory school. Via computer it can be simulated and presented these phenomena so that they can be pursued by each student. On the other hand it is known that the possibility of understanding of material is different from one individual to another, not all students can understand it. The computer gives everyone the opportunity to adjust the learning of new knowledge in their own pace and the quality of learning and deep understanding of the phenomena will increase incontestably.

**1.1. Theoretical Background**

Electric current may be Direct Current – DC, or Alternative Current – AC.

DC refers to charge flowing in one direction. For examples, the terminals of a battery always have the same sign "+" or "-". Electrons move through the circuits in the same direction, from the repelling negative terminal toward the attracting positive terminal.

Electric power is equal to the product of current and voltage.

[1] $P = U \cdot I$

In AC, electrons are moved first in one direction, and then in opposite direction, alternating to and fro about relatively positions – an alternator or generator switching the sign at the terminals. All electric energy generators produce electric energy using electromagnetic inductions which produce AC output. Electrical energy produced in AC fashion can be transmitted economically over long distances.

A capacitor in a DC circuit is equivalent to an infinite resistance, and opens the circuit. In AC the alternating voltage continually charges and discharges a capacitor.

[2] $I = I_0 \sin \omega t$

[3] $U = U_0 \sin \omega t$

[4] $I = \dfrac{U_0}{R} \sin \omega t$

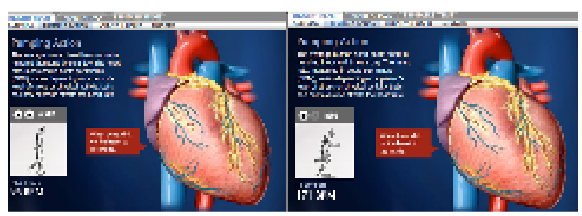

*Figure 26*
**(http://science.nationalgeographic.com/science/health-and-human-body/human-body/heart-article/)**

During a heart attack, the heart may go into an unregulated beat pattern, and this condition would be fatal in minutes. Fortunately, it is possible to return the heart to its normal pattern by cardiac defibrillator which passing an electrical current through it. To restart the heart are needed several hundred joules of electric energy. The main component of defibrillator is a capacitor charged to a high voltage.

**1.2. Experimental Background**

**1.3. Computational Background**

The computer can become a tool for all those who wish to find in it a friend and the mysteries will turn into knowledge. Will be used a dedicated

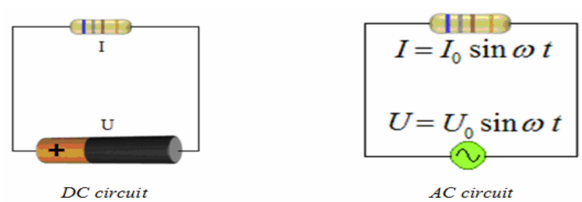


*Figure 27*

simulation software for physics experiments – the Yenka software – a new generation of educational modelling tools from Crocodile Clips. The Yenka program allows simulation of experiments that cannot be completed in class, completion of laboratory experiments, to realize animated graphics, contributing in this way to develop skills to organize specific information and use it to produce new knowledge.

This modelling experiment will demonstrate the differences between direct current and alternative current. When will be clicked on the switch, the circuit will be activated. The Star model button will be run the simulations, and light bulbs will be activates; the light bulb of AC circuit alternates between being on and off. The current and voltage of DC circuit in the two graphs shown in red, and current and voltage of AC circuit shown in blue. The students can compare the current flow in the two circuits; in the DC circuit, current always goes in one direction, with same magnitude, and in AC circuit, current alternates its direction and magnitude over time, like in figure 3 and figure 4.

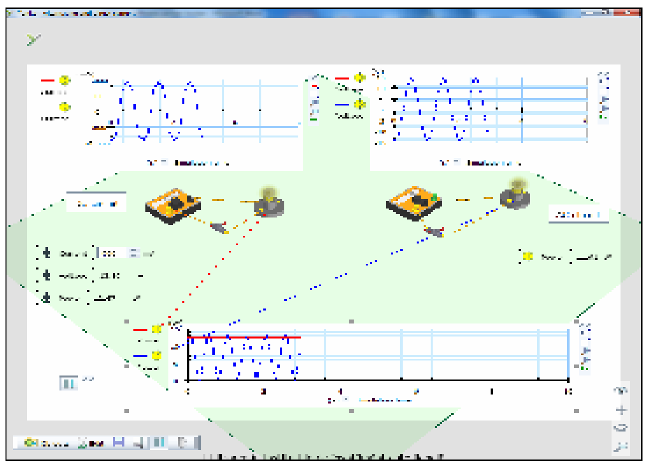

*Figure 28*

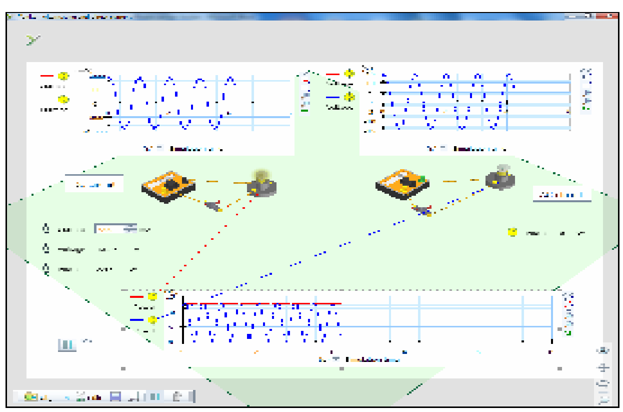

*Figure 29* **Simulations on Yenka**

In Figure 3, we can observe that in DC circuit

[5] I = 900 mA

[6] $U = 13{,}86V$

[7] $P = UI = 12{,}47W$ is true.

In AC circuit, current, voltage and power isn't constant.

**1.4. Didactical Methods**

The teaching methods used are: explanation, conversation, experiment, demonstration, discovery, computer modeling.

**2. Discussion**

The computer simulation reveals as follows:

- diagrams I=f (t), U=f (t), P=f (t) for DC and AC circuits

Advantages :

- Gaining time;
- Completing and fixing the knowledge acquired through classical experiment;
- Experimental data more accurate.

Disadvantages:

- Passive participation in front simulation;
- Internet connection can be brooked.

Computer simulation of physics experiments is welcome as a complement to classical experiments in laboratory, together leading to a deep, long-lasting learning.

**3. Conclusions**

Introduction of the computer in the didactical activities going to increase students motivation in learning physics, offers alternative suggestions for the teaching-learning, the approach to issues of physical phenomena, encourages creative and critical thinking, and the students will be develop skills for processing and presenting of information.

For a good efficiency, it is recommended: the teacher must create a favourable climate for his students to learn, for a good understanding of the didactical message. He must explain the incomprehensible words, he must ask problem-questions; he will use the educational cards, pictures, training films that can affect his students, which can develop the interest to learn. The teacher points out to his students that, after seeing the film, he makes the feedback. Because the computer is a new didactical aid, the teacher must know how to use it, some software learning, the programming language, to draw on the computer, make the maps or other teaching computer tools. The Computer Assisted Instruction does not eliminate the traditional teaching means (film, experiments, manuals, exercise book); the computer is a didactical tool that fits the others, completing the traditional tools of instruction those school supplies (Malinovschi V., (2003); UNESCO, (1983)).

The audio – video tools make an interactive lesson, the students don't have time to get bored, and their interest is raised in a nice manner. It isn't necessary to insist on the modern tools. Also it is recommended to use them with the traditional tools for a dynamical lesson. It is dangerous that the students "sleep" in the class.

The access to the different soft, the access to the Internet or other information resources determines that the student's evaluation isn't only traditional based on memorizing the lesson or resolving the problems, but also on the student's portfolio or the student's individual paper or team paper.

In this way the audio – video tools have one important impact for the teaching – learning processing of Physics and the Computer Assisted Instruction stimulates visual memory and hearing memory and transposes the student in the depth of the Phenomena.

The lesson will prove to be successful if the students understand the concepts and use them in exercises and problems. The teacher can avoid improvised or useless activities and stimulate his students to progress gradually, by avoiding boredom and lack of interest, wasting time and effort. The lesson must contribute to their systematic knowledge and to their maturity. The information they learn must be used in everyday life, so that teaching and learning can connect to their life.

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# Raising engagement in e-learning through gamification

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**Abstract**

*Games are part of day to day life, entertaining users, but at the same time modelling behaviors. By applying game mechanics and dynamics to tasks and e-learning processes we can increase user engagement with an e-learning application and its specific tasks. While having multiple uses in commercial practices, gamification implies well established techniques similar to those found in games. We will take a closer look at the ones that are appropriate to the learning process and moreover to e-learning and analyze relevant examples.*

**Keywords**: gamification, e-learning

## 1. Introduction

The idea of using games for learning is not new. This is customary especially in the case of direct interaction between teacher and student. Transposing this into a digital form of teaching and learning might become an issue. Our proposed solution when confronted with this problem is attempting to gamify the e-learning process.

Gamification (Deterding *et al*, 2011) is the use of game-play mechanics for non-game applications. Any application, task, process or context can theoretically be gamified. Gamification's main goal is to rise the engagement of users by using game-like techniques such as scoreboards and personalized fast feedback (Flatla *et al*, 2011) making people feel more ownership and purpose when engaging with tasks (Pavlus, 2010).

Gamification is used in several different contexts mostly business and marketing, but we further wish to demonstrate its utility and importance in the educational environment as well. By incorporating game elements into work activities we wish to raise motivation (Shneiderman, 2004) but, in order to do so, we need to pay attention to the integration of tasks and exercises within the game design (Von Ahn and Dabbish, 2008).

Creating gamers for learning employ costly resources. A simpler yet still efficient approach is to use gamification in order to make the content more attractive and engage users.

By using gamification in e-learning we wish to trigger a more efficient and engaging learning behavior. B.J. Fogg argues that people respond to computers as they were persons, especially when gaming (Fogg, 2002). In order to change or trigger a certain behavior students need to be motivated and at the same time have the ability to solve the challenges.

Gamification also implies a social game and interaction with other participants. Fogg explains that when people perceive social presence, they naturally respond in social ways and have feelings like empathy or anger, or following social rules such as taking turns (Fogg, 2002).

## 2. Persuasive Technology And The Fogg Behavioral Model

The limitations of e-learning from a pedagogical point of view are the fact that it cannot transmit emotion or engage the student as a teacher could. For this lack of *feeling* or emotional interaction, an e-learning system must compensate and try and stimulate learners with other means.

JB Fogg studied the concept of persuasive technology (Fogg, 2002) and how we can design systems that impact the user also on an affective level. He proposes a model Fogg's Behavior Model (FBM) (Fogg, 2009) that studies the factors that can generate a certain behavior. This model has a high applicability in the case of a human-computer interaction.

The model comprises 3 main elements: motivation, ability and triggers, which occurring at the same time can determine a target behavior.

We further try to view how we can apply this model to an e-learning system and its users. As mentioned before, in order to effectively go over course and learn, the student must be at the same time motivated, capable and triggered in order to accomplish a desired action or a target behavior. He must reach the behavior activation threshold in order to read, learn or solve. The desired state for the student is referred to as flow, an optimal state which translates into concentration, when we believe the students interacts most effectively and the actual learning takes place.

*Motivation*, at its core, can be caused by couples of opposites like pleasure/pain, hope/fear, and social acceptance/rejection. If for example a student is able to solve a problem but has no motivation to do it, he will not do so. Once his social reputation is at stake or he is conscious of the fact that he might get a small grade, the motivation, either positive or negative will determine him to solve the problem.

On the other hand *ability* is also a factor that influences the occurrence of a behavior. Even if a person is highly motivated, a behavior cannot occur if he does not have the ability. On the other hand a high motivation can determine a subject to find the means to accomplish a task, thus gain the ability

Fogg also states that motivation and ability alone are not enough to determine a behavior. A certain behavior needs a *trigger*, something to tell the user to complete the action in a certain moment; it is also referred as a call to action. Triggers are connected to motivation. They can be a spark – this tends to motivate a user, a facilitator – tends to offer ability to highly motivated users, and lastly a signal – when users have both ability and motivation, but it functions as a reminder.

Examples of target behavior can be: donate money, buy a product or share with a friend. Computers and the use of technology enable us to act instantly to triggers. A future trend is moving technology towards mobile and thus e-learning can become m-learning, and courses can also be context aware and supporting multiple formats (Morar, 2010). Because of the size limitations of mobile phones we must adapt the structure of courses and evaluation to fit to these smaller environments, but nevertheless achieve the desired goal.

## 3. Games In Real Life And In E-Learning

Games are part of everyday life. Americans spent over $25 billion on video games in 2010. Their main goal is entertainment, but their universal applicability gave games extra functions in various aspects of everyday life. Games are used not only for leisure but also by industries like defence, education, scientific exploration, health care, emergency management, city planning, engineering, religion, and politics. They are also called serious games and their main purpose is to train, investigate, or advertise.

Serious games are complete games with serious intentions and designed accordingly whereas in gamified application only certain elements from games are used.

Learning through games is not a novel approach. Elisabeth Corcoran (Corcoran, 2010) claims that there are at least 3 types of games used in education: the classic edu-tech games, games developed by students themselves like Scratch and the last approach gamified courses, meaning adding game mechanics to various applications, tasks, etc. Whether offline or online, games have helped scholars reach their educational goals in a more engaging way. Nevertheless we must note the difference between the so called "educational games (serious games, simulators)" and the gamification of e-learning. While the first employs a bigger quantity of resources, game design knowledge and graphics, the second one does not engage as many resources or a special design.

**4. The Gamification Of Education**

There is little research however regarding the usefulness of gamification in education. In (Lee and Hammer, 2011) the authors start by explaining the meaning of gamification, what it is and how it can be used, while also pointing out the possible disadvantages in case of misuse. They define it as the use of game mechanics, dynamics and frameworks to promote desired behaviors. Returning also to the point made by Fogg we can use gamification to determine certain behaviors or correct others and we can thus see the utility of using gamification in learning, and even more in e-learning. There might be possible dangers if the gamification design does not suit the purpose of motivating students to engage and offer support to teachers and on the contrary for example it might teach students that they should learn only when provided by an extrinsic motivation.

Authors of (Kapp, 2011) notice a large increase in the gamification of learning and instruction. Due to the user of game elements like time, accuracy, point systems integrated intro all types of training programs encourage users to achieve their desired goals.

**5. Gamification**

Gamification is the use of game play elements for non-game applications, particularly consumer-oriented web and mobile sites, in order to encourage people to adopt the applications. It also strives to encourage users to engage in desired behaviors in connection with the applications (http://en.wikipedia.org/wiki/Gamification).This definition is related to similar pre-existing concepts such as serious games, serious gaming, playful interaction, and game-based technologies (Deterding *et al*, 2011).

Mundane activities especially for a longer period of time are not appealing but by combining these activities with simple games we can create a more effective way to motivate people (Chrons and Sundekk, 2011). Turning useful activities into games is called gamification and it has found its way into many uses such as education.

Gamification is a quite recent concept, on the market as well as in research, but it has a big potential. It has been added to the Gartner Hype Cycle for 2011. Gartner Group predicts gamification will be a key trend that every CIO, IT planner and enterprise architect must be aware of as it relates to business (Gartner Group, 2011).

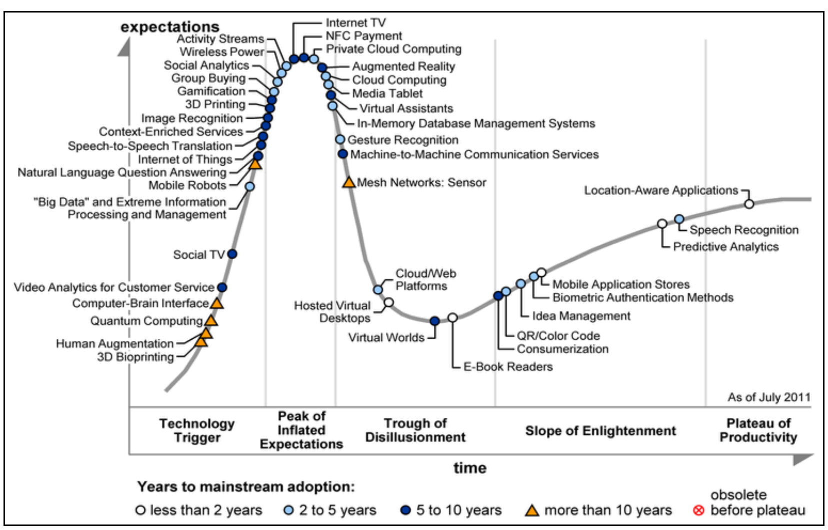


*Figure 30.* **Gartner Hype Cycle for 2011**

Gamification is recently successfully in websites in order to create loyalty, brand awareness and effective marketing engagement (Foursquare, Stack Overflow) (Daniels, 2010), but according to our observations it can successfully be used also in the educational environment.

There are several successful gamification examples like ZeroEmission from Nissan used for its ecological model Nissan Leaf. Kobo Reading Life is an application that tries to gamify reading, Nike ID is an e-commerce gamified application allowing users to design they own shoes and the most popular designs gather points. Various application of gamification can be found in the industry of health and wellness: Keas, FitBit, Lose It. Motivation and learning also offer examples like: Stick.com, MindSnacks, and EnglishAttack.

Gamification desires to combine intrinsic motivation with extrinsic one in order to raise motivation and engagement. Intrinsic motivations come from within, the user/actor decides whether to make an action or not, some examples are: altruism, competition, cooperation, sense of belonging, love or aggression. Extrinsic motivations, on the other hand, occur when something or someone determines the user to make an action for example: classifications, levels, points, badges, awards, missions (Viola, 2011).

In Figure 2. we can see which intrinsic motivation can be generated through existing game mechanics.

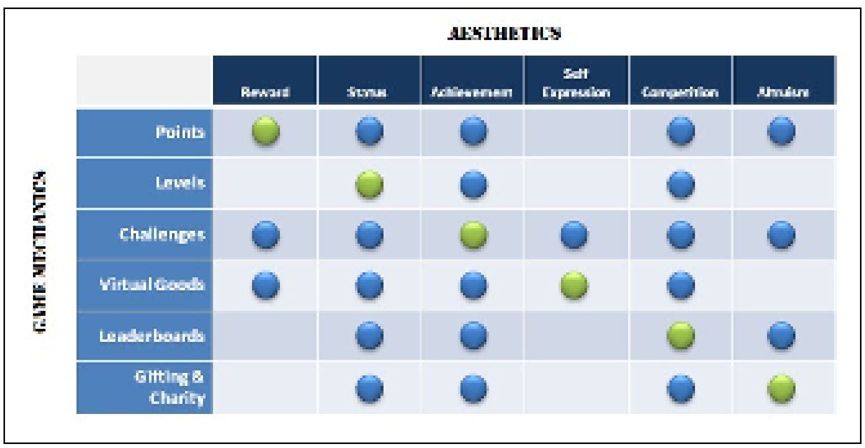


*Figure 31.* **The relation between game mechanics and aesthetics [Bunchball.com]**

When trying to gamify an application there are some key components that need to be taken into consideration and that build up a coherent overview of the entire functionality (utility) of an application/website. Game mechanics and features are comprised in the game design in order to create gameplay (http://gamification.org). Game mechanics are a set of rules and feedback loops that create the gameplay. They represent the fundamentals of any gamified context. Each game mechanic is characterized by three attributes:

- Game mechanics type: Progression, Feedback, Behavioral
- Benefits: engagement, loyalty, time spent, influence, fun, SEO, UGC, Virality
- Personality types: explorers, achievers, socializers and killers.

**6. How to gamify an e-learning application?**

In the following section we try to exemplify how gamification can be applied in the context of an e-learning course. E-learning courses are usually linear courses. This kind of content structure can allow us to easily gamify the content. The basic idea is to uncover content progressively, put more focus on exercises while offering the theoretical means for them to be solved and offer points for correctly solving them.

When designing the gamification of the course we try to answer the following questions: why do we gamify a service, what are the goals and what are the benefits expected. It is important to take into consideration the subject we are addressing. In game psychology there can be identified several personality types. These types are: achievers, explorers, socializers and killers (Bartle, 2004).

We will start on discussing an e-course example studied by Bamber (Henrich and Morgenroth, 2007), a course in information retrieval. We do not have access to the contents of such a course but by studying the example we try to come with some propositions for system improvement.

The purpose of any e-course application is to share knowledge to the users and in most cases offer means of evaluation and feedback. The main goal is to motivate students to learn the available information as best as possible in order for them to perform well during evaluation and advance through the course with success.

By using this application we wish to motivate users to study, rise engagement of students with the systems. By spending more time with the system we expect that the users get better results, advance through the course faster and perform better on final tests.

In (Henrich and Morgenroth, 2007), the authors present an Information Retrieval e-learning course divided into two different modules IR1 and IR2 that have been used for five years for students enrolled in distance learning and which present different characteristics. The didactic concept is presenting the course content two 4 different types of users:

- Presence learning supported by e-learning materials
- Distance learning with physical on-site presence for discussion
- Distance learning with supervision
- Distance learning without supervision

The informative material varies from the first category to the last one. The information presented regardless of each form should be complete, but the fact that for example the first group can benefit from constant supervision and assistance the e-learning system should compensate this for the last group and create support mechanisms for students with questions. The first group benefits from teaching and exercises during the course but also from materials provided by the e-learning application like scripts, self assigned tests and mid-terms. While the first two groups have contact with the teacher on a regular basis, the last two use forums, emails or chat.

In addition to the information already included in the course we propose the following gamification elements:

- Any student needs an account where they can edit their personal profile, in game mechanics known as *avatar* and customize it according to their preferences. They select preferences and courses followed and passed, thus focusing on positive the positive results). They can belong to groups and have access to an activity feed where *notifications*, news and updates are received.
- The course is divided into main *chapters* or sections. By applying the *cascading information principle*, we divide the course into smallest bits of coherent content. The content should be synthetic, but should offer link to more detailed information (links, graphics etc.). Each piece of content should be followed by exercises and an evaluation step. By doing the exercises at the end of each section the student accumulates *points*. At the end of each chapter the student advances a *level*, this being a valuable *achievement*. This has a direct effect on his *status*. A relative positioning between his peer can be presented in a *leaderboard* but also *top scores*.

- They must be constantly offered feedback and be informed of their *progression* within the course, for this it is important to use progression bars.
- Offer the ability to create periodical physical or virtual *appointments* or curfews and deadlines in order to motivate them to return periodically to the application.
- The system should be made as *social* as possible (Farzan and Brusilovsky, 2005) in order to simulate the familiar environment of a classroom and a classroom community. This is important for achievers that need recognition from peer but also to motivate students through peer pressure or comparison with other students.
- For accomplishing difficult tasks or exercises the students receive special *bonuses*.
- The system should compensate students not only for their academic achievements but also for proper behavior and social engagement like helping peers, commenting, and adding value to the application etc. by offering *badges*.
- Offer the possibility to convert points or badges into *virtual goods* or even get discounts for the tuition fees. Students will engage more with the application and will be motivated to earn more points in order to benefit from these advantages.
- While advancing within the course the student should be informed of the next step so as to know what to expect. *Anticipation* is a strong motivator which can get users excited and engage for a longer period of time and maintain the *flow* of learning.

## 7. Conclusions

Gamification does not imply creating a game. It means makes education more fun and engaging, without undermining its credibility. Gamification helps students gain motivation towards studying, and because of the positive feedback they get pushed forwards and become more interested and stimulated to learn. Gamification can constitute a powerful boost to determine them to study/read more.

According to (http://gamification.org/wiki/Encyclopedia) engagement is the important metric for success in gamification. There are several metrics to analyze engagement which due to technological advancement in analytics can be included into such a web application. These metrics are: page views per visitor, time spent on site, total time per user, frequency of visit, participation and conversions.

In our future work we wish to implement the gamification elements proposed on an e-learning course and follow the above mentioned metrics. It is however intuitive that gamification can improve motivation and engagement of users with such a system.

By gamifying an e-course we do not wish to replace the intrinsic motivation of student, which is stinger and more long term, with the extrinsic one, but offer a combination of the two for a better performance. Gamification offers the proper tools to generate positive change in behavior as according to Fogg. We can use this mean to create more effective and engaging e-learning applications.

**Acknowledgement**

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# The digital portfolio- interactive method of assessment

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**Abstract**

*Modern methods / evaluation are complementary methodological options that enrich the practice of avoiding routine and monotony evaluative. Valences formative support that it recommends that the successful practices for evaluation and for central objective of education, namely learning.Among modern methods of portfolio assessment is presented as a comprehensive evaluation method, longitudinal design in a sequence of time, providing the opportunity to make a value judgment based on a set of results.Different types of digital portfolios favors a pedagogy that makes an ally in charge of their child training. The focus is on capacity analysis and discrimination, the spirit of critical and reflective, the ability to argue your choice.Formation through the project INSAM provides teachers the opportunity to access a university computer system performance assessment accessible to all participants in the education process. One of the objectives of the project is developing an evaluation system to provide students and teachers tools and digital evaluation mechanisms. They will then be in digital portfolio assessment for different subjects.*

**Keywords**: evaluation, evaluation methods, portfolio, digital portfolio

## 1. Modern perspectives on the assessment

In terms of curricular and systemic approach to educational process, evaluation is part of a whole, being in close correlation with other activities through which the process of education: teaching and learning. Making evaluative modes of action, and functional interaction with other components of the process are multiform, but their presence is a necessity and implementation, they are in a ratio of functional interaction with them, encouraging them and making them more effective. Thus, evaluation of school activity shall constitute a real stimulus valence training, opening a spiral approach, through which the continuous improvement of teaching.

New directions for the development of postmodern pedagogy assessment, the evaluation requires the transfer of control centered, assessment-centered learning, the evaluation of teacher-centered initiative to control, to one that emphasizes student initiative to reflect on their process to know, learning from mistakes. The important evaluative act becomes how to involve the student in optimizing their learning. Evaluation thus becomes reflexive capacities of a process whereby the learner becomes aware of their own acts and for himself, of his own abilities, and the teacher assumes the role of guide it towards achieving information-oriented formative.

Linking teaching strategies for teaching and learning with assessment is essential for the effective exercise of the educational school. Interactivity can occur both in assessing classroom learning and employment outcomes. Interactive evaluation involves a partnership between educational agencies, which is based on collaboration and negotiation processes aimed at empowering and constructive education and mobilization initiatives in its learning and assessment processes. The main aims of the evaluation is to stimulate interactive self-assessment ability of the subject involved in the process, awareness of its need and to increase self-confidence of education.

This means that the student must realize more strongly that teaching and learning and how to introduce self-control and self-regulation mechanisms.

**2. Traditional and modern assessment methodology**

The practical evaluation requires a flexible attitude in terms of methodology and also in charge of the assessor, it must examine each situation is unique in its own way, to reach a value judgment pertininentă for making the best decisions. To meet these requirements, the teacher has available a wide range and diverse methods and evaluation techniques. Traditional methods were added others more modern, more flexible, especially with the expansion of the scope of the evaluation from the results to processes. Multiplication and diversification of this methodology corresponds also a qualitative improvement. Unlike traditional methods, conducting the assessment of academic results obtained in a limited time and a content area defined modern methods of assessment evaluation conducted in conjunction with training, often along with it and also the results obtained school a longer period of time, those aimed at training capacities, acquiring skills and especially changes in terms of interests, attitudes, learning-related activity. Evaluative practice demonstrates that it can not abandon the classical methods of evaluation, an intermingling functional, fruitful addition, optimal two methodological trends, and not use unilateral, exclusive, their competitive. Modern methods / evaluation are complementary methodological options that enrich the practice of avoiding routine and monotony evaluative. Valences formative support that it recommends that the successful practices for evaluation and for central objective of education, namely learning.

Thus, these methods:

- stimulate students active involvement in the task, they are more aware of who assumes responsibility;
- ensure better implementation of knowledge, practice skills and abilities in various contexts and situations;
- provide a better conceptual clarification and a smooth integration of knowledge acquired in the notional system, becoming operational;
- some of them, such as portfolio, provides an overview of student activities for a longer period of time exceeding the limits of traditional evaluation methods that have been random, both among the contents of the vehicle and among students;
- provide an interactive approach the act of teaching - evaluation, adapted individualization of workload for each student, building on and stimulating its creative potential and originality;
- discourage speculative practices, learning just for the note;
- reduce stress factor to the extent that the teacher acts as counselor, as the assessment is aimed, firstly, to improve and stimulate the student and not punishment at all costs, and evaluation activities include eleaborate products over a period of time.

**3. Portfolio - complex evaluation method**

Among modern methods of portfolio assessment is presented as a comprehensive evaluation method, longitudinal design in a sequence of time, providing the opportunity to make a value judgment based on a set of results. Traditionally, the portfolio mean a plurality of products made by the student after a teacher gave instruction or personal criteria. Portfolio is "card" the student by the teacher can monitor his progress - at the cognitive, attitudinal and behavioral - to a certain discipline, over a longer period of time.

Being a flexible portfolio stimulate creativity, ingenuity, perseverance and originality of the student and provides excellent opportunities for combining the individual success of collective activity. Portfolio over the elements of its functions to other methods and evaluative tools that are found throughout this method. This feature provides a clear portfolio instructive value, and formative. Through it we can point out a number of skills or predispositions of education that can not be x-ray through classical methods.

Structure and composition of the portfolio is subject to the purpose it was designed and established by the teacher with the students concerns the baseline.

The portfolio consists normally of compulsory and optional materials, selected by student and teacher and that relate to different goals and cognitive strategies. It includes a selection of the best works were student's personal achievements, those that emphasize repezintă and its progress, allowing assessment of skills, talents, passions, personal contributions. Portfolio composition is a unique opportunity for students to self-assess, to uncover the value of skills, and limits mistakes.

In the digital environment, the portfolio acquired new dimensions, providing educational features in at least three areas: teaching, learning, evaluation. Traditional media presentation can be arranged on floppy disks, compact discs or on a web page.

There are several facets of the digital portfolio. Portfolio as a source of learning includes works that are a measure of student progress. Some pieces are selected by students independently, some are determined by teachers. Students compose their portfolios constantly adding new songs, new points of view, we remark, reorganizing and mystifing it with new themes structure arrived at by trial or by suggesting them indiviual by teachers or peers. Suppleness and flexibility of digital compositing provides students opportunities to information entities. Such a portfolio is set up progressively and show student progress over a period of time. Technical means to support such a portfolio as computers, printers, video cameras or whose products can be inserted in portfolio composition. Due to heterogeneity and large number of pieces, the student must use a minimal organization, based on certain classification criteria, which shows the student's involvement and basic information processing. Over time, you can reach new structure, the reorganization of the material. The real interest indexes can be built by students, notes that can be edited on the components.

The establishment of such portfolios can be done and asking the students to the various software theme, presenting topics in the curriculum. Thus, we resort to physical discipline AEL platform, it allows viewing and administration of broad types of educational content, such as materials, interactive tutorials, exercises, simulations, educational games Fig 1.

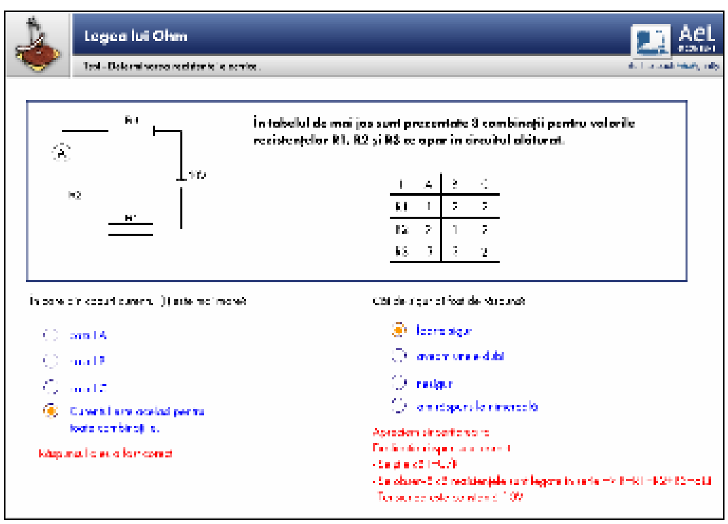


*Fig. 1* **Ohm's Law. Determination of electrical resistance**

Educational materials library acts as a manager of materials is adaptable, configurable, index and allow easy search. Allows easy creation of content (HTML editor built, editor math, tests and dictionary editors), import / export content from files, archives resources using standards such as SCORM and IMS packaging, adaptation or edit content, build their portfolios of existing components. Content can be structured and adapted according to need and enriched with information on curriculum, keywords, version, author, etc.

Portfolio that serves as reference case assessment of student performance measurement. Through this method can be both a continuous assessment, formative and summative one, to end the collection of elements that show student performance after a learning phase. Evaluation by portfolio can lead to obtaining a diploma and appropriate certification. For this portfolio will be interested teachers: Following on from this, he will evaluate and grade student achievement. Evaluation by portfolio remains a complementary formula evaluation by traditional evidence

Digital portfolio has the same features, but requires a computer equipment and a transcription, digital. No more the form of a material object, identifier, but is immaterial structure virtually requires a computer and efficient handling of multiple data networks, support may be a CD, a hard disk and can be accessed from school laboratories from home, from different locations at any time. Digital portfolio allows asynchronous communication with teachers, classmates, parents. He gives a new vision education. Also indicated that the network is quite powerful, so that the student come to their own operational portfolio and enable team work where appropriate. Using this tool requires certain skills of the student to enter or improve. It is a source cross tracking progress of the students' progress. There is the possibility of securing or so that only authorized personnel confidențializări it can consult or frequency.

A digital portfolio can consist of the following elements (cf. de l'Education du Quebec Ministries, 2002): a management program students (how to join the network, how to apply for classification, where each student in computer assembly, ways of composing the virtual group), a program office document management (identification, multi ranking, moving, copying, deleting documents by each student) and a program of management comments and annotations to students, teachers and parents about products made and a program to display student work and consultation to their well-defined circumstances, with any restrictions and limits, a program management office secure areas. All these programs interact with each other, correlated with each other, making the entire assembly to be easily used and exploited. Intake of students is only displaying the contents of these structures.

Such a portfolio can be made to physical discipline of children by giving them access to assessment tests included in the platform myself - digital tools for quality improvement in pre-assessment (Figure 2, 3).

Formation through the project provides teachers in myself the opportunity to access a university computer system performance assessment accessible to all participants in the education process. One of the objectives of the project is developing an evaluation system to provide students and teachers tools and digital evaluation mechanisms. Thus, each teacher will be able to generate a variety of evaluative evidence, and they will then be in digital portfolio assessment for different subjects.

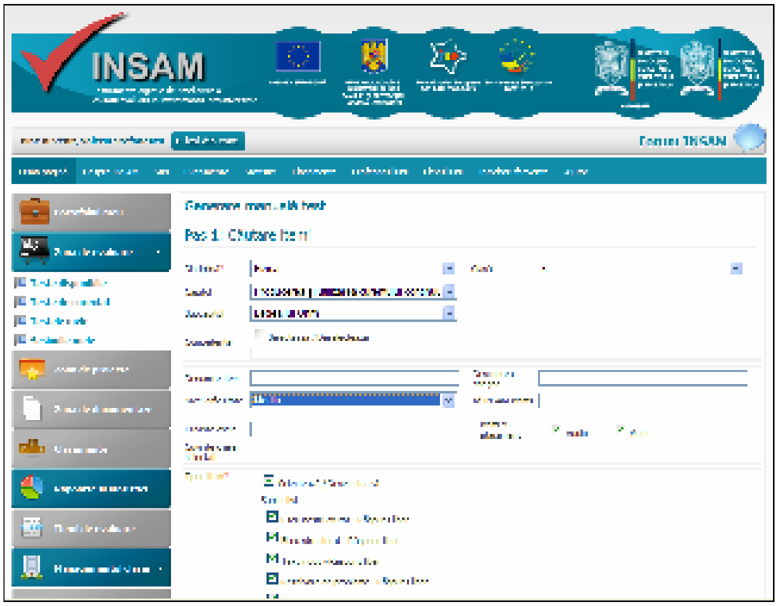


*Fig. 2* **Generating a test in Physics class X of Chapter-production and use of DC**

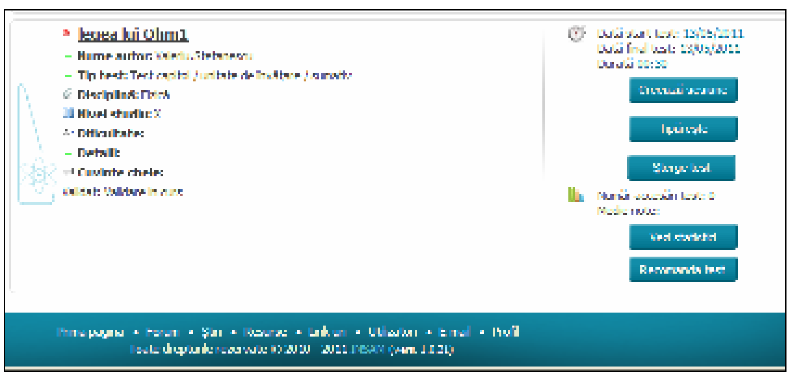


*Fig. 3* **Test items generated**

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https://insam.softwin.ro/insam/report.do

http://advancedelearning.com

# Laboratory experiments and interactive models of physical training lessons

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**Abstract**

*The study of physics can be achieved through a methodological diversity. Between laboratory experiment is a method of learning with a strong participatory active-specific physics. However, computer penetration in the classroom allowed the appeal through the CAI, the software simulation, which prove to be particularly useful in studying this discipline. Using interactive models using computer but should not be regarded as an attempt to replace physical experiments with the real simulations, each situation must be analyzed within each mode avantjele experimentation and in shaping the students skills range species.*

**Key concepts**: laboratory experiment, the types of experiments, computer training, educational software, interactive training models

## 1. Introduction

In physics, the source of knowledge and research method is the experiment. The papers consist of teaching specific experimental observation, verification and measurement of size or characteristic phenomena caused and directed in a more or less.

Professor John Cerghit defines experiment as an observation triggered a search action, the test to find evidence, legitimate, is an intentional provocation, under specified conditions (facilities, equipment, appropriate materials parametriloretc variation and change.), a phenomenon for observation of behavior, the test causal relationships, the discovery of its essence (meaning of the laws that govern it), the verification of hypotheses. Experiment serves simultaneously as a source of knowledge, method of teaching - learning - evaluation and training to students primary means of concrete representations. These representations adequately reflect the consciousness of real physical phenomena and processes students.

## 2. Laboratory experiment

Designed in conjunction with the principles of modern didactics laboratory experiment follows hierarchical steps of learning, leading students to observe physical phenomena based on the demonstration to observe phenomena through their own activity (training phase concrete operations), then check and their practical application (formal operations stage) when formal structure of crystallized intelligence and further the interpretation of observed phenomena corresponding to the highest stage of development hierarchical steps (operations phase synthetic).Any type of experiment the following features are characteristic: the study of natural phenomena and processes using special equipment and facilities, essential properties and establish links between them to study the phenomenon or process and eliminate coincidental properties neesanțiale and influences, reproduction and repetition phenomena and processes studied under certain conditions, planned change in the conditions for the phenomenon or process, making organized and directed the experiment to minimize random influences.

Stages of the procedure include: creating a justification (reasons), making a problem (to serve as a system of thought), analysis and formulation of hypotheses, development of experimental strategies based on existing equipment, conduct the actual experiment, organization and observation, discussion of procedures used, data processing and drawing conclusions (a temporary solution), verifying the results (findings), through practical application and validity and significance discovery conclusions (Cerghit, I., 2001, pg.76).

The experiment has a great formative value because students develop a sense of observation, investigation, ability to understand the essence of objects and phenomena, processing and interpretation of experimental data, etc. stimulate interest in knowledge.

Experiments can be classified according to several criteria. From an organizational perspective, we distinguish experimental work carried out: individual (separate topics or not, each student working independently, provided with all necessary technical and material conditions) in groups (2-3 students) when you do not have enough equipment and installations or intentional, especially, to train the students with teamwork and combined forms or front - experiment is carried out by each student, while at the same pace, on the same subject, under the direction of teacher, provided that can provide equipment, materials, facilities for each pupil. However, in practice we distinguish school: experimental demonstration, prepared by the teacher before the lesson and subsequently Vedra class demonstration, explanation, confirmation or verification of facts specifying; experiment applied, used to verify the possibilities their students in practice teroetice acquired knowledge, skills training for the experiment, the driving skills of handling laboratory equipment.

Computer use and application of new technology-based teaching strategies in educational activities contribute to the development of forms of organization of training not possible using the methods and traditional means. Possibilities of computer processing, recording and retrieval of information triggers the situations in which the student acquires knowledge and skills independently, in accordance with the interests and aspirations. Computer Aided involves direct intervention in the organization of computer learning situation through an educational software. Field studies show that using computers in practical work and laboratory learning efficiency increases by about 30%.

**3. Models of physical training lessons**

Educational software is a program designed for use in teaching - learning - assessment as a means of interactive learning, providing opportunities for individualization. It is made according to certain educational requirements (specific content, target group characteristics, behavioral objectives) and certain technical requirements (preparation of individual interactions, feedback and formative assessment sequence).

After the priority function that can meet the training process can be divided into educational software: software interactive software to exercise (Drill and Practice), simulation software, computer models of laboratory work, theme software, software testing / evaluation of knowledge, software tools, educational games.

Simulation software (interactive models) allow students to observe the monitor screen representation of a controlled trial or a real phenomenon, based on a simplified model. The simulation aims at training the students' mental models of phenomena, processes or real systems, enabling them to understand their formation and functioning. By design, the software allows you to modify some parameters, the student can see how it changes the behavior / response system. In some cases, interactive model can replace the real experiment, especially if the experiment is dangerous and requires expensive equipment (laser operation of a movement of the planets and artificial satellites, operating a nuclear reactor, etc.). Interactive models provide a saving of time in preparing lessons and during lessons. With their teacher present phenomena, processes, etc.., More intuitive and can demonstrate some features of phenomena and processes. This increase student interest in physics and promote a deeper understanding of them.

Computer modeling allows the scaling of time, varying in a wide range of parameters and experimental conditions and model situations that can not be achieved in a real experiment. Some models allow you to display on-screen graphics showing time dependence of physical quantities describing the experiment, while conducting the experiment, which facilitates understanding of dependence of physical quantities that characterize the phenomenon or process studied.

The computer provides unique visualization capabilities that can not be achieved in a real experiment, the theoretical model connecting the successive factors coming model natural phenomena. Using interactive models allow the creation of dynamic images on the screen of experiments or phenomena.

Interactive models can be used effectively in lessons so they may be proposed by students to conduct interactive research model and to establish certain conclusions. In this way students acquire knowledge through independent creative activity, and this knowledge are useful for obtaining a concrete result, observable on the computer monitor. The teacher's role is to guide the work of individual students to acquire new knowledge. Also, the solutions obtained urn problem solving can be experimentally verified by computer. Possibility of verifying individual experiment with computer solutions increase students' interest, turn them into a creative activity and scientific research approaches. Students begin to propose their own problems and check solutions using computer experiments, and the teacher has the task to stimulate the students for this activity.Using interactive models using computer should not be regarded as an attempt to replace physical experiments with the real simulations, because the number of physical phenomena studied in school and can not be presented with a demonstration experiment is large enough.

For example, the class X of the lesson Ohm's Law, to develop specific competence: Comparison of theoretical data with experimental results for a simple electrical circuit can appeal to two types of experiments: real or virtual. In the first case, the student made an assembly of Fig. 1, collect and process experimental data worksheet as received.

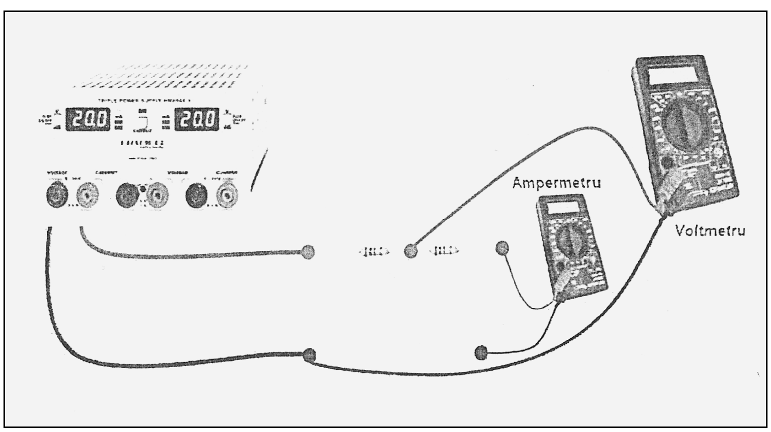


*Fig. 1* **Ohm's law for real circuit**

Thus find that this type of experiment allows students to explore a real phenomenon, to make contact with real equipment, to develop a range of skills, skills. Student have the opportunity to be put in various new situations generated by experimental investigation and to discover new methods of experimental investigation than the one proposed. Disadvantages of using this type of experiment can be found in a sufficient material basis, the possibility of equipment failure during the course of the experiment, large budget allocated by the teacher time to prepare the laboratory work and individual work groups during the course of the experiment.

If virtual experiment, Fig.2, the student can access the AEL or a Java applet Fig. 3.

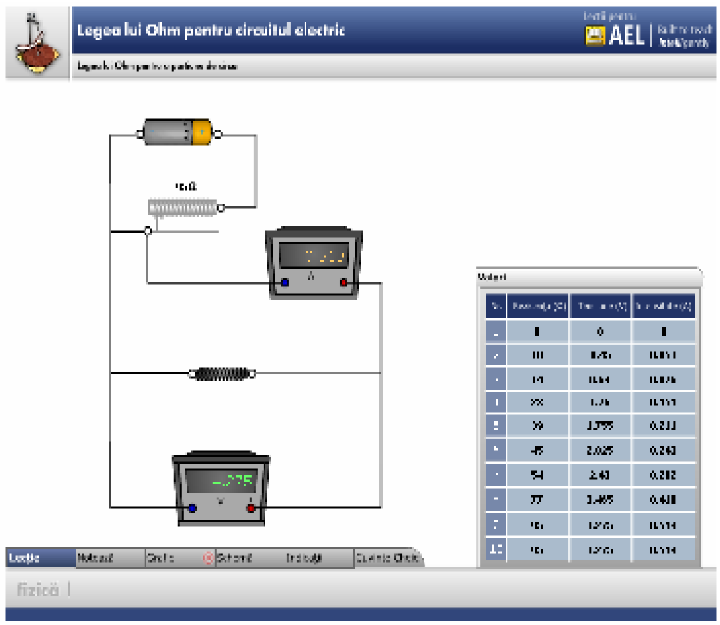


*Fig. 2* **Ohm's law for virtual circuit**

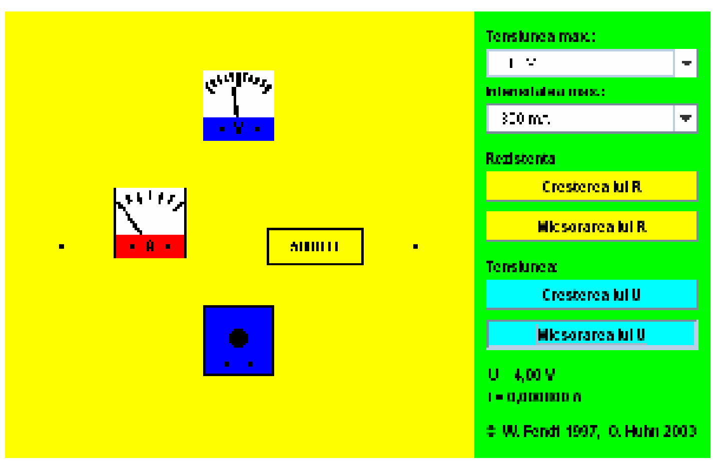


*Fig. 3* **Java applet shows a simple circuit with a resistor**

This Java applet shows a simple circuit with a resistor. He also includes a voltmeter (parallel with the resistor) and an ammeter (in series with the resistor). You can select the maximum values of voltage and intensity measurable with instrumentation. If the message "Overcoming the measurement range," should select another maximum for the instrument. Resistance (R) and electrical voltage (U) can be modified using the four buttons. In Fig. 3 shows the measured values of voltage (U) and intensity (I).

Among the advantages of this type of experiment the following: can be used as a demonstration experiment, allows varying the values of physical quantities quickly covered the teacher than a budget for the preparation of the laboratory is a short period of time necessary to collect experimental data in view of processing, the student is placed in a position to do much of the assembly, allows the experiment in the absence of equipment, which can be opertunitate schools with poor equipment. The limits of this type of experiment are: inability student to explore a real phenomenon, to make contact with real devices, achieving a perfect experiment, the impossibility of identifying sources of errors that occur in real experiment.

Integrating new technologies in education and the use of CAI in educational activities provides important opportunity to develop skills of our students. Software evolution, the predominant aspect of verification, testing knowledge, the more complex issues, providing meaningful contexts for learning, change the scope of activities the teacher quantity and quality. It is a new element of pressure on the school, which must rethink approaches to teaching approach.

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# Google Apps for Education – a powerful solution for global scientific classrooms

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**Abstract**

*This article provides a description of possibilities provided by Google APPS for University and K-12 education. The theoretical section is written in accordance with mathematical models of learning. The practical section provide the practical guidelines for application for Google Apps for Metasystems Learning Design through concept mapping techniques and self, peer and group assessment. Advantages and disadvantages of Google Apps for Education are discussed regard to new strategy of science, math and technology competence development. The opportunities for competence knowledge based structure are provided.*

**Keywords**: globalisation, electronic textbook, global scientific classroom

**Introduction**

Globalization adds new values to global educational system. The implications of globalisation for knowledge, education and learning are: the focus on abstract concepts; the use of holistic understanding; the enhancement on student's ability to manipulate symbols; the enhancement the ability of learners to access, assess, adopt, and apply knowledge, to think independently, to exercise appropriate judgment and to collaborate with others to make sense of new situations. In the Globalisated Age the research and development is a critical component that blurs the distinction between mental and physical labor. The globalisation encourages students to work in teams and to use virtual teams around the world. The academic institutions become less rigid and more flexible in their attempt to meet the varied needs of learners and the global economy. In the education and learning are used a wide range of synchronous and asynchronous activities, which break the boundaries of space and time (Kalantzis&Cope, 2006; Cogburn, 2011).

There are new learning design approached and methodologies for Globalisated Age (Cooper, 1993; Gustafson&Branch, 1997; Hakkinen, 2002; Donovan&Bransford, 2005; Edyburn et al, 2005; Eun et al, 2008; Glahn, 2009; Carr-Chellman, 2011). Metasystems learning design is one of them (Railean, 2010). The metasystem learning design idea is based on metasystems methodology (Hall, 1987). Through fostering globalisation, the scientific management is replaced by knowledge management (Koulopoulos, 2000). The knowledge management processes constitute the base for cybernetic modeling of informatizated didactic process.

Google Apps represent a suite of free email and collaborative tools for K-12, University Education, or large school districts, university consortiums, and state governments to create high-level legal agreements which allow child institutions to quickly and easily deploy Google Apps for Education.

**2. Cybernetic Learning Models for Globalisated Education System**

In Google Apps can be incorporated many cybernetic models of learning, for example: Social Learning Model (Bordogna&Albano, 2001), Statistical Learning Theory (Guergachi&Patry, 2002), Neo-Vygotskian sociocultural perspective (Zbiek& Conner, 2006) and others.

According to Social Learning Model the cognitive impact (CI) acting on an individual is the overall result of those interactions with his/her environment, capable of modifying his/her knowledge, and the self-elaboration of such influence. He/she can also become a source of CI to other individuals by persuading and supporting. The persuasiveness, $P_{ji} \geq 0$, describes the degree to which the ith individual can persuade the jth individual. Also, the support, $S_{ij}$, describe the degree to which the ith individual support the statement of the jth individual during, e.g., a discussion. The knowledge of the jth individual $\sigma_j(t)$, at time t, is defined as a dynamic variable such as $-1 \leq \sigma_j(t) \leq 1$, where $\sigma_j(t) = 1$ corresponds to optimum knowledge. In the autors point of view, the CI due to all multimedia information accessible to the jth individual ($CI^{MM}(j,t)$), is given by:

[1] $CI^{MM}(j,t) = A(j)Q(t)(1-\sigma_j(t))$

where $0 \leq A(j) \leq 1$ is the ability of the individual to search and locate the information in the Internet, its capacity of understand such information, to perform critical analysis and to establish relationships among correlated topics. On the other hand, CI due to social interaction through discussions ($CI^{SI}(j,t)$ is assumed to be:

[2] $CI^{SI}(j,t) = \sum_{i=1,\, i\neq j}^{N}[P_{ij}(t)(1-\sigma_i(t)\sigma_j(t)) - S_{ij}(t)(1+\sigma_i(t)\sigma_j(t))]$

where the first(second) terms accounts for mutual persuasiveness (support), and N is the number of individuals. $S_{ij}$ and $P_{ij}$ depend on the strength of psychological coupling, affinity of social and educational status, rhetorical abilities, personal skills, etc. The knowledge is considered a dynamical variable which changes as follows:

[3] $\sigma_j(t+\Delta t) = \sigma_j(t) \pm \Delta\sigma$

where $\Delta t$ represent an interval of time, $\sigma_j(t)$ - a discrete variable and $\Delta\sigma$ - a quantum of knowledge. For this consideration $\sigma_j(t)$ may improve (or become worse) with a certain probability. Both processes have their own noise.

Guergachi and Patry (2002) describes the concept of system model identification. In the author point of view a system *S* whose state space x is a finite dimensional one can be represented by a mathematical model of the general form:

[4] $\dot{x} = f(x, t, p)$

where $f$ is a mathematical function which is generally nonlinear, $x$ is the system state vector, $p$ is the parameter vector and $t$ is the time. A fundamental problem in system modeling is the determination of the values of model parameters $p = \{p_1, p_2, ..., p_k\}$ such that the corresponding response of the model equation approximates as closely as possible the actual response of the physical system.

One main idea that is widely adopted for Globalisated Educational System is the concept of *zones of proximal development* (Vygotsky, 1978). Lesh& Lehrer(2003) note that student's level of understanding can be influenced by a variety of factors such as: guidance provided by an adult or peer, conceptual tools that may be available either by luck or because of interventions from an adult or approaches limited by sociocultural norms and standards that have been developed by relevant communities—such as students and teachers in classrooms. In the author point of view, the notion of a zone of proximal development needs to be expanded from a *1*-dimensional interval to an *N*-dimensional region in which a variety of paths lead to any given construct.

On the other hand, the globalisated learning system is both real and virtual. This implies a need for *Neo-Vygotskian sociocultural perspective.* Zbiek and Conner (2006) comments, that learning is a discursive activity that involves social and material resources. Mathematical modeling on learning is a non-linear process that involves elements of both a treated-as-real world and a mathematics world. The modeling process involves movement among elements such as the real-world situation, solution, a mathematical entity, and a mathematical solution. This can be done by enhancing motivation through real simulations or activities that prove the real world insight.

### 3. Competence based Knowledge Structure and Google Apps

According to Heller et al, 2006 the competence based knowledge structure can be represented by the knowledge of the learner in a certain domain, which is characterized by a set of assessment problems (denoted by Q). The knowledge state of an individual is identified with the set of problems the person is capable of solving. There are various possible learning paths for moving from the native knowledge state (that is an empty set $\Theta$ ) to the knowledge of full mastery (set Q). Each knowledge state (except Q) has at least one immediate successor that contains the same problems, except one (set Q).

A knowledge structure in which learning is taken step by step is called *well graded*. But, what is step-by-step learning: auditive learning, visual learning, haptic learning, learning through the intellect, learning through all senses or holistic learning? Can be one student deeply involved in learning, if design of the competence based knowledge structure is based on classroom activities in learner centred environment?

In our point of view, the answer of these questions is competence based knowledge structure. The competence based knowledge structure can be developed according to EQF standards, if learning will be designed according to *Learning Metasystems Design* (LMD) approach. Metasystems approach represents an alternative paradigm to systems approach dominant in the educational technology and instructional design. The LMD is based on core integrative principles of philosophy, pedagogy, cybernetics, psychology, and knowledge management.

The competence based knowledge structure, named *savoir –vivre,* integrate *savoir-dire or savoir* (which represents „theoretical and verbal knowledge"(Minder, 2003), *savoir-faire* (which represent „learner's own strategies, methods, procedures, and techniques" (*ibidem*)) and *savoir-être* (which represents „wishes, affectivity, emotions and motivations" (*ibidem*)). Such a structure represent the main learning outcomes, which can be defined, using EQF terminology, as proven ability to use knowledge, skills and personal, social and/or methodological abilities, in work or study situations and in professional and personal development.

The competence based knowledge structure is dynamic and flexible. The dynamicity and flexibility signifies that the structure is strictly individual and can be formed only after each individual has been deeply included in learning process. The strategy of LMD is based on the following principles: the principle of self–regulation, the principle of personalization, the principle of clarity, the principle of dynamicity and flexibility, the principle of feedback diversity and the principle of ergonomics.

Google Apps http://www.google.com/apps/intl/en/edu/ is a powerful tool to develop knowledge and social skills. It is designed for Higher Education, K-12 and large school districts. Google Apps include free email and collaborative tools, which permit to connect campus through emails, messaging, phone and video calls from a single interface. The students and the staff can share ideas, collaborate and work together. They use email, chat, voice and video calls. The activities can be planned and managed efficiently, using Google Docs and Google Calendar. The schools can publish school event calendars, plan meetings and share course schedules. Google Apps permit to connect tablets and other mobile device.

**4. Google Apps for study Science, Technology, and Math**

Basic Competence in Science, Technology and Math is one of EQF eight key competences. It's requiring the ability to develop and apply mathematical thinking in order to solve a range of problems in everyday situations, the ability to use mathematical modes of thought (logical and spatial thinking) and presentation (formulas, models, constructs, graphs, charts). The competence in science require the ability and willingness to use the body of knowledge and methodology employed to explain the natural world, in order to identify questions and to draw evidence-based conclusions. Competence in technology is viewed as the application of that knowledge and methodology in response to perceived human wants or needs. Competence in science and technology involves an understanding of the changes caused by human activity and responsibility as an individual citizen.

Basic competence in Science, Technology and Math is expected to be developed before the phase of the K-12 will end. So, Google Apps, designed for K-12, provide emails and tools for collaboration and working anytime and anywhere. Fast, easy collaboration is what makes Google Apps unique. This means that K-12 students can edit one document together in real - time, without attachments. Also, the students can work together in assessment projects. Self, peer and group assessment is the most used strategies for learning. As was noted by Roberts (2006) with reference to Schunk (2000) "developing self assessment strategies helps students gain control over their learning …[and] allows them to focus more effort in studying those areas where they need more time". Peer assessment refers to the process of having the learners critically reflect upon, and perhaps suggest grades for, the learning of their peers. It is important for the instructors to provide clear and concise guidelines, and for the instructor to maintain the ultimate responsibility for the final grades. Group assessment is a general term, which covers the meaning from assessment of groups as a whole, to the assessment of individuals within a group and the group members assisting other group members' contributions to the group.

Our idea is to develop a Global Scientific Collaborative Classrooms. The idea is to establish a new approach, consisting in a total redesign of the introductory University's mathematics, chemistry, physics and biology courses using collaborative learning environment. The proposed idea aims at the production of a new generation of personalised e-textbooks with stimulators, intelligent analyses of students' answers and virtual laboratories with generators of semantic based items. A real way to make this idea a reality is to join the technology of virtual learning environment and the methodology of electronic textbooks, based on LMD. There are a few uncertainties that need to be addressed. The uses of true / false and multiple-choice tests are unwelcome.

The role of global collaborative learning scientific classrooms in studding Science, Technology and Math is based on the application of a method of instructions in which students with various performance levels and culture of learning work together in small groups, towards a common goal. Proponents of collaborative learning claim that an active exchange of ideas within small groups not only increases interest among the participants but also promotes critical thinking. To archive the collaborative learning environment will be used dynamic and flexible instructional strategy.

Shared gives students an opportunity to engage in discussion, take responsibility for their own learning, and thus become critical thinkers. As result, the students became deeply involved in personal acquisition of knowledge and the learning is more efficient.

The proposed aim could be realised through the following project objectives: 1) To elaborate a new approach of learning technology of electronic textbooks based LMD; 2) To promote learning outcomes based on student – centred approach through global scientific classrooms; 3) To create a world network that will permit cooperation and collaboration with lecturers and students taking involved in natural science courses at both lyceum and university levels; 4) To provide a platform for career development, innovation and further graduated study applied in a new Europe of knowledge.

The K-12 students involved in the scientific collaborative networks are more motivated to learn science, math and technology. Instead, the scientific collaborative classrooms increase understanding in order to study the mathematics, chemistry, physics and biology. One of the main examples is "concept mapping techniques" (Railean, 2006) with affordance to represent the competence structure and to provide the level of understanding the main concepts in deeply learning.

## 5. Toward Metasystems Learning Design for Google Apps

Google Apps can be viewed as promoter of Learning Management Systems like Moodle is. In the case of University Learning we used Moodle for teaching the course "Methodology of Educational Software Development". During the course was observed that students need new collaborative tool for self, peer and group assessment. Moodle with traditional computer based assessment items designed to apply it in solving scientific problems no longer meet the requirements. The students need more personalised learning environments and new methods of assessment (figure 1).

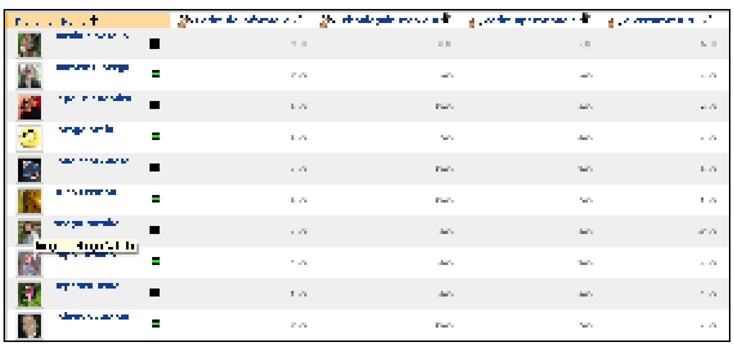

*Figure 1*. **The personalised learning environment**

Students need to develop competence based knowledge structure in collaborative environment and, also, to design and conduct own or group research as well as to analyse and interpret data gained from real learning objects. That is why the global environment needs for dynamic and flexible metasystems learning design.

Khan (2007) reports about well-designed, learner-centered, affordable, easily accessible, efficient, and effective flexible learning systems to meet learners' needs. They expect on-demand, anytime/anywhere high-quality learning environments with good support services. In other words, they want increased flexibility in learning—they want to have more say in what they learn, when they learn, and where and how they learn. They may choose a mix of traditional and new learning approaches and technology; they may want to study at their chosen time and location and at their own pace. As one of the Internet tools, Google Apps distributes resources and information, making it the tool of choice for those interested in delivering instruction. Google Apps is the tool that supports flexible, collaborative, but not dynamic learning.

**6. Conclusion**

The concepts tested using Google Apps tools are often done in an incomplete fashion and are very sensitive to the wording used by the developers. In addition, although the use of web-based instruction appears to be quite promising, there are some dangers in using Google Apps as a testing tool. Steps should be taken to ensure the flexibility and dynamicity in learning, the student's anonymity and the reliability of information transfer. Google Apps need to be developed as powerful tool for analysing students' answers like essay, mathematic formula or stereoscopy of the chemical formula.

The other trends seem to be testing the performance taking into account the individual differences via performance, such as cognitive style, experience and culture of learning. These can be done by the way of optimization verbal and nonverbal learner – computer communications through knowledge graph. The other way is to analyse as much as possible the learning variables such as complexity, difficulty, abstraction etc.

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# Technical and technological skills of teachers

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## Abstract

*The model of a professional teacher requires training and development of a sumum of cognitive skills (related to the knowledge and skills involved in planning, organizing and preparing lessons, and those gained from the experience accumulated from interacting with students and participating in methodical and scientific activities), affective skills (connected to relations with students, other teachers, family and community), cognitive (related to the assessment, self-evaluation and improvement of professional activity) and practical (related to forming and developing practical, motion and technical skills) with a double nature: technical and didactic, in preparing contents, relational, educational and social, in adaptation to the interaction with students, school and community. Among them, the competences connected with acquiring knowledge and operations necessary for using information technology in education and communication require particular attention because the teacher changes through practice in class from just a keeper of this knowledge to a user and promoter of modern techniques in education. Thus, in the era of computerized pedagogy, modern education requires the teacher's greater dynamism, an extended distributivity towards school problems and a faster adaptation to new educational demands..*

**Keywords**: the teacher personality, teaching competence, general skills, specific skills, technical skills and technology

## 1. Introduction

The society of knowledge has imposed the use of new informational technologies as reforming elements in educational systems and the changes aimed at important directions such as: endowing schools, training teachers and providing the necessary resources, these combining with priority directions such as assuring quality in education, lifelong learning, and professionalizing teaching. In this context, teachers are required to build new competences and skills that match the profiles of new staff training and a profession that acquires new meanings.

## 2. Teaching competence - the core of teacher's personality

The personality of the teacher is one of the important psycho-socio-moral variables of developing the educational process. Like all components, this is subject to a renewal process in accord with the new objectives of education in the European context, the meaning being that of the transformation of a job into a profession with well defined standards, which should be systematically pursued.

From a structural point of view, the teacher's personality is part of a special typology determined by the specific work performed, characterized not only by complexity, but also by adaptability. The core of the personality of the teacher which ensures performance in teaching is the competence that can be defined as a unity of what the teacher knows, what he can do, how he can behave and how he can become. [3].

Referring to the practical value of teacher's personality in relation to his role as educator, Gherghinescu R. (1999) presented teaching competence as including a set of skills referring to the possibilities of diagnosing educational states, of predicting them, of organizing the educational process, but also the modalities of assessing and motivating students. The author defines the teaching competence as a way of objectifying educational capacities specific to education in the context of the educational field. The teacher's competence profile is built by assuming roles, specific functions by activating personal dispositions and it involves complex provisions of integrated knowledge, skills, abilities and attitudes.

**3. Teachers' General and Specific Skills**

The "professional teacher" model requires training and developing skills related to: the responsibility of designing and organizing the curricular activities in innovative strategic and procedural perspective (the teacher creates habits that will allow the execution of operations based on the acquired knowledge, seeking to rally these acquisitions for conceiving, structuring, changing and assessing its approach on student's advantage); the maximum usage of all resources for learning, due to adopting a modern outlook on the educational process focusing on student and group, differential treatment of students, rescaling student - teacher relations (the teacher guides, advises the student in his effort to develop), the acquiring the knowledge and operations necessary in using information technology and communication in education: the teacher changes through practice in class from just a keeper of this knowledge to a user and promoter of modern techniques in education.; the responsibility for personal professional development and teaching career: becoming aware of the roles assigned and the need for training, assuming new roles, according to a society that is seeking its own identity by developing the capacity necessary for self-reflection, promoting partnerships with structures from the civil society, using languages specific to the society of knowledge, resizing the socio-professional status, the development of an organizational culture at school level leading to establishing of an optimal organizational climate.

Romanian school should become the basis of social progress and modernization, the promoting factor of cultural, scientific, technical, civic and spiritual values, and the teacher needs to know what is expected of him and be able to act professionally.

Applying national standards for teaching positions in secondary education represents a fundamental condition of modernizing the Romanian school in accordance with the achievements and trends in European education systems and global performance. The standards are qualitative statements, but may be developed on the real, quantitative data. They are targets, describing what is expected. The individual and organizational training programs are projected according to these targets. Teachers' training, reflected essentially in students' performance, is a major problem of contemporary education. It is widely accepted that the basis of a quality education is the level of competence and involvement of teachers. The standards for the teaching profession represent an instrument for assessing the results whose necessity is claimed more and more frequently. They should be regarded as a living and dynamic assembly of skills that are continuously improving.

The national standards for teachers of secondary education represent a document that describes the map of skills necessary to carry out educational activities, grouped into general and specific skills. They are clear, qualitative benchmarks, describing the minimum levels of performance for teachers, at the same time constituting benchmarks in assessing the quality of professional performance [5].

The professional competences required for teaching are: cognitive skills, related to the knowledge and skills involved in planning, organizing and preparing lessons, and also those gained from the experience accumulated from interacting with students and participating in methodical and scientific activities; affective skills, connected to relations with students, other teachers, family and community, as those resulting from an affective, balanced expression in applying the responsibilities towards others and towards himself; cognitive, related to the assessment, self-evaluation and improvement of professional activity, and practical, related to forming and developing practical, motion and technical skills.

They have a double dimension:

- technical and didactic in processing the contents involving the identification, selection, processing, design and developing the teaching - learning – assessing
- relational, educational and social regarding the adaptation to the interactions in the classroom, school and community.

Thus, methodological competences refer to acknowledging and selecting the units of content concerning designing and organizing, the management of factors involved in teaching situations and in methodical scientific research. The communication and relationship skills, those that bring a touch of specificity to the teacher, involve facilitating the exchange of information with students, teachers, parents and community through adapting the modalities of communicating and creating the psychosocial context for communication, favorable to achieving positive educational objectives. Evaluation skills are expressed in setting assessing objectives and in accordance with these, the development of assessment tools, applying assessing tests, the interpretation and valorization of the results as critical thinking and practice. Psychosocial skills are general skills necessary for teachers to identify students' potential concerning guiding them in the educational process and its suitability to their individual skills and characteristics, the psychological and moral characteristics. The managing competences for the career are about fairness and dignity, communication with all educational factors, flexibility of behavior and thinking, self-control, stress resistance, balanced behavior in all situations and education and openness to innovative trends necessary for personal and professional development [5].

**3. Technical and technological skills**

Technical and technological skills are imposed by the technological nature of contemporary civilization and can be described as methodical skills necessary for teachers to facilitate training, developing and improving students' learning skills and self-control. The categories of activities related to these are: forming and developing practical, motion and technical skills. The following specific skills are required in order to realize the activities:

- use of computers in the educational process;
- practicing the action schemes to acquire / improve practical skills;
- designing and using materials / learning resources;
- applying strategies for efficient use of didactic resources in education.
- due to the fact that information and communication technology involves significant changes in educational process, teachers, through their work performed with new technologies, must determine students to act, to engage in activities that require a selection of documents and a completion of real tasks. The educational computerized programs encourage teachers to focus on the fundamentals of learning new methods and techniques: new philosophies and approaches (constructivism, cognitive, learning styles, multiple intelligences, critical thinking), designing education, designing support materials, more effective strategies for achieving learning objectives. This fact requires forming some skills – useful keys for approaching new didactic activities, skills that include:
  - general skills and knowledge of computer use, word processing, general knowledge of communication, including e-mail and Internet connection, the general procedures of web search, online tools, searching online archives, downloading procedures, and use of software suitable for these functions;

- specific skills and knowledge of using computers in teaching - learning – assessing

Information and communication technologies tend to become current tools in schools and so the need to develop a specific attitude and a new way thinking that will allow the teachers an adequate response before any new requirements. In these complex and dynamic conditions, school faces the urgent need for change, adoption and effective utilization of the potential offered by information technologies for learning. Moreover, education specialists are concerned to provide new instructional models adapted to the new conditions of teaching and learning, to explain how digital technologies can create new learning environments in which learners are engaged in their own learning, able to assume increased responsibilities in building their knowledge. Regarding these trends, academic institutions of initial teacher training included in their curricula ICT and CAI courses, so that each future teacher will receive a basic training in this area, which will further develop in numerous graduation training programs, the ultimate goal was to build an information culture understood not only as a specialized knowledge and competence, but also as a new orientation and reference to reality. The main objectives of these programs are [4]:

- to develop an overview of the extent and importance of new technologies and their effects on the individual and social and economic community;
- to acquire common principles governing the application of information, knowledge of nature, the properties and structure information in the context of new technologies;
- to develop the ability to use specific tools and applications of new technologies in activities such as searching, processing and storage of information, supervision and control of information, communication through email and Internet;
- to form the capacity to identify the situations when it is appropriate to use new technologies and design appropriate solutions to different situations.

The incidence of new technologies in education entails the development of complex skills to search, selection, and organization, creation of information and self-development of cognitive abilities. The new electronic learning environments convert the structural model of educator-educated interaction in a triangular pattern educator - computer - educated, and this fact requires that each user to have certain skills and knowledge about computer operating about the way it can be used. It is important that teachers have specific competences in the area referring to [4, 1]:

• basic operations. Using the computer requires a series of skills and abilities that allow teachers to carry out basic operations training activities assisted by new technologies: appropriate use of various computer components and peripherals, storage media, information, customizing the work environment under a widely used operating system.

• information technology. Teachers are put in a position to manipulate information for research, preparing new lessons, disclosure, development of assessment tests, collaborative activities through the Internet with remote colleagues. These activities are associated skills and competence to use information technology: to locate information, select appropriate software and applications, organize material, analyze relevant information and present them through: the use of software tools, including word processing, creating graphs, making presentations, computer spreadsheet and database handling, use interactive presentations, the ability to use the Internet and e-mail programs.

• evaluation of educational software. Lessons in electronic form are a common tool for teachers wishing to provide more quality teaching - learning. This involves: the ability to select multimedia and electronic lessons according to learning objectives, the ability to assess the relevance of material in electronic format for educational situation. The most used assessment methods are based on lists of criteria. Their purpose is to serve the assessment of the educational potential of different software systems. There are many lists of criteria proposed by the organizers of such systems or by specialized organizations. Almost all of these lists contain a number of positions on the necessary hardware for the implementation of programs, presence and quality of documentation, support materials provided, the application, ease of use, use of graphics, color, and sound. The lists include education on learning objectives and criteria, the relevance of the area covered in the curriculum, assessment system's ability to achieve. A relevant and useful list in this aspect is the one created by Olimpius Istrate, it contains the standardized design and evaluation criteria of a good educational software on objectives, program structure, amount of exercise, how to assess the relations with the student software (criteria can be accessed at www.1educat.ro).[6]

• pedagogical aspects of using new technologies in education. The key aspects of CAI competences have a more pedagogical than technical nature. The role of new technologies in learning, especially educational software, varies from providing access to information and knowledge to facilitating understanding of phenomena, individualized instruction, and differentiated treatment. In order to use efficiently various electronic applications in teaching, beside initiation in using computer technology, teachers need a new pedagogical training adapted to new requirements, engineering curriculum with an ICT component, development of lesson plans starting from learning objectives, development of teaching strategies including electronic educational items. Innovative approach to lessons by integrating information and communication technologies requires exploiting the creative, inventive, innovative potential of the teacher. Posting the classical way of teaching through the use of electronic resources polyvalent intake rises for teachers, sometimes less prepared for such a change in their own teaching style. If the traditional teaching models do not fully meet the quality of teaching and learning, CAI and e-learning, used creatively and effectively, can provide support, maintain and improve students' learning.

New technology requirements are becoming larger and more numerous for teachers, and the formation of their personality is a long process that is triggered when a program starts including initial training and continues throughout their professional development, assuming as demanding a permanent opening to what is new. Initial and continuous training are the two stages of effort undertaken institutionally and personally of the process of professionalization, each with specific features and finality described by professional standards. It is important that each teacher be aware of its role in this process.

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# Training Teachers University - some reflections on the development of digital competence in the knowledge society

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**Abstract**

*In this article from the reflections on the major transformations and challenges of the Knowledge Society, and the main implications of Information and Communication Technology (ICT) on higher education, universities, and specifically on the development teaching professional at this level, both in its profile, functions and roles, as in their training and skills. The main objective of this article is to present the functions and digital skills to be developed by faculty to function adequately as a Teaching Professional in the Knowledge Society..*

**Keywords**: Training Teachers, Knowledge Society, Information and Communication Technology (ICT).

## 1. Introduction

Human societies are transformed. The man is transformed and adapted, going beyond ... collaborative model building and its reality evolves. The company now emerges is a society full of rapid change and uncertainty - globalization, immediacy, information, valuation uncertainty - (Tejada, 2007), in which man lives and builds these transformations.

Many authors are already (Drucker, 1969, 1993; Bell, 1973, 1979, 1993 in Webster, 2002; Toffler, 1980; Castells, 2005) and international organizations (UNESCO, 2005) that since the last quarter century have been reflecting on the kind of society that has been emerging rapidly and setting the twenty-first century context where we are today.

It is now undeniable that we live in a society increasingly complex and multidimensional (De Alba, 2007) in flux that is permeating and transforming the entire social, cultural, economic, political, legal and environmental issues of global human. The core of this change, or rather of these massive transformations is, as Castells (2005), in the "Technologies of Information Processing and Communication", namely, that technologies are not just an exogenous source of change, but rather constitute the very fabric of all human activity (Castells, 2005).

In the Information Society or Knowledge Society, "... the key technology is the Information Technology, which is distributed via the Internet, which makes it possible to 'Red' as the new form of organization. In this sense, the Internet is not just a technology, but a key organization through which the virtual processes in our reality, therefore, directs and transforms our reality" (Castells, 2005).

## 2. Conceptualization and characterization of the knowledge society

The contributions made to the description and characterization of modern society since the last quarter century until today, as noted Mattelart (2001), provide a vocabulary full of great ambiguity. Thus, over time have been coining of terms such as diversity Global Village, Post-industrial Society, Technology Era, Era Digital, Technological Revolution, the Information Society, Network Society, Society of Learning, Knowledge Society, among others.

But how can we name and characterize the current society with a more or less inclusive and understandable? From the ideas and characterizations of society given by the authors mentioned, we see that they have been in a continuum of ideas, and meanings that have been refined and reconfigured over time, but nevertheless, remains open and with consensus given the very questionable constant change, increasing complexity of society and the transformation of the elements of value in each time and context (technology - information - knowledge-communication-services - ...?).

What seems most apparent evident of all is that there is a change or transformation of global magnitude where advances in information and communication technologies and knowledge, reveal a great importance. "Information" and "Knowledge" seems to be the core values of modern society.

The latter concept - knowledge society – “... has become a subject of immense economic challenges, political and cultural, to the extent that societies begin to glimpse the outlines of which may well qualify as knowledge societies” (UNESCO, 2003).

Thus, the most common denominations currently in both everyday language and in the scientific literature are the 'Information Society' and 'Knowledge Society', used interchangeably, when in fact they mean two different things, but nevertheless We realize that both are key elements of value to determine the society in which we live.

The information, according Atlet (1994, in Perrenoud, 2008) is “outside the subject and social order” Knowledge is "composed of the subject and is of a personal nature. For its part, Didrikkson (2002) in his analysis of higher education with respect to technological change, considers itself important to distinguish between the two terms, as some of this confusion, it seemed to the university as part and parcel of “industries that produce information” as part of the industries of “knowledge”.

The information, according Atlet is "outside the subject and social order" Knowledge is "composed of the subject and is of a personal nature”.

The information differs from knowledge, because the first refers to the data, acquisition and processing, but especially now associated with the management of these through the computer. With regard to knowledge, the same author tells us that not only includes information or data processing, but the generation of its production, transmission and dissemination, and strictly dependent on a social relationship.

But is it really the knowledge itself, the true value to society? On the verge of their first decade of the century, the evidence on the practices and customs that are being made in the world and in education with advances in information and communication technologies, it seems that the value is no longer in both information or knowledge, but precisely in the uses made of the latter.

Above all, it is noteworthy that knowledge is a value that lies in people, and that the configuration of the communications over the Internet and Web 2.0, information and knowledge are being shared, reflected and generated global scale, where people, users of these technologies become creators and not just consumers. In fact, being created every day new uses and services they use and transform this information and create new knowledge and services across the network, according to the particular needs and interests of diverse communities of people around the world.

We agree with UNESCO (2003) that "... the concept of 'knowledge societies' is preferable to the 'information society' because it better expresses the complexity and dynamism of the changes that are occurring," "... the knowledge issue is not only important for economic growth but also for empowering and developing all sectors of society”.

### 3. The Challenges of Knowledge Society for university teacher training about ICT

The evolution of society and the impetuous development of science and technology in the contemporary era have led to a strong demand for education, which attracts, in turn, increase the role of academics.

Thus, the field of education has not been exempt from these changes, to be affected more and more, all education systems at all levels, its agents and processes. Among the various changes that we are already seeing the impact of education in ICT, particularly in higher education and universities, we can mention the emergence of new forms of teaching-learning (blended learning, e-learning, ...) new environments and learning platforms (Moodle, ATutor, Blackboard, WebCT, ...), new ideas and ways to create, manage, transform and share information and knowledge technologies (Web 2.0 and Web 3.0), new ways of communicating and working in social communities (Ning,

MySpace, Facebook, Flickr, Twitter, Windows Live Spaces,), among many others. A characterization of new learning environments, training XXI century is what makes Cabero (2005) (Figure 1).

It claims that more and more success reaching new directions for reform in higher education is appropriate training for university staff. At European level, are a range of trends and projects for teacher training university, which is a concern for governments, international organizations and, not least for themselves teachers and experts in science education. Thus, a different dynamic process of training and professional development of academics is a priority and an important aspect for improving the quality of higher education in the XXI century.

Given these new scenarios, it becomes clear that the university professor is facing major challenges in order to develop properly in the Knowledge Society: assume new models and conceptions about teaching and learning, new methodologies, new roles and functions, new skills and new attitudes especially that allow the teachers to address all these aspects in which ICTs play an inescapable where what matters is developing the skills of the individual teacher to use and integrate the technology and critically reflective.

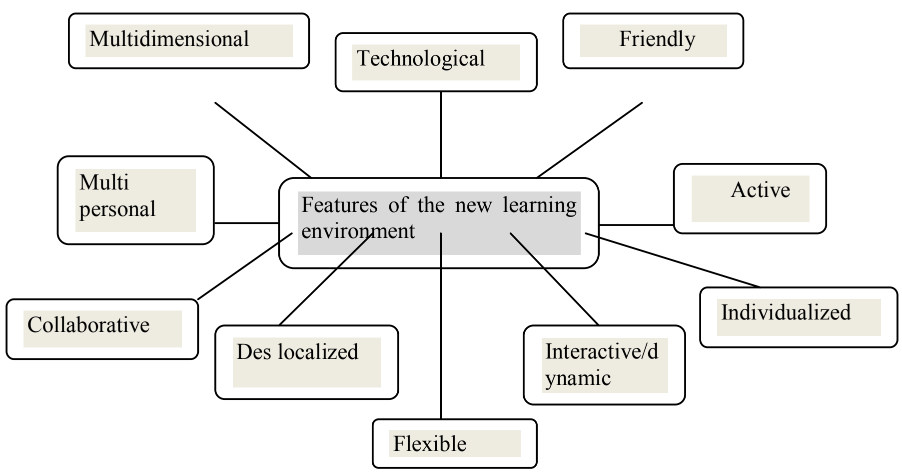


*Figure 1.* **Features of the new learning environment (Cabero, 2005)**

Some of these concerns and challenges for teacher training in the XXI century, have been addressed in different ways and perspectives by different authors in recent years (Area, 1998, 2008; Cano, 2005; Cabero, 2001, 2005, 2008 ; Cardona, 2008; Coll, 2008; De Alba, 2007; Escofet, 2006; Fandos, 2006; Hargreaves, 2003; Imbernón, 2007, Perrenoud, 2004; Salinas 2004; Tejada, 2007; Zabalza, 2007), among which we identify, in broad terms, some common or overlapping:

- Know how to accept and manage change

- Commit to lifelong learning
- Teamwork
- Managing diversity
- Managing information and communication technologies
- Manage and critically analyze the vast amount of information
- Manage and share knowledge
- Taking an ethical and responsible behavior
- Manage your own training.

Thus, we understand that the college professor can successfully develop the knowledge society am if you can have what we call digital competence, is being able to search, manage, analyze critically and to transform information into knowledge, as well as being able to work together and share this knowledge with ethics and social responsibility technologies appropriate integration of information and communication in their personal and professional development, not only as mere objects, instruments or accessories for your activity, but as an integral part of your reality , its performance in scenarios where you set your activity and legitimate profession. But above all, we need to develop a university professor also the ability to learn at a faster rate, giving the characteristic rapid changes and advancements of this society, therefore, one of the core competencies to develop the knowledge society will of learning to learn, is at both personal and professionally, the challenge is to principal that learning throughout life (Delors, 1996), in multiple contexts and modes of learning.

Given the technological developments as the evolution of society, academics condition is in full mutation, so that training cannot remain in second place. As noted Fandos (2006), training of teachers as insurmountable step for access to the knowledge society must be analyzed the intrinsic and extrinsic aspects of new technologies, possibilities and potentialities, cultural and political effects.

The new teacher's professional profile with the incursion of information technology and communication, has been formed and studied by various authors, which have been identified that synthesize new professional roles, without being exhaustive, the following:

*Table 1*. **New roles and functions of the university professor**

| AUTHOR | NEW ROLES / FUNCTIONS |
|---|---|
| Tejada, J. (2007) | Programmer, director and coordinator of learning processes with interactive media.<br>Transmitter of information and promoter of the exercise of knowledge, procedures and attitudes.<br>Motivator and as a connecting link between the objectives to be achieved and the participant. |
| Cano, E. (2005) | Designer and manage of process.<br>Guidance staff.<br>Provider of information and resources.<br>Enabling environment generator and dynamic groups.<br>Motivator and facilitator of learning.<br>Supervisor and assessor |
| Salinas, J. (2004) | Mediator in the construction of knowledge.<br>Student guide and facilitator in the use of resources and tools they need to explore and develop new knowledge and skills.<br>Manager of learning resources.<br>Guidance. |

| | |
|---|---|
| Tardiff, J. (2001) | The teacher as a creator of learning experiences for students.<br>Mediator between knowledge and learning.<br>Researchers, cooperative and strategic users of ICT.<br>Tutor and guidance to foster students' critical |
| Adell, J. (1997) | Curriculum Design<br>Content development and facilitation, Tutoring Evaluation<br>Technical Support |
| Tatch and Murphy (1995, in Tejada, 2007) | Tutor<br>Instructor<br>Teaching Engineering Graphic<br>Expert, Reviewer<br>Document Editor |

This will have built a series of Digital Competence Units for the profile, which we must assume the teachers in the knowledge society, emphasizing that such competition must be integrated into the fabric of each of these roles, as a transverse and impact to a greater or lesser extent, in each of the roles and activities of the teacher, allowing you to put aside the purely instrumental approach to technology, we feel is only part of skills and approach to be considered equally alongside those methodological skills, personal and participatory form of knowing all types of competition (Tejada, 2007) and open the way to the priority of the person, professional, for that he, who from critical reflection, properly use and integrate information and communication technologies not only in the classroom, that correspond only the role of teaching, but integrates them in each of their professional roles and contexts for, according to its discretion and expertise. Thus, the focus is not on the technology, but in the power of reflection and decision of human beings to strategically use the technology.

*Table 2.* **Competence Units**

| Competence Units |
|---|
| 1. Planning and designing learning experiences and virtual environments. |
| 2. Development and conduct of collaborative classroom learning experiences and networking. |
| 3. Direction, guidance and evaluation of knowledge construction processes and virtual environments. |
| 4. Managing growth and professional development with ICT support. |
| 5. Research, development and pedagogical innovation with / for the use of ICT in education. |
| 6. Diversity, ethics and responsible use of ICT in the performance of teachers. |
| 7. Environment, health and safety with the use of ICT in the teaching profession. |

## 4. Conclusions

From these roles and functions, the Profile of a Professional Teaching with Digital Competition would be described as an autonomous professional, efficient, responsible, critical and thoughtful in selecting, processing and use of information and its sources and different technological tools, also a teacher with digital competence, and respect has to use the socially accepted norms to regulate the use of information and its sources in various media.

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# Study Strategies of Online Learners

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**Abstract**

*The number of institutions providing online (virtual) learning is increasing day by day. The increasing number of institution leads to the increase of the students numbers obtaining education using this method. Technological, especially interactional and communicational, developments provide many opportunities to students studying by the method of online learning. Distance education students, who mainly used printed instructional materials in the past, now benefit from the diversity of educational environments (such as flash demonstrations, videos, forums... etc.) that have high interaction levels.*
*Thus, the main aim of this study is to investigate of the online learners study strategies and preferences. The study is designed as a qualitative research. Interview technique was used as a tool for collecting data. Data gathered as a result of the study was dissolved with descriptive analysis.*
*At the end of the research, the student's studying strategies and preferences have tried to be deducted. In consequence of the study, it has been determined that online learners (students) have some difficulties to constitute effective study strategies. In addition, the initial learning resources (instructional materials) that the students prefer while studying have tried to be determined.*

**Keywords:** Online learning, Study strategies, Study preferences

## 1. Introduction

Distance education actually is an implementation that appears with the studies being applied in education field over a century. When it is assessed in line with its historical development, it can be observed that it is renewed and changed in the light of both technological developments accomplished from past to present and developments in the field of Educational Sciences (or pedagogy).

Rapid development in Information and Communication Technologies (ICT) at the present provided widespread deployment of distance education and extensive and significant acceptance. Particularly, institutions started to think that distance education can be an implementation which can be considered as a good solution for time, place and cost problems in training when they face with such problems intensively.

Today, many educational institutions try to reach students particularly with online or virtual courses. Day by day an increase is accomplished in the number of the courses suggested by such institutions. The increasing number of institution leads to the increase of the students numbers obtaining education (learning) using this method.

When historical developments in distance education are evaluated, it can be seen that many novelties appeared in application. Technological and theoretic changes can be shown as the basis of such novelties. All experienced technological developments integrated in distance education environment and dedicated to the service of students. For example: radio, television, computer… etc. These developments caused composition of different period cycles in distance education.

Moore and Kearsley (2005) classify historical development of distance education in five periods (generations). According to this classification generations are named as follows;

1st Generation: Correspondence Study
2nd Generation: Broadcast Radio and Television
3rd Generation: System Approach (Open Universities)
4th Generation: Teleconferencing
5th Generation: Computer - and Internet-Based Virtual Classes.

Today, Virtual Learning has popularly developed as a result of rapid development in internet and computer technologies. It is a stubborn fact that developed technology has a great contribution in educational environment particularly in distance education. However, no doubt one of the most important elements of education and particularly distance education are students. Therefore, distance education (virtual learning) should focus on to increase motivation of the students within the system, to provide their efficient studying and to increase their success in every session.

According to Teker (2002), Moore's transactional distance theory argues that, there is a great (long) distance between the student and the teacher in distance education. In more detail this distance is defined as Transactional Distance. Mentioned distance is related to educational sciences and communication (or dialogue) rather than geographical location (that means geographical distance). Therefore, students should take much more responsibility so that they can be successful in their lessons. A student, who can study autonomously, shall need lesser assistance (Simonson and Scholosser, 1998; Teker, 2002).

According to Erdamar (2010), who reviewed studies in the literature, one of the most important factors in success of students in school are their studying strategies and behaviors.

Furthermore, alone learning obligation of the students are much more in distance educational implementations. In this case, students who take distance education should have good planning, motivation, and regular and efficient studying skills and should be capable to analyze learning materials (Teker, 2002).

Technological, especially interactional and communicational, developments provide many opportunities to students studying by the method of online learning. Distance education students, who mainly used printed instructional materials in the past, now benefit from the diversity of educational environments (such as flash demonstrations, videos, forums... etc.) that have high interaction levels.

Motivation, success and regularity of students can be considered to be affirmatively affected by knowledge of preferred learning materials by the students and more usage of relevant materials in today's virtual learning environment. Furthermore, status of effective studying strategies of the students who take education by this means, shall directly affect their success in their lessons. Therefore, it is very important to determine which educational materials are being preferred by the students and whether they have effective studying strategies or not in today's virtual environment where many kinds of media is being used.

### 1.1 Purpose of the study

The main aim of this study is to investigate of the online learners study strategies and preferences learning resources (instructional materials). Answers to below given questions were sought in order to reach this general aim:

a. What types of instructional materials (learning recourses) are the students prefer in online learning?
b. What is the status of effective studying strategies of the students?

## 2. Methods

The study is designed as a qualitative research. *Qualitative Research* is defined as "A research during which a qualitative process is followed in order to expose perceptions and events in a natural environment by a realistic and integrated manner and in which qualitative data collection methods such as observation, interview and document analysis are used" (Yildirim & Simsek, 2005). In qualitative studies, it is very important to expose the nature of various (multiple) points of views. Additionally, qualitative research methods assist the researchers to scruintinize any complex issues by using qualitative data collection and analysis (Leedy & Ormrod, 2005).

### 2.1 Participants

The study was conducted during the 2010-2011 academic year, fall semester in the "ITEC443 - Cryptography and Network Security" course. The population of the study consisted of a total of 42 students who enrolled the course. No sampling is selected in this study. All students who had taken the course were interviewed at the end of the term. By this means, we tried to collect as much data as we could from the participants.

Distribution of students according to their Gender, Previous Online Learning Experience and Grades are given in below Table 1.

*Table 1.* **General Characteristics of the Students**

| **Gender** | **Female: 11** | **Male: 31** |
|---|---|---|
| **Grade** | 3rd and 4th grade undergraduate students | |
| **Distance learning experience** | They haven't got any distance learning experience. | |
| **Total** | 42 Students | |

As to be seen in Table 1 total 42 students participated in this study as 31 male and 11 females. All of the participants were students of 3rd and 4th grade undergraduate students. Furthermore, none of these participants had previous distance education experience. In other words, all of these participants have taken online education for the first time.

### 2.2 The Online Environment

As mentioned previously vehicle of the study was selected to be "ITEC443 - Cryptography and Network Security" course. Moodle LMS was used as the online learning environment. Prepared learning materials relevant to the lesson were given to the students in two types such as materials convenient for printable and visual (non-printable) materials which are not convenient for printing. Visual elements that were prepared for each unit of the lesson were videos and animations (prepared by flash) and printed materials were power point presentations, word documents, additional reading materials (as a pdf). Links to web pages on any issues that may be required during lessons and an environment was enabled so that students could study from various resources. Furthermore, every week study questions and tests were prepared for the students.

## 3. Data Collection

Interview technique was used as a tool for collecting data. In this study face to face interviews were carried out with each student. Interviews held in the study were carried out deploying "a semi-structured interview form" approach. All interviews were recorded by sound recorder in this study. By this means all data obtained in these interviews were recorded. According to Yildirim and Simsek (2005) both recording by any type of recorder and taking down notes are required for interviews. The notes and records taken in interviews were later used in data analysis.

Data gathered as a result of the study was dissolved with descriptive analysis. During descriptive analysis, data was arranged and described according to selected analyzing method (Yildirim and Simsek, 2005). Data of this study were organized according to the themes that are exposed by research questions.

## 4. Findings

As previously mentioned, data in this study were analyzed by means of descriptive analysis method. Results obtained at the end of the performed analysis are submitted parallel to research questions. Selected data obtained from student interviews were quoted without making any change thereupon.

### 4.1 Instructional materials (learning recourses) preferred by the students in online learning

During the interviews carried out with students majority of them stated that they have preferred visual materials such as video and animations and some of them which can be considered as minority, stated that they prefer presentations with voice. Furthermore, students prefer education materials which are completed in a short time. Additionally, it is determined that students are always in communication with each other on web and they prefer to use chat and forums. Students, particularly stated that they find instant feedback materials both on asked questions or in lecturing, more useful.

Statements of some of the students on this issue are quoted as follows:

> *....I generally prefer to study the topics by means of watching animation prepared as video or flash. If I see I have missing knowledge on that topic I prefer to read additional resources or to ask it to my friends in the forums ...*
>
> *....I generally follow the lessons from videos or vocal lecturing and try to answer questions at the end of each unit. Having taken feedback continuously while I was answering the questions provided met o control what I've learned ...*
>
> *....I continuously controlled the questions asked by my friends to each other (forums and chat) and I've solved many of my questions with the answers there ....*
>
> *....The important thing for me was to be able to repeat any material as much as I wished. I study by repeating many video and presentation files. The only problem I face is some of the materials need a long time to complete and this sometimes caused me to lose my concentration ....*
>
> *....sometimes it takes long to complete the materials so in that case I tried to study some of the topics from the materials which I believed these would take shorter ....*

According to the answers of the students it is determined that students prefer materials which are prepared with today's technology and which are visual, animated and voice based, and having continuous feedback and which can be completed in a short time. Furthermore, according to the statements of the students it is determined they utilize various types of education resources and this had an affirmative affect on them. According to Erkunt and Akpinar (2002), one of the most important advantages of internet based learning is the opportunity to provide students rich learning materials according to their individual requirements.

One of the most significant findings explored during the interviews performed with the students, is that students study on any materials in computer environment by either directly using them on pc or on any portable devices (cell phones, PDA or tablet pc).

Statements of some of the students on this issue are quoted as follows:

> *....I did not study any of the topics in the lesson by taking print outs, I completely studied on computer environment. By this way I had no additional costs and I had a chance to rapidly study …*
>
> *....It made me feel comfortable to follow up and study the materials of lecture in computer environment. I did not have to spent a hard study during Exam Week so that to complete my missing notes ….*
>
> *...I generally followed the lessons on pda, I took just a few printouts to study but I felt relieved since I knew all materials were ready in my computer. Therefore, I could study where ever I wished …*

According to the statements of the students it is determined that they prefer to study with their computers (tablets or pdas). They prefer to follow up necessary studies in computer environment rather than taking printout of them. It is determined that students prefer to continue studying in computer environment instead of taking print outs and studying them by reading. It can be considered that this is caused by their young age. Prensky (2001a; 2001b) points out that students of today (digital natives) who are growing up by using digital media tools such as internet, computer and mobile phones have different learning behavior than the ones who are raised in an environment where printed materials were mostly used (digital immigrants). The results obtained in this study also support Prensky (2001a; 2001b).

### 4.2 Studying strategies of the online students

As a result of the obtained data from the students, most of them do not have much knowledge about effective studying strategies. It is seen that students faced some problems in preparation for studying and concentration in online learning environments. However, it is determined that students think they utilize online exams and any online materials effectively.

Statements of some of the students on this issue are quoted as follows:

> *...I do not believe that I have effective studying strategies for lessons based on distance education … I could only determine my correct studying style at the end of the semester...*
>
> *....I could not find a chance to make preliminary preparation for my lessons. However, the opportunity to be able to access lesson materials any time was a great chance for me …*
>
> *....It generally takes a long time for me to start studying, I cannot rapidly concentrate. I believe I tend to group study. Therefore, at the beginning it was hard for me. I could only put some issues in order at the end of the term …*
>
> *....Usually having lessons in web environment slackened my studying. I had a lot of time waste in various issues during studying. For example I spent a lot of time in facebook and youtube….*
>
> *....I generally do not have preliminary preparation for studying. But accessing to various resources through web caused met o easily study the lessons ….*
>
> *... I could have opportunity to study when it was convenient for me. Since I can study mostly at night, I could organize my studying environment before. The opportunity to access all required information on web site had a great role for me to achieve it ….*

As it can be understood from the statements of the students, they think it is very important to have such a flexible structure provided by online learning. However, it is seen that it sometimes cause problems to get prepared for studying and they think they do not get prepared enough before the lectures. This may be as a result of non-experience of all students in distance learning since now. According to their statements, it is understood that they think they have started to acquire correct planning and studying strategies at the end of the semester.

It is also observed that having acknowledged that all kinds of materials are ready in the web site of this lesson make students feel relieved. Another important finding as a result of the interviews performed with the students is individuals who does not have correct studying strategies stick in various interests (facebook, youtube, msn…etc.) and get apart from the subjects of the course. This may be a result of insufficient concentration of the students.

Other highlighted remarks of the students are as follows:

> *....I could find all lecture materials in the web site while I was getting prepared for the exams. I could continuously repeat them.....*
>
> *....I took assistance from my friends and instructor of the course online when I stuck in any topic whenever I needed since we study all together with my friends during exam period…*
>
> *....Since all subjects are well ordered and the things that are necessary to be followed are well prepared I could deliberately study as I should ....*
>
> *....I did not have to make an additional studying order during studying before exams, therefore I studied on existing topics …*
>
> *....I could have the opportunity to utilize additional course materials and additional resources in order to complete my missing knowledge on the issues I determined during exam period…*

It can be said that they generally think that the materials and the type of their presentation are sufficient. The students stated that they utilized such materials and they think this had an affirmative effect on them. Furthermore, it can also be stated that students believe that they utilized any additional or different materials on the subjects and they think this also had an affirmative effect on them.

## 5. Conclusion

This study tried to determine the learning materials that are preferred by the students who were in online learning environment and the status of the studying strategies of the students having online learning.

In this study it is found out that the learning materials which were preferred by the students who were in online learning environment are videos, flash animations and voiced presentation files respectively. It is observed that students prefer any learning materials which take short time to be completed. In other words, students do not prefer learning materials which take long time to complete. Furthermore, students think that communication tools such as chat and forums have affirmative contribution in their learning process. During the interviews most of the students stated that they have solved any problems they faced during studying by sharing them with their friends in chat or forum environment. Another important issue pointed out by the students is learning materials which instantly feedback are very useful. Another important result obtained in this study is students rather prefer studying in computer environment instead of taking printouts.

It is determined that students have problems of not having affective studying strategies particularly on preliminary preparation and concentration in the lesson. This may be a result of their first time in such an implementation (online learning). Furthermore it is determined that students think such an environment is very useful for them due to variety of materials and the ease of getting prepared for the exam of that course.

It is very important for the students to gain more experience so that they can develop more effective studying strategies in online training. Taking various lessons in online environment shall increase the speed of their studying strategy development.

It is very important to make new studies on their studying strategies that directly affect their success and behavior in their lessons. To continue scientific research studies on these issues and to perform different studies with extended groups shall provide students the opportunity to develop their effective studying strategies.

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# The Past, Present and Future of a wiki in the higher education

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**Abstract**

*With the advent of extensive wireless networks that blanket physically compact urban enclaves such as office complexes, shopping centres, or university campuses, it is possible to create software applications that provide location-based mobile/ online services.*

**Keywords**: Wiki, Web 2.0., Internet, Learning.

## 1. Introduction

A location-aware wiki is a relatively new application. Prior literature on this type of application has focused primarily on the technological challenges. There is a need to explore users' perceptions of the usefulness of, and concerns about, this type of technology. Understanding users' perspectives can guide development efforts in this nascent field in order to maximize acceptance.

The first wikis appeared in the mid-1990s. Scientists and engineers used them to create dynamic knowledge bases. Wiki content - contributed "on the fly" by subject-matter specialists - could be immediately (and widely) viewed and commented on. Adapted as an instructional technology in the past few years, wikis are being used for a wide variety of collaborative activities. In addition to compiling information, faculty and staff in higher education use wikis as repositories for meeting notes. Agenda items are contributed prior to a meeting; notes added during the meeting are saved in a public archive. The ability to export notes to Microsoft Word makes reporting easy and adds versatility to the meeting wiki. Some institutions are experimenting using wikis as e-portfolios. Artefacts within a wiki-folio are easily shared when the wiki is used as a presentation tool.

According to The Wiki Way, "[O]pen editing' has some profound and subtle effects on the wiki's usage. Allowing everyday users to create and edit any page in a Web site...encourages democratic use of the Web and promotes content composition by nontechnical users."

Since wikis are easy to edit, they carry an inherent potential to change how we construct knowledge repositories on the Web. Wikis allow groups to form around specific topics. The low barrier to entry makes them the equivalent of shared digital paper—literally anyone with access to the Web can post, modify, and delete content on that site. Because they are so easy to use, the technology recedes into the background, allowing anyone to become a publisher. Wikis show great potential as collaborative spaces that may become semi-authoritative voices on particular topics. Wikipedia, for example, has become an often-used reference, especially among students, many of whom see it as a reliable source of information.

In general, the two contexts within which wikis are used are:

(1) As a shared knowledge repository for virtual communities: Wikipedia is probably the best known example of such a repository. Another example of a virtual community wiki site is www.fluwiki.com, highlighted in Palen et al. (2007), which provides vital information to local communities in preparing for and coping with an influenza pandemic.

(2) As a depository for shared artefacts and knowledge management within an organization: Project documentation, for instance, can be prepared collaboratively using wikis (Raman, 2006). Also, wikis can be used as a collaborative tool to develop a community of practice (COP) which, as described by Godwin-Jones (2003), is “a way of achieving collective applied learning with the expectation that over time, expertise in a given subject area is developed and solutions to common issues and shared problems are found, posted and discussed.”

Since their introduction in the mid 1990’s, wikis have been gaining widespread adoption for a number of reasons. A variety of wiki engines are readily available as open source software, there is no need for registration or for knowledge of web publishing technology, and these wikis are relatively easy to use. Wikis can assist in fulfilling knowledge management needs such as ad-hoc knowledge creation, ease of finding required knowledge, dynamic update of knowledge, and quality assurance through quick error recovery.

## 2. Using wiki in higher education

E-learning 2.0 is expected to address some of the problems which characterized the first generation of E-learning implementations.

Wikis are among the most promising E-learning 2.0 tools because they require active student engagement which facilitates constructivist learning.

Wikis have originally emerged and are most commonly known as social software, but there is also a growing trend to use wikis as a learning and assessment tool in Higher Education.

Wikis are gaining ground as a learning tool in higher education, but relatively little is known about factors that affect the way students use wikis in the context of a course. There are at least two common ways in which wikis are used: as social software and as a tool that provides support for group projects and activities, with the former usually associated with open access and the latter associated with restricted (or authenticated) access.

The first use is best demonstrated by Wikipedia (http://en.wikipedia.org/) – a large collections of interlinked editable web pages that are created and kept up-to-date by users world-wide. Open-access wikis also exist for more specific knowledge areas, such as culture and art, education, politics, travel, science and technology. Key principles of wikis as social software are voluntary participation and self-regulation.

Implementing a new e-learning technology in higher education institutions is a complicated process. Most of the literature discusses the implementation of various e-learning tools, often collectively known as Learning Management Systems or Virtual Learning Environments.

These environments usually contain course materials and forums for asynchronous online discussions. The focus of previous studies was on the transformation that was required from the university in moving from traditional face-to-face teaching to online teaching.

The adoption of e-learning technologies is dictated by the pedagogical goals of the university and the students’ needs. As a distance learning university, students can benefit from using an online learning environment, which allows them better contact with the academic staff, better access to learning materials, and an opportunity to collaborate from a distance.

A wiki can be used as a tool that allows a group of dispersed users, such as conference organisers, to work together to draft and fine-tune the details of an upcoming event, or for a group of authors or researchers to collaboratively work on a report or publication. Wikis are also used as a meeting management tool, which allows participants to suggest and negotiate an agenda and to publish minutes and comments after the meeting. Demarcation between the two types of wiki uses described above is not clear-cut, with some large restricted-access wikis (for example, organization-based wikis) being closer to social software than to a group project tool. The use of wikis in a formal course of study, such as a university course, has common aspects with both of these two types of uses, but is also conditioned by the fact that it is perceived as a learning or assessment activity.

Developing Wiki pages involves three simple steps: write (or edit), save, and display. Known as “open editing,” Wikis allow users to browse through Wiki pages, edit existing pages, or create new ones. Wikis encourage internal linking of pages but limit the appearance of the so-called “orphaned pages” (i.e., pages that have no direct links to them); thus, a constantly changing body of content is evolving. Besides, Wikis offer an opportunity for groups of users to join their efforts in developing content.

Many Wiki systems utilize web-based open source software technologies. The users can choose to either install or run a Wiki on their own computer or use Wiki hosting services. Wiki pages can be displayed by any web browser, are available anytime, and can be accessed from anywhere. Wiki platforms are highly flexible in terms of their structure and can be customized to suit various purposes.

In addition, Wikis can have different read-and-edit access; they are either open (anyone can edit the Wiki) or allow only registered members or selected persons to access and edit the Wiki. The ease and speed with which web pages can be created are the fundamental concepts in Wiki deployment. High flexibility and functionality of Wikis have led to their rapid proliferation in many areas. Examples of successful Wiki implementations can be found in the practices of many organizations and corporations, Wikis have also become common in the educational landscape.

**2.1. Wikis can be used to enhance the learning process**

Wiki is a major component of Web 2.0, the emergent generation of web tools and applications. Web 2.0 has the potential to complement, enhance, and add new collaborative dimensions to the classroom. Web 2.0 technologies such as blogs, wikis, podcasts, and RSS feeds have been dubbed 'social software' because they are perceived as being especially connected, allowing users to develop Web content collaboratively and open to the public.

Social software offers a variety of unique and powerful information sharing and collaboration features, acting as cognitive reflection and amplification tools, and aiding the construction of meaning through the act of self-design of knowledge databases. Wikis in particular actively involve learners in their own construction of knowledge. Social software helps to realize the original vision of the Web as a space in which anyone can participate.

The term 'wiki' is derived from the Hawaiian phrase, wiki-wiki, which means quick. A wiki is a collaborative web site whose content can be edited by visitors to the site, allowing users to easily create and edit web pages collaboratively. In essence, a wiki is a simplification of the process of creating HTML web pages in combination with a system that records each individual change that occurs over time, so that at any time a page can be forced to revert to any of its previous states. A wiki may also provide tools that allow the user community to monitor the constantly changing state of the wiki and discuss the issues that emerge. Some wikis restrict access to a group of members, allowing only members to edit page content although everyone may view it. Others allow completely unrestricted access, allowing anyone to both edit and view content. Wikis can be used as a source of information and knowledge, as well as a tool for collaborative authoring. Wikis allow visitors to engage in dialog and share information among participants in group projects, or to engage in learning with each other by using wikis as a collaborative environment in which to construct their knowledge.

**2.2. Uses of a Wikis**

Wikis have experienced increasing popularity as teaching tools in recent years. Although wikis have been utilized in many areas of education, including composition, literature, distance education, philosophy, design engineering, symbolic logic, and mathematics, they have untapped potential in many other areas as well. For example, both the collaborative nature and the convenience features of the wiki make it an ideal tool for software project collaboration and communication.

Wiki use is increasing in the software development industry, but wiki usage in student software project collaboration is not as common. Students were, initially, only to maintain a group diary of individual and team activities, but they soon began to devise innovative ways of using wikis for project activities that were unanticipated by the professor. In addition to group diaries, wikis were used for such software development activities as:

Project planning. Student teams developed the project plan collaboratively using a wiki. At the end of the each iteration, project plans were to be updated according to the iteration results. Wikis have the potential to serve as a good version control tool since wikis track change histories on all pages and provide convenient mechanism for comparing different versions of the document.

Requirements management. User requirements were maintained on wikis. The requirements were assigned to student developers, and the estimates were published on wikis.

Project tracking/progress reports. Student developers report their progress on assigned requirements. When a requirement is completed, the responsible developer records the actual hours spent.

Test case management. For each requirement, acceptance test cases were created and published by the responsible students on wikis. Once the test cases were executed, the results were also reported on the wikis.

Defect tracking. Instead of using a costly commercial defect-tracking tool that was not readily available, defect-tracking pages were created on wikis for defect reporting and fixing.

Client notes. Client logs were created on wikis to record all client and developer communications so that they could be shared among team members.

Developing user documentation. Since different parts of the software were developed by various student developers, end-user documentation was created collaboratively by the whole team on wikis.

**3. The "sustainable embedding" of a wiki**

The "sustainable embedding" of a new learning technology in the institution demands a complex set of changes and transformations. Its success depends on the willingness and capability of the academic staff to embrace the new technology, and on the ability of the institution to manage and coordinate the process of implementation using a holistic approach.

It demands the development of a detailed, multi-dimensional institutional strategy to cover all aspects of implementation: technological, pedagogical, and organizational.

The technological aspect of implementing a new learning technology in the organization involves a whole range of technical issues: choosing the right software and hardware to meet the needs of the institution, the students and the academic staff; maintaining the technology; and supplying the end users with the proper support.

From a pedagogical perspective, the adoption of e-learning requires changes in teaching approaches. Teaching face-to-face or the traditional mode of distance teaching (correspondence courses) is different from teaching online. Special skills are required from the instructors to carry out online teaching. This is also true in the transformation of distance teaching from the self-learning model to collaborative learning, as in the case of the adoption of wikis into teaching and learning. Staff development is therefore a crucial component in the implementation process.

The third aspect to be considered in the implementation process is organizational. The strategic challenge to the institution is to efficiently coordinate e-learning development without stifling innovation. Implementing learning technologies successfully depends on a set of institutional moves and conditions.

Sustainability is measured in terms of time and continuous use. The sustainable embedding of e-learning is indicated by the number of courses that make use of the technology an integral part of their course's learning environment for a long period of time.

The wiki is still in its early stages, and summaries and conclusions are naturally limited. However, the research on the diffusion and sustainability of the wikis should continue as develops.

Universities, like other institutions, are confused about what to do about the impact of technology and learning. But they must reshape themselves to take advantage of new opportunities to serve Digital natives. Today's students must master more skills than ever. Reporting and writing for one medium is no longer sufficient. What is now needed is at least a working knowledge of how to shoot and edit photos and video, record audio, design Web sites, and create multimedia elements. A solid knowledge of how to start, run and market a business is also a plus. Online learning may offer some solutions.

Providing prospective online students with a data-driven description of the type of student that typically succeeds in online programs, or perhaps developing an initial screening tool, could save students and schools wasted time and money.

To be sure, a large community of non-traditional students are already using online learning to meet their educational goals. It is not unreasonable to believe that what "digital natives" born after 1980, who have already changed the way live, is definite, produced and consumed, also will demand a new way to learn that will incorporate online methodologies.

**4. Conclusion**

Wikis and other emergent technologies are beginning to fill a gaping void in existing practice. They enable extremely rich, flexible collaborations that have positive psychological consequences for their participants and powerful competitive ones for their organizations. Collaborative creativity promises to be a key business skill in upcoming years. Educational institutions can offer immense value to their students by familiarizing them with the simple technologies that make collaborative networks possible. Today's students will not only manage business innovations of the future, but in many cases will drive them. Rather than being limited to today's skills, students must learn the skills of the future. Educators need to teach what wikis and other social software may mean to business, not just as a phenomenon, but also as a skill. By incorporating wikis into the classroom, educators can better prepare students to make innovative uses of collaborative software tools.

Wikis are great hypertext tools that let one person or a group of people manage content easily. They are used to create static Websites, manage online communities, connect businesses with their customers, and even write magazines and books. The Wiki is the simplest online database that could possibly work.

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# S e c t i o n

## TECHNOLOGIES

**Technologies (TECH):**

- **Innovative Web-based Teaching and Learning Technologies**
- **Advanced Distributed Learning (ADL) technologies**
- **Web, Virtual Reality/AR and mixed technologies**
- **Web-based Education (WBE), Web-based Training (WBT)**
- **New technologies for e-Learning, e-Training and e-Skills**
- **Educational Technology, Web-Lecturing Technology**
- **Mobile E-Learning, Communication Technology Applications**
- **Computer Graphics and Computational Geometry**
- **Intelligent Virtual Environment**

# Exploring Direct Communication and Manipulation on Interactive Surfaces to Foster Novelty in a Creative Learning Environment

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**Abstract**

*Information technology has supported learning in many different ways as improvements in communication, virtual environment embodiment and even mobility has allowed remote discussion and collaboration in exploring topics and developing ideas. However, learning environments often lack validation studies related to the grounding technology being used and do not consider creativity as a factor despite being essential for ideas generation and innovation processes which push human development. Moreover, computer-mediated communication quite often limits the effective expression of ideas between peers because technology may be a barrier rather than an aid. Taking this into consideration, this paper proposes the use of interactive surfaces as a promising technology to develop future creative learning environments. An exploratory experiment with 22 teenagers has been conducted. The experiment consisted of reflection, discussion and creation processes in which participants created entities with basic building blocks. The environment based on the interactive surface was compared to a completely tangible approach based on a tabletop with wooden blocks. A creativity model is used in the evaluation in terms of novelty, flexibility and fluency of thinking and motivation. The results showed that creations' novelty is significantly higher in the digital environment and also higher collaboration degree was observed so that this technology should be considered in the development of future learning environments to support creativity.*

**Keywords**: Interactive Surface; Tangible User Interface (TUI); Creativity

## 1. Introduction

Since computers became popular and affordable at home there has always been an attempt to support autonomous learning. From the beginning of personal computers offline multimedia applications distributed in physical means such as floppy disks, CDs or DVDs have been present. They have been normally characterised as interactive systems but usually mono-user without or with low interaction among other peers or teachers and have focused on convergent thinking relying on behaviourism, by teaching some specific content and giving knowledge acquisition exercises.

With the advent of the Internet and Web standards, more powerful learning management systems have appeared, allowing tutors to follow students' progress. Students are able to share material and discuss the activities, thus encouraging critical and divergent thinking, although activities are normally performed individually. Also social environments have been used in search of cooperation, providing with "just in time" information but communications are normally remote and computer mediated by means of completely virtual sharing and collaboration spaces (Carr and Oliver, 2009). Augmented Reality and Mobile computing have also showed suitable for learning since physical embodiment can facilitate direct communication between peers, and interaction with virtual entities in the ecosystem can be simplified (Mocholi et al, 2008)(Facer et al, 2004).

Thus a wide range of technologies have been used in many different contexts with the purpose of supporting several aspects of learning. In spite of all these development efforts and also taking into consideration learning theories in the design of these systems, evaluation of the involved technology is not usual. This fact may affect to the development of more founded learning environments in the future as we are limiting our knowledge on technology that could be better applied to achieve the proposed learning goals. Taking this into consideration, we are interested in exploring interactive surfaces as a technology to support collaboration and direct communication processes as they are positive for learning support. This is especially important to facilitate generation and discussion of ideas, which is the basis for creative learning. Hence the aim of this paper is to explore the suitability of interactive surfaces in terms of collaboration and creativity traits. To do so we have developed a digital editor of structures that may be animated on a physics simulation environment, and we have performed an experiment proposing a creative task to a group of teenagers to evaluate it against a pure tangible tabletop considering reflection, discussion and action processes which actual creative learning environments should support.

The rest of the paper is as follows. Section 2 describes some related work. Section 3 introduces the digital platform and Section 4 the creativity model. Section 5 describes the experiment and reports the results.

## 2. Related Work

Some sample developments that apply information technologies in the field of creativity are discussed in the following. Most of them included studies and discussion focused on usability and collaboration design issues rather than on the creativity evaluation itself. (Aragon et al, 2009) conducted an empirical study on the on-line community of Scratch, a programming environment based on a block-like visual language, aimed at fostering creativity by enabling children to create programmable media such as game interactive stories. The work concluded on the importance of socio-emotional communication to successfully develop creative work.

(Gallardo et al, 2008) presented Turtan, a tangible programming language for creative exploration. It has successfully combined the main Logo concepts, used often in learning systems, with the interaction mechanisms offered by interactive tabletops. (Buisine et al, 2007) presented a tabletop interface to build-mind-maps. The study compared this interface to traditional paper-and-pencil mind-mapping primarily focused on usability and usefulness. The results showed that the tabletop condition significantly improved both subjective and collaborative interaction dimensions.

A system based on interactive tabletop and digital pen is presented for browsing topics and annotating idea scribbles in (Geyer et al, 2010). User feedback questionnaires on professionals from creative industry were used to corroborate and validate the usefulness of this kind of interfaces to support creative tasks.

IncreTable is a mixed reality tabletop game built up on the idea of Rube Goldberg machines (Chen et al, 2009). Each level presents a puzzle requiring multi-modal interaction provoking user creativity as the general objective of the platform is to arrange a given collection of items in a complex way in order to solve a puzzle. The evaluation explored the relationship of certain aspects of interaction with flow.

(Farooq et al, 2007) performed a study aimed at detecting breakdowns in creativity by using the BRIDGE system, a desktop based prototype of a collaborative infrastructure and system, integrating existing tools that support the process of creativity according to a previous synthetic analysis of diverse literature on creativity and groups. Graduate students in computer and information science were asked to write an opinion piece related to computer science in groups within the system. Some issues related to the collaboration and communication in the brainstorming and idea generation processes were measured and the creativity of the produced opinion piece was assessed. The authors proposed two strategies to overcome breakdowns such as under-consideration of minority ideas, easily loss of novel ideas, lack of critical evaluation of perspectives, and weak reflexivity during convergence.

## 3. A Surface Implementation for Edition and Simulation of Structures

In our research, an environment supporting the creation and simulation of physical structures has been developed. The user interface is based on an interactive surface enabled with multi-touch and tangible input. The software basically supports the construction of physical structures composed of blocks and joints. Blocks are basic shapes that have mass, are able to collide between them and can be affected by forces by touching them. They have a position and rotation in the workspace, as well as a friction coefficient, which defines how the block is speeded down as a consequence of the friction between the surface and the block itself.

The blocks can be attached to each other by means of joints. Several types of joints have been included to support several ways of joining blocks. The most basic joint is the *rope,* whose ends are just fixed to a position in two different blocks, and the other popular joint is the *spring*. The Figure 32-(left) shows the representation of the different joints and the menu giving access to them in the system. The Figure 32-(right) shows the creation of a structure by two people collaborating using touch input and tools.

User interaction relies on multi-touch input and tangible tools in the form of pucks, in such a way that users can interact at the same time and collaborate in the construction of structures. Touch input is used to positioning and rotating blocks and joints, while tools are used for a range of different operations. Basically, the “magic wand” tool gives access to the creation menus, which allow the creation of new blocks and joints in the workspace. The “clone” tool allows the copy-and-paste of blocks already existing in the workspace. To do that, the user only has to put it down on a block and then to be put back down in the place to create the copy. This tool furthermore allows the fine adjustment of blocks in terms of position and rotation. Another important tool is the “eraser”, which deletes any block or joint when the tool is applied on an element by means a *zig-zag* gesture. The “friction modifier” tool allows the adjustment of the friction coefficient of the blocks to be used when block surfaces touch each other. Finally, the “simulation” tool alternates between the editor and the simulator. When this tool is present on the surface, the simulation is started and performed. This mechanism allows users to observe the structures evolving according to physics and also interact with them to introduce forces and impulses in the system getting blocks moving as desired.

The software has been developed in C# using the Microsoft XNA framework and the Microsoft Surface SDK v. 1.0. The Farseer Physics Engine 2.1 is being used in simulation. It has different abstractions (*body*, *geom*, *joint* and *spring*) than the generic ones considered in our structures. As a result, when the simulation is started, the structure has to be translated into the Farseer abstraction as required in order to perform the simulation.

## 4. Creativity Assessment

A precise definition for creativity must be taken to be able to assess it. However creativity is a very difficult term to be defined as some works have already shown (Treffinger, 1996). Most definitions rely on the core idea of innovation, using abstract terms such as originality, unusual, or surprising. The basic factor involved in creativity is the term creative thinking, according to the definition given by Amabile who said that creativity arises as a combination of knowledge, creative thinking, and motivation (Amabile, 1983). This is related to the idea of thinking differently to most people when solving problems, by exploring alternative solutions, especially in the case of problems with no known optimal solution or which require more than just involving knowledge.

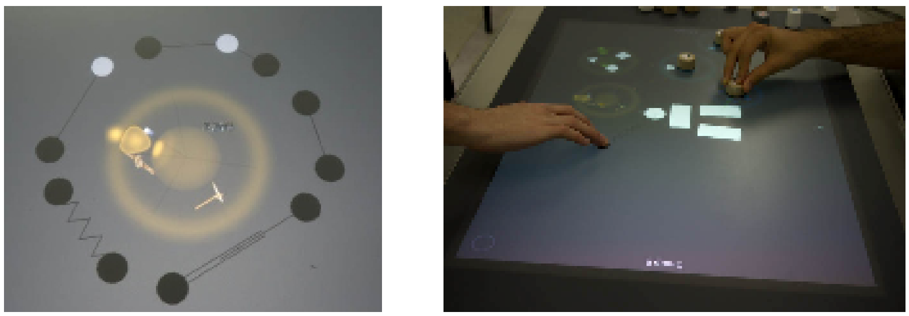

*Figure 32*. **(left) Joints and Joint Selector Menu; (right) Creating a sample structure**

Creativity is actually a construct composed of several traits as already psychologists have stated (Guilford, 1970). Many different adjectives and traits have been jointly considered and used as indication of creativity: *originality, curiosity, be open to new experiences, independence, frustration tolerance, establishment of remote relationships, trade-off assessment, etc*.

The creativity assessment model presented in this paper has focused on a short list of traits but has included those that are typically and mostly found in the literature. In this model, the most relevant trait is *Originality*, which is defined as the characteristic conferring something is unusual, unique or surprising. Another trait is *Fluency of thinking*, which refers to the ability to generate new ideas, and/or formulate significant problems and hypothesis (i.e. ability to provide a range of valid solutions). *Elaboration* is the ability to "embellish" ideas, including more details. Finally, *Motivation* has been also included as proposed by Amabile. This creativity model will guide the variables reported in the study presented below.

## 5. Experiment

An exploratory study has been performed to get insight into whether an interactive surface as a base technology for some sort of creative task is promising in terms of collaboration and creativity traits. The study compares the profile performances in the digital platform introduced above against a fully tangible platform. Such a tangible platform was used instead of a desktop-based application because it was important to have two platforms that were similar when enabling co-operation by two subjects. A desktop-based application would have been confined to a keyboard and a mouse device, and manipulation would have not been comparable since two participants would have not been able to interact simultaneously. Moreover, already existing physics workbenches are mono-user and do not support actual multi-touch input.

### *5.1. Participants*

Twenty-two teenager students participated in the experiment, 8 female. They were 16 years old on average (m=16.23, sd=1.6). Although all of them declared to use computers regularly, they did not have previous experience with interactive surfaces.

Participants took part of an extramural short course about new and emerging technologies organized by a clubhouse dependent on the Education & Culture section of a local city council.

*Figure 33. (*__left)Participants building solutions in the digital; (right) and tangible platform__.

### *5.2. Equipment and Instrumentation*

Two platforms were used to support the experiment. One was the digital platform based on the interactive surface implementation previously presented. The other was a fully tangible approach based on wooden blocks and an actual tabletop.

Solution forms printed in paper sheets were given to participants. These were used to report each proposal solution by means of a sketch and annotations before its implementation in the experimentation platforms. Two video cameras were used to record the sessions to support further video analysis. Coloured cards were used to identify participant groups and switch between their workspaces. Also coloured strips were used around wrists in order to identify participants' hands in the video.

The tangible tabletop platform consists of a tabletop with dimensions 590x700 mm. with a regular grid of 28x32 holes on it with separation of 2 cm. between them (see Figure 33-right). Several types of wooden blocks equivalent to the ones in the digital platform are available. These have been drilled so that can be fixed to the surface as needed by using screws and bolts. The tabletop has four legs to keep it conveniently raised in horizontal position to facilitate structure assembly. The use of joint elements such as short strings, elastic bands, screws, hooks, nuts and bolts allows keeping blocks fixed or creating movable constructions.

This tangible platform provides for the construction of structures as in the digital platform also based on basic rigid bodies and joints. However, the difference is that physics is not simulated and constructions are manipulated in the real space. In this platform users have a high number of pieces of each type at hand in a bucket and they only have to grasp them as needed.

### *5.3. Method and Procedure*

Test sessions were accommodated at the end of the extramural course. Participants were assigned in sessions according to their availability limiting to 8 people per session. They were randomly grouped in pairs, but always taking into account age pairing. After an introductory talk about each experimentation platform and supervised interaction training for 40 minutes, the participants started the experiment task.

The task consisted of creating entities, living or not, with movable components, which could be represented with the material in the experimentation platforms. The Figure 33 shows participants in the process of building a human-like entity and a vehicle in the digital and tangible platforms respectively.

Participants were encouraged to have good performance with two rewards for the best two groups. They were said to have good performance by producing a variety of solutions being as creative, original and elaborated as possible. They were reminded that it was important to give expression of as many solutions as they could on paper to promote divergent thinking and diversity of solutions

Three stages with distinguished locations were considered: individual thinking, collective discussion, and testing platform. In the individual thinking place, subjects had to generate proposal solutions to the problem using solution forms in paper and pencil. Once each member had produced a bunch of solutions individually, they discussed collectively about improvements and generation of new solutions. Then they decided what solutions to implement on the experimentation platform. As they had discussed the ideas on paper, they already knew what parts needed to be constructed and could collaborate. Thus, the first two stages are also relevant as they promote divergent thinking important to creativity as well as collaboration in implementation.

Participants were enforced to go to the next place if the limit of 10 minutes was reached. These three places were put in a loop. The task had a duration of 60 minutes.

### *5.4. Results*

The participants formed eleven groups. Five were assigned to the digital platform and six to the tangible. A total of 161 proposals were generated and 91 were tested in the end. In the digital platform, almost 5 proposals were tested per group on average, while groups using the tangible platform tested on average 11 proposals.

The creativity model described previously has determined the concrete variables to be measured to assess creativity. First, the fluency of thinking has been taken as the number of proposals produced per cycle in the thinking-discussion-test loop since it gives us an estimation of the capability of the platform to support the generation of new ideas. The groups working with the tangible platform showed a significant higher fluency according to the comparison mean performed by a t-test ($t = -2.689$, p-value $= 0.012$). On average, the tangible groups produced about 7 proposals per cycle ($m=7.1$, $sd=4.6$) and the digital ones 3 ($m=3.4$, $sd=2.4$). The elaboration trait from the creativity model has been measured as the complexity degree in terms of number of blocks and joints involved. The t-test also showed that differences were significant ($t=3.064$, p-value$=0.005$) with subjects obtaining more elaborate solutions when using the digital platform (Digital: $m=11.96$, $sd=6.8$; Tangible: $m=7.38$, $sd=3.6$).

The originality was measured by asking two people with background in creativity to rate each solution in a 5-point scale. The rating was performed having into account several aspects such as how unusual the creation was, whether there was any surprising element, or whether the way of assembling pieces was common or unexpected but advantageous. Since this kind of measure is not objective at all, an inter-rater agreement test based on Kappa statistics was run to make sure that the two judges rated consistently. It showed that the agreement was very good ($K=0.860$). Thus the rates were taken to perform a t-test to compare originality in both platforms ($t=2.44$, $sd=0.017$). The test showed significant differences in originality. On average, solutions in digital rated 3.5 ($m=3.5$, $sd=1.2$) and 2.78 in tangible ($m=2.78$, $sd=1.2$).

Motivation was considered by measuring the average time that users interacted divided by the average implementation time in the platform. In both platforms this measure showed similar performances. In the digital about 62.17% while 61.29% in the tangible platform.

Beyond creativity traits, the experiment also evaluates the suitability of technology to support collaborative tasks as the one considered. On the one hand, the implementation time was measured (Digital: $m=217.56s$, $sd=139.35$; Tangible: $m=118.36s$, $sd=80.74$). Since normality was not met in data, a Mann-Whitney test was run. It showed that the implementation time differences in both platforms were significant ($z=-3.19$, p-value$=0.01$).The time to implement solutions in the digital platform took longer. Although some learning issues were observed in operating the digital platform, solutions were also more elaborated.

On the other hand, the time that both participants in a group were manipulating the platform doing useful work was also measured. This is actually the co-operation time, and gives us an idea of how facilitating the platform is to support sharing and co-manipulation in the construction of structures. A priori, since both platforms are based on tabletops, an expected result would be obtaining similar cooperation profiles. However, co-operation was higher in the digital platform (about 37.7%) than in the tangible (20.15%). Moreover this difference was showed highly significant according to a Mann-Whitney test comparison (z=-4.1,p-value= 0.000). This means that the digital platform is supporting better the co-operation of subjects and, therefore, it is advantageous in tasks requiring collaboration as the one performed in the experiment.

## 6. Conclusion

On the necessity to explore the use of interactive surfaces as a base technology for our future learning environment supporting creative learning, an experiment with teenagers has been conducted on using two tabletop-based platforms that allow the construction of structures with blocks and joints. A basic creativity assessment model has been presented and used in the evaluation. While motivation remained similar in both platforms, the digital platform based on an interactive surface showed a significant better profile in terms of creativity traits such as elaboration and originality. However, in terms of fluency of thinking, the groups using the tangible platform outperformed the others using the digital. Finally, an interesting and important trait for creativity is the co-operation. This desirable property resulted significantly higher in the digital platform, what is also an indication of a better facilitation of co-located collaboration interaction. Our future work will include the implementation of a more ambitious creativity environment allowing the inclusion of interactive virtual objects whose properties and behaviours can be controlled by users by defining choreographies and reactive rules. This environment will be the testbed for a complete evaluation of our creativity model in the context of interactive surfaces.

## 7. Acknowledgement

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# 3D interaction techniques in Virtual Reality Applications for Engineering Education

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**Abstract**

*This article is an overview of 3D interaction techniques with virtual objects, perception of virtual objects and some aspects about hardware devices, software and technologies used in Virtual Reality Applications for Engineering Education. The solution presented uses open source software (CHAI3D) and low-cost hardware that allow quickly integration into current mechanical curriculum.*

**Keywords**: 3D interaction, educational haptics, engineering education

## 1. Introduction

Qualifications in mechanical engineering require skills and technical competences with a high degree of complexity which involves a modern curriculum, instruction based on student-centered strategies that encourage motivation and interest developing critical thinking and problem solving through active involvement in learning. It will combine individual learning activities with the ones implying teamwork, traditional methods with the modern, interactive ones. The introduction of teaching in virtual reality techniques can be one possible answer to all these requirements.

Either old or recent studies consider that the use of virtual reality methods add value to the traditional learning methods in the classroom, first by the fact that participants face specific learning /training situations required by the application producer. His ultimate goal is to improve methods of learning, training and education (Schroeder, 1995), (Youngblut, 1998), (Inoue, 2007). According to (Jacobson, 2006) results that immersive 3-D VLEs, may provide 'value-added' learning over 2-D technologies used to deliver equivalent educational content. In recent years, the ubiquity of multimedia and Internet-capable PCs has led to a resurgence of interest in web-based virtual reality (Dalgarno and Lee, 2010).

Designing didactic applications based on virtual reality initially involves two important aspects, namely:

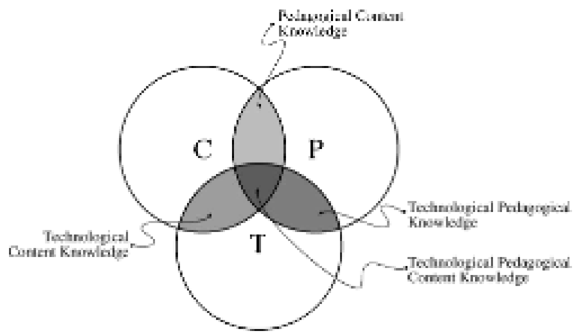
- developing a pedagogical model;
- specifying necessary hardware and software technologies.

## 2. Developing a pedagogical model

A traditional learning environment integrates courses, formal and informal resources, a management and communication system, all in a classic teaching model. Similarly, a virtual reality learning environment has to integrate functions like: information, communication, collaboration, learning and management. Developing a pedagogical model is difficult because curriculum goals, classrooms and teachers vary from case to case. The relationships between content, pedagogy and technology are complex and nuanced.

The chosen solution must be in line with patterns like Technological Pedagogical Content Knowledge (TPCK) proposed by (Mishra and Koehler, 2006) – figure 1. Their "framework emphasizes the connections, interactions, affordances, and constraints between and among content, pedagogy, and technology. In this model, knowledge about content (C), pedagogy (P), and technology (T) is central for developing good teaching. However, rather than treating these as separate bodies of knowledge, this model additionally emphasizes the complex interplay of these three bodies of knowledge." (Mishra and Koehler, 2006, pp.1025).

*Figure 1.* **Pedagogical Technological Content Knowledge. The three circles, Content, Pedagogy and Technology, overlap to lead to four more kinds of interrelated knowledge Mishra & Koehler (2006).**




The pedagogical model specific for learning through virtual reality must highlight the new skills and attitudes to be acquired (based on formal professional standards), the level at which the student is, skills to be practiced through repetition and practice, personal learning opportunity, the skills they need to practice, the possibility that through repetition and practice in the virtual environment to acquire new attitudes and competences, learning opportunity in their own space. The solution might be to integrate the lessons based on virtual reality on a platform like Moodle that allows organization and administration of educational material. Moodle is a Course Management System (CMS), also known as a Learning Management System (LMS) or a Virtual Learning Environment (VLE) and it is free.

**3. Specifying necessary hardware and software technologies**

The solutions chosen for the hardware and software technology are very different, depending on costs. A typical VR system results from the integration of a wide variety of components – figure 2, in a system that mainly solves problems such as: graphics hardware, 3D modelling, visualisation and rendering software, tracking technology, interaction devices, motion control, collision detection, network, display systems. The components have some specific requirements for a real time interactions, sufficient graphical rendering performance and rendering of other senses such as haptic (touch) or sound information.

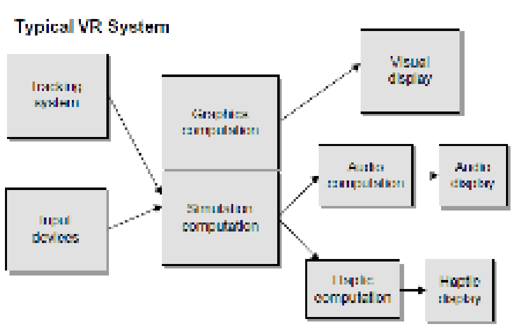



*Figure 2.* **Typical VR System (Craig, 2009)**

In order to implement virtual reality in the training process of the mechanical disciplines from the technical high school curriculum, as a first step, we have acquired the necessary components of a low – cost system: a head-mounted display or a pair of stereoscopic glasses to begin with, a pair of gloves DG5-Vhand, the appropriate interface between them and the virtual environment (VRML), a computer system and the corresponding software.


*Figure 3.* **Components of a low – cost VR system: head-mounted display and DG5-Vhand glove**

**4. 3D interaction**

Interaction is an important characteristic of any VR system. The user may be able to manipulate 3D objects into virtual environment. According to (Poupyrev, 2000), the design of manipulation techniques depends on interaction tasks and several variables.

The basic tasks are:

- position, the task of positioning an object from an initial to a final, terminal, phase;
- selection, the task of manually identifying an object;
- rotation, the task of rotating an object from an initial to a final orientation.

Variables that affect manipulation are: distance to the object, object size, required translation distance, amount of rotation, object's density and others. Most of the manipulation techniques are based on a few interaction metaphors or their combinations. A taxonomy (Poupyrev, 2000) of manipulation techniques is the following:

-by metaphor:
  - Exocentric metaphor: World –In – Miniature, Scaled – world grab, Vodoo – Dolls
  - Egocentric metaphor:
    - Virtual Hand metaphor: "Classical" virtual hand, Go-Go, Indirect, stretch Go-Go
    - Virtual Pointer metaphor: Ray – casting, Aperture, Flashlight, Image plane

-by component - Manipulation:
  - Object Attachment: attach to hand, attach to gaze, hand moves to object, object moves to hand, user/object scaling
  - Object Position: no control, 1-to-N hand to object motion, maintain body – hand mappings, indirect control
  - Object Orientation: no control, 1-to-N hand to object motion, other hand mappings, indirect control
  - Feedback: graphical, force/tactile, audio

In our pilot system the problem of manipulating the parts with virtual hands was solved (the actual hand movements made with DG5-Vhand for operations such as taking a piece with virtual hands and identifying constructive guidance through visual observation and acquisition of two objects or two components in order to simulate an operation of mounting). Interaction with the virtual scene is achieved by using two VR gloves type-Vhand DG5. The development of the application is carried out under the form of C++ projects, gloves being included in the project by software libraries:- HandManager.lib, VhandManager.dll, Project.h, DataGlove.h, delivered with the gloves. The files are intended to be used with Windows 98/2000/XP and Vista environments, and geometric modelling was done in Solidworks.

**5. Haptic interaction**

Understanding concepts and phenomena delivered in the training process of the mechanical disciplines from the technical high school curriculum can be improved by ”force feedback”. The term describes kinesthetic / vibrotactile feedback and is incorporating hands, upper torso, head and other parts of the body.

Haptic devices allow users to touch, feel and manipulate three-dimensional objects in virtual environments. Haptic devices are an input-output of the devices, meaning that they track a user's physical manipulations (input) and provide realistic touch sensations coordinated with on-screen events (output). Examples of low-cost haptic devices (Sharma and Gupta, 2011):

- Haptic Paddles
- Haptic knobs
- Novint Falcon
- Force Feedback Gaming Joystics
- SensAble’s Omni Phantom

To make haptic interfaces accessible to small groups of students in the training process of the mechanical disciplines from the curriculum, the device must be low cost and relatively small. (Grow and Okamura, 2007). Our pilot system allows haptic interaction via a low cost Novint Falcon device. – figure 4.

**6. Experiment**

In (Stareţu and Dudulean, 2009) we presented an experiment which aimed an evaluation of 3D object manipulation using a virtual hand. Effectiveness of the metaphor strongly depends on the sensory channels they refer to and on the users characteristics. The haptic device inserted into the application aims to increase the efficiency of the interaction metaphor. The solution chosen is low - cost and the applications software, Chai3D, is open - source.

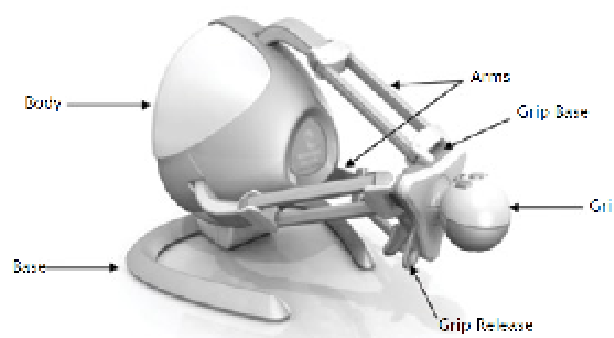


*Figure 4.* **The Novint Falcon low – cost haptic device**

First was made an application, a haptic game (Towers of Hanoi), allowing students a training on haptic device. – figure 5.

Next we used several virtual objects: a parallelepiped, a cube, interchangeable gears, and a spindle. The student can change the orientation and position of all the component elements of the virtual environment in real time, with haptic feedback. Models have been developed in . 3ds or . obj format and loaded in CHAI3D through Visual Studio. – figure 6.

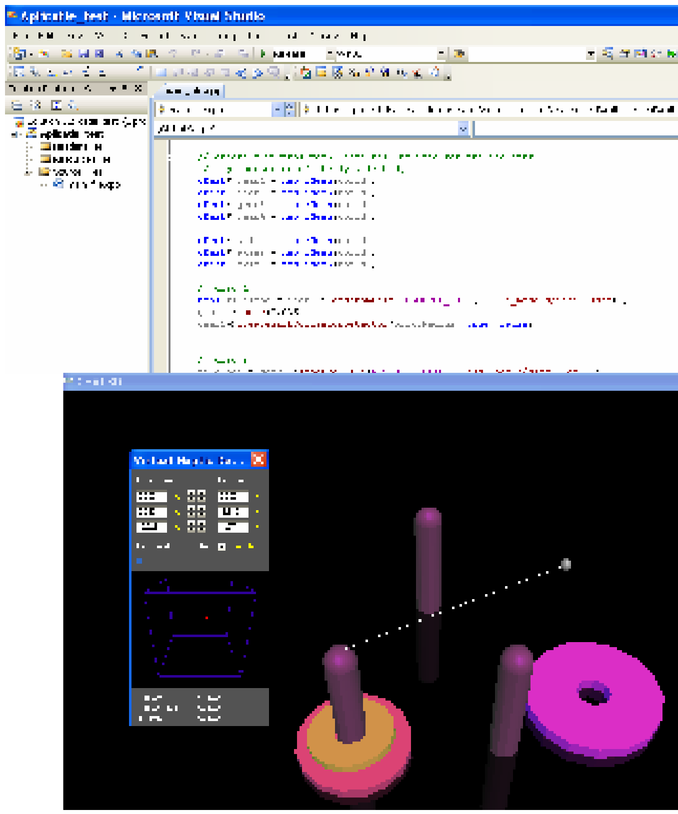


*Figure 5.* **A haptic game in Chai 3D**

Chai3D is an open source set of C++ libraries for computer haptics, visualization and interactive real-time simulation. Chai3D supports several commercially-available three-, six- and seven-degree-of-freedom haptic devices and makes it simple to support new custom force feedback devices. Chai3D is especially suitable for education and research purposes, offering a light platform on which extensions can be developed. (http://www.chai3d.org).

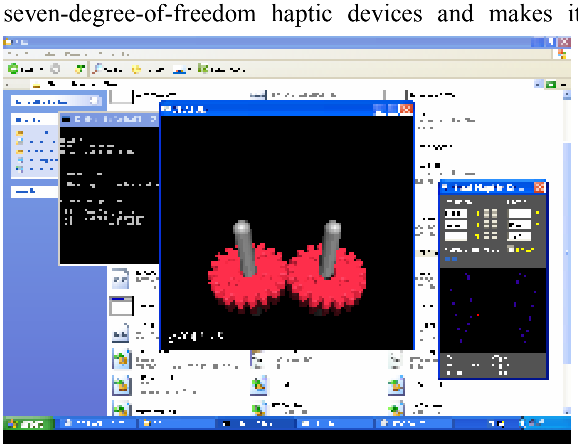


*Figure 6.* **A haptic educational application in Chai 3D**

## 7. Conclusion

Based on those presented we consider:

1. haptic feedback through a low cost and relatively small device is a solution to increase effectiveness in interaction
2. the involvement of haptic feedback in teaching showed that the students spent more time exploring the virtual objects; these are perceived and

conceptualized similar like in real life, the result is increased interest of students.

3. the student behaviour changes through haptic feedback; the method encourage motivation and interest, develop critical thinking and problem solving through active involvement in learning

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# Principles of Serious Games Interoperability

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**Abstract**

*As serious games (SG) emerge as a new opportunity for education, the research on interoperability remains a challenge due to the complexity of SGs in comparison with the traditional learning content. The opportunity for SG interoperability lies in the fact that SG development is at an early stage, which facilitate sustainable behaviours and standards adoption. This paper presents the premises for the development of a Serious Games Multidimensional Interoperability Framework that would enable educators and developers reach a common understanding and implement cost-efficient, qualitative SG interoperability solutions. The analysis considers the three key topics that impact SG interoperability: the components included in a serious game, the ecosystem where the serious game will be implemented and external factors that go beyond the core technical aspects of a serious game.*

**Keywords**: Standards, Interoperability, Serious Games

## 1. Introduction

Today, more than at any other time, the potential for technology to provide a major catalyst for change in education has never been more apparent. Increasingly, new technologies are changing the everyday practices. Advances in computer hardware and software have generated a rapid increase in virtual world activity for an infinitely diverse range of uses spanning across the educational environment. Serious games have emerged as a new opportunity to explore education in new and entertaining ways, which formed the genesis of innovative practices and, at the same time, emerged as a source of novel challenges in terms of development and implementation.

A critical area of interest within the serious game communities is standards for interoperability (Robson Robby, 2010). Interoperability is one of the core themes in information technology development. To effectively exchange educational information, educational IT systems and products must use consistent, specific data and technical standards. Over the past decades, organizations addressing different domains of activity have attempted to develop standards to promote interoperability among applications. Such efforts have needed to accommodate the heterogeneity and scale of the modelled entities (Annetta, 2008).

In the educational field, with the dawn of various specialised eLearning tools, more and more learning resources became stored in closed environments, restricting accessibility to a closed user community. While standardization bodies and consortia such as ADL, CEN/ISSS, IEEE, IMS, and ISO have already identified the need for interoperability of educational systems (Stănescu, Ştefan,

& Roceanu, 2011), the implementation process has to adapt constantly because technology advances at a fast pace (Reimsbach-Kounatze & Wunsh-Vincent, 2010).

The entertainment industry, to date, has expressed different interests regarding interoperability standards. While the academic community has a strong interest in ensuring that various simulation systems can work together, the entertainment industry places strong emphasis on developing proprietary systems and standards that preclude interoperability (Davidson, 2010). For example, game console accessories are incompatible between Sony PlayStation, Microsoft Xbox and Nintendo Wii.

Therefore, collaboration of heterogeneous software developers leads to interoperability issues, which represent a major barrier in the software development sector. Moreover, they use various collaboration scenarios with different organizational constraints.

Under these premises, this paper focuses on mechanisms that support the ability of serious games and serious games components to work together easily and effectively by design. The authors present a Serious Games Multidimensional Interoperability Framework that will enable educators and developers reach a common understanding and implement cost-efficient, qualitative SG interoperability solutions.

**2. Serious Games Interoperability Issues**

Serious games share many of the same design considerations and development issues as other video games. However, significant differences exist, caused by the shift in goal from entertainment to education. One of the most common differences concerns interoperability in serious games.

**2.1. Interoperability and standards**

The relationship between standards, the dynamic nature of technology, and the accelerated rate of innovation is evident in all computer-enabled markets, including the serious games industry. Standards have always been particularly important. With several organisations involved intensively in temporary project collaborations, having compatible electronic assets within the project has always been of critical importance (Chen & Daclin, 2006), and the emerging serious games make no exception.

The ability of systems to interoperate with another is a constant concern which must be considered simultaneously from technical, semantic and pragmatic perspectives and covering all the issues relevant for different stakeholders (Ruokolainen, Naudet, & Latour, 2007).

Interoperability represents the ability of computers to communicate and share resources in a heterogeneous environment (Davidson, 2010). Developing simulations, serious games, and other forms of training in a way that enables interoperability is one means of increasing the depth and scope of instructional materials available to learners while reducing overall development costs and time (Makila, 2010), (H., 2008). And interoperability dependents on standards.

While researchers and practitioners agree that standardization is important, there is still a wide gap between theory and practice. On one hand, some researchers consider that standardization stifles innovation, or that it does not reduce costs significantly (Robson Robby, 2010). On the other hand, the lack of standards in games is seen by developers as presenting significant challenges, particularly regarding interoperability, testing and international expansion (Reimsbach-Kounatze & Wunsh-Vincent, 2010). There are also considerable locks-in effects due to the development of de facto standards, for instance, by console manufacturers. There are also important standards and interoperability issues (e.g. in the PC hardware or in the content-control software), which are not specific to the game industry but which might hamper game interoperability (Gee, 2003).

### 2.2. IEEE LOM's relation to Serious Games

Educational content metadata is a set of additional information added to facilitate the learning content classification and their later retrieval. As result of the IEEE Learning Technology Standards Committee Working Group drew up the IEEE Learning Object Metadata is a standard metadata schema, aiming to provide a common vocabulary to describe e-learning content materials.

IEEE LOM metadata is organized in categories. In particular, LOM defines 9 different categories:

- *General*. Provide general information of the learning object describing it as a whole.
- *Lifecycle*. Describe history and current state of learning object, in particular describe who have been participated during the authoring process of the learning object.
- *Metametadata*. Describe information about the metadata.
- *Technical*. Describe the technical requirements (i.e. OS, required specific software, etc.) and characteristics of the learning object.
- *Educational*. Describe the educational intention and uses of the learning object and complexity, and intended audience.
- *Rights*. Describe the Intellectual Property Rights associated to the learning object.
- *Relation*. Describe the relationship between the described learning object and other learning object, usually stored in the same repository.
- *Annotation*. Describe some annotation and comments of the learning object.
- *Classification*. Describe the learning object based on classification taxonomy.

*IEEE LOM's relation to Serious Games*

Serious Games can be seen as a particular case of learning object, hence seems reasonable to add metadata to SG, with the aim to foster re reuse of already created SG (IEEE Learning Technology Standards Committee (LTSC)). In fact, adding metadata to SGs is a need, because of creating a SG is a costly process from human and monetary perspective, hence it is important to precisely describe the SG to facilitate their reuse.

## 3. Serious Games Multidimensional Interoperability Framework

Interoperability provides a context for the development of sharable education resources and technologies which in turn allow for collaborative education in a field in which rapid technological developments are making it difficult for instructors and developers to stay up-to-date with both the science and the related technologies. Such collaborative education initiatives raise many issues, both technical and institutional. Moreover, the nomenclature of interoperability is growing and confusing. The role of interoperability specifications is to provide a robust basis for semantic interoperability: when machines as well as people can process the information.

At the moment, there are thousands of simulations, teaching programs and also games that cannot interoperate (González Alonso, Fernández, Maestre, García Fuente, Pinta, & García, 2011). Even sharing media stored in standard formats remains a challenge. The problem of incompatibility due to multiple hardware platforms, operating systems, and languages also apply to the serious games development environment. The experience of educational communities illustrates the need for standards, so that content and code can be readily shared. Unfortunately, many content standards are still discipline dependent.

Under these premises, a general effort to create a framework for the development and distribution of interoperable, shareable education materials and technologies emerges as a necessary undertaking in the field of serious games.

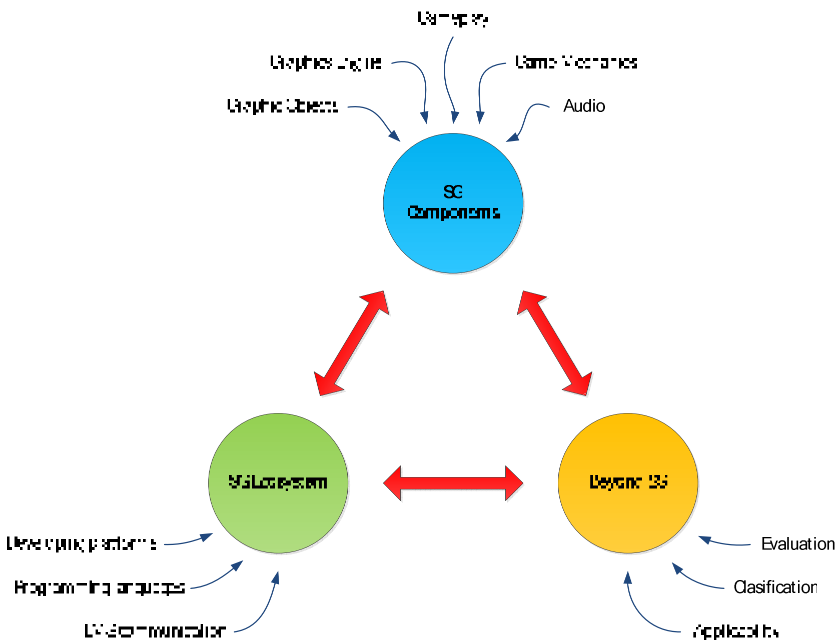


*Figure 1*. **Serious Games Multidimensional Interoperability Framework (SG-MIF)**

In order to facilitate a better understanding, development and implementation, the authors consider it is necessary to divide serious games interoperability across three topics of interest: the components included in a serious game, the ecosystem where the serious game will be implemented and external factors that go beyond the core technical aspects of a serious game. Standards and interoperability apply to each of the ingredients of the three main topics, which generate a multidimensional model that needs to be tailored according to the objectives of the game or other reference points. Moreover, as some of the ingredients cross the boundaries of the three topics, this multidimensional approach highlights these interconnections.

The domain of serious game interoperability is not precisely defined and the concept of interoperability itself is still confusing and interpreted from many different points of view (Chen & Daclin, 2006). Interoperability demands can be recognized both at the horizontal level (between various systems) and at the vertical one (between formal models). In neither of these two cases we can be satisfied with the existing solutions (Kravcik, 2006). This paper presents the core level of development of an SG interoperability framework that aims to identify the basic and the complementary dimensions of SG interoperability and to define its domain of research.

**4. Conclusions**

Developing serious games in a way that enables interoperability is one means of increasing the depth and scope of instructional materials available to learners while reducing the overall development costs and time.

Interoperability standards initiatives, such as LOM, although not universally accepted, can have a serious impact on serious games development when compliance is mandatory. Eventually, these and other interoperability standards should evolve to a level that enables developers to create serious games more quickly and easily and reduce needless duplication of effort. Unless immediate measures are taken to alleviate spectrum shortfalls and promote interoperability, the booming serious games development will not be able to adequately answer to efficiency, quality and cost requirements.

This paper presents a Serious Games Multidimensional Interoperability Framework that would support a common understanding between educator and developer communities, as well as the implementation of cost-efficient, qualitative SG interoperability solutions. The authors have developed a general framework that integrates three main topics – SG components, SG ecosystem and Beyond SG – and that maps the ingredients that falls underneath each of these topics with the purpose of providing a reference model that enables different interoperability scenarios, correspondent to the objectives set for the development of a particular serious game.

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# The Energy and the Entropy of Hybrid Multi-Agent Systems

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**Abstract**

*This paper could be seen as a transdisciplinary paper. We first review some history facts about artificial intelligence and our previous research. Then, we explain the meaning of two concepts coming from physics, energy and entropy, giving plenty of examples of how these concepts were adapted in other fields of study. We then propose the use of some concepts (efficiency, energy, entropy and transdisciplinary distance) in the study of hybrid multi-agent systems deriving some equations for them. Finally, we refer to other thermodynamic accounts within multi-agent systems, discuss on the results presented in this paper, and conclude with some remarks on knots.*

**Keywords:** multi-agent system, energy, entropy, artificial intelligence

## 1. Introduction

Attempting to apply (and to clarify) some important concepts from physics, this article is mainly addressed to computer scientists, but could also be of some interest for mathematicians, physicists, etc. Thus, it also could be seen as a transdisciplinary paper - see (Nichita, 2011a; 2011b) for an interpretation of transdisciplinarity and its relations with intersdisciplinarity and pluridisciplinarity. Physicist Basarab Nicolescu explains that the “trans-“ in transdisciplinary signifies working simultaneously *through* disciplinary practices, *between* the disciplines (as in multi- and interdisciplinary endeavors), and *beyond* the disciplines and the institutions they form and in which they reside, in the hope of approaching something like the unity of knowledge – cf. (Weislogel, 2011).

The history of ***artificial intelligence*** has several distinct steps. In the ’60, scientists hoped to obtain programs, for calculators and intelligent robots, which could prove theorems. This was not a realistic target for many problems solving; so, in the ’70 and ’80 the accent was moved to constructing formal languages. Nowadays, scientists study, among other topics, the ***hybrid multi-agent systems*** (collaborative and interactive man – computer systems). By hybridization of the systems, the human problems solving and the ability to perform computations of the computer systems are combined in an advantageous way. While the human intelligence and knowledge is used to solve problems of high difficulty, the computational systems may analyze large number of data, having the capability to make a large quantity of computations. Thus, a computational system has a specific form of intelligence, called computational intelligence, which is different from the human one.

Our previous paper (Hobby et al, 2009) was on the study of a particular case of agents, namely the software mobile agents (agents which migrate during their operation from host to host). The software mobile agents represent a relatively new paradigm in the area of distributed programming and a useful supplement of traditional techniques like the Client/Server architecture. Mobile agent technology has been applied to develop solving methods for various kinds of parallel and distributed computing problems. The main disadvantages of the mobile agents are the limited: intelligence, protection possibility against the malicious hosts and network sources and communication capability (Borselius, 2002). Another drawback of the mobile agents consists in the limited possibility of endowment with knowledge bases (Collier et al, 2000; Busetta and Ramamohanarao, 1998). Some problems solving may require the use of knowledge bases. For example, we mention the medical diagnosis problems: (Iantovics, 2005a; 2005b). The endowment of a mobile agent with a knowledge base increases the mobile agent body size and his behavioral complexity that can make impossible its use from practical reasons. During some previous research, we have developed a novel mobile agent architecture, called *ICMA* (*Intelligent Cooperative Mobile Agent Architecture*).

## 2 The energy and the entropy

The ***energy*** is a concept coming from Greek, and appearing currently both in science and in theology. In science, it represents the property of a physical system to produce mechanical work; so, the energy can be seen as a number associated to a physical system. In theology, the energy is found in the context of defining the difference between living creatures and the dead matter (Caragiu, 2009). A visible form of energy, studied in optics, is the light (Nichita, 2010). In Knot Theory, there exists an energy associated to a geometric knot, called the *Möbius energy*; as a geometric knot deforms and tends to acquire a double point the Möbius energy will blow up and thus constrains the deformation of the initial knot within its isotopy class (Lin).

The ***entropy*** is a thermodynamic property that is a measure of the energy not available for useful work in a thermodynamic process. There are two related definitions of entropy, the thermodynamic definition and the statistical mechanics definition, but this concept was also adapted in other fields of study: information theory and cosmology (Villani, 2011), psycho-dynamics, thermo-economics, mathematics, sociology, etc. Ice melting in a warm room is an example of increasing entropy. A translation of a poem by Eminescu has bigger entropy than the original poem (Ciuperceanu; Spandonide and Paun, 2010). An example of high entropy in sports is a team with a continuous movement and a good circulation of the ball.

## 3 Evaluating the hybrid multi-agent systems

A hybrid multi-agent with human ($M_1, M_2, ..., M_p$) and artificial ($c_1, c_2, ..., c_n$) components is considered in the following figure.

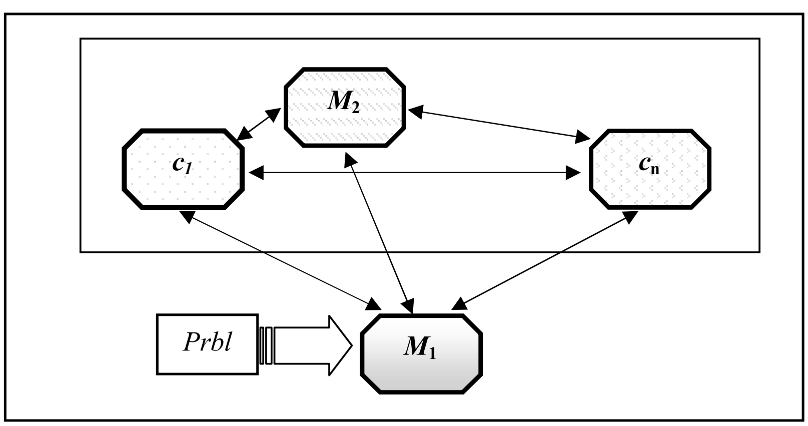


*Figure 1.* **A hybrid multi-agent system solving a problem denoted Prbl**

We propose the following concepts for the above hybrid multi-agent system.

Efficiency during a period (a year, a month, etc):
***η*** = total number of solved problems / total number of proposed problems · 100 %

Entropy:
[1] $S$ = log (α p + β n) , with suitable values for
[2] $\alpha >> \beta \in [1 = 10^0, 10 = 10^1]$.

Energy:
***E*** = the total number of types of problems which are supposed to be solved by a hybrid multi-agent system

Transdisciplinary distance:
***D*** = some measurement of different classes of problems which can be solved by a hybrid multi-agent system

For example, let us consider some medical diagnosis problems. We have to chose (a hospital which has) a hybrid multi-agent system with a transdisciplinary distance coherent with our selection of problems and with the biggest energy. The efficiency will give information about how well the work was done while solving the problems. The lower the entropy, the lower the price of (a performance of) a hybrid multi-agent system.

As in the first law of thermodynamics, we expect that the entropy and the energy are related by an equation. We propose the following equation:
[3] dE = (constant) · dS / S

Obviously, η ≤100, but not that obvious is the following equation:
[4] $$X(\eta) = 100\, e^{-\omega E \|D\|},$$
where ω is a small positive constant and $\|D\|$ measures the "length" of D.

## 4 Comments and conclusions

A thermodynamic account of self-organization within a multi-agent system led to the investigation of stigmergic coordination inspired by organization in insect colonies

(Parunak and Brueckner, 2001). A continuation of that work was presented by (Gambhir et al, 2004), where the authors apply a computational model of an ant foraging system to demonstrate how complex organization of interacting agents can be explained in terms of ideas from thermodinamics. Our paper proposes a slightly different point of view on the entropy in a hybrid multi-agent system. It aims to give a way to evaluate the effectiveness of a hybrid multi-agent system. Our applications could be, for example, in medical diagnosis problems. A future study would complete the information about the values of the constants α, β, ω, etc.

Back to Knot Theory, there is an interesting way to use knots for computing the partition function of a vertex model from statistical mechanics, thus leading to some knot invariants (Jones, 1989); so, the number of crossings of a knot plays the role of some kind of energy for the given knot. By the same token, the determinant of a knot (i.e., the absolute value of the Alexander polynomial evaluated at -1) plays the role of the entropy. In the Rolfsen knot table, the knots are listed in the increasing order of their numbers of crossings. For knots with the same number of crossings, the knots are listed in (sequences in which they have) the increasing order of their determinants (with a few exceptions)! If we look at the knots with less or equal than 10 crossings, the expected value of crossings of a randomly chosen knot is approximately 9.

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# Lectora – a Complete eLearning Solution

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**Abstract**

*As a teacher you have to prepare your courses in an attractive, understandable and convenient way to make sure that information is transmitted in adequate form and substantial content to the students. E-learning experts develop new learning technologies and various software solutions to gain more users in this field. Lectora e-learning software provides a complete end-to-end e-learning solution both for corporate learning departments and professional e-learning companies. Using Lectora to build rapidly e-learning courses without any programming language is a substantial advantage. In this paper the authors present an example of Lectora usage highlighting its benefits equally for teaching staff and students.*

**Keywords**: Lectora, eLearning solution, content learning

## 1. Introduction

Information Society or Information Age is a well-known term used at the present. Internet technology explosion and global information infrastructure development, as well as constant changes in humans' behavior regarding the concern for discovering new learning solution are providing necessary background for experts in this field.

Despite many technological advances and the integration of new pedagogical concepts and models, the majority of today's education organizations continue to utilize the traditional learning methods.

The education area is now an adequate place where various technologies meet to respond on global challenges of forming successful people. Education and training organization should focus their activities on creating knowledge to use it for teaching next generation of students. Virtual classroom, chats, forums are few popular examples of new realization in the education field. These "products" demand an appropriate curricula and teaching technologies in order to take into account the students' needs.

Lectora e-learning software provides a complete end-to-end e-learning solution both for corporate learning departments and professional e-learning companies. Using Lectora to build e-learning courses without any programming language as background is a substantial advantage. In this paper the authors present an example of Lectora usage highlighting its benefits equally for teaching staff and students.

## 2. E-Learning solutions

All forms of electronically supported learning and teaching define the e-learning concept. E-learning applications include Web-based learning, computer-based learning, virtual education/ virtual environment, digital collaboration etc. The learning content is delivered via the Internet of other electronic support (audio or video), including media tools in the form of text, image, animation etc.

Creating the e-learning content is not simple, because the units of educational material must correspond to the curricula and must follow the establish guidelines. The consistency of pedagogical approaches needs to be evaluated in order to find the adequate template to efficiently create educational materials.

As a teacher you want to quickly and easily build your courses that your students access them using various devices (desktops, laptops etc.). Most of the online learning frameworks combine user-defined content and behaviors with animation, flexible testing and certificates (Flex Training, 2011, 1educat.ro, 2011).

Lectora Inspire represents a complete eLearning solution for education and training organizations with build-in resources for rapid eLearning development (templates, wizards etc.). In the following section the authors present an example of course build with Lectora software, the trial version (Trivantis, 2011).

**3. Building a Lectora application**

Before you start using Lectora to build your own application you have to follow several steps such as:

- establishing the course to be translated into electronic format and guide studying;
- splitting topics in the units and setting a course template (specific competencies and objectives are established for each unit of learning);
- establishing the learning content and the tasks for each units;
- establishing the evaluation form and the review process for course publication of the eLearning platform;
- publishing the course.

Lectora supports all universal multimedia formats and can convert and compress audio and video to Flash format. Lectora Inspire includes Camtasia for Lectora, SnagIt for Lectora and Flypaper for Lectora to easily develop screen recordings, screen captures, videos, and engaging Flash (Trivantis, 2011). A menu builder helps users to easily design interactive navigation buttons. The learning content is organized into Chapters, Sections and Pages. Lectora offers a template gallery with helpful descriptions for each template.

A benefit of Lectora is that engages students by instantly displaying question feedback after each question is answered, but before the answer is submitted.

When the user accesses Lectora a friendly window appears and the user have to choose the way he want to define and build the application (creating a new title or opening an existing title) (fig.1). In the following example the authors create a new title. The course chosen to be translated into electronic format refers to operating systems and is addressed to the students from Mathematics, the Letters and Science Faculty (fig. 2).

The next step is to split topics in the units and to choose the adequate template for course building. The course objectives are well defined and the competencies for each unit should be established. In this example the learning content is organized in nine learning units. As a result of defining the all learning units, Lectora builds a hierarchical structure where the user can access each unit to modify or to add new properties using the Title Explorer window (fig. 2).

The operation of defining objectives, tasks, competencies, proprieties is repeated for all units using the existing hardcopy version of the course. The resulted pages of the each unit contain the most important topics reflecting the main objectives.

The next step is to publish the course on different format such as: single file executable, CD-ROM, HTML, CourseMill (CourseMill Learning Management System offers the most affordable and easy solution for managing online training.the Lectora server) etc. (fig. 5).

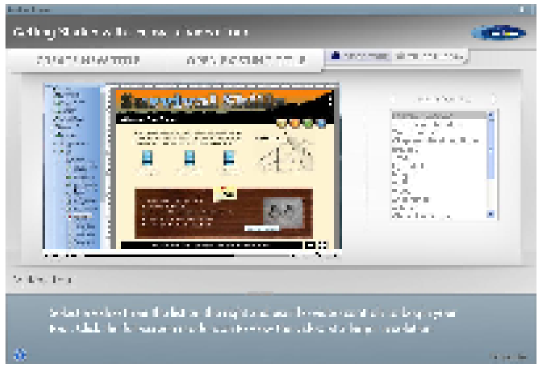

*Fig.1.* **Getting started with Lectora**

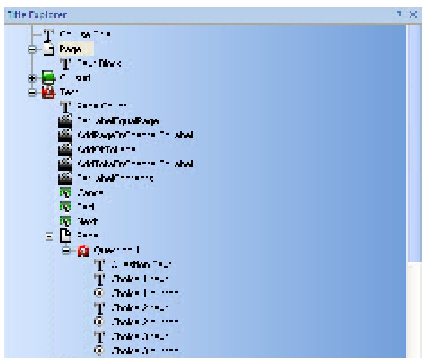

*Fig. 2*. **The Title Explorer window**


*Fig. 5*. **The publishing options**

The publishing job refers also to the process of verifying the errors resulted after the design process. In the current example the option for publishing was the single file executable.

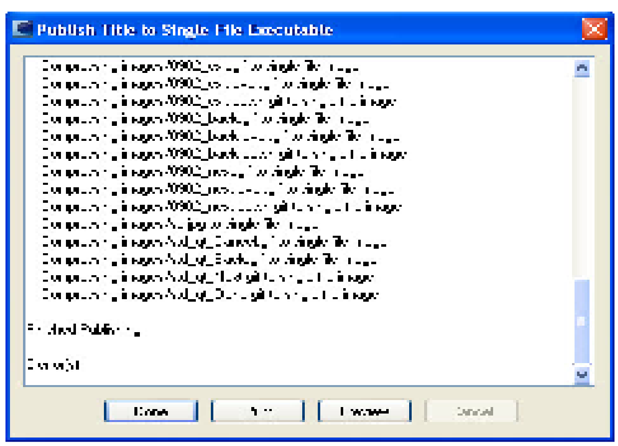


*Fig.6*. **The results of course publishing**

The executable file can be run on the computer without any connection to the eLearning server. The graphical user interface is presented in the figure 7. The learning content consist in nine units, named curs01, curs02, …, curs09 and an evaluation unit named test grila.

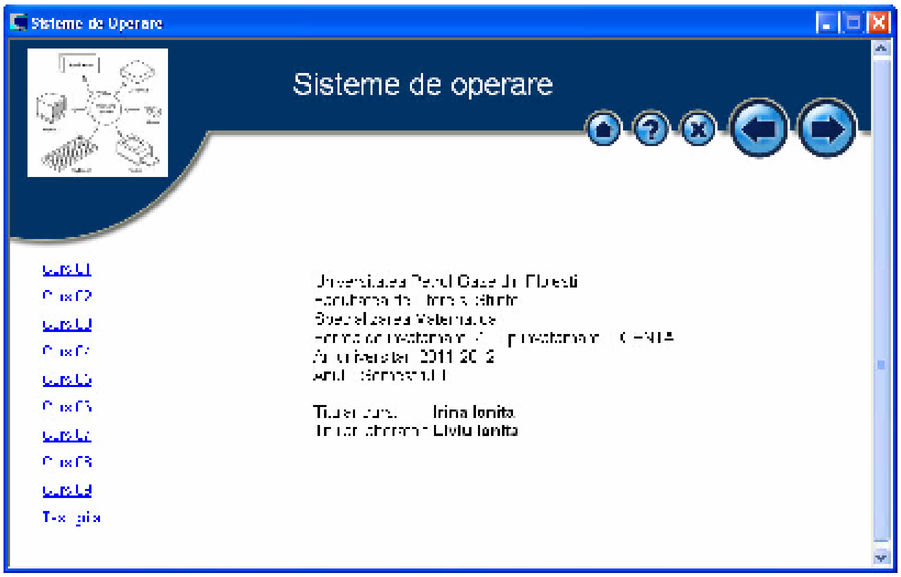


*Fig. 7.* **The "welcome" window**

An example of learning unit is presented in the figure 8. The entire learning content for this unit can be accessed using a hyperlink.

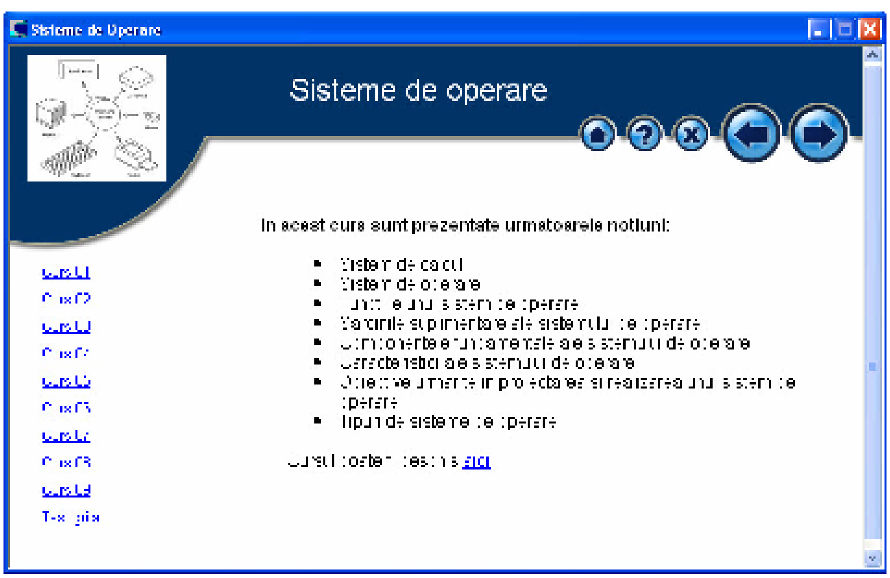


*Fig. 8.* **An example of learning unit**

Lectora offers a variety of testing options such as automated grading, weighted questions, timed testing and randomized test questions for the knowledge check. The question type can be: true/false, multiple choices, short answer, essay, fill in the blank, matching, drag and drop, hot spot. The authors used the true/false questions in the current example (fig.9).

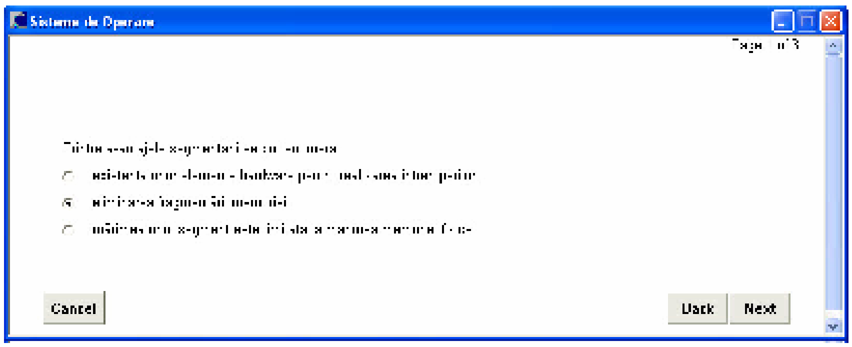


*Fig. 9.* **The knowledge check**

Some significant features of Lectora regarding the knowledge check are: resetting questions (automatically reset individual questions on a page and repeating the question until it is given the correctly answer), printing test results, customizable questions and tests etc.

A certificate tool rewards users for a job well done by quickly creating certificates for test or course completions. Using certificate templates the teacher can easily customize with desired colors and fonts as well as specified names and dates for the students.

As a conclusion, Lectora represents an eLearning solution to develop professional eLearning courses and presentations and can be used by academic institution, government agencies etc.

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# Semantic Web Technologies Integrated in a SOA-Based E-Learning System

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**Abstract**

*The exploitation of new Semantic Web technologies in the context of E-learning services requires a deeper understanding of the relevant issues as long as they will be able to incorporate even perception and pervasive or ubiquitous computing. This paper describes the structure of an ontology-based metadata digital library designed in the environment of new emerging virtual and semantic E-learning systems. Using a SOA (Service Oriented Architecture) model, the Search Engine integrated in the Resources Management Level captures the educational "essence" of shared and re-usable E-learning content and even provides a very large-scale Adaptive Educational Hypermedia database. Determined by the Semantic Web technologies and ontology, as a representation of the conceptualization of a particular domain, this SOA design belongs to the next generation of intelligent and virtual E-learning systems and applications.*

**Keywords**: Semantic Web Technologies, E-Learning Services, Metadata Digital Library, Service Oriented Architecture, Adaptive Educational Hypermedia.

## 1. Introduction

In the last two decades E-learning technologies and Internet-based education was dominated by traditional Learning Management Systems (LMSs), or E-Learning Platforms. They support online course creation, maintenance and delivery, student enrollment and management, education administration, and student performance reporting.

In the first generation of Learning Management Systems (LMSs) we can identify two main categories: open source initiatives and proprietary solutions.

- Open source initiatives include Moodle (www.moodle.org), Sakai (www.sakaiproject.org), ATutor (www.atutor.ca), and Whiteboard (http://whiteboard.sourceforge.net );
- Proprietary solutions include WebCT/Blackboard (www.blackboard.com), Gradepoint (www.gradepoint.net), Desire2Learn (www.desire2learn.com), and Learn.com (www.learn.com).

These platforms focused on the delivery and interoperability of content designed for a specific purpose, such as a particular course. During this time, several standards emerged to describe the content that compliant LMSs could share at the asset level: *Dublin Core (www.dublincore.org), IMS Learning Resource Metadata (www.imsglobal.org/specifications.html), IEEE-LOM or Learning Object Metadata (http://ltsc.ieee.org/wg12/ ), etc.*

The second-generation of E-learning platforms (WebCT/Blackboard, Moodle and Sakai) provided a shift toward modular architectural designs and support semantic exchange. They began to focus not only on sharing content but also on sharing learning objects, sequences of learning objects, and learner information. Standards and specifications emerging during this time, such as the Shareable Content Object Reference Model (SCORM; www.adlnet.gov), IMS Content Packaging, and IMS Learning Design (www.imsglobal.org/specifications.html), supported the ability of standards-compliant platforms to share courses or parts of courses via an import–export paradigm, while IMS Tool Interoperability provided guidelines for interoperating tools between different LMSs. Another significant development was that second-generation platforms began to embrace the "services" principle and moved toward separating content from tools, and the learner information became more distinguished. However, these systems aren't entirely learner-centric: they still focus strongly on learning administration (course management) rather than on the learner.

Next-generation platforms such as the E-Learning Framework (ELF), the IMS Abstract Framework, and the Open Knowledge Initiative (OKI) are be based on these service-oriented visions and they have defined the initial steps toward service-oriented e-learning platforms.

**2. Next-generation Service-Oriented E-Learning Platforms.**

The next-generation of E-Learning platforms apply service frameworks to the platforms' modular design. They provide support for greater interoperability by separating LMS and Learning Content Management System (LCMS) functionality. The next-generation of e-learning platforms can share content and learning scenarios and can dynamically exchange tools, functionalities, semantics and control. This also involves a much wider range of information — such as user information, context, sequencing, workflow, and control — which services can use and reason across in e-learning platforms. This will let users build custom E-Learning platforms from a vast range of E-Learning services, for their specific needs, at specific times and in dynamic ways.

Several standards and technologies support the interoperability requirements for next-generation E-Learning platforms, as figure 1 illustrates. Existing and emerging methodologies evolve around modularization and separation of concerns. This, in essence, means that functionality is divided into modules, which can then be combined to provide an integrated e-learning platform. Service-Oriented Architectures (SOAs) describe an architectural concept that defines the expression of processes and logic as individual services, which in turn publish or expose facets of their functionality in a standardized way, letting other services access and use this functionality in a flexible manner.

In middleware architectures, a software layer between applications or services facilitates interoperability, helping to provide services such as identification, authentication, authorization, information exchange and security. Middleware is the connection between Web services and is especially applicable to modern knowledge-based systems developed on XML, SOAP, and SOAs.

For service-oriented E-Learning platforms new standards, frameworks, specifications and guidelines have emerged to modularize functionality and to define services:

- sets of applications (e.g. LMSs);
- application services (e.g. quizzes, simulations and other finer-grained services); educational services (usually revolving around education administration such as course management and scheduling);
- common services (e.g. authentication, file sharing, logging, database management);
- infrastructure (the backbone of the services, including HTTP, SOAP and XML).

Thus, the IMS Abstract Framework (www.imsglobal.org/specifications.html) identifies and represents the core components and interfaces of an E-Learning system. The E-Learning Framework (ELF; www.elframework.org) illustrates E-Learning systems' common functionalities.

Similarly, the Open Knowledge Initiative (OKI; www.okiproject.org) defines service layers for developing E-Learning platforms.

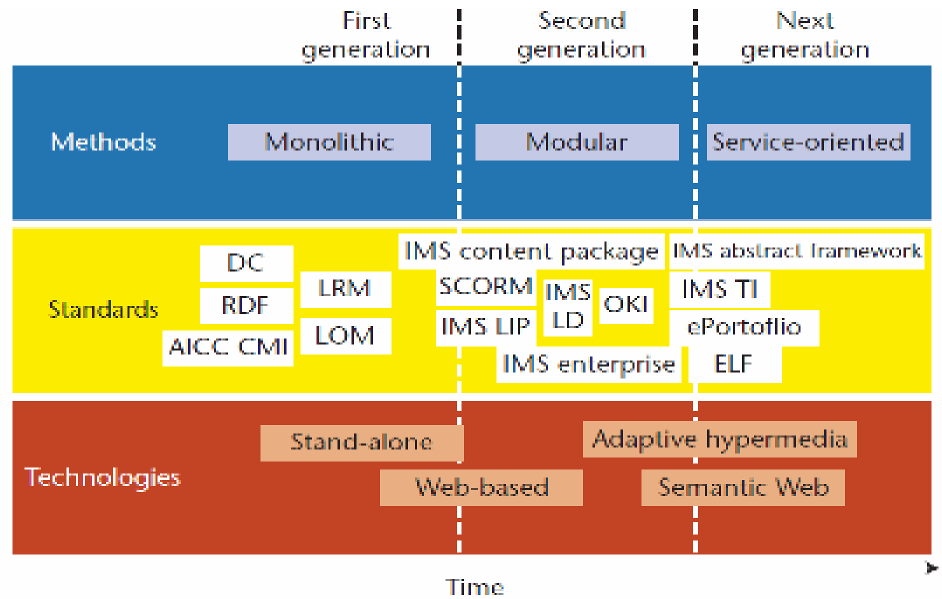


*Fig. 1* **The three generations of Learning Management Systems(LMS)**
First generation LMS supported content-only interoperation. Second generation LMS began to take account of users and their associated profiles, whereas next-generation systems will support targeted personalization.

The frameworks, specifications, and guidelines then define layered approaches to constructing e-learning systems from these collections of previously defined services.

These specifications provide representations for person and group information (IMS Enterprise), a person's profile and learning history (IMS Learner Information Package and ePortfolio), assessment (IMS Question and Test Interface), groupings of learning content (IMS Content Package and SCORM- Shareable Content Object Reference Model), dynamic content sequencing (IMS Simple Sequencing), learner competencies (IMS Reusable Definition for Competence and Educational Objectives), learning activities (IMS Learning Design), searching across federated databases (IMS Digital Repositories Interoperability), and connecting different eLearning tools (IMS Tool Interoperability; www.imsglobal.org/specifications.html).

At a fine-grained level, these standards and specifications describe the syntax that the various services should implement to present information externally.

Here, Semantic Web technologies have an important contribution to interoperability component with the ability to use the information meaningfully and dynamically. This makes possible machine-readable information and services to interoperate and negotiate on the fly. The Semantic Web began with RDF (Resource Description Framework) and DAML+OIL (DARPA Agent Markup Language) and has since progressed toward the W3C standard Web Ontology Language (OWL; www.w3.org/TR/owl-features/ ). OWL can be used to express ontologies — knowledge bases of concepts that services can query to retrieve information. In particular, ontologies can help produce new knowledge, in that inference can occur within the knowledge base to achieve a goal, independently of information input specifically by the ontology's creator. This ability extends to the realm of Web services with OWL for Services (OWL-S).

At a finer-grained level, developers can use W3C's Web Service Description Language (WSDL; www.w3.org/TR/wsdl) to describe a Web service's functionality in terms of its inputs, outputs, pre-conditions and effects (IOPE). WSDL provides a syntax through which a calling system or service can access exposed functionality without concerning itself with its inner workings.

At a broader level of granularity, the Semantic Web community is developing specifications for services organization and workflow. Web Services Business Process Execution Language (WSBPEL; http://docs.oasis-open.org/wsbpel/2.0/wsbpel-specification-draft.html) supports service organization and flow within SOAs. Enterprise Service Bus (ESB) also illustrates service organization and orchestration.

Adaptive Hypermedia Systems form the second tranche of technology for interoperation. Adaptive systems benefit from a different approach because they tend to be open-ended information systems with a highly developed sense of their domain.

This means that external sources can add new information relatively easily and that a small amount of additional information will considerably improve performance. Adaptive services, taking advantage of OWL-S in addition to core OWL, provide a rich, highly expressive framework for interoperating services.

The main link between the Semantic Web and adaptive hypermedia is Web service technology and composition. SOAP and REST allow remote systems to use Web-based communication to create complex systems built from atomic services.

E-learning services can represent and manage any technical aspect of an e-learning scenario. They include functionalities such as: authentication, tracking, course management, scheduling, activities, tools, assessment, personalization, resource harvesting, context management, federated exchange, simulation, games, wiki, blogging, podcasting, etc.. Additionally, e-learning platforms must be able to support loose coupling, thus enabling interoperability of services' semantics.

Service interoperability concerns the seamless creation, deployment, consumption, and orchestration of Web-based services. Most research in this field focuses on service syntax interoperation (i.e. the ability to create a service on any platform in any environment and interact with it from a different platform and environment). Common framework-based APIs provide support for tightly knit collections of services, grouped according to functionality.

The semantic exchange supports a more detailed view of what a service can do, what it produces, how to manage it, and its uses. It also paves the way for generating and interpreting other information, such as context, trust, and security (context-informed services). Pure ubiquitous computing research is based on two key concepts: pervasive computing and calm computing. Pervasive, calm systems help users by managing their complex information profiles in an easy, blended way. Context-informed e-learning aims to lower the information burden on users and let them concentrate on their learning tasks. Numerous projects (www.cs.cmu.edu/~aura/) demonstrate how various cooperating systems can enhance users' experience by placing a much wider variety of information at their immediate disposal.

Educational applications represent a natural application domain for this type of work, in part because of their immediate familiarity for academic researchers, but more importantly because of students' rich information needs. Projects such as ActiveClass address domain-specific concerns while maintaining the generalized ubiquitous computing approach.

Typically, current systems represent context via physical properties such as location. Next-generation systems are able to leverage rich information sources made available by a service-oriented approach. Services will provide a great deal of information about learners and their activities, including metadata to describe that information. This richer information space lets systems incorporate a much wider amount of information, much of it located and integrated at runtime.

**3. Semantic Web services**

Service-oriented architectures (SOA) are rapidly becoming the dominant computing paradigm for emerging generation of information technologies. Web services define a new paradigm for the Web, in which a network of computer programs becomes the consumer of information. However, Web services technologies only describe the syntactical aspects of a rigid Web service and cannot adapt to a changing environment. Realization of the full potential of the Web services requires further technological advances in the areas of service interoperation, discovery, choreography and orchestration. A possible solution to all these problems is likely to be provided by converting Web services to Semantic Web Services (SWS), which are self-contained, self-describing, semantically marked-up software resources that can be published, discovered, composed and executed across the Web in a task driven semi-automatic way [5]. Semantic Web Services (SWS) can constitute a solution to the integration problem, as they enable dynamic, scalable and reusable cooperation between different systems and organizations.

There are two major initiatives working on developing a world-wide standard for the semantic description of Web services. The first one is OWL-S (http://www.daml.org/services/owl-s/), a collaborative effort by BBN Technologies, Carnegie Mellon University, Nokia, Stanford University, SRI International and Yale University. OWL-S is intended to enable automation of Web service discovery, invocation, composition, interoperation and execution monitoring by providing appropriate semantic descriptions of services. The second one is the Web Service Modeling Ontology (WSMO) [17], a European initiative intending to create ontology for describing various aspects related to Semantic Web Services and to solve the integration problem. WSMO has been under development over the past four years and has been adopted in several IST FP-6 Integrated Projects such as DIP (http://dip.semanticweb.org/), SEKT ( http://sekt.semanticweb.org/), Knowledge Web (http://knowledgeweb.semanticweb.org/), ASG (http://asg-platform.org/), INFRAWEBS (http://www.infrawebs.eu) and LUISA( http://www.luisa-project.eu) by a consortia including more than 70 academic and industrial partners, in total.

In Research Framework of the European Commission also provides substantial funding for research into "Service and Software Architectures, Infrastructures and Engineering". This Objective integrates research activities in the areas of services, software, grid and virtualization technologies. Under its First Call EU is now funding 28 new research projects in this area among which Soa4All (http://www.soa4all.org/),

ADMIRE (http://admire1.epcc.ed.ac.uk/), ROMULUS (http://www.ict-romulus.eu/home), SHARE (http://www.shape-project.eu/) and SLA@SOI (http://www.sla-at-soi.eu/) address the issue of developing new Service-Oriented Architectures.

**4. Semantic SOA E-Learning System**

This system will contain innovative user-friendly ontologically-based tools for creating, indexing and storing learning ontologies, e-Learning Semantic Web Services and learning goals as well as specialized middleware for dynamic composition of such services. The system will significantly facilitate integration of SWS infrastructure with end-user applications and digital object repositories.

This approach involves integrating adaptive systems with semantically described services can transfer information known by external services to the e-learning application. By generating a shared semantic view of the user's context, the e-learning platform can include a wide variety of extra information relevant to his or her task without having to model the types of useful information a priori. The semantic approach provides a way to tailor adaptive systems' knowledge and behavior to exploit extra available knowledge in a dynamic fashion. The platform adds rich descriptions to services and their information (such as the Semantic Web) present a clear opportunity to greatly enhance the e-Learning process.

The conceptual layered architecture of the Semantic Web Service (SWS) E-Learning System is presented in figure 2.

The first layer, "Semantic Web Service (SWS) Deployment Layer", is responsible for discovery, dynamic composition, execution and monitoring of SWS. It contents 3 components: SWS Discovery Module, SWS Composition Module and SWS Execution Module.

The second layer, "Problem-Solving Method Layer", contains methods used for creating and maintaining Semantic and Learning objects: "SWS Composition Methods", "Logic-Based Matching" (combination of E-Learning-specific and logic-based methods for learning object discovery), "E-Learning Methods" (E-Learning-specific decision-support methods for dynamic service composition), "Similarity Evaluation Methods"( structural, linguistic, statistical and fuzzy methods for calculating similarity and object retrieval).

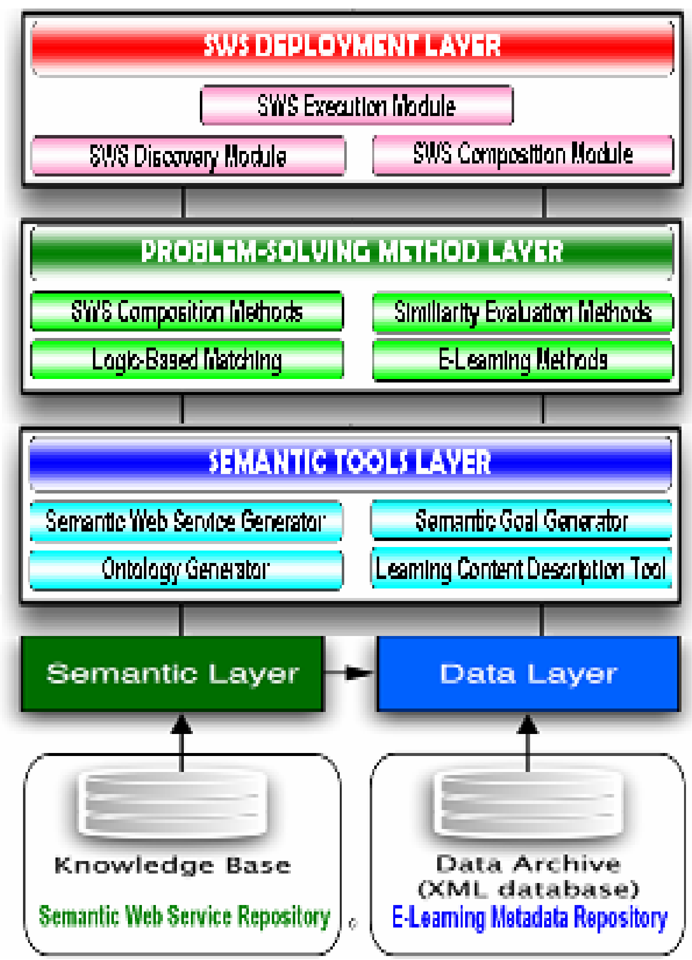


*Fig. 2* **The conceptual layered architecture of Semantic Web Service (SWS) E-Learning System**

The third layer, “Semantic Tools Layer”contains tools for creation and maintenance of resources, metadata and supporting ontologies: ”Semantic Web Service Generator” (creates Semantic Web Services (SWS) by reusing already existing semantic and non-semantic descriptions stored in the Semantic and Learning Metadata Repositories), “Ontology Generator” (creates ontologies in a user-friendly manner), “Semantic Goal Generator” (provides means for creation of reusable goals based Web Service Modeling Ontology-WSMO, used for designing of SWS-based eLearning applications and end-user goals), “Learning Content Description Tool (creates metadata annotation of multimedia and learning objects according to certain E-Learning standards and some formal ontologies).

The basic (fourth) layer contains Information Structures for storing and retrieving semantic and nonsemantic data: “Semantic Web Service Repository” (enables efficient storage and retrieval of all elements of the Semantic Web (WSMO objects): goals, ontologies and Semantic Web Services) and “E-Learning Metadata Repository”(contains annotated metadata about E-Learning Objects, used for grounding of Semantic Web services).

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# Enhanced Virtual E-Learning Environments Using Cloud Computing Architectures


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### Abstract

*This paper presents the essential information about the most complex software systems and platforms managing enhanced educational virtual spaces that can integrate adaptive hypermedia units, video-conference support, mobile devices, etc.. In the description of these modern e-learning technologies, their most important features are revealed, like communications across disciplines, collaboration and team capabilities based on Web infrastructure. These enhanced education services use shared cloud computing approaches or methods and provide an optimized e-learning management to generate creative and intelligent decision. The basic architectural concepts and principles are imported from grid computing and cloud computing systems (e.g. Microsoft Azure, IBM Smart Cloud, IBM Tivoli-Live Monitoring Infrastructure Services, IBM Computing on Demand (CoD)™"). World-class social networking services and online collaboration tools, including file sharing, Web conferencing, and instant messaging are described subsequently (e.g. IBM LotusLive™)".*



**Keywords**: Cloud Computing, Enhanced E-Learning Services, E-Learning Management Systems, Intelligent Virtual E-Learning Environments


## 1. Introduction

Cloud Computing technologies have changed the way applications are developed and accessed. More and more complex applications (e.g. word processors, spreadsheets, hypermedia presentations, database systems) are delivered as services over the Internet on a scalable infrastructure. All of them can be accessed from a web browser, while the software and files are hosted in the Cloud.

Clouds are developed to address Internet-scale computing problems where some assumptions are different from those of the Grids. Clouds are usually referred to as a large pool of computing and/or storage resources, which can be accessed via an abstract interface using standard protocols. Clouds can be built on top of many existing protocols such as Web Services (WSDL, SOAP), and some advanced Web 2.0 technologies such as REST, RSS, AJAX, etc.

Educational institutions can take advantage of Cloud applications to provide students and teachers with free or low-cost software environments. Browser-based applications are also accessible with a variety of computer and even mobile platforms, making these tools available anywhere the Internet can be accessed. This paper presents a Private Cloud Computing-based solution for the implementation of a virtual and personal learning environment using a wide range of technologies for science education.

**2. Defining Cloud Computing Paradigm**

The major providers in the field of Cloud Computing are *Google, Microsoft, Amazon, Yahoo, IBM and Intel*. Cloud Computing applications are mainly intended to help organisations, institutions and individuals to stretch resources and work smarter by moving everything to the Cloud.

One of the biggest promoters of the Cloud Computing is Google that already owns a massive computer infrastructure (the Cloud) where millions of people are connecting to. Today, the Google cloud can be accessed by *Google Apps* intended to be Software as a Service suite dedicated to information sharing and security. *Google Apps* covers the following three main areas*: messaging (Gmail, Calendar and Google Talk), collaboration (Google Docs, Video and Sites) and security (email security, encryption and archiving).*

Microsoft is developing a new Windows platform, called *Windows Azure*, which will be able to run cloud based applications.

Amazon extended its *AWS* (*Amazon Web Services*) suite with a new component called *Amazon Elastic Compute Cloud* (or EC2), that allows to the users to rent from Amazon processing power to be used to run their own applications. The EC2 users rent out from Amazon virtual machines that can be accessed remotely. The user can start, stop and create small, medium or large virtual machines through the web service, depending on the physical hardware performances.

One of the many possible definitions for Cloud Computing may be the following:

*Cloud Computing is a large-scale distributed computing paradigm, driven by economies of scale, in which a pool of abstracted, virtualized, dynamically-scalable and managed*

*– computing power,*
*– storage capabilities,*
*– software platforms and*
*– services*

*are delivered on demand to external customers over the Internet (Foster et al. 2009).*

The main characteristics of Cloud Computing as a specialized distributed computing paradigm are the following (Brunette and Mogull 2009):

*Scalability and elasticity*. Cloud resources can be dynamically ("on-demand") delivered in real-time on a fine-grained and self-service basis. Users are able to re-provision with technological infrastructure resources;

*Economies of scale*. Services are claimed to be free of charge or low cost even for hardware upgrades. Capital expenditure is converted to operational expenditure in a public cloud delivery model. The cost of licensing different software packages is moved to the data center level and there is no need to upgrade the local system when new service packs or patches are released. Also the infrastructure is centralized in low cost locations (such as real estate, electricity, etc.);

*Abstract entity*. The provider can encapsulate and deliver different levels of services to customers outside the Cloud. The services can be dynamically configured (via virtualization or other approaches) and delivered on demand.

*Accessibility to software* enables machines to interact with the Cloud software in the same way the user interface facilitates interaction between humans and computers. Users can reach the same result by using any Internet connected device having minimum software requirements. Cloud computing systems typically use REST-based API (Application Programming Interface).

*Device and location independence* enables users to access systems using a web browser regardless of their location or what device they are using (e.g., PC, mobile phone). Devices with minimal hardware requirements could be successfully used as cloud clients. As infrastructure is off-site (typically provided by a third-party) and accessed via the Internet, there is no need to download or install a specific software. Only the Internet connection is required, in order to become part of the Cloud.

*High reliability* is achieved because multiple redundant sites are used. In case of client computer crashes, almost no data are lost due to centralized storage into the multiple cloud resources. Thus well-designed cloud computing are suitable for business continuity and disaster recovery.

*Improved security* is achieved due to centralization of data, increased security-focused resources, etc. The complexity of security is greatly increased when data is distributed over a wider area or greater number of devices. Private cloud installations are in part motivated by users' desire to retain control over the infrastructure and to avoid losing control of certain sensitive data or lack of security for stored kernels.

*Improved efficiency and utilization* for under-used systems (only 10–20% often utilized). Increased peak-load capacity is achieved with no need to engineer for highest possible load-levels on the client side;

*Constant performance monitoring*. Most of the consistent and loosely coupled architectures are implemented using web services as the system interface.

*Maintenance* of cloud computing applications is easier, because they do not need to be installed on each user's computer. They are easier to support and to update, as the changes reach the clients instantly.

On the other side, few Cloud Computing disadvantages could be indentified:

- overall performances may be affected by the Internet connection transfer rate;
- data center subscription fee may be more expensive than the private hardware costs, on a long term basis;
- data security require a high level QoS (Quality of Service) management and the need for backups is critical.

Cloud computing systems are implemented and structured over 5 layers:

*1. Client Layer* may be any computer hardware device (e.g. regular PCs, notebooks, mobile phones, PDAs or any other similar equipment) and/or computer software application (operating systems, web browsers) that relies on cloud computing for application delivery and that is in essence useless without it.

*2. Software as a Service (SaaS)*. Cloud application layer deliver software as a service over the Internet, eliminating the need to install and run the application on the customer's own computers and simplifying maintenance and support. Software as a Service (SaaS) delivers special-purpose software that is remotely accessible by consumers through the Internet with a usage-based pricing model. Salesforce is an industry leader in providing online *CRM (Customer Relationship Management) Services*. *Live Mesh* from *Microsoft* allows files and folders to be shared and synchronized across multiple devices. Partial taxonomy: *Google App, Microsoft Dynamics CRM online, Microsoft Live@edu, Business Producivity Online Suite, Exchange Hosted Services, Microsoft Office Web Apps, CampusEAI, EducationERP.net, Campus Management, Jaspersoft, Coupa's e-Procuiement.*

*3. Platform as a Service (PaaS)*. Cloud platform services deliver a computing platform and/or solution stack as a service, often consuming cloud infrastructure and sustaining cloud applications. It facilitates deployment of applications without the cost and complexity of buying and managing the underlying hardware and software layers. The *Platform Layer* adds on a collection of specialized tools, middleware and services on top of the unified resources to provide a development and/or deployment platform. For instance, a Web hosting environment, a scheduling service, etc. *Platform as a Service (PaaS)* offers a high-level integrated environment to build, test, and deploy custom applications. Generally, developers will need to accept some restrictions on the type of software they can write in exchange for built-in application scalability. An example is *Google's App Engine*, which enables users to build Web applications on the same scalable systems that power Google applications. Partial taxonomy: *Google App Engine, Microsoft Azure Services, Amazon SimpleDB, Microsoft SDS, Oracle Higher Education Constituent Hub, Amazon SQS, Dynamsoft, Force.com, Microsoft Dynarnics CRM online.*

*4. Infrastructure as a Service (IaaS).* Cloud infrastructure services deliver computer infrastructure – typically a platform virtualization environment – as a service, along with raw (block) storage and networking. Clients can access these resources as a fully outsourced service. The amount of resources consumed (and therefore the cost) will typically reflect the level of utility computing activity. Infrastructure as a Service (IaaS) provisions hardware, software, and equipments to deliver software application environments with a resource usage-based pricing model. Infrastructure can scale up and down dynamically based on application resource needs. Typical examples are *Amazon EC2 (Elastic Cloud Computing) Service and S3 (Simple Storage Service*) where compute and storage infrastructures are open to public access with a utility pricing model. Eucalyptus is an open source Cloud implementation that provides a compatible interface to *Amazon's EC2*, and allows people to set up a Cloud infrastructure at premise and experiment prior to buying commercial services. Partial taxonomy: *EducationERP.net, Amazon S3-EBS- EC2, Eucalyptus, Microsoft, Oracle Coherence, Rackspace, RightScale, 3Tera App Logic, EnStratus, Flexiscale, GoGrid, CloudStatus, CampusEAI.*

*5. Server or Fabric Layer* contains the raw hardware resources, such as computing resources, storage resources and network resources. These computer hardware and/or computer software products are specifically designed for the delivery of cloud services, including multi-core processors, cloud-specific operating systems and combined offerings.

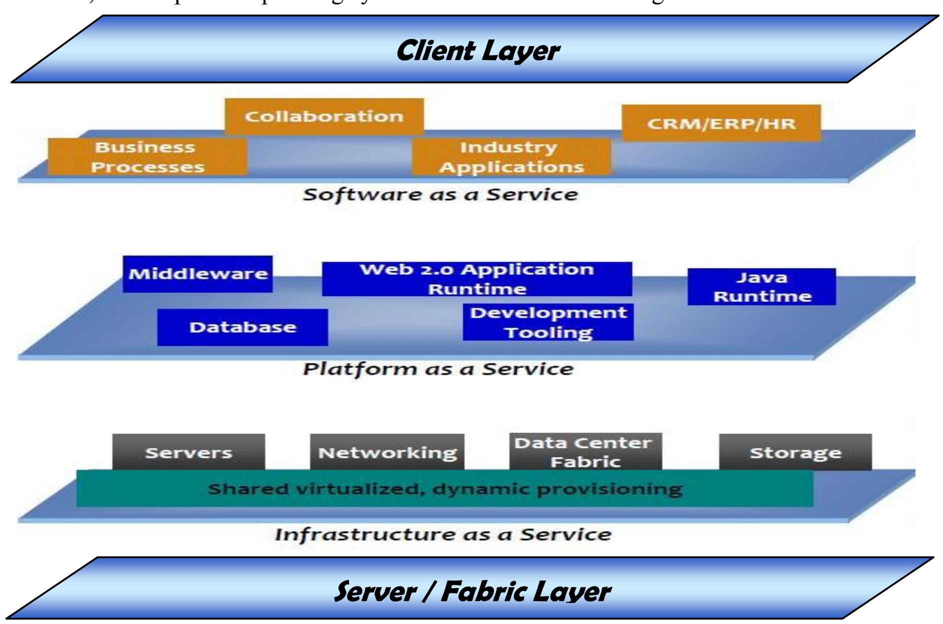


*Fig. 1* **Cloud Computing structuring layers**

The complete Cloud Computing taxonomy can be found in a technical report from Cloud Security Alliance Organisation (Brunette and Mogull 2009).

**3. Cloud Computing for E-learning**

The architectural pattern of Cloud Computing-based E-learning systems follows the layered structure of services (Saas, PaaS and IaaS) and abstract/virtualized resources offered by Cloud Computing (figure 2).

Studying the related work in this domain, one may found several interesting achievements and implementations. A brief analysis of these systems is presented here.

Several modern Cloud Computing-based e-Learning applications that can use IaaS for dynamic assignable storage and compute resources were proposed by (Dong et al. 2009a). They describe a general and simple architecture with monitoring, policy and provision modules.

*BlueSky* cloud framework (Dong et al. 2009b), developed by Xi'an Jiaotong University (China), enables physical machines to be virtualized and allocated on-demand for e-Learning systems. The BlueSky framework is focused on delivering IaaS and has some architectural layers dealing with physical resources, provisioning, monitoring and user interface but no security layer for user access policies.

*Virtual Computing Laboratory (VCL)* (Vouk et al. 2008), developed by North Carolina State University (USA), enables students to reserve and access virtual machines (VMs) with a basic image or specific applications environments, such as Matlab and Autodesk. VCL does not offer collaboration features, but offers (IaaS and PaaS) platforms which could be used to host collaboration systems (SaaS) on top of it.

*Snow Leopard Cloud* (Cayirci et al. 2009) provides PaaS for North Atlantic Treaty Organization (NATO) to run its various military exercises and mission events. In addition, *Snow Leopard* is used to run web 2.0 applications, such as video teleconferencing, voice over IP, and remote management, over handheld devices and terminals. As *Snow Leopard Cloud* is targeted towards military usage, it has a multi-level security and the network infrastructure is encrypted.

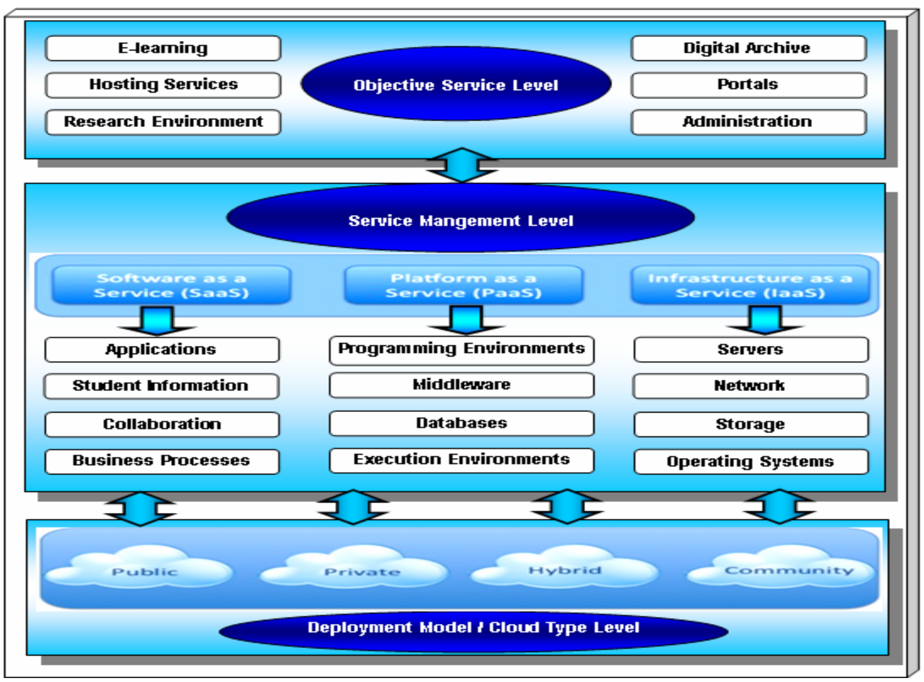


*Fig. 2* **Cloud Computing architectural levels for E-learning**

The *Google App Engine* provides a Java web framework. It is based on the servlet container Jetty and BigTable for data storage. Applications written for Google App Engine are scaled automatically by Google.

**4. Private Cloud Computing Architecture for E-learning**

The proposed private cloud architecture is implemented on top of an existing hardware infrastructure (figure 3). It consists of three computer pools (*PC Pool, Research Pool and Server Pool*), using separate IP subdomains within different locations of education institution. The PC Pool computers may use a Linux operating system (e.g. Ubuntu) and may have *KVM (Kernel-based Virtual Machine)* installed, whereas the other pools may have Debian OS and Xen configured. The PC and *Server* pools are used by students and staff for teaching purposes while, the *Research Pool* is used for research and development purposes.

The pools are managed by a *Cloud Management System (CMS),* as shown in figure 4. The *CMS* is divided into several layers for extensibility and maintainability, while *Monitoring, Management* and *Security* components are incorporated across all layers to ensure high reliability and secured services, as described in the following paragraphs:

– *User Interface Layer* provides various access points to users and/or administrators of the cloud system CMS.

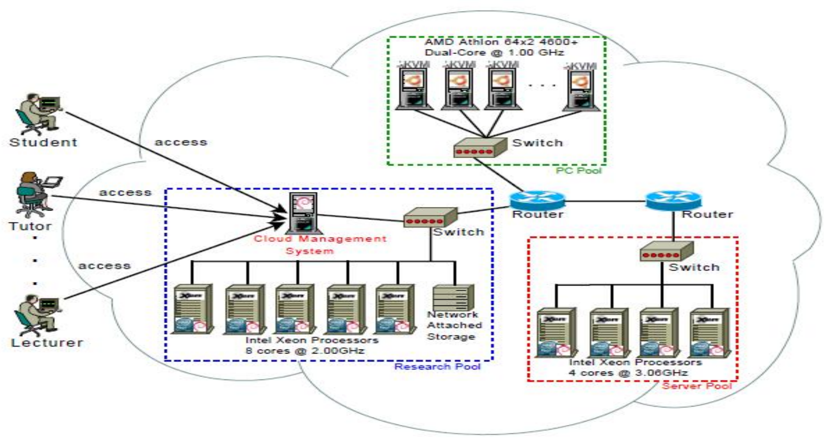


*Fig. 3* **Cloud Computing architecture for E-learning**

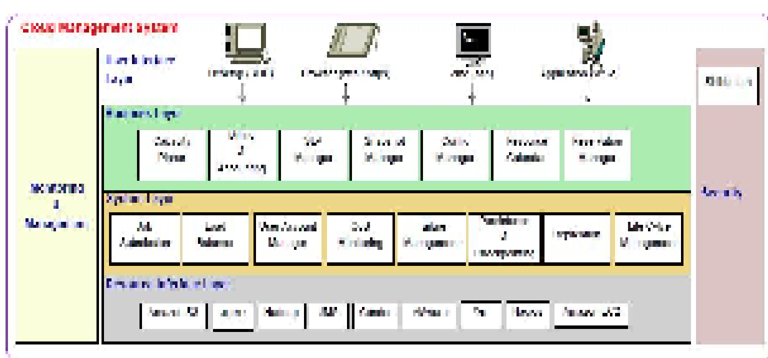

*Fig. 4* **Cloud Management System for E-learning**

– *Business Layer* regulates resource supply and demand to comply to economically use and Service-Level Agreements (SLA). This layer enables users to reserve VMs in advance and manage their personal VMs.

– *System Layer* monitors daily operations of the CMS, such as submitting jobs, managing user accounts and monitoring Quality of Service (QoS).

– *Resource Interface Layer* deals with the physical hardware. It provides interfaces and plug-ins to various virtualization, database and distributed systems as well as other technologies, such as Xen, Amazon EC2, Amazon S3, and Nagios.

– *Monitoring & Management Component* ensures the reliability of each layer in the cloud. This component allows system administrator to monitor and to initiate activities of each layer, in case of failures, conflicts with SLA objectives, under- or over-utilized resources.

– *Security Component* ensures the privacy, recovery, integrity and security of user data and transactions, on all system layers.

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# Learning environments in eBook format

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## Abstract

*Today the e-learning materials have more and more significance. At universities almost for all subjects there are websites containing the projected presentations in PPT or PDF format, and sometimes even the complete notes are available. At University of Debrecen at Faculty of Informatics we have began an experiment in which a total learning environment has been developed on TiddlyWiki basis. For each subject which is included in the experiment, there is an HTML file containing the notes, presentations, instructions and exercises. Students could add to these files their notes and solutions. The TiddlyWiki system has the advantage of the possibilities offered by hypertext: any information is one click away. By our opinion it is very uncomfortable to learn by reading the computer screen, so our plan is to convert this material to other file formats, which are suitable for eBook reader devices. We would like to do this on such way that we preserve the benefits of the TiddlyWiki and make the best of eBook reader options.*

**Keywords:** e-learning material, e-book, wiki

## 1. Introduction

If the student knows that he can get the book, the exercise book, handouts and the slides then he does not need to write down every words of the teacher to create usable notes, he will not make errors at copying long formulas or complicated pictures. Instead of writing he can listen carefully to the teacher and understand the material. Of course to distribute materials among students have disadvantages, too. If the student is lazy and knows, that he can get all the materials, he will omit lectures and if it possible the seminars, too. If he does not understand the first lectures, he will not understand the later ones, and will not pass the exam.

Recently only a few persons buy printed lexicons, almost everybody use on-line lexicons like Wikipedia, or get them on CDs or on DVDs. It is easier to type the search term and to get the answer within one second than turn over a lexicon to find some data. This is reason why the students like the e-material. A printed book could contain a table of contents, a table of figures, a glossary and an index, to find the information in a fast way. It is hard and boring for our students to find some definition, citation or a theorem in a printed book, or even in their handwritten notes.

It's becoming more and more common that a whole book is not interesting for us, only some part of it. We can read it at that point. We realize almost immediately, that it use some fact expressed before. So we try to find and understand it. Maybe that part refers to previous part, etc. In this case it is hard and takes long time to locate the suitable part and get back later.

A well-written e-material contains lot of link between referring parts. It helps to move between topics in very fast way. Maybe it is familiar for everybody, just look at Wikipedia, where is absolutely easy to browse between articles.

There is a big difference on reading printed or screen-based material (Liu, 2005). The in-depth reading belongs to the printed material; this is the reason why we would like to print every serious reading.

It is possible to combine the hypertext possibilities of e-material and in-depth reading of printed books, newspapers? By our opinion yes, and this would be profitable for students, too.

## 2. TiddlyWiki

We mentioned before the Wikipedia which is the most known wiki system. It says about himself: a wiki is a website that allows creation and editing any number of interlinked web pages via a web browser using a simplified marker language. There are hundreds of wiki systems, and most of them need a server, on which runs the wiki software. There are only a few exceptions, and one of them is the TiddlyWiki (Figure 1). Jeremy Ruston wrote this software which is nothing else but an ordinary HTML file. It contains several JavaScript programs, and this enable to use it as an ordinary wiki system: we can create and delete pages (called tiddler here), and can move between them. All the word written in blue is a link, and can be activated by clicking on it. The list on right in Figure 1 is generated automatically, and helps a lot both the author and the readers. At top right there is a search field, and if we type some word here, then we get all the articles containing this words. There is a grey field at top center containing tags. By clicking on it we get all the articles tagged with this word.

As we wrote before, we can use a simplified marking langue: e.g. we need to use explanation marks for headings, stars for ordered lists and hash marks for enumerated lists, similarly as we take notes. It is possible to use colors, tables, pictures, but in this case the notation not obvious, but easy to learn. All the rules are fit on a sheet of paper. We asked our students at University of Debrecen to submit their resume in this format, and they were able to do it.


*Figure 1.* **TiddlyWiki at** www.tiddlywiki.org.

On the internet we can find many TiddlyWiki files. One of the author uses it as a homepage, personal notebook and project management tool, as many else. We can find full course materials, presentations, and there is a small list about its usage at www.tiddlywiki.com/#Examples. One of the reason of this diversified usage, that is just a computer file, it can be copied anywhere and can be used with any web browser, even offline.

In the previous year we started an experiment (Aszalós, 2011). Besides the standard e-material: books in PDF, presentations and exercise books, we constructed TiddlyWiki files which contain all these materials. We take into considerations the students reading habits, hence we wrote short articles, not more than one page; and we added as many links as we could. We are teaching mathematics and informatics, so one article could contain a definition, a theorem with/without proof, an example, a solution, a remark. We created these files before the first lecture and promoted for students. Unfortunately we have not seen that any student bring his notebook for lecture and added comments to this file, even it was possible for him. We have no information what percent of them used it home at learning.

As everybody knows mathematical texts use special symbols. Some symbols – like the letters of the Greek alphabet – are included in set of the HTML entities, but not all. Hence for mathematical texts we need to install plug-ins and even special font files.

If someone prepares for an exam, then it is not recommended to do this at a computer screen. The LCD monitors are better than CRT ones, but not for all day. Nowadays there is an option to read e-material without LCD.

### 3. E-book readers

There is some misunderstanding around this concept. By Wikipedia any device can display text on a screen can act as e-book reader. But only device which uses the eye-friendly e-paper technology is the e-book reader.

Of course an e-book reader cannot replace an ordinary computer, you cannot see flash movies on it, it is uncomfortable to take notes on it (if it is possible) and you cannot do many things on it; but by our opinion unbeatable at in-depth reading.

An ordinary e-book reader knows several file formats. But to enjoy the possibilities of the devices we need to use some special formats. EPUB is a free and open e-book standard. This means that any developer can get the standard and could create software which saves our documents in this format. Unfortunately just commercial word processors are able to export in this format. We hope that in the future will be open ones, too. But this is not a big problem. The EPUB is based on XHMTL and XML. If somebody has some knowledge on authoring HTML without generators, he will able to produce EPUB books. Moreover several free projects aimed to produce software to convert DOC files to EPUB. It is possible to produce EPUB files by hand (Pang, 2010).

Our starting point was the TiddlyWiki, hence we took a different direction.

### 4. Technical details and discussion


*Figure 2.* **A TiddlyWiki article**.

Our aim was to write a program which converts any TiddlyWiki files to EPUB. As we wrote before any TiddlyWiki file contains the text of the articles (like in Figure 2), JavaScript programs and some auxiliary parts.

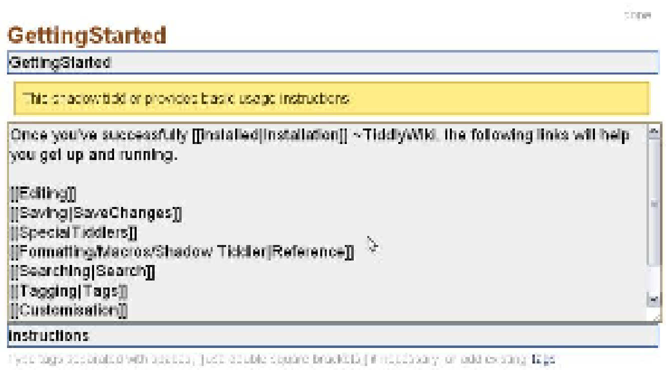


*Figure 3.* **Source of a TiddlyWiki article**.

These articles are stored in source form (as you see in Figure 3). Hence it is easy to edit, but we cannot insert this source into the EPUB source, we need to interpret it. There are some plug-ins to the TiddlyWiki to export articles even in HTML format, but we cannot install them due some incompatibility error between versions. Hence we had chosen a different method. We are interested in small software which processes the TiddlyWiki file and extracts the articles in HTML format.

Misfortunately there are many wiki formats, so there was a little chance that somebody has already solved this problem. We did not find anything, so we wrote a short AWK program. This programming language is rather old, but we got used to it, and it is planned for text processing. This program does not process all the notation of the TiddlyWiki. We had chosen a small subset, which is suitable for simple texts. Furthermore we had chosen a philosophical text (Figure 4) which does not contain special characters. This file can be treated a glossary, which defines the main concepts. The definitions are short, hence its e-book variant is a bit weird (Figure 5). We hope at longer texts it looks better.

At first we were thinking on Hungarian texts, but these use accented letters which would have complicated our program. But it is our ultimate aim to convert Hungarian texts.

Finally it turned out that this choice was not the best: many links were dead i.e. many articles were missing, and this caused warnings at compiling the book. So the reader would follow as take care about quality of the wiki.


*Figure 4.* **Skills for philosophy** http://reasoningwell.tiddlyspot.com/

Our software extracts each tiddler into an own HTML file. Now we use the title of the tiddler as the name of the file.

*Table 1. Source of one tiddler.*

```
<div tiddler="aesthetics" modifier="ESpringer" modified="200601051710" created="200601051710" tags="philosophy">inquiry into the immediate values of experience, including concepts such as beauty, taste, art, and the role of criticism in relation to these.
* Usage: //Several thinkers in the pragmatist school argued that logic and science ultimately depended upon an "aesthetic" appreciation of correctness and fit.//i
</div>
```

*Table 2. HTML variant of the tiddler.*

```
<html><body><h2>aesthetics</h2>
<p>Tags: philosophy</p>
inquiry into the immediate values of experience, including concepts such as beauty, taste, art, and the role of criticism in relation to these.
<ul> <li> Usage: <i>Several thinkers in the pragmatist school argued that logic and science ultimately depended upon an <b>aesthetic</b> appreciation of correctness and fit.</i></ul>
</div></body><html>
```

At a next version when we will use accented letters, we will need to use symbol tables to harmonize files and titles. During the extraction the program constructs the table of contents, and the NCX file. For the compiling a book we need an OPF file which describes the book's metadata, file manifest, and linear reading order. Of course usually there is no linear reading order at Wikis, but this is obligatory now. It is possible to generate some part of the OPF file, but the program cannot know the metadata, hence it needs some assistance.

Moreover Wikis can refer to remote pictures. In the case of an online browser we can see the picture. At offline case we cannot see it. We need to improve our program to create a local copy of such images and compile into the e-book.

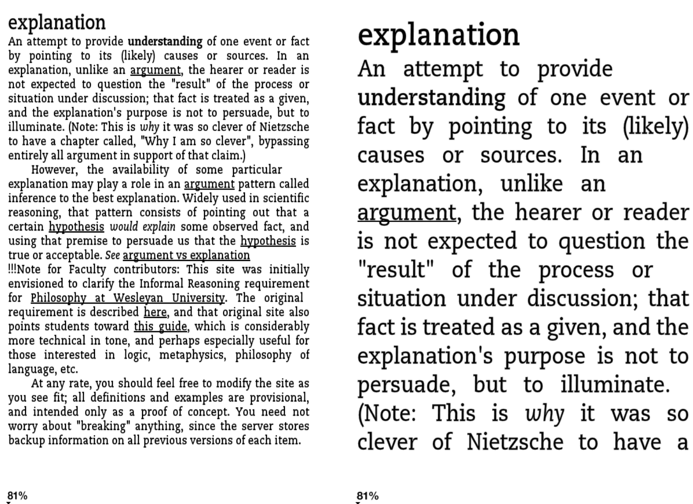


*Figure 5.* **Generated e-book and reflowable text.**

## 5. Conclusion

In this article we had shown a small program which converts TiddlyWiki files into some intermediate format suitable to generate EPUB files. This program is not complete, but usable. We are planning to implement the missing notations to create a widely usable software.

We tested our program on a file containing a glossary about philosophical terms. The original file referred to missing tiddlers. This was problematic for the compiler, so we need to find a general solution.

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# Web-based teaching of a Computer Graphics course in a Computer Science Faculty

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**Abstract**

*The paper summarizes the author's research, material selection, reevaluations, successive changes in topics, and some final results, after four years of the delivery at distance of a Computer Graphics course to undergraduate CS students at their 6th semester. In its final version, in a top-down attempt, this course is primarily focused on digital photography, discussing today digital photo devices as complex dedicated computing systems, and jointly discovering the photo transforms into the Web space, through the online photo-editors. In a virtual group, dedicated to this course, students are encouraged to discover the DSLR offers and shooting options, experimenting through taking new pictures, building (and sharing in the group) their own photo-albums at Picasa Web (PhotoBucket, or other similar Web2.0 photo-services). To understand the role and potential of the usual photo-transforms, different online photo-editors, like Picnick, or Photoshop.com are considered, and used as CG virtual laboratories. Comparing them with locally installed powerful graphics editors, like GIMP, Inkscape, or Adobe Photoshop.*

**Keywords**: Computer graphics, Digital photography, Image Processing, Online graphic tools

## 1. Introduction

After the Bologna style changes, in the Computer Science Faculty, an introductory course in Computer Graphics arrived in the last semester, just before student graduation. Usually, such a course in computer graphics include different fields like Presentations, Charting, Drawing - Painting and Design, Image Codification, eventually introduction in Image Processing, 3D Representation and Scientific Visualization, Fractal Geometry, Desktop Mapping and GIS, with Subroutine Libraries for Graphics, and a lot of mathematical stuff. There are also some attempts especially oriented to graphic programming (with C, OpenGL, Java, or Processing programming languages)

"How to teach a Computer Graphics course" is the subject of different ACM Special Interest Group for Computer Graphics (SIGGRAPH)' studies [2-6]. For the first time the questions of delivering at distance a CG course appeared in 2005 [7]. The paper resumes the teaching ideas, experiences and result of such a computer graphics course delivery.

First of all, a DE course for students in Computer Science must be Web-based. With author' experience, a dedicated virtual group, a well organized Google-group was used. Course description and materials available also into the already used LMS (MOODLE) platform. But as local LMS configuration don't assure enough interactivity (with course forum), nor graphics editors, nor proper space for image visualization, we take the googlegroup sollution combined with Web2.0 tools.

The first reports regarding this subject were already presented at eLSE-2010 [13], and REV-2011 [14].

In the last four years, the author' attempt in teaching this CG course to the students of CS Faculty continuously changed, arriving finally more to a Digital Photography course, using the online photo editing tools available on the Web. This way, the students active participation grows, as they generally like this direction, daily using their own photo-devices, organizing own digital photo-albums, etc.

The resulted CG course being not only a DE one, but a Web-based, using adequate Web tools for photo-albums publishing, and for picture improvement or transform.

Such a topic being attractive for students, as they are more-or-less oriented to digital movies and pictures from the Web. The course topics was limited to some Web 2.0 specific learning and imaging tools, escaping the usual connections with geometric representations, as well the differences between specific applications from different computing platforms (with all difficulties connected with commercial licenses of the most frequently used graphic tools, like Adobe Photoshop, or Corell Draw). From the pedagogic point of view, the author' option was for collaborative informal learning, in a top-down approach; using online teaching techniques oriented towards authenticity [8].

**The CG Course Description and Materials**

The course description files were initially loaded into the special configured virtual group http://groups.google.com/group/grafica-uvvg, but moved last January to GoogleDocs (and sharing with grafica-uvvg@googlegroups.com). These are html and pdf files in Romanian language, including prerequisites, general topics, organization and role of such a curse, main references – basic bibliography, suggested subjects and supplementary papers for projects, evaluation rules, auto-evaluation questions, course notes, guides, and other useful texts, etc.

**The On-line Photo-Editing Tools as a Kind of Virtual Laboratories**

Since the beginning of 2006-7, appeared some Ajax-based editing tools like the *Picture2Life* <http://www.picture2life.com/>, PXN8, or Snipshot, or Flash-based tools like Fausto and Picnik. All presented in a short Web guide "Online Photo Editing Overview" by Michael Arrington' (February 2007), maybe the first one in this field, http://techcrunch.com/ 2007/02/04/online-photo-editing-overview/ .

Since than the offer of the online image editors grows, with appearance of more W3C compatible tools running on machines without Flash installed, like Phixr, Pixenate, LunaPic or Snipshot. Also growing the offer of advanced online photo-editors taking advantage of Adobe's Flash platform, like Picnik, Phoenix, Flauntr, Splashup, FotoFlexer (http://fotoflexer.com). Picnik (http://www.picnik.com) is a powerful photo editing tool directly connected with the photo-albums applications like Flickr, Picasa Web, Facebook, Photobucket... Also it is possible (and quite simple) to install it into the Chromium Browser. As it is written in his entry page, Picnik "fix your photos in just one click". Between simple and usual operations like the Crop, Resize, or Rotate of the picture, Picnik includes also an usefull photo-correction tool - the *Exposure* transform.

Pixlr (http://pixlr.com), another advanced online editor, build with Adobe Flash 10, has the main advantage of an extension with a powerfull and friendly editor (http://pixlr.com/editor) having a well localized interface, in Romanian language too.

There is also an online version of the well known (and expensive) Adobe Photoshop – called Photoshop.com (www.photoshop.com), including a lot of useful Photoshop picture editing powerful instruments, and a Romanian user interface, too.

Some of online photo editors are asking for an user account, other accept photo loading and editing as a guest, without the login procedure.

Also, a lot of other online photo editing tools are simple transform oriented for funny; examples include PiZap (http://www.pizap.com), FunnyPhoto (http://funny.pho.to) or FunPhotoBox (http://www.funphotobox.com).

The growing offer of such tools could be visible with a Web search for "Online photo editing tools", finding also different top-tens classifications, like Josh Lowensohn' 2009 CNET study "15 online photo editors compared", http://news.cnet.com/ 8301-17939_109-10170333-2.html , or "17

Best Online Photo Editing Tools Compared" http://webification.com/best-online-photo-editing-tools, until a recent list of fifty [12].

Consequently, there are enough online image editing tools, free available through a browser (with, or without Adobe Flash installed), a lot online resources able to be successfully used for a computer graphics course and laboratory, or to integrate into your teaching [9].

## 2. The course delivery

Taking into account the author' previous experience from other courses, and following the idea that today DE courses must be Web-based, the adopted solution uses a dedicated virtual group (i.e. a well organized Web-based virtual group).

Why not a traditional Virtual Learning Environment, a Course Management System, like MOODLE? Because, in author' opinion, such a virtual group better stimulates the continuous communication between students and teaching staff, without the usual divide, reducing the status differences between student and tutor/teacher. Especially as a preference for the open Web, without the LMS complexity and restrictions, giving the autonomy to deliver course content, and following Matthew Allen "*Students appreciate difference: constantly using the same, standard LMS can be repetitive and dull – changing it up with tasks and activities involving knowledge-networking applications improves motivation and attention, making learning more engaging*" [http://www.knowledgenetworklearning.net/practicalities/lmsvle/ ]; i.e. not all online learning requires a LMS !

A private (un-listed) group at Googlegroup had been configured, associated to the Computer Graphics online course; i.e. a virtual group were members must be invited by owner, and only members can post, and receive messages, only members can view/read group content (the Google Docs files shared with the group).

For all registered students the group is available as an URL: http://groups.google.com/group/grafica-uvvg/, as well as the email address grafica-uvvg@googlegroups.com .

With such a group, the members have all the benefits of Google Docs, Google-Books, Google-Sites and Picasa Web services for sharing documents, Web stuff, and references. It is a Web2.0 environment with enough memory space.

Last years, until January 2011, each group member was able (and asked) to load files (own projects or other resources as documents, images, html files), with a limitation to the overall group space. But the Google team changed recently this service, limiting groups to email communications.

Consequently, into the last semester all course presentations and materials, as well as student' work, have been uploaded at the user Google Docs account, with images and photo-albums loaded and organized into corresponding Picasa Web accounts. Those files access being assured through a sharing procedure based on the group email address.

### Four Years of the CG Course Online Delivery

At 2011 first semester, this CG course has been taught online for the fourth time, including the last years ideas and previous accumulated best practice [13]. As each student own at least a photo-device, even a mobile phone incorporating a photo device, such a course orientation is well received, helping them to improve their abilities in taking photos. Already it is a good occasion to analyze the digital photo device as a complex dedicated computing system, to understand the multiple options available, usual hard & soft components, possible commands, basic operations and successive steps to follow to receive a good image file.

Within the laboratories student have learned how to create, upload photos, and organize photo-albums (at Picasa Web, Photobucket, Shutterfly, or Flickr), giving them a platform (into the virtual group) to discuss their results, and helping them to correct or transform their photos, understanding image file formats, image histograms, layers philosophy, with all stuff of picture manipulation on the Web. Students have been asked to organize their own photo albums at Picasa Web, to share its with all group members, writing adequate comments or explanation, understanding and interpreting the meta-data included inside the photo file. For such goals they need to take photos, to select images, to improve somehow, or to combine - transform their photos using one of the available (online, or locally installed) graphic editors. Especially they have been asked to explain, in all details, their editing intention, all the steps done, and the conclusions regarding resulting images.

Continuous effort has been done by the tutor to convince students to follow all these steps. As well to stimulate student' critical opinion, to help them to properly comment their colleague works, to look carefully at the photo meta-information, to understand better the photo realization, with corresponding plus and minus, to find and discuss the proper image transformation for a given result.

The student interest for such a topic, and their participation may be illustrated through the great number of messages in the group (Table 1). The most active students counted 287, 93, 74, 67, and 63 messages, respectively. Of course, there are some uncommunicative (silent) students, too. But the student' real participation is measured by student photo-albums, including interesting picture transforms, presenting new graphic tools, and so on. As well counted by mature comments, interesting resources, examples, or good questions. There where students who buildup tens photo albums, with hundreds of photos into their Picasa Web accounts. Some of then discovering such a facility, loaded their old photo albums for public access, too; or modifying images with selected online editors. A real competition started to take photos with different Spring flowers, or different landscapes.

As an indirect result, a photo exhibition with student best images has been organized with the occasion of University days, receiving a good feedback and growing the course overall attraction. The photos selection being done through a group debate.

*Table 1.* **The number of messages per month (total - 3390 messages)**

| | I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2008 | - | 3 | 57 | 103 | 190 | 110 | 52 | 2 | 15 | 2 | 6 | 3 |
| 2009 | 3 | 10 | 88 | 116 | 221 | 14 | 1 | 2 | 2 | 12 | 7 | 1 |
| 2010 | - | - | 248 | 293 | 671 | 314 | 15 | 13 | 33 | 1 | 14 | 1 |
| 2011 | 4 | 29 | 209 | 166 | 327 | 21 | - | - | - | - | - | - |

*Table 2.* **Tutor' Posting Activity (total 756 messages)**

| | I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2008 | - | 8 | 31 | 39 | 52 | 23 | 10 | - | 4 | 2 | 2 | - |
| 2009 | 1 | 1 | 30 | 45 | 61 | 7 | - | 1 | 1 | 7 | 1 | - |
| 2010 | - | - | 54 | 61 | 83 | 31 | 6 | - | 15 | 1 | 5 | - |
| 2011 | 1 | 8 | 46 | 39 | 73 | 3 | - | - | - | - | - | - |

There were 186 student messages after exams, with new questions or interesting news. Also 14 graduate students asked to maintain their group memberships. The most active students organized and reported dozens of interesting photo-albums, including different image combinations (collage, HDR composition, panoramas). Even comparative studies between different photo-editors on the same image transformation task.

**Previous Results and Student Acceptance**

Until now, statistically, student seams to be very interested in this topics, and they generally like to learn how to take better photos, how to improve photos, or how to transform a picture writing a title in it, or including authors signature, changing the contrast, luminosity or colors, eliminating or changing an object from the image, or other much more complicated transforms. They generally like such tricks combinations and are happy to discover tools giving them the chance to combine or to build strange images, trick photos, fictions, or images like into the virtual reality.

The fine and complex transformations as HDR imaging, or the panoramic construct, received high student interest. Also some students are discovering the beauty of landscape photography, or the challenge of taking images of the sky.

Such overall attempt isn't simple, asking an important dedication from the tutor. As a very short proof, through the discussed period (February 2008, August 2011) the author sent near 750 messages (Table 2), from a total of 3390 messages (Table 1), grouped in 1134 subjects.

At the final part of the course other provocative topics were discussed, covering the introductory chapters regarding the image classification and analysis through their content, as well as the transform of a photo into a painting through the corresponding file conversion from the pixels' matrix (raster image) into a geometric description as a scalable vector graphics image; with a short insight into the fractal imagery, too. As well, other applications, like aerial and satellite imagery, with all actual GIS and GPS applications, together with specific ones like Google-Maps, Google-street-view, Panoramio, have been discussed, giving them an insight about the domain complexity.

**The Student' Projects**

It is really difficult to select few example between the best student' projects. The following ones reflecting the student abilities, as well there creativity. While in the first example the change of the original photo is quite natural, taking off the cables, in the second project it was the student own idea, like a challenge to "build" a violin with 6 cords from a normal one.

*Fig.1*. **The original image – project starting point**

*Fig. 2*. **The cables are already removed**

*Fig.3*. **A new kind of violin - a graphical student project**

**Conclusions**

The students acceptance of this kind of learning way seams to be high, comparing the student activities into the Graphics group with all other courses delivered by the author in a similar way. Last year results count hundreds of photo-albums with more than a thousand of pictures, and there were students with dozens of different image transforms, and more than hundred of messages and comments to the group. A big challenge for the tutor- professor.

The student interest and enthusiasm could be observed through their group participation after the graduation.

About one-third of the previous year students ask for permission to remain as group members, to be able to learn more, to bring news. Consequently, their group participation gave a plus, helping the tutor with their prompt comments.

Generally the students attraction to digital photographies seams to be remarkable. Involving as well some effort to stimulate their imagination and creativity, together with their curiosity regarding device performances, and possible changes of final images.

A common preference for the use of so called “online graphic editors for fun” must be noted.

Some students succeeded to prepare useful users' guides illustrated with their own photos; other students succeeded to do interesting comparison of different online editors, even between online ones, and a locally installed graphic editor.

The group discussions seams to mobilize good students to the discovery of imaging universe.

There were, of course some difficulties with understanding of recommended English materials (texts, guides), and also in comments of other' work.

Finally, the students response was unexpectedly high, as direct online participation, as well as in the quality of their own work/projects.

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# Student's attitudes towards learning in educational environment

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**Abstract**

*The main issue of the European higher education space is to prepare students for labour market, make them able to acquire further qualifications and to continue their education. However, the curriculum restructuring has developed consumerist mechanisms which on the surface seems to offers students greater choice and control over their learning. This could result in a loss of responsibility for their learning, little tolerance for the expansion of study beyond the routine of the predictable and consequently affect their disposition and motivation towards learning. The present study aims to explore the student motivation and approval of the educational environment. The Learning Orientation Questionnaire (LOQ) as an assessment instrument to reveal the dominant power of emotions and intentions in guiding and managing cognitive processes and identifying conative processes specific to learning settings, was used. The results show that students don't seem to be ready to assume a leading role in their learning and motivation. Students generally perceive the ideal learning environment to imply a less hierarchical relation and more interaction between teachers and students.*

**Keywords**: Higher Education, Motivation towards Learning, Learning Orientation

## 1. Introduction

Today's students live in a world of change-climatic, economic, educational, political, and social change. They are competing and collaborating in an emerging third era of a global knowledge economy (Friedman, 2005). Thereof, there is an urgent need to adjust the curriculum to create a more contemporary sphere of learning that features quality assurance, social access, transparency, mobility, and recognition of qualifications. Like other consumers, students, hold unique perspectives of what constitutes quality and must be able to distinguish between "receiving a diploma" and "receiving a quality education" (Freeman, 1997). Therefore, the perception and experience of the educational process and environment by the students is an important issue to be addressed to accomplish their expectations. Accordingly, all social institutions and all individuals whose existence depends upon higher education institutions, have to possess the ability to improve themselves and undertake lifelong learning, because learning is the key to better performance (Vakkayil, 2008).

Nevertheless, there has been a tendency in the field of pedagogy to put a stronger emphasis on learning in recent years. Priority is to be given to a combination of teaching methods involving a high level of student activity, new forms of assessment and regular feedback that promotes learning (Karseth, 2006). Some academics and students fear that the compressed nature of new programmes does not allow enough time to develop a critical and reflective approach to the materials presented and generally does not foster an independent mind. There were frequent comments that efficiency, time management and completion in due time are now playing a greater role, while academic curiosity and intellectual development have become less important.

There is a considerable amount of research on the effects of attitudes toward learning on students' behaviours. Positive attitudes toward any subject are frequently found to enhance the students' interest in the subject and their motivation to learn. Successful learners are enthusiastic, exhibit confident attitudes toward learning, have positive expectations and do not experience anxiety about learning (Braten and Stromso, 2006; Duarte, 2007). Students' belief in acquiring information was seen to trigger learning (Saade 2007; Pierce et al, 2007). Students were also observed to be more eager to solve problems, to acquire the information and skills useful for daily life and to engage themselves emotionally, thereby meting the requirements of the courses in terms of behaviours, emotions and psychomotor skills (Yang and Lau, 2003; Scheiter and Gerjets, 2007; Yudko et al, 2007; Tsai and Kuo, 2008).

## 2. Learning orientation

The increasingly rapid technology changes are creating skill shortages and revealing that our learners are not prepared to learn smart, fast, and well enough to manage change successfully or initiate change productively (Martinez, 2001). Some learners have strong beliefs about learning and like to work hard, set high standards, achieve lofty goals, take risks, and use their initiative to discover and apply new information. In contrast, many learners remain satisfied with less effort, comfortable standards, highly structured environments, and easily attained goals, and certainly some learners generally or situationally resist learning.

In particular, the affective and behavioural components, and their potential relationship to the cognitive components of students' goals, have been largely ignored. For this reason, the potential multi-dimensional structure of students' goals should be explored further. In addition to the above, several authors (Blumenfeld, 1992; Lemos, 1996; Covington, 2000; Bempechat and Boulay, 2001) have identified the need to more systematically investigate students' goals, particularly in real life and classroom contexts. Students' motivation should be conceptualised as a process of managing multiple goals, which may interact in conflicting, converging, or compensating ways. For this reason, students motivational orientations in the classroom settings may comprise a much more complex and dynamic system of goals than has been acknowledge in the literature. Interventions based on a more complex understanding of students' motivational goals may be maximally useful to practitioners, as they seek to positively influence students' achievement strivings.

In recent years, Elliot and his colleagues developed a trichotomous model that draws from the approach and avoidance motivation theory (Elliot, 1999; Elliot and Thrash, 2001). They argued that the distinction between approach and avoidance motivation is critical and fundamental to the study of human behaviour, affect, and cognition. The model posits three types of achievement goals: performance-approach goals (the attainment of favourable judgments of competence), performance-avoidance goals (the avoidance of unfavourable judgments of competence), and mastery goals (the development of competence and mastering tasks). Both mastery and performance-approach goals are considered approach orientations because they represent regulation according to positive potential outcome such as persistence/effort while studying, absorption during task engagement, and challenge construal. The performance-avoidance goals are considered avoidance orientations because they represent regulation according to negative potential outcomes such as low absorption during task engagement, decreased intrinsic motivation, and poor performance.

One of the critical developmental tasks that students face in college is to identify and solidify their interests as they select courses, choose their academic major, and make decisions about career paths. Students' achievement goals may play an important role in shaping academic motivation and interest because they reflect the purpose of achievement behaviour in a particular setting, and can influence how a student approaches coursework (Nicholls, 1984; Dweck and Leggett, 1988). The questions why do some students become involved and interested in their coursework and why they continue in a particular academic discipline, as well as, do students learn more and perform better in their classes when they are interested, highlight the importance of interest in college education (Harackiewicz et al, 1998; Hidi and Harackiewicz, 2000; Hidi and Renninger, 2006). A variety of studies have shown that different goal orientations determine students' cognitive and behavioural reactions as well as their educational performance (Ames, 1992; Ames and Archer, 1988; Valle et al., 2003).

The learning orientation construct describes, from a whole-person perspective, the dynamic flow between: deep-seated psychological factors (conative, affective, social, and cognitive factors); learning orientation; subsequent choices about learning, including cognitive learning preferences, styles, strategies, and skills; responses to different treatments and solutions; intended learning outcomes; and progressive or regenerative efforts toward improved learning performance. The intentional learning theory defines successful learning as a continuous, regenerative human process that supports intentional, discriminating management and use of intrinsic and extrinsic resources for meeting challenging goals, building new knowledge, acquiring new skills, and improving strategies, abilities, and performance. Successful learning is a satisfying, self-fulfilling, transformative experience. Less successful learners constrain the learning process by allowing psychological and extrinsic influences to limit beneficial outcomes. In addition to the more commonly researched cognitive and social factors, key conative and affective factors, such as passion, intentions, emotions, aspirations, and desire for autonomy or learner control, play a significant role in explanations on how we learn.

The area of conation is slowly gaining recognition as an important influence on learning and is no longer demoted to a secondary role in the process. Research conducted by Martinez (1999) suggests that there is a way to determine a more stable predictor of individual difference than by using cognitive measures alone. Her work on conative and affective measures suggests that recognizing the dominant influence of emotions and intentions on learning is a primary factor in understanding why individuals learn differently and how they develop, manage, and use cognitive ability. In other words, it is the emotional response that drives learners as they try to navigate a course, acquire new skills and knowledge, or improve performance.

If educators and administrators want to improve the academic experience of college students, understanding the potential factors that enhance motivational strivings should therefore be of primary concern.

**3. Current study**

The present study aims to explore the student motivation and approval of the educational environment at the Faculty of Transport and Traffic Engineering in Belgrade. The pilot study included 50 undergraduates, between the ages of 18 and 22.

Instrument used in this study is the 25-question Learning Orientation Questionnaire (LOQ) with a seven rating point Likert scale (1 = Not At All True of Me and 7 = Very True of Me) to measure the dimensions that underlie the Learning Orientation Construct (Martinez, 2000). LOQ was designed as an assessment instrument to reveal the dominant power of emotions and intentions in guiding and managing cognitive processes. The questionnaire was administered in paper-and-pencil format and individuals were asked to respond to items about the occurrence of particular behaviours, thoughts, and feelings. Subjects were asked to voluntarily participate in a study. Assurances were made that all data collected would be kept confidential and their responses would in no way affect their class grades.

**4. Results**

The results show that most of our students often carefully plan out learning goals, strategies, and expected outcomes before beginning a learning task (Fig.1). Their abilities to monitor their own progress to help them manage and improve their learning and professional performance were vague (Fig.2). The majority of students were uncommitted with regard to setting risky or challenging learning goals, believing that they, not the instructor can show the best way to evaluate achievement of learning goals, and that the instructors failed in planning the best learning approach for accomplishing training objectives (Fig.3).

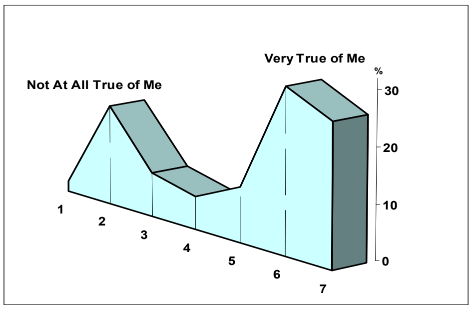


*Figure 1.* **"I carefully plan out my learning goals, strategies, and expected outcomes before I do a learning task"**

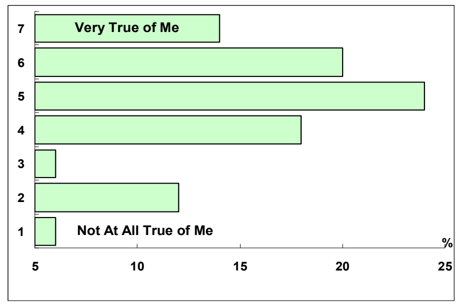


*Figure 2.* **"Monitoring my own progress helps me manage and improve my learning and professional performance"**

Learning about new topics does appear to be an enjoyable and comfortable process for half of the participants (Fig.4).

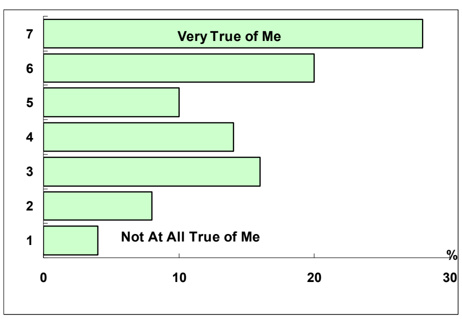


*Figure 3.* **"I rely on myself (not the instructor) to judge if I am not doing well in a course"**

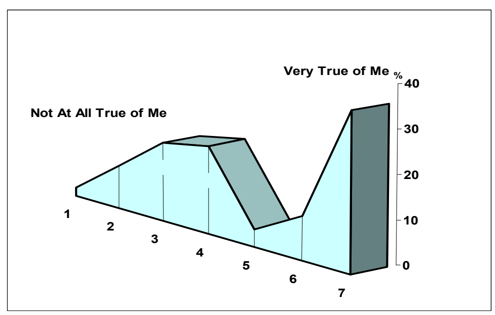


*Figure 4.* **"When I learn about new topics, it is not an enjoyable or comfortable process"**

26 % of the participants avoid, and 20 % show a tendency to avoid learning situations if possible, while 20 % were uncommitted regarding this question, reflecting our students' learning orientation (Fig.5)10 % students didn't show differentiated attitude, while 23% don't like to learn, and 9% like to learn and feel comfortable learning for any reason (Fig 6.).

But surprisingly, at the end of a course the majority of them assess their progress to determine how to improve their learning ability. This response indicates the importance of feedback on learning outcomes and interaction between students and the instructor.

A large number of students do believe that learning can help to achieve challenging personal goals, improve the quality of life, help to accomplish professional learning goals beyond stated course objectives (Fig. 7).

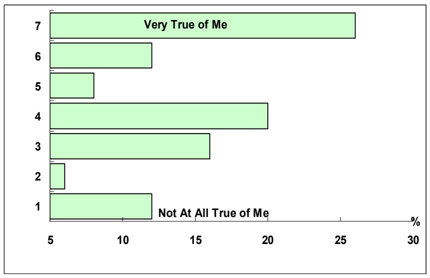


*Figure 5.* **"I avoid learning situations if I can"**

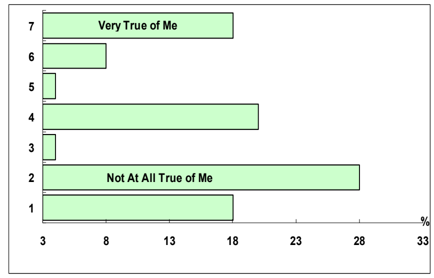


*Figure 6.* **"I like to learn and feel comfortable learning for any reason"**

Upon the question that learning provide enjoyment while exploring new topics to help achieve personal learning goals, the equal number of participants considered this statement either characteristic or very uncharacteristic of them.

The majority of students are not seeking new learning opportunities because they enjoy learning, not relying on the instructor to monitor and evaluate how well they learn, relying on themselves. When it comes to the choice to seek and use supplemental information helping in learning more about new topics, two separate groups of students appear (motivated and demotivated) (Fig. 8), but most of the participants know that if they want to do well on a course, they will, which indicates that if there is a will to achieve something that will be achieved.

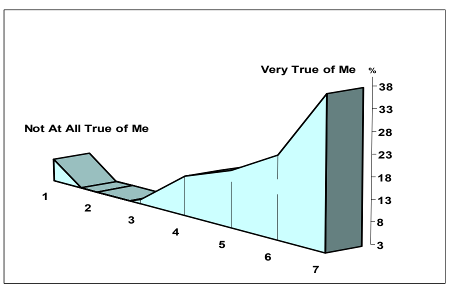


*Figure 7.* **"I use learning to improve the quality of my life"**

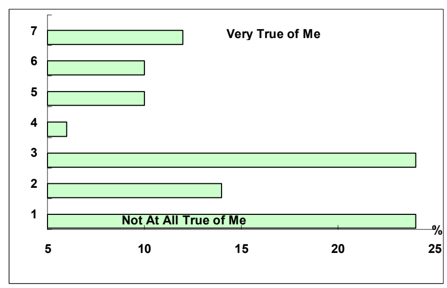


*Figure 8.* **"I seek and use supplemental information that helps me learn more about new topics**

On the questions dealt with issues concerning pushing beyond the goals expected by the instructor to accomplish personal learning goals the students choose extreme alternatives, either 1 of 7. There are confusing answers on whether personal or educational learning goals have priority over the instructor's objectives, and who they rely to judge if they are doing well in a course, while the majority learn best if they personally manage their learning goals, strategies, and tasks (Fig.9).

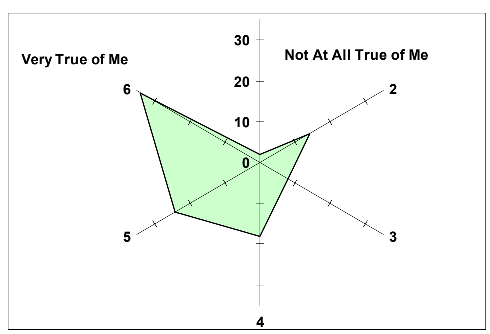


*Figure 9.* **"I learn best by personally managing my learning goals, strategies, and tasks"**

Students who are involved more actively in the teaching and learning process and who receive and give a greater amount of feedback are more secure and assertive in transmitting academic content. The study finds that students generally perceive the ideal learning environment to imply a less hierarchical relation between teachers and students. These conclusions seem to denote what students perceive as improvement in higher education learning, this being more information, more consultation and more involvement.

## 5. Discussion and conclusions

Students, in general, don't seem to be ready to assume a leading role in their learning and motivation. The intensity of an individual's motivation will trigger him or her to execute good or bad learning strategies. Both motivation and learning strategies affect student's learning performance. Students' beliefs interact with the learning environment to influence motivation and cognition. Those who believed that learning occurred quickly or not at all were more likely to have fewer problems in searching for information or evaluation than the students who believed learning requiring both time and effort. In the new knowledge economy, students must be able to distinguish between "receiving a diploma" and "receiving a quality education." Students' emotions, interest and beliefs about learning affected their behaviours. Positive attitudes led to the exhibition of positive behaviours toward courses of study, with participants absorbing themselves in courses and striving to learn more.

The questionnaire used in this study was found to focus primarily on identifying conative processes specific to learning and teaching settings. Additional studies built on this research will be able to ask more probing questions while strengthening the case for validity of the LOQ. Its use can take us one step further in finding new ways to assess individual differences in learning. Based on this knowledge, those who understand the intentional learning construct claim to be able to tailor learning treatments to that which an individual can most easily adapt.

## Acknowledgement

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# A Novel Architecture for Content Recommendation in E-learning Environments Based on K-Means Clustering & Association Rule Mining

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## Abstract

*Grouping e-learners based on their model in the e-learning environment is a key issue to build a personalized learning system. Recommender Systems can be useful to recommend learning resources or any other supportive advices to the learners. These systems could be used to suggest the contents being interested for learners in an e-learning environment. Different kind of algorithms such as user-based and item-based collaborative filtering have been used to establish a recommender system. In this paper, an innovative architecture for a recommender system (AELTRec) dedicated to the e-learning environments is introduced. This architecture simultaneously takes advantages of K-Means clustering technique and association rule mining. We first build a learner model based on PAPI learner model, which is the basis of learner grouping. Furthermore, K-Means is used to cluster the e-learner types. When groups of related interests have been established, the association rule mining techniques will be used to elicit the rules of the best content for each learner. Based on e-Learner groups, users can obtain content recommendation from the group's opinions. It was expected that the proposed architecture has excellent performance.*

**Keywords**: Personalization, Recommender Systems, Clustering Techniques, Association Rule Mining, E-learning

### Introduction

In e-learning environments, presenting appropriate contents for each section of a course is an effective way for personalization of learning objects and improvement of learning. Therefore, recommendation of learning contents suitable for each section of a specific course has a significant role in improvement of learner's functionalities.

### Motivation and Necessity

The main goal of suggesting this architecture is an implication of a recommender system to recommend suitable learning resources for each section of a course.

It is obvious that exploiting this system in e-learning environment has major effect on improving learner's performance. Because, if it is possible to help learners to utilize appropriate learning materials in its learning process it can improve learning progress in this process.

### The Paper Content

Moreover, in this paper, at the very beginning in section 2, related works regarding to paper's title are briefly discussed. After that, in section 3, the basic concepts such as clustering, association rules mining and recommender system are reviewed. Following that, in section 4, the proposing architecture with detail description of the components and their functionalities are offered. At last, in fifth section, we summarize the obtained results of this research and consider future works which are appropriate in this area.

**Related works**

Offering a solution related to e-learning is different from other domains. (The most domains which are studied in recommender systems are presenting recommendations related to movies.) Special issues for a recommender system in e-learning are as follows (Zhang Kun et al, 2007):

Items where are interested by learners, might not be usable for them. In compare with other conditions, suggestions are made according to learners' preferences.

Personalization should not be solely related to select learning items; rather it should consider their deliveries.

In overall, the general work process in recommender systems is as first to retrieve a series of entered data and information. Hence using different techniques are processed and finally results, which are the recommendations, are shown.

In Table 1, these three phases are analyzed and compared with the proposed method in this paper.

Table 3. **Comparing three main phases in recommender systems with the proposed method**

| | **Information Receipt** | **Information Process** | **Recommender System Results** |
|---|---|---|---|
| (Birukov Alexander et al, 2005) | Learner past behaviors and the keywords he/she has entered. | Factors included in the system are inter-related. Their knowledge are shared in order to enhance quality of recommendations using similarities in learners' behavior | Learning Content |
| (Hsieh Tung-Cheng, 2010) | A learner with aid of other leaner is entered to learn a topic which has interested in. if it is a new topic which has not been discussed yet. Learner mediator, dispatches retrieval agents for gathering learning contents from internet based on desired learning topics and store them in the warehouse of contents. | Major components of performing procedures are: user interface, candidate course production, preprocessing of learning topic content, production of weighted and cohesive learning topic and learning topic recommendation module. | The best learning contents for each course unit of a learning path. |
| (Tai David et al, 2007) | Gathering data which can varies in the form of explicit data (age, gender, field) or sequence data (learner score, course score) | Association mining rules for extracting recommended rules of each cluster of learners. | Learning Content |
| (Liu Feng-jung, 2007) | Use of precious learners' behaviors | Learners' behavior mining | After processing received information in system, it filters document links and shows them to users. Users can click on these content links to study according to their desires. |
| (Liu Feng-jung, 2008) | Use of inquiries which are entered by learners to system. So that, at least 10 keywords, which are used in previous activities of users, are recorded. Also, their frequencies are considered. | Learners' behavior mining and utilization of semantic web technology. | The most adaptable contents to users |

| | | | |
|---|---|---|---|
| Proposed method | Use of learners' profile. | Clustering learners and association rule mining ( user 's personal preferences and neighbors' suggestions are applied) | Appropriate learning contents in each section of a course for each learner |

**Basic Concepts**
In this section, we are being familiar with definitions, terms and basic concepts which are related topics accordance with areas of the proposed architecture. Being familiar with these definitions make them more understandable in following sections.

**Clustering**
Clustering techniques can be counted as an effective tool for clustering students according to their similarities. K-Means as a clustering method is simple; nevertheless, it is a basic way to analyze other methods including fuzzy clustering.

The simplest way to implement K-Means Algorithm is firstly to select members to the number of clusters required, randomly as centroids. Then, other members based their similarity measures to these centroids are lied in distinct clusters and thus the first clusters are formed. Now, in each produced cluster using average distance function, central node (member) is calculated and repeatedly distances of member from new centroid are processed using K-Means algorithm. In this step, some of the member may transmit to other clusters. This procedure continues until there are no changes in distances of members. Formula 1 is a target function to minimize distance called Euclidean function.

$$[1] \quad d(x,y) = \sqrt{\sum_{i=1}^{n}(x_i - y_i)^2}$$

In this Formula, the vectors $x = (x_1, \ldots, x_n)$ and $y = (y_1, \ldots, y_n)$ includes attributes of two vectors. One of these vectors is related to attributes of the central member and the other is relevant to a member to which distance from the central node is calculated.
n is representative of the number of attributes of each member and it ranges from 1 to n.

**Association Rules Mining**
Association Rules represents relations between items based on their occurrence pattern in transactions (unsorted). In web transactional context, association rule are used to show the relations of web-page visits based on learner patterns.

The goal of mining using association rule is to find relations among components of a set. In this case, searching and finding interdependencies, solidarities and existing cause and effect structures among a series of components or objects in relational database and warehouse take place in this category. This rule is as following:

Prior → Poster [Support Coefficient, Confidence Coefficient]

Support Coefficient is a probability of prior and poster inclusion in a transaction.

Confidence Coefficient is a probability that if a transaction meets conditions of prior, then also meets conditions of poster. This coefficient is represented by C sign.

**Recommender Systems**
With considerable growth of internet and expansion of information within that, the problem of information redundancy is being appeared more. Hence, information available on web is more than capability of users in management, absorption and maintenance of them. One of the solutions to this issue is personalized or recommended systems. These systems attempt to offer users' favorable items.

The most popular recommender systems used and produced nowadays are categorized as Collaborative Filtering. In this method, at first, information regarding to users are cumulated and after identifying the similarities between users, they will be notified about recommendations.

**Proposed Architecture**
In this section, we analyze the architecture of proposed system and its major components
AELTRec Architecture

Proposed architecture is explained in figure 1. As you can see, this architecture has been composed of three major parts. They are AELTRec User Interface and Recommender System. In the user interface, each of learners can interact with the system using this module.

Recommender: it includes a recommender system for personalizing learning contents that interconnect with three databases. These databases are Content Rate, learner profile and learning contents. The procedure of recommender system is to input learners' profiles and the marks learners gave to each of the contents; based on result obtained by this process, suggest learners appropriate learning contents.

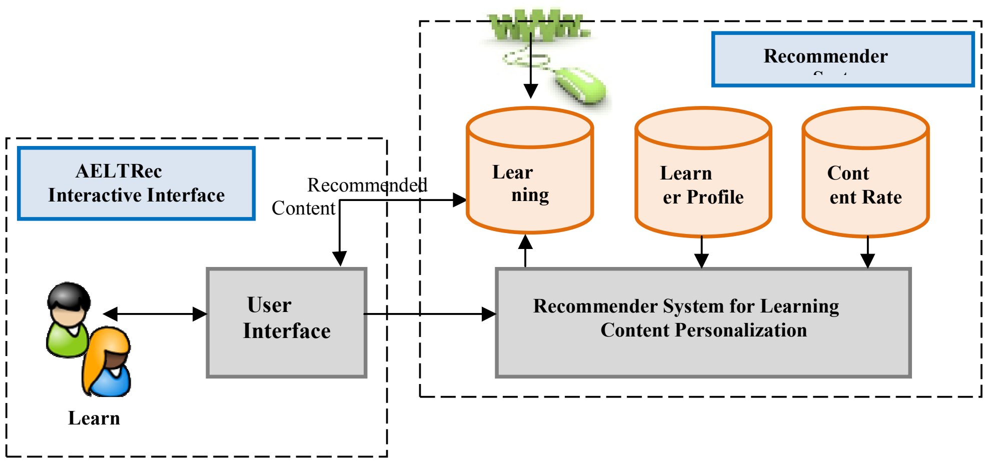


*Figure 34.* **AELTRec Proposed Architecture**

**Learner Modeling**
One of the important sections in implementation of the architecture is learner modeling in this system. One of the existing models for learner modeling is PAPI (Public And Private Information). Descriptions of this model by IEEE LTSC as a data transfer protocol have been designed for communication between collaborative systems. It describes learner's information (OunnasAsma, 2005).

PAPI standard reflects Intelligent Tutoring Systems in which information related to learner's performance is described as vital information about him/her (PanevaDesislava, 2004).

This model allows viewing learners' information in different perspectives. (Known perspectives can be learner, instructor, parents, school, employee and others) to some extent privacy and security are considered. One of the vital clues of this standard is logical division which separates security and management of different kinds of learner information. This standard is depicted in Figure 2 which is categorized in six parts covering different parts (Jerman-BlazicBorka and KlobucarTomaz, 2005).

In the proposed architecture, for extracting input parameters and completion of learner's profile, PAPI learner model will be used.

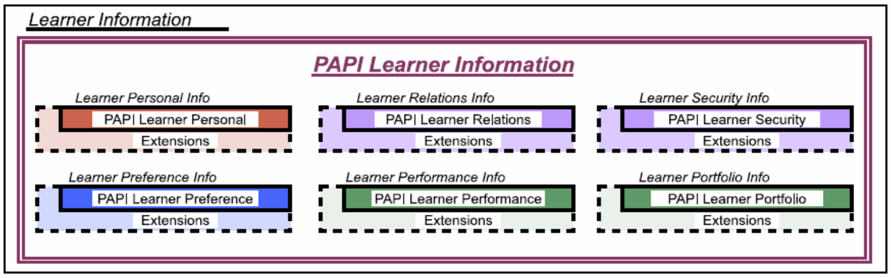


*Figure* 35. **High-Level Architecture of PAPI Profile**

**Description and Preprocessing of Data**

Each of input attributes in the proposed architecture has different importance in clustering process. Also, each attribute value has variant domain. Hence, extracted row data related to each leaner must be processed before clustering. As it is mentioned, domain value of each attribute is varied; for example age of people in data gathered for testing recommended algorithm might be ranged from 22 to 48. But, gender of attendance can be 0 (male) and 1 (female). So it requires that values of all attributes are converted to a domain of values. New values for each attribute are calculated according to Formula 2:

$$[2] \quad v_a' = \frac{v_a - v_{amin}}{v_{amax} - v_{amin}}$$

In this formula $v_a$ is the value of attribute $a$ and $v_a'$ is the converted value of attribute $a$. $v_{amax}$ and $v_{amin}$ are minimum and maximum values of attribute $a$. For example, if age of people in data gathered ranged from 22 to 48 and we are willing to normalize 35 years of old, according to above formula we have:

$$v_{35}' = \frac{35 - 22}{48 - 22} = 0.5$$

**Learner Clustering**

At the beginning, in the recommended system with the intention of suggesting contents to learner, it needs to be clustered. In this solution, K-Means as clustering algorithm will be used. In this algorithm several factors are considered which exist in learner's profile that is accordance with PAPI model and learner's interested criteria for self-regulated learning. In order to cluster and help learners to become self-regulated learners, criteria must be stipulated which are in the learner's profile and are asked him/her before course is started.

After all the values are normalized, there must be a weight associated with each of attributes which describes its degree of importance. This work is done so as to specify effects of different attributes on learners clustering.

Based on weight concept, vector $\overline{V_a}$ indicating learner's attribute is presented as formula 3:

$$[3] \quad \overrightarrow{V_a} = \left((v_{a1}, w_1), (v_{a2}, w_2), \dots, (v_{an}, w_n)\right)$$

In vector $\overrightarrow{V_a}$, $v_{a1}$ to $v_{an}$ represent attributes of learner a and values of $w_1$ to $w_n$ indicates weights of learner's attributes. This vector for learner b is presents as formula 4:

$$[4] \quad \overrightarrow{V_b} = \left((v_{b1}, w_1), (v_{b2}, w_2), \dots, (v_{bn}, w_n)\right)$$

Difference between learner a and b is calculated using formula 5 (Jin Du et al, 2006):

[5] $$d(a,b) = \sqrt{w_1^2(v_{a1}-v_{b1})^2 + w_2^2(v_{a2}-v_{b2})^2 + \cdots + w_n^2(v_{an}-v_{bn})^2}$$

As it is obvious in formula 5, importance level of a feature in learners' cluster boosts with increase in value of the weight associated with.

Results obtained from applying clustering algorithm on a dataset according to selections of algorithm's parameters, are so different. The goal of validating clusters is to find clusters which mostly relate to their data.

In this part, silhouette coefficient is introduced which allows selecting the best value of K in K-Means algorithm:

The idea behind this coefficient is that components within a cluster are most similar to their representative; average distance between O and components with the cluster is calculated using Formula 6:

[6] $$a(o) = \frac{1}{|C_i|}\sum_{p\in C(o)} d(o,p)$$

In this formula C represents a cluster including o as one of its members. P shows other members in the cluster. $|C_i|$ shows the number of members in the cluster and d represents distance function.

Components in different clusters must be dissimilar to each others. Average distance between o and the second closest cluster are calculated using Formula 7:

[7] $$b(o) = \min_{C_i \neq C_o}\left(\frac{1}{|C_i|}\sum_{p\in C(i)} d(o,p)\right)$$

According to Formula 7 and 8, the aforesaid coefficient for o is calculated by Formula 8:

[8] $$s(o) = \begin{cases} \text{if } a(o) = 0, \text{i.e. } |C_i| = 1 & 0 \\ \text{else} & \frac{b(o)-a(o)}{\max\{b(o)-a(o)\}} \end{cases}$$

Value of this coefficient ranges between +1 and -1 and if the value is more close to +1, it will indicate that assigning o to its cluster is an excellent assignment.

It is worth mentioning that, in developing the Silhouette algorithm, value of coefficient for k=2 to k equals to a half of the number of input data calculated and the value of k which is selected so that maximum possible value of this coefficient is produced, is selected for clustering.

**Extracting Association Rules and Recommend Contents to Learners**

After clustering learners, using Apriori algorithm and based on scores learners gave to the contents read before in the system, association rules regarding to each cluster of learners must be extracted. According to extracted rules for each cluster of learners, system recommends contents to learners in the cluster.

**How to Test and Extract Results**

For extracting results in this work, first we should select among learners to work with the developed system based on the proposed architecture. Also an electronic course must be opted for teaching the learners. It is assumed that for learning content selection, resources available on web and internet are used dynamically. These learners will work with the system for ten days to extract desire data such as similar learners, contents viewed by each learner, scores given by each learner to studied contents and other similar items for recommending content to other learners. After this step, derived from the proposed architecture and described procedures, right contents to right learners are recommended.

Before studying contents, one pretest embedded in the system is to be done which relates to each of the educational goals. After finishing course, one posttest is hold. It seems that the proposed architecture is good enough to enhance learner's performance; it is expected that average progression percentage of learners from pretest to posttest, in the case that contents are suggested to learner over run the case where it is free to select contents.

**Conclusion and Future works**

As it is discussed in this paper, recommender systems in e-learning have significant effects on improving learners' functionalities. In this paper, with analyzing of recommender systems in e-learning, using one of clustering algorithm and association rules techniques, a recommender system was proposed.

Research area related to subject of this paper includes:

– One of the useful topics in context of recommender system in e-learning is assessment of its effect on self-regulated learning. Combining self-regulated theory with those items which should be considered in recommender systems, leads to presenting a useful recommender system which in addition of suggesting suitable contents exclusively for each learner, also enhancing its abilities in self-regulated learning (Chen Chih-Ming, 2009).

– Over and above, suggesting contents to learners, it is possible to providing them with guidance during their learning sessions. Work on adaptive and personalized guidance is a topic of great research in future.

– Another context which being raised by this paper, is considering a new concept titled "attack on recommender systems". The purpose of this attack is misuse of open nature of recommender systems and entering unreal information (ex. scoring items) with aim of altering functionalities of recommender systems (Bhaumik, R. et al, 2007).

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# Intutionistic Fuzzy-Based Method for Assessing the Learner's Knowledge Level and Personalization of Learning Path

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**Abstract**

*Currently most of the Web-Based learning systems assess the learner's knowledge in terms of the learner's crisp responses to the tests that are taken during the learning process. However, several factors such as successful guesses or choosing a more probable answer lead to uncertainty about the evaluation process. To this end, this paper investigates the use of a novel method based on the Intuitionistic fuzzy set theory to handle inaccurate information about the learner in the assessment process. Also, based on the assessment results, personalized sequence of learning concepts are provided for the learner using Intuitionistic Fuzzy Weighted Averaging (IFWA) operator.*

**Keywords**: E-learning, E-assessment, Personalization, Content sequencing, Intuitionistic fuzzy set theory

**Introduction**

Rapid Growth of the internet and more specifically the World Wide Web (WWW) provide highly personalized, accessible and interactive sources of information to a widely distributed user base. Hence, Web-based learning has become a new mean to learn such that learners can access learning materials of the applications without time and distance barriers via web services. Web-based learning systems are designed to help learners with diverse knowledge level, skills, backgrounds, preferences and learning styles (Schiaffino et al., 2008).

According to (Dolog et al., 2004) learning in open environments demands even more effective personalization approaches to provide learner orientation and individualized access support. Therefore, Adaptation and personalization is the basic characteristics of most of current web-based learning systems.

Curriculum sequencing or learning path finding is considered as a critical element of personalized learning. It provides each learner the most suitable individually planned sequence of concepts to learn and contents to work with. To provide an effective learning path, most of the personalized tutoring systems consider learner knowledge, backgrounds, and interests for providing adaptive and personalized content sequencing (Brusilovsky, 1996).

However, most of these systems determine the learner knowledge merely through the learner's crisp responses to the tests that are taken during the learning process. There exist some factors that contribute to uncertainty about the evaluation process such as successful guesses or choosing a more probable answer. To illustrate it more, the learner may select a response of the multiple choice question based on the more probable correct answer or similarly the learner may choose an answer by guess. Considering uncertainty in determining the learner's knowledge level was the focus of only few researches. Example of such researches includes the work done in (Chen and Duh, 2008) in which a method is proposed for estimating the learner's ability based on the fuzzy inference mechanism. This method modifies estimation function of the learner's ability according to the learner's answers to two basic questions i.e. the difficulty level and comprehension percentage of each studied courseware. Another work in (Magoulas et al., 2001) evaluates the learner's knowledge level under uncertainty through a Neuro-fuzzy scheme and with regards to the ideas from cognitive science.

This paper investigates the use of a new method based on the Intuitionistic fuzzy set theory to handle inaccurate information about the learner and to provide a personalized sequence of learning material for him/her. The learner has the option of determining the percentgea that he/she believes each answer is right. Then the assessment is done through the Intuitionistic fuzzy set theory. The result of this assessment is later used in sequencing the most suitable learning materials for the learner.

This paper is organized as follows. Section 2 provides a brief review of the Intuitionistic fuzzy sets. Section 3 presents the proposed method for the learner's assessment under uncertainty and describes how this assessment can be used to provide a personalized learning path for the learner. Finally, conclusions are made in Section 4.

**Intuitionistic Fuzzy Sets**

The theory of Intuitionistic Fuzzy Sets (IFSs) was introduced by Atanassov in 1986 (Atanassov, 1986). It generalizes the fuzzy set theory, and hence all fuzzy sets are IFSs but the converse is not necessarily true. The most significant role of IFSs is in handling inexact and incomplete information.

Besides, it is beneficial in dealing with vague information. According to the predicted results (Atanassov, 2003) and based on the literature researches, IFSs is proved to be useful in various application areas of science and technology. To name the most outstanding areas of applications, IFSs have been successfully applied to medical diagnosis (De et al., 2001) and decision making problems (Xu and Yager, 2008). In the following, we introduce some basic concepts related to IFSs.

**Definition 1**. Let a set $X = \{x_1, x_2, ..., x_n\}$ be a finite non-empty set, then IFS $A$ in $X$ is defined as [1]:

$$[1] \qquad A = \{< x, t_A(x), f_A(x) \mid x \in X >\}$$

where the functions $t_A : X \to [0,1]$, $f_A : X \to [0,1]$ determines the membership degree and non-membership degree of the $x \in X$ respectively with the condition in [2]:

$$[2] \qquad 0 \le t_A(x) + f_A(x) \le 1$$

All the fuzzy sets can be represented in the form of an IFS as in [3]:

$$[3] \qquad A = \{< x, t_{A'}(x), 1 - t_{A'}(x) \mid x \in X >\}$$

In other words if $t_A(x) + f_A(x) = 1$, then the Intuitionistic fuzzy set is equivalent to the fuzzy set.

**Definition 2.** Let $a = (t, f)$ be an Intuitionistic fuzzy number. The score function $S$ of $a$ is defined as [4]:

[4] $$S(a) = t - f \qquad S(a) \in [-1,1]$$

**Definition 3.** Let $a = (t, f)$ be an Intuitionistic fuzzy number, an accuracy function $H$ of $a$ can be represented as [5]:

[5] $$H(a) = t + f \qquad H(a) \in [0,1]$$

According to (Xu, 2007) two Intuitionistic fuzzy numbers can be compared based on the score function and accuracy function:

**Definition 4.** Let $a_1 = (t_1, f_1)$ and $a_2 = (t_2, f_2)$ be two Intuitionistic fuzzy numbers, $S(a_1) = t_1 - f_1$ and $S(a_2) = t_2 - f_2$ be the score functions of $a_1$ and $a_2$, respectively, and let $H(a_1) = t_1 + f_1$ and $H(a_2) = t_2 + f_2$ be the accuracy functions of $a_1$ and $a_2$, respectively, then:

If $S(a_1) < S(a_2)$, then $a_1$ is smaller than $a_2$, denoted by $a_1 < a_2$;
If $S(a_1) = S(a_2)$, then
(1) If $H(a_1) < H(a_2)$, then $a_1$ is smaller than $a_2$, denoted by $a_1 < a_2$;
(2) If $H(a_1) = H(a_2)$, then $a_1$ and $a_2$ represent the same information, denoted by $a_1 = a_2$.

**Definition 5.** Let $a_1 = (t_1, f_1)$ and $a_2 = (t_2, f_2)$ be two Intuitionistic fuzzy numbers, then [6] and [7] are hold:

[6] $$a_1 \oplus a_2 = (t_1 + t_2 - t_1 t_2, f_1 f_2)$$

[7] $$\lambda a_1 = (1 - (1 - t_1)^\lambda), (f_1)^\lambda), \lambda > 0$$

**Definition 6:** Let $a_i = (t_i, f_i)$ $(i = 1,..., n)$ be a collection of Intuitionistic fuzzy numbers on $X$. In this paper, this collection is briefly called Q. Also, Let Intuitionistic Fuzzy Weighted Averaging (IFWA): $Q^n \to Q$, if

[8] $$IFWA_w(a_1, a_2, ..., a_n) = \prod_{i=1}^{n} a_i^{w_i} = (1 - \prod_{i=1}^{n} (1 - t_i)^{w_i}, \prod_{i=1}^{n} (f_i)^{w_i})$$

where $w = (w_{1,} w_2, ..., w_n)^T$ is the weight vector of $a_i (i = 1,2,...,n)$, and $w_i > 0, \sum_{i=1}^{n} w_i = 1$.

**Methodology**

This section presents the proposed method for evaluating the learner's knowledge level and personalization of the learning path accordingly. The following subsections describe the proposal in detail.

***Intuitionistic Fuzzy-Based Learner Assessment***

The purpose of this paper is to present a method for assessing the learner's knowledge level under uncertain conditions and while insufficient information is available on the learner's responses to the test items. To this end, IFS theory is applied to evaluate the learner's knowledge level.

A multiple choice question is designed for each of the concepts in the knowledge domain. In the proposed method, the learner has the option to set the correctness percentage for each option of the multiple choice question. This value indicates the percentage that the learner believes each option is the correct answer of the multiple choice question. In case the learner has no idea about the correctness of an option, he/she can leave its correctness percentage blank. The sum of the correctness percentage can be less than or equal to 100. The strength of the IFS theory lies behind this fact, i.e. it enables incorporating the lack of the learner's knowledge about his/her answer.

When the learner sets the correctness percentage for each of the options, the Intuitionistic fuzzy score of the $i-$th tested concept is denoted in the form of [9]:

$$s_i = (t_i, f_i) \quad [9]$$

where $s_i$ presents the Intuitionistic fuzzy score of the $i-$th tested concept which, in this paper, is briefly called IF score. $t_i$ and $f_i$ is the degree of the learner's understanding and not understanding in the $i-$th concept respectively. $t_i$ and $f_i$ can be calculated by [10] and [11] respectively as follows:

$$t_i = \frac{c_i}{100} \quad [10]$$

$$f_i = \frac{w_i}{100} \quad [11]$$

where $c_i$ is the correctness percentage that the learner has assigned to the correct option of the multiple choice question. $w_i$ is the sum of correctness percentage that the learner has assigned to all incorrect options of the multiple choice question.

To illustrate this more, the learner can set the correctness percentage of each test option as follows:

1)10%  2)70%  3)5%  4) –

Suppose that the correct answer of the test is option 2. Based on the values of correctness percentage that are provided by the learner, the value of $c_i$, and $w_i$ is:

$c_i = 70$, $w_i = 10 + 5 = 15$

Now the value of $t_i$ and $f_i$ for the test is calculated according to [10] and [11] respectively.

$$t_i = \frac{70}{100} = 0.7 \qquad f_i = \frac{15}{100} = 0.15$$

Finally, the value of $S_i$ for this test is equal to (0.7, 0.15). The IF score that is obtained using [9] is able to model the uncertain information related to the learner's responses. This value is later used in the content sequencing process for recommending suitable contents to the leaner.

***Intuitionistic Fuzzy-Based Content Sequencing***

In order to provide a personalized learning path for the learner under uncertain conditions, this paper proposes a method based on the Intuitionistic Fuzzy-Based Learner Assessment. The following steps should be followed for sequencing of the suitable learning contents to learner:

Step 1. The learner selects a learning goal from the list of goals that must be learned throughout the learning process.

Step 2. Since the leaner has no prior learning records in his/her profile, the first ranked list of the learning concepts are presented to the learner according to the instructor's rule. The learner is free to select any concept in the list.

Step 3. The learning content related to the leaner selected concept is then presented to him/her. After the learned finishes studying this content, a test is presented to him/her with the purpose of estimating his/her understanding degree.

Step 4. The learner's response is evaluated based on the IFS theory described in section 3.1.

Step 5. The learner's knowledge level in the tested learning concept is updated in the learner profile according to the value obtained in Step 4.

Step 6. To recommend learning contents based on the learner's feedback, the set of concepts that are related to the Learner-Selected goal will be chosen. Next, the concepts that the learner has already learned will be removed from the set. A concept that the learner has fully learned has the IF score of (1, 0). This means that the learner definitely selected the correct answer. Step 7 is then executed for each unlearned concept in the set.

Step 7. The weighted average of the IF score of the semantically dependent concepts of the selected concept must be determined in this step. This paper considers two kinds of semantic relationships between the selected concept and other concepts of the knowledge domain: 1- Prerequisite Concept that are necessary to perceive the selected concept, and 2- Related Concepts that are related to the selected concept and are in the same Sub-domain. Hence, the value of $IFWA_{total}$ of a concept is calculated as [12]:

$$IFWA_{total} = IFWA_{pre} + IFWA_{related} \qquad [12]$$

where $IFWA_{pre}$ and $IFWA_{related}$ is IFWA of the IF score in Prerequisite and Related Concepts of the selected concept respectively and can be calculated using (8). $IFWA_{total}$ is the total IF score of a concept.

Step 8. The comparison logic for Intuitionistic fuzzy numbers (see Definition 4) is used to rank the concepts based on the $IFWA_{total}$ obtained in Step 7. In this way, the concepts that get higher rank than the other concepts, are the ones that the learner has better IF scores in their Prerequisite and Related Concepts. This will, in turn, help learner better understand the recommended concept, since he/she has better understood its Prerequisite and Related Concept.

Step 9. Step 3 to Step 9 is repeated until the learner learns his/her selected goal.

To illustrate the above steps more, suppose that there are four Concepts $A, B, C, D$ that are related to the learner selected goal and there exists data related to IF score of previous studied concepts. Table 1 shows the IF score of the concepts the learner has studied so far. According to (12) to calculate the value of $IFWA_{total}$ for a typical concept $A$, $IFWA_{pre}$ and $IFWA_{related}$ must be calculated first. As it is shown in Table 2, Concept $A$ has two Prerequisite Concepts, namely $E$ and $F$, and no related concept. It should be noted that since $A$ has two Prerequisite Concepts, the weight vector is in the form of $w = (0.5, 0.5)^T$ which assigns equal weight to each of the Prerequisite Concepts according to the expert's view. So, the value of $IFWA_{pre}$, $IFWA_{related}$, and $IFWA_{total}$ can be obtained as follows:

$$IFWA_{pre} = (1-(1-0.60)^{0.5}(1-0.30)^{0.5}, (0.10)^{0.5}(0.60)^{0.5}) = (0.47, 0.25)$$

Since $A$ has no Related Concept, the $IFWA_{related} = (0.0, 0.0)$.

$$IFWA_{total} = IFWA_{pre} + IFWA_{related} = (1-(1-0.47)^{0.5}(1-0.0)^{0.5}, (0.25)^{0.5}(0.0)^{0.5})$$

So: $IFWA_{total} = (0.27, 0.0)$.

The $IFWA_{total}$ can be similarly calculated for the rest of concepts $B, C, D$. The final results are shown in Table 3.

*Table 4. IF score of the studied concepts*

| Concept | IF score |
|---|---|
| E | (0.60,0.10) |
| F | (0.30,0.60) |
| G | (0.34, 0.20) |
| H | (1.0, 0.0) |

*Table 5. Semantic relationships between the concepts*

| Concept | Prerequisite Concepts | Related Concepts |
|---|---|---|
| A | F,E | - |
| B | - | G |
| C | E | F |
| D | H | F |

*Table 6. Final values of IFWA for each concept*

| Concept | $IFWA_{total}$ |
|---|---|
| A | (0.27,0.0) |
| B | (0.19,0.0) |
| C | (0.27, 0.49) |
| D | (1.0, 0.0) |

According to the data shown in Table 3, concept $D$ is greater that all the other concepts since $S(D) = 1.0 - 0.0 = 1.0$. The final ordered list of concepts that is recommended to the learner is $D, A, B, C$.

## Conclusion

In this paper, the problem of learner's knowledge level assessment by proposing a new method based on the Intuitionistic fuzzy set theory is investigated. To this end, the learner's determines the correctness percentage of each option in the test. The correctness percentage shows denotes that how much the learner is certain with the correctness of each option. This information obtained by the learner response enable considering the impact of successful guesses or choosing a more probable answer. This paper also utilizes the Intuitionistic Fuzzy Weighted Averaging (IFWA) operator to aggregate the Intuitionistic fuzzy information corresponding to each concept. The most suitable sequence of concepts is obtained according to the score function and accuracy function. Future work of this research will explore the impact of other attributes which are influential in determining the suitable sequence of concepts for the learner.

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# Human motion reconstruction based on static postures

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## Abstract

*This work is proposing to create the human motion starting from a 3D body captured from 3d scanner. The human motion can be performed in virtual reality by using a series of static postures. The points cloud (mesh) coming from the scanner it doesn't present the body segmentation for each anatomical part and this means that is not possible to use the skeleton for modify the body parts positions. This thing involves a segmentation for create a mesh deformation for each body parts. The movement is finally based temporary fusion of the static postures and involves increasing the speed of the positions. In this case every posture xi has allocated a time ti seconds. The dynamic human body can be used in simulation of the garment product. The virtual presentation of the garment product on a moving body is more attractive than a static presentation. This study is useful for students, game industry or production area, for discovering the body-cloth collision and improvement of the simulation.*

**Keywords**: motion, 3D body, scanner, segmentation, dynamic.

## Introduction

The images on static or dynamic are perceived by using the visual channel, like a result of the received images processed by the brain [1].

Human movement in the virtual environment consists of all frames of statically images transmitted sequentially over a period of time (figure 1). The visual perception due to inertia, or inability to discern the eye still image frames, if succeed at a speed high enough, the image is perceived as having a continuous evolution [1].

To ensure continuity perception of static images which succeed each other sequentially or otherwise, for the playback picture may not be accompanied by the phenomenon of flicker when changing from one frame to another, it is necessary to choose the frame rate, fc, the less than the critical fusion frequency of the eye, which is 16 ÷ 20 frames / second. This frame rate to create the overall impression of continuous motion picture based on visual perception of a finite number of images [1].

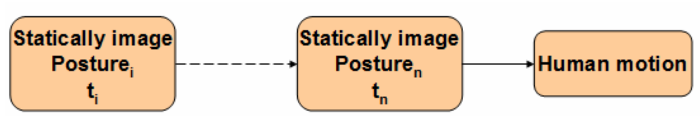


*Figure 1.* **Human motion by using the statically images with ti,** $i = \overline{1,n}$

The human motion is based on kinematics structure by using a fixed number of joints with specified degrees-of-freedom. The kinematics initialization is then limited to estimation of limb lengths [Moeslund et. al., 2006].

For this objective it can be used the human body captured from a 3D scanner or human body created on Poser software (figure 2). The both options for create human motion are based on static images. The human mannequins created in specialized software have the advantages that are the perfect body and accepts the positioning of a skeleton for creating the different postures.

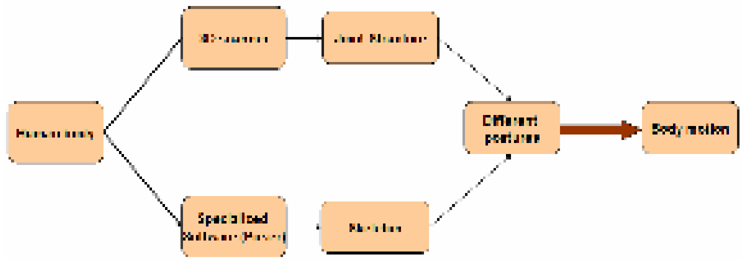


*Figure 2:* **Steps in creating movement on different bodies**

Human motion by using a body from a specialized software

By using a parametric mannequin from Poser software it is possible in simple way to create a human motion. The first step is to select the body and to add the skeleton system with joint points for bones structure (figure 3). By moving the skeleton structure between two points is creating deformations useful for new posture (figure 4).

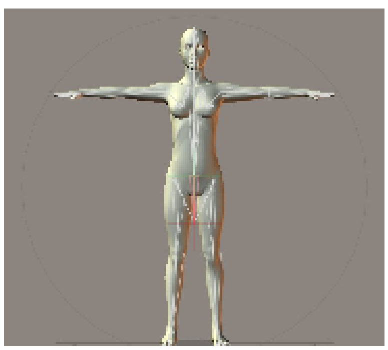

*Figure 3*: **Skeleton positioning** [Aileni et. al., 2011]

*Figure 4*: **Virtual body – different postures** [Aileni et. Al., 2011]

*Figure 5*: **Body scanned**

Human motion by using a body from 3D scanner

The human body coming from 3D scanner (figure 5) can't be used in correlation with skeleton.

For eliminate this inconvenient it have to use joint point (figure 6 a.) and structure by using the Mudbox software. The position of the points is anatomical point of articulation. Between two points of articulation is positioned a joint bar (figure 6 b.) for distorting the anatomical segment. The deformation must follow the real esthetic posture. It can create a wrong deformation by overlapping positions of points in 3D space (figure 7).

If it is required to simulate a cloth on these different postures it must simulate the cloth for all postures (figure 8) [Aileni, 2011].

**Conclusion**

The human body motion based on static image is useful for simulate the motion of the body scanned. Especially it is necessary in e-commerce area for garment product visualisation and for verification of the product on the different posture of the body. This motion it is required if a client ask for how is looking the garment on his scanned body on motion. This is a substitute for real test of the apparel products and it is necessary on specialized courses for students.

*Figure 6:* a**) joint point position** b) **joint bar**

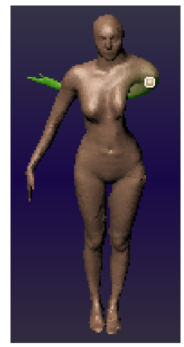

*Figure 7*: **Deformation by overlapping positions of points**[Aileni, 2011]

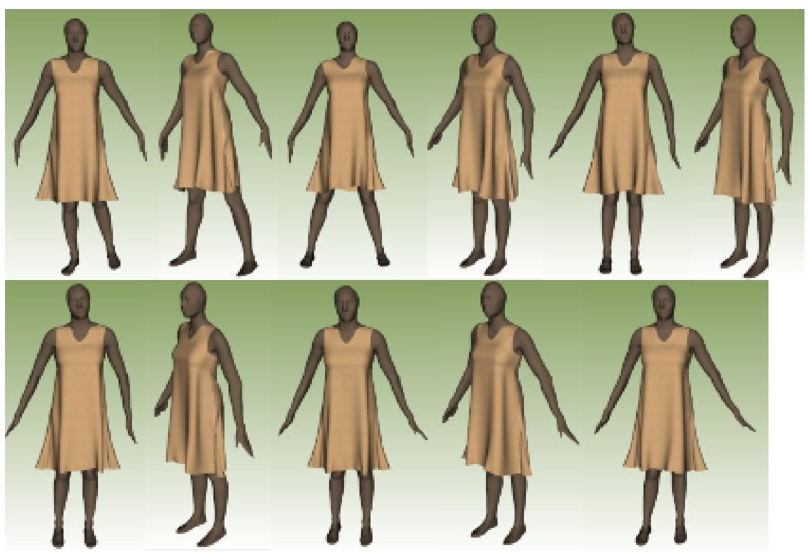

*Figure 7*: **Cloth simulation for different postures** [Aileni, 2011]

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# Project Method Implementation At The High School Grades, Qualification Mecatronist Technician

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**Abstract**

*Education in virtual laboratories, using The Project Method has its place in the education system at all levels of schooling and education and it is subject to a specific and cumulative education. This kind of education enphasises the skills of learnind bz doing, the powers to be doing, to have knowledge, calls for interdisciplinarity, suggesting global activities that imply a whole set of skills. It must feed teamwork, documented research, workshops, reflection sessions and debates, as well as professional skills certification projects, all of which are specific technical disciplines. The material and its objectives, education in virtual laboratories, the project method, contributes to the creation of points of convergence of content and learning meetings, which very often remain separate. Teaching technical subjects requires harmonization of all learning styles with the latest methods of teaching.Teachers are focusing on the acquisition of key skills, they all need for personal fulfillment and development, environmental education, social inclusion and employment, growth, adaptation and providing opportunities better learning, to develop a highly skilled workforce that is responsive to the needs of the economy in the Europea financial crisisand growing unemployment. Project Method is a model student-centered instruction. Projects involve students in solving complex tasks, facilitating the development of higher level skills: responsibility and capacity to adapt, communication skills, creativity and intellectual curiosity, critical thinking and systems thinking, information and media skills, collaboration capabilities and interpersonal identification, formulation and problem solving, self-training, social responsibility, skills required in this century.*

**Keywords**:Mecatronic, Education, Technical Skills

## 1. Introduction

School is the place where most Europeans students spend at least nine or ten years of life, is the place where they acquire the knowledge, skills and core competencies, and many of the norms, attitudes and values that will guide in life. Professional development of young people will follow unpredictable paths, and they will need a wide range of general skills to adapt in a society ever more complex were creativity, lateral thinking, skills and ability to adapt cross tend to be more popular than combinations of specific knowledge.

Skills are crucial. Almost a third of the European workforce has low skills and, according to some estimates, by 2020, 50% of new jobs created will require highly skilled workers and only 15% will address people with basic education. Should be noted that schools have difficulties to capture young people's interest in matters related to science and mathematics, basic materials for Europe's competitiveness. Regarding mathematics and science, girls get inferior rezultats to those obtained by the boys.We discuss more about the role that "traditional" teaching methods we have in the transmission of knowledge and in training students, and the extent to which teaching for older students who have acquired sufficient skills and competencies to be autonomous, could or should become a student-centered activity, characterized by active collaboration between students and teachers to acquire knowledge and skills. We decided to use the project method in class, wich is a student-centered approach, encouraging independent learning, collaboration to develop knowledge and skills, acquired twenty-first century skills.

**2. Virtual Reality and the Project Method Implementation At The High School Grades, Qualification Mecatronist Technician**

Virtual reality favors the formation of mental images relating to real entities in space or topological relations between objects, thus helping to explain and understand phenomena or processes. It allows to look at the surrounding world in another dimension and experience things that otherwise we would not be accessible in real life, or not even been created yet. Education in virtual laboratories using the project method has its place in the education system at all levels of schooling and education is subject to specific and cumulative education sistem. This kind of education give the students the powers to be doing, to have knowledge, calls for interdisciplinarity, suggesting global activities that imply a whole set of skills. It must feed teamwork, documented research, workshops, reflection sessions and debates, as well as professional skills certification projects, all of which are specific of technical disciplines. Throgh the material and its objectives, education in virtual laboratories with the project method, contributes to the creation of points of convergence of content and learning meetings, which very often remain separate.

Teaching technical subjects requires harmonization of all learning styles with the latest methods of teaching.All teachers know that the mere exposure of the lesson does not work. More to learn, create, discover and retain when students participate interactively. To inspire and motivate there must be communication between teacher and student, thus improving the learning experience and evaluation, this method effectively realizing the project.Experience has shown that the use of audio-visual media capture students' interest, the lessons taking place in an engaging, involving the whole class. Information, values, aesthetic criteria of law, contributions and new emotional dimensions of imagination that students receive through the use of information technology - media are taken into account in educational practice.

Any audio-visual features is recommend to be used in technical subjects, like this:

• providing multiple views on the same subject, leading to debates;

• detailed unusual perspective not found in usual textbooks and can not be seen by their own means;

• play in a way accessible to a complex problem through a "file" with multiple entries;

•allowing the observation of the genesis of a phenomenon, its forms successive time in history, its relations with other phenomena, develop a critical spirit in relation to representations of reality and their simulations;

• building capacity to express themselves with images and / or sound;

• use pictures and sounds to build knowledge and develop their creativity;

• uniform coding, whatever its medium, which facilitates portability and processing.

• the possibility of transformation and information processing, using power of the computer. Once an image is digitized, the computer will "know" and apply all changes to the type of focus, distortion or change color at a speed unmatched.

• consistent quality without degradation of children. Binary data can be multiplied without a degradation of quality.

• reliable transport. Numerical coding of information allows easy control during transmission.

At the intersection of technology and creative inventions lies in multimedia virtual reality characterized by:

• real time - user actions can change instantly 3D space;

• interactivity - can move and manipulate objects in 3D space;

• immersion - a sense of belonging / presence in the virtual 3D

Applications of virtual reality which ca be succesfully applied in Project methodthe, are considered the following:

• modeling, simulation and visualization in science, which get image and study models or direct observation inaccessible phenomena (flows of information, atomic structure, systems, weather systems, cosmic etc.).

• experiments and simulations plant operation, learning various devices or procedures without destroying life to make the team dangerous substances.

• simulation systems (simulators) for training pilots, drivers or astronauts that can practice difficult maneuvers without life-threatening or cabin safety of vehicle (airplane, helicopter, car, train, ship, spacecraft, etc.. );

• computer aided design (CAD) in different fields (construction, architecture, etc..), Which the designer is able to see the results of the project as its image in real time to observe.

Distributed virtual environment has the following characteristics:

• Common space illusion - the illusion that participants in the environment are on the same three-dimensional space (the same room, same classroom etc.).

• presence illusion common - each participant is transmitted into the role of virtual people, called avatars, that is, among others, associated the following:

• a graphic (as most plausible);

• a model of the body structure (the presence of limbs);

• a model of movement (movements, gestures, mimicry);

• a physical model (height, volume, etc.).

• common illusion of time - distributed virtual environment allows interaction users in real time.

• the possibility of communication - environmental facilities in terms of providing communication include communication through gestures, the text entered from an input device or voice;

• sharing information - opportunity to interact with the virtual environment, participants can assemble with a machine, can write or draw on a virtual blackboard.

Because we are a technical college we prepare our students become good entrepreneurs and the project method also helps the students to be creative, to be confident in everything we undertake and to act in a responsible manner, protecting and respecting nature for sustainable economic development, teachers focusing on the acquisition of key skills, they need all the individuals for personal fulfillment and development, environmental education, social inclusion and employment, growth, adaptation and providing opportunities better learning, to develop a highly skilled workforce that is responsive to the needs of the economy in the European financial crisis and growing unemployment.

For all the technical qualifications, the implementation of the project method is to say, a necessity because the students are prepared for the demands of European labor market in which the young employee is familiar with the latest discoveries of science and technology.

Project method is a model student-centered instruction. Projects involve students in solving complex tasks, facilitating the development of higher level skills: responsibility and capacity to adapt, communication skills, creativity and intellectual curiosity, critical thinking and systems thinking, information and media skills, collaboration capabilities and interpersonal identification, formulation and problem solving, self-training, social responsibility, skills required in this century.

Students will work in teams, collaborating, exchanging ideas, with varite documented sources, making various investigations to formulate answers to questions they choose to express the modalities agreed upon their views, to formulate answers to curriculum, to present results activities.

Activities that students carried out during the course of a project are multiple and not only focus on the development project itself but also all related activities: preparation of brochures and magazines announcing the new project running mates, working their literal intelligence, and visual arts, applying interviews and questionnaires they relate with other teachers, students, parents, organizing a presentation of the project will enhance the spectacle of their artistic skills by designing and developing the project will acquire and develop their key skills in project management.

The teacher will play the facilitator, making it material that will support efforts students will identify the right strategy for them, appropriate assessment methods and tools for observing and measuring student progress continuously. Teachers will share concrete knowledge of theory, strategies and tools that reflect the modern methods of teamwork.

Parents will always be up to date on the activities of the sudents. They will encourage and support children, following their evolution, can participate in supporting the project will be connected with the European education system through their students involved in the project. Evaluation will be done through various methods, and reflections on students achieving their own learning.

By using this method is also promoted the use of new technologies to facilitate learning, project method assuming tasks and extensive use of Information and Communication Technology to facilitate learning.

For Mecatronist Technician qualification, project implementation method is to say, a necessity because the students are prepared for the European market demands of work in which the young employee is familiar with the latest discoveries of science and technology, mechatronics is called "Science of the future". Mechatronics education provides flexibility in action and thought, defining features of market economists. Offering effective solutions to promote interdisciplinarity, mechatronics has become support steps to encourage initiative and creativity. Interdisciplinary mechatronics laboratories is the basis for implementation of project approaches, the materialization of the principles of "learning by doing", "education through research" to turn ideas into action, to develop creativity, develop innovative thinking and risk-taking and ability to plan and manage projects in order to achieve the objectives. For Mecatronist Technician class the introduction of the project methods in the education process was beneficial for both students and teachers alike.

## 3. Stages in Implemantation fo Project Method

In order to acheved their tascs they were grouped as follows: Group 1 - Robots, Group 2 - Pistons; Group 3 - Valves. Each of the groups have to realise a project that you will be post on the site www.mecatronicastiintaviitorului.wikispaces.com .

Group 1 - The Robots will perform the "Burner device", Group 2 – Pistons, will make the "Bending device" and Group 3 - Valves with the project "Container load device" The project aims are the development of pneumatic or electropneumatic device with items such as "distibution valves." The project will first be executed and verified in simulation program FluidSIM, to choose the optimal operating scheme, so that when they will done the scheme on Festo Didactic stand, the possibility of damage will be eliminate. For the project students have all documentary materials posted on the project site (fig.1).

### 3.1. Simulation Program FluidSim

In virtual laboratory with the simulation program, students performed pneumatic diagrams, identify mechatronic components, their symbols, performs functional mechatronic circuits thus ensuring the connection between theory and practice.

Modern trening principles used in mechatronics laboratories:

- Learning by doing - learning by doing all the practical experiences needed in a real factory;
- Hands on - palpable presence of objects, devices;
- Interaction - training in the use of specialized software programs.

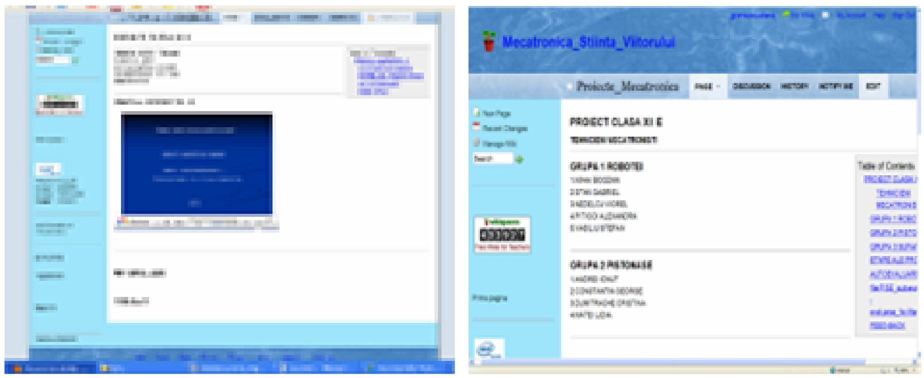


*Fig.1*. **Stages of working with Project method on the site**

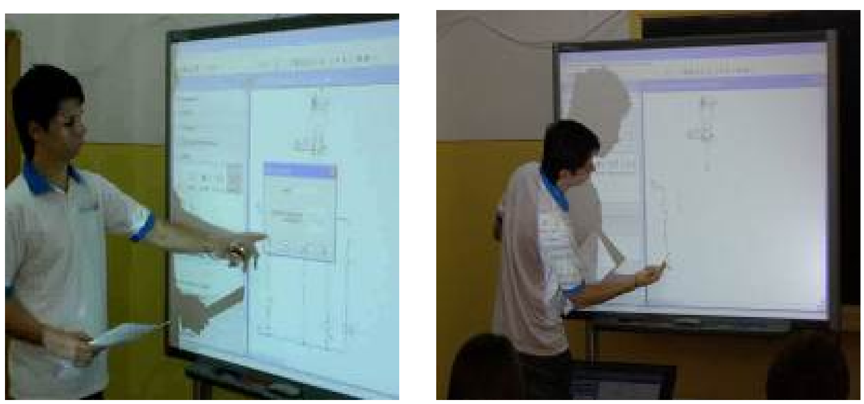

*Fig.2.* **Working with FluidSIM simulation program**

These principles underlie all activities taking place in the virtual laboratories. Virtual laboratories activity stimulates students' imagination and creativity and abstract thinking develops, simulates the capacity of decision, responsibility, initiative and team spirit, allows students to identify symbols electropneumatic components to make circuits, capable of bringing the system to detect and to correct any errors. Because the virtual laboratory components are not damaged, students can experience an infinite number of variants of mechatronic circuits, finally choosing the best solution in terms of mechanical, electronic and not least economic.

The stages of work with the simulation program are:

1. Identificaton of the needed elements from the library, for the drive scheme, indicating the functional role of each;
2. Execution of the draft operating scheme;
3. Execution of operating scheme in the FluidSIM simulation program. (fig.2)

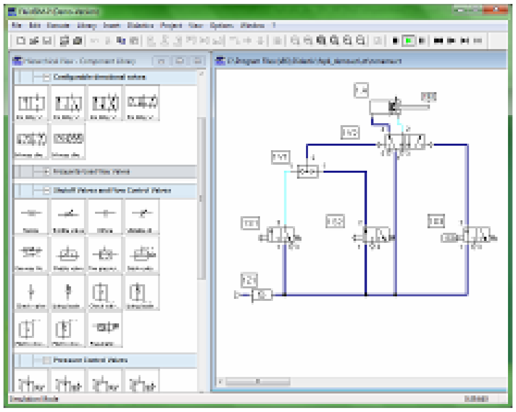

*Fig. 3* **FluidSIM working page**

### 3.2. Stages Of Work In Real Laboratory, Festo Didactic Stand

In real laboratory, mechatronic students performed real factory circuits. This activity promotes learning palpable presence of mechatronic components, stimulates the ability of decision, responsibility, initiative and team spirit, allows students to identify symbols electropneumatic components to make circuits, capable of making the system fuctionable, to detect and correct errors. Finally the three groups of students simultaneously check the functioning of both systems, virtual and real, adjusting the speed of reaction by drawing conclusions from a comparative analysis.

The stages of work at the stand are:
1.Prepare mounting elements (working area);
2.Placing components on the board;
3.Realizarea circuit by connecting hoses and pneumatic components;
4.Compressedair supply assembly;
5. Performance settings for the proper functioning.

*Fig. 4* **Working at the Festo stand**

## 4. Conclusions

The need to equip young people with essential skills and improve educational attainment is a fundamental element of the EU strategy for growth and employment and sustainable development. This requirement emphasizes the objectives set out in the National Reform Programmes of the Member States. Request of competence involves two aspects: rapid technological progress require high skills, constantly updated, while globalization and new ways of organizing businesses, including horizontal hierarchies, appeal to social skills, communication, cultural entrepreneurship and to facilitate the adaptation of individuals to changing environments.

It is important to improve education, because the level achieved in compulsory education has a direct impact strongly on the level of training and pay later. This is also important for society. Since a higher level of education (as assessed from the average test results internationally comparable assessment of students, such as PISA and TIMSS) is closely related with economic growth, increase the general level of education of students Europe will lead to improved competitiveness and economic growth of the European Union.

College "Dimitrie Leonida" is a technical school, so we prepare our students to become good entrepreneurs using the project method also helps to be creative to have confident in everything you undertake and act in a responsible way, protecting and respecting nature for sustainable development of economy. The focus will be on acquiring key skills, those that require all individuals for personal fulfillment and development, environmental education, social inclusion and employment, growth, adaptation and provide better opportunities for learning to develop a highly skilled workforce that is responsive to the needs of the economy in the European financial crisis and growing unemployment.

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# Learner Behavior Analysis through Eye Tracking

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**Abstract**

*In e-learning, it is necessary to create more effective interaction between the educational content and learners. In particular, increasing motivation by stimulating learners' interest is very important. Users' eyes can be a significant source of information to analyze learner behavior. What we look at, and how we do that, can be exploited to improve the learning process.Eye tracking is the process of measuring either the point of gaze ("where we are looking") or the motion of an eye relative to the head. An eye tracker is a device for measuring eye positions and eye movement.This paper introduces the use of eye tracking technology to track and analyze the learners' behavior on e-learning platform. Specifically, interesting areas of the course for each learner and also the learner's emotions like level of attention, stress, relaxation, problem solving and tiredness.*

**Keywords**: E-Learning, eye tracking, eye movement, gaze tracking, learner profiling, learner behavior.

**Introduction**

In a virtual learning environment, learners can lose motivation and concentration easily, especially in a platform that is not tailored to their needs. Our research is based on studying learner's behavior on an online learning platform to create a system able to clustering learners based on their behavior, and adapting educational content to their needs.

Eye movements provide an indication of learner interest and focus of attention. They provide useful feedback to personalize learning interactions, and this can bring back some of the human functionality of a teacher. With a study of eye movement, learners may be more motivated, and may find learning more fun.

**Eye tracking technology**

**Eye Tracking Methods**

Many different methods have been used to track eye movements since the use of eye tracking technology was first pioneered in reading research over 100 years ago [7] :

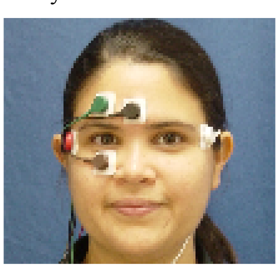

*Figure 1*. **Electro-oculographic method**

- Electro-oculographic method (EOG): Relied on electrodes mounted on the skin around the eye that could measure differences in electric potential induced by eye rotation (Fenn & Hursh, 1934) [11].

- Scleral search coils method: This technique required the wearing of large contact lenses that covered the cornea (the clear membrane covering the front of the eye) and sclera (the white of the eye that is seen from the outside).

- Corneal-reflection method: Most commercial eye-tracking systems available today measure point-of-regard by the "corneal-reflection/pupil-centre" method. These kinds of trackers usually consist of a standard computer with an infrared camera mounted beneath a display monitor, with image processing software to locate and identify the features of the eye used for tracking. In operation, infrared light from an LED (Light-Emitting Diode) embedded in the infrared camera is first directed into the eye to create strong reflections in target eye features to make them easier to track (infrared light is used to avoid dazzling the user with visible light). The light enters the retina and a large proportion of it is reflected back, making the pupil appear as a bright, well defined disc (known as the bright pupil effect). The corneal reflection (or first Purkinje image) is also generated by the infrared light, appearing as a small, but sharp, glint [7].

Once the image processing software has identified the centre of the pupil and the location of the corneal reflection, the vector between them is measured, and, with further trigonometric calculations, point-of-regard can be found. Although it is possible to determine approximate point-of-regard by the corneal reflection alone by tracking both features eye movements can, critically, be disassociated from head movements [7].

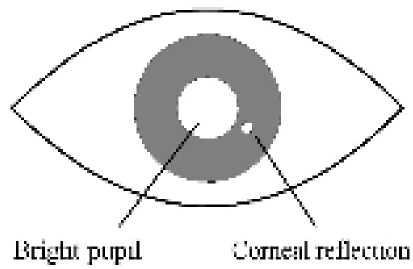


*Figure 2.* **Corneal reflection (The glint) and bright pupil**

**Eye-Movement Metrics**

Eye movement is typically divided into fixations and saccades, fixation is the moment when the eyes are relatively stationary, taking in or encoding information, and saccade is an eye movement occurring between fixations, typically lasting for 20 to 35 milliseconds. The purpose of most saccades is to move the eyes to the next viewing position. Visual processing is automatically suppressed during saccades to avoid blurring of the visual image. Most information from the eye is made available during a fixation, but not during a saccade.

The resulting series of fixations and saccades is called a scanpath. Scanpaths are useful for analyzing cognitive intent, interest, and salience. Other biological factors (some as simple as gender) may affect the scanpath as well. Eye tracking in human-computer interaction studies typically investigates the scanpath for usability purposes, or as a method of input in gaze-contingent displays, also known as gaze-based interfaces.

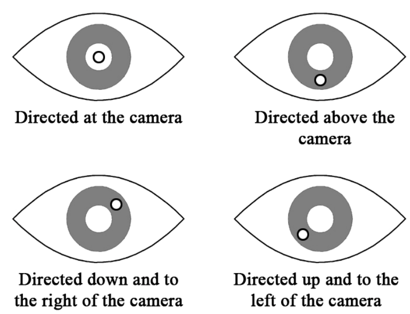


*Figure 3*. **Glint position changing according to point of regard**

**Eye Tracking VS Gaze Tracking**

Eye trackers necessarily measure the rotation of the eye with respect to the measuring system. If the measuring system is head mounted, as with EOG, then eye-in-head angles are measured. If the measuring system is table mounted, as with sclera search coils or table mounted camera (remote) systems then gaze angles are measured.

In many applications, the head position is fixed using a bite bar, a forehead support or something similar, so that eye position and gaze are the same. In other cases, the head is free to move, and head movement is measured with systems such as magnetic or video based head trackers.

For head-mounted trackers, head position and direction are added to eye-in-head direction to determine gaze direction. For table-mounted systems, such as search coils, head direction is subtracted from gaze direction to determine eye-in-head position.

**Using An Eye Tracker**

After attaching a camera, the application starts by detecting the pupil, however, we can select it manually. First, we must configure the tracking engine; most eye trackers contain two types of tracking: pupil tracking and glint tracking, you can also activate both at the same time.

Video-based eye trackers need to be fine-tuned to the particularities of each person's eye movements by a calibration process. This calibration works by displaying a dot on the screen, and if the eye fixes for longer than a certain threshold time and within a certain area, the system records that pupil-centre/corneal-reflection relationship as corresponding to a specific x,y coordinate on the screen. This is repeated over a 9 to 13 point grid-pattern to gain an accurate calibration over the whole screen.

Finally, you can configure the software to redirect the mouse cursor to the gaze position, or display a new cursor for tracking.

*Figure 4.* **ITU Gazetracker 2.0 Beta Setup**

**Eye Tracking in E-learning**

Applications that use eye tracking can be categorized as either diagnostic or interactive. Diagnostic applications show where the learner's attention has been caught, thus providing evidence of the learner's focus of attention over time. In the interactive type, the eye movements are used to replace an input system, such as mouse, allowing the user to interact with a computer using only the eyes [1].

**Learner's Emotion Tracking**

The data collected from eye-tracking devices indicates the person's interest level and focus of attention. From eye position tracking and indirect measures, such as fixation numbers and duration, gaze position, and blink rate, it is possible to draw information about the user's level of attention, stress, relaxation, problem solving, successfulness in learning, tiredness, and more. Even emotions can be tracked, and based on the data; the eye-tracking system can provide more personalized learning [1].

For example, if the average pupil size has progressively increased within a certain time interval, also user workload may have augmented. A decreased blink rate in the same period would further confirm such a supposition. When detected, such evidences could for example be used to dynamically modify the learning path, proposing a topic related to the main one but less complex (a sort of break). Or, if the user is potentially having problems in understanding something, extra information may be displayed.

Since several external factors may come into play, however, it is practically impossible to be absolutely sure that these signals derive from changes in the user emotional state. Therefore, rather than undertaking direct actions, such as displaying help windows, the system can assist the user indirectly with gradual assistances. For example, when signs of non-understanding or high mental workload are detected, the system simply proposes links to additional material, which progressively enlarge as the signals of stress persist. When eye data suggest that the user may be tired, and the session has been going on for more than a configurable time interval (e.g. one hour), a message advising to take a break is shown [3].

And here are some experimental evidence in psychology / physiology:

- Mental workload depends on the fluctuation of the rhythm of the pupil area.

- Saccade occurrence rate and saccade length decrease with increased complexity of the task.
- Saccadic and blink velocity decrease with increasing tiredness.

**Learner's Interest Tracking**

We can track learner's interest according to his eye movement on an online learning platform. In this example, we used a free Eye Tracker "Gazetracker 2.0 Beta", and we have activated the "Eye mouse" option to redirect the mouse cursor to the gaze position. We can use any eye tracker provided that it supports the "Eye mouse".

The web page is divided into several areas "<div>", each div contains a different type of information of the same chapter and we will calculate the time spent by the learner on each div by tracking the mouse cursor. To do this, we use two Javascript events: onMouseOver and onMouseOut, whenever the cursor enters a div, it starts a timer that calculates the time in milliseconds, and it stops when the cursor leaves the div or when user leaves the entire page, using setInterval() and clearInterval() functions. When the cursor enters again the same div, the timer continues where it stopped last time.

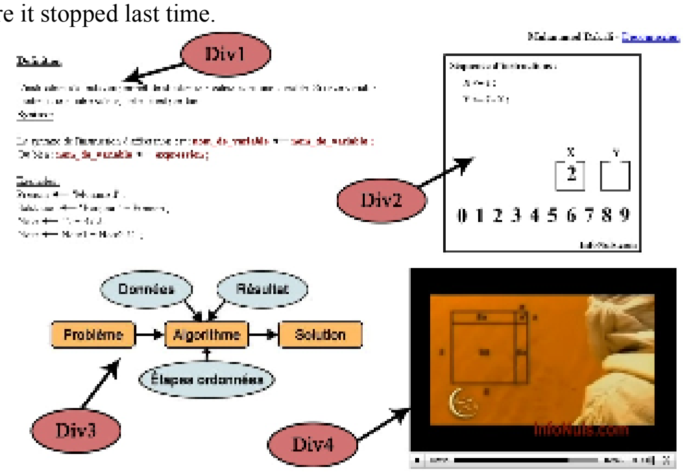


*Figure 5*. **Web page divided into 4 areas to track learner's interest**

Tracking data will be stored in the database; teachers can find the gaze duration statistics of each area and for each learner. We converted the durations from millisecond to second to make them easier to understand.

*Table 1*. **Gaze duration statistics**

| Course : Algorithms, chapter 3 : Assignment statement | | | | | |
|---|---|---|---|---|---|
| | Div 1 (Text) | Div 2 (Interactive Flash animation) | Div 3 (Schema) | Div 4 (Video) | Learner Total |
| Learner 1 | 210.22 sec | 73.40 sec | 43.05 sec | 165.25 sec | 491.92 sec |
| Learner 2 | 144.12 sec | 124.67 sec | 29.87 sec | 170.45 sec | 469.11 sec |
| Learner 3 | 243.49 sec | 142.32 sec | 12.01 sec | 98.71 sec | 496.53 sec |
| Div Total | 597.83 sec | 340.39 sec | 84.93 sec | 434.41 sec | --- |

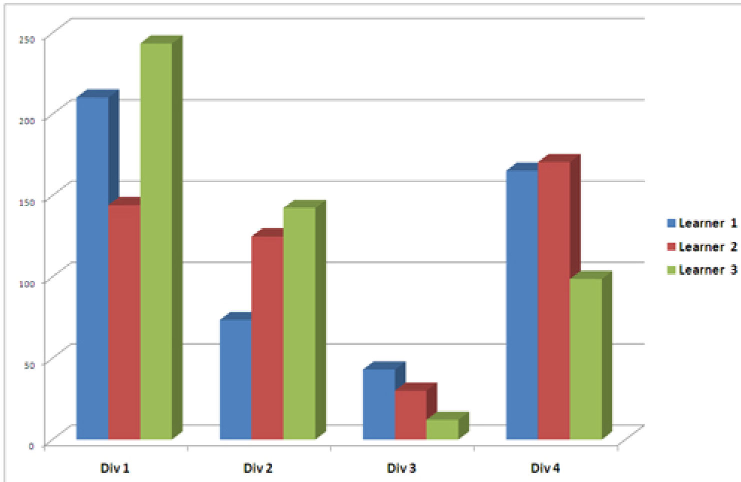


*Figure 6.* **Gaze duration chart**

Further analysis on the learner profile such as learning style, tiredness, confusion can also be performed once the data are set. For example a learner with a strong visual memory but weaker verbal processing will spend more time on the picture rather than the text. Once the learner's learning method is identified, the educational content is adapted to provide mainly images and video, rather than text, and thus increasing the efficiency of the learning process.

When learner logs in, the results from the parameters analysis block are saved in the database. Every time when the user starts a course, his behavior is recorded in the database. This includes when the course is started, which page the learner had visited and how long she/he spends on each area. This data is combined with eye movement to get a fine-grained user profile.

## Conclusion

We talked in our first paper about using learner personal data, and his statistics of interaction with the system and the available educational tools (quiz, forum, wiki, chat…), and also using data from the client's machine extracted from web server to analyze learner behavior. In this paper, we introduce the use of eye tracking technology for the same purpose.

Eye-movement analysis does appear to be a promising new tool for evaluating learners' behavior. This technology can provide many benefits to e-learning, such as facilitating adaptive and personalized learning. Even though the cost of an advanced eye tracking system is still high, in a couple of years the rapid technical progress may come with low-cost solutions and accurate eye tracking systems.

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# S e c t i o n

# SOFTWARE SOLUTIONS

**Software Solutions (SOFT):**

- **New software environments for education & training**
- **Software and management for education**
- **Virtual Reality Applications in Web-based Education**
- **Computer Graphics, Web, VR/AR and mixed-based applications for education & training, business, medicine, industry and other sciences**
- **Multi-agent Technology Applications in WBE and WBT**
- **Streaming Multimedia Applications in Learning**
- **Scientific Web-based Laboratories and Virtual Labs**
- **Software Computing in Virtual Reality and Artificial Intelligence**
- **Avatars and Intelligent Agents**

# The New Graphic Tools In The Easy-Learning Platform

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**Abstract**

*The present paper aims to present the new graphics tools module developed for the Easy-Learning online platform. The Tools module is very useful in the study of waveforms, coding and modulation, which requires for learning a well-defined and suggestive graphic display. It can be used as a laboratory segment on its own or as a part of a practical session of any study discipline involving graphic tools.*

**Keywords**: e-learning, modulation, waveform, coding, amplitude, phase, frequency

## 1. Introduction

*This article aims to present the new graphics tools module developed for the Easy-Learning platform. The Tools module can be used as a laboratory segment on its own, presenting binary coding types and digital modulations. The tools module represents an application created with ActionScript 3.0. This dynamic application includes 3 parts: Wave shapes, Binary codes, and Digital modulations.*

As shown in the paper entitled *The New Mail And Newsletter Modules In The Easy-Learning Platform*, the interaction between the user and the Easy-Learning platform is achieved using three specific interfaces: administrator, tutor and student. With their help, you can manage common objects that are stored in the database, with the mention that each interface provides certain rights of access to these objects, depending on user type.

## 2. The *Tools* module in the Easy-Learning platform

This module contains an application designed in AS3, this module is found only in the student interface.

The application is formed of three parts:

- A wave generator;
- Examples of binary codes: NRZ (*Non Return to Zero*), FM (*Frequency Modulation*), and Manchester or PE (*Phase Encoding*);
- Examples of modulations: ASK (*Amplitude Shift Keying*), FSK (*Frequency Shift Keying*), and PSK (*Phase Shift Keying*).

This application is a dynamic one, designed specially to ease the coding and modulation representations module. As shown in Figure 1, the menu is formed from the three already mentioned parts: Wave Shape, Binary Codes and Modulations.

### 2.1. The Wave Shape module

*In this part of the application, the generation of sinusoidal, triangular and rectangular waves can be visualized. The interface is similar to a rudimentary oscilloscope. The goal of this part is to exemplify wave shapes, being a preparatory part for the following sections of the application. In* *order to be an interactive part, it does not just show the wave shapes, but it has two sliders that can be used to modify the amplitude and frequency of the generated waves. In addition, the module contains three buttons that change the type of wave to generate.*

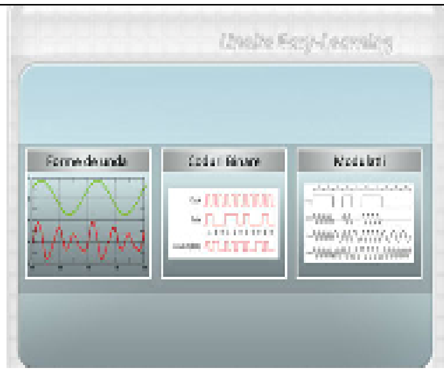

*Figure 1*. **The Main Tools menu**

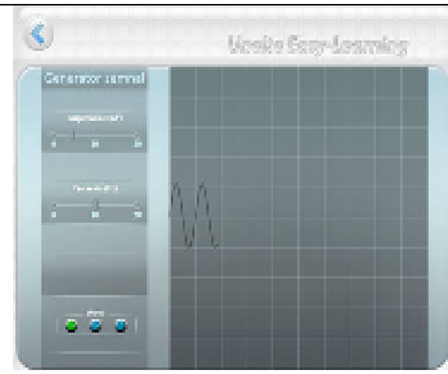

*Figure 2.* **The Wave generator (sinusoidal wave)**

As shown in Figure 2, the maximum amplitude is of 20mV and the maximum frequency is of 20Hz. A button returns the user to the main menu**.**

### 2.2. The Binary Codes module

Binary codes are a string of values formed of 0 and 1, necessary to the data storage on the memory supports of the electronic systems. The strings of binary values the represent the data wanted for storage are transformed in rectangular wave shapes.

From a menu, one can select (see Figure 3) the type of coding to be studied. The application contains four types of binary coding: NRZ (*Non Return To Zero*), NRZI (*Non Return To Zero Inverted*), FM (*Frequency Modulation*) and Manchester or PE (*Phase Encoding*).

a) **NRZ** *(Non Return to Zero)* and **NRZI** *(Non Return to Zero Inverted)*

In telecommunications, a NRZ sequence is a binary code, where a positive voltage represents 1, and a negative voltage represents 0, without a neutral or rest condition. When this code is used to represent data in an asynchronous communication system, the absence of neutral states requires other mechanisms for the synchronization of bits if a separate clock signal is not available.

For the NRZI code, the 1 bit represents a transition of signal and the 0 bit represents a non-transition signal.

The application allows the user to enter a code sequence of up to 30 characters (see Figure 4). You can select the sequence to be automatically covered or bit-by-bit (step-by-step) covered. By choosing automatic browsing, it will run until the end and then start over again, but if the bit-by-bit browsing is chosen then it will run each bit by waiting for the step-by-step button to be pressed.

The NRZI code advantage is a good value for the density ratio and the disadvantage is that this code does not allow long strings of void symbols because of the loss of auto-synchronization.

b) **FM** (*Frequency Modulation*)

This code codes a data symbol in two data symbols (see Figure 5). The first symbol is always a transition, assuring the auto-synchronization, and the last bit corresponds to the coded information (transition for 1 and no transition for 0). The FM code meets the registration form in simple density (SD)


*Figure 3.* **The binary codes menu**

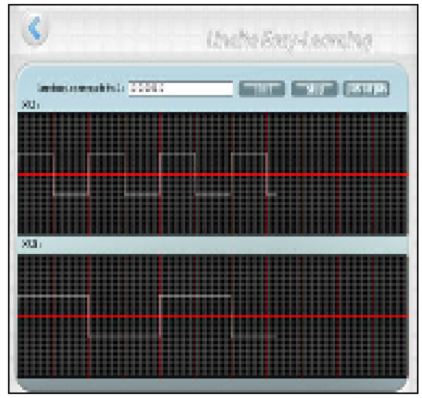

*Figure 4.* **The NRZ and NRZI codes**

As the NRZ or NRZI codes, the interface for FM offers the possibility of introducing a string of characters to be encoded.

c) **Manchester** or **PE** *(Phase Encoding)*

*In telecommunications and data storage, the Manchester code (also known as the phase encoding or PE) is a line of code in which encoding each data bit has at least one transition and occupies the same time period. It does not have a continue component but has an internal clock, which means that it can be inductively or capacitive coupled, and the clock signal can be recovered from the encrypted data (see Figure 6). This code is widely used (e.g.: the Ethernet standard).*

Manchester encoding is a special case of the BPSK encoding (*Binary Phase Shift Keying*), where data controls the phase of a rectangular signal whose frequency is represented by the data rate. Such a signal is easy to generate.

The introduction of test data is also possible here; pressing the step-by-step button makes the bit-by-bit execution.

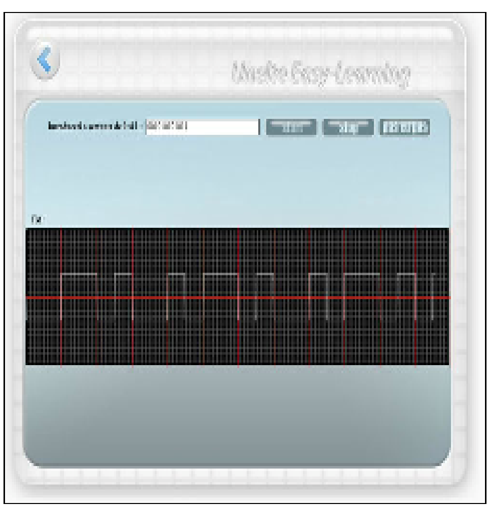

*Fig. 5.* **The FM Code**

*Fig. 6.* **The Manchester encoding or PE**

**2.3. The Modulations module**

The modulation is the electronic method of signaling used by modems. They have to use the same method of modulation to communicate with each other. The most spread digital modulation methods are:

- *Amplitude Shift Keying* (ASK);
- *Frequency Shift Keying* (FSK);
- *Phase Shift Keying* (PSK).

The application and exemplify these three modulations (ASK, FSK, PSK). The modulation type is chosen from a very simple menu (see Figure 7).

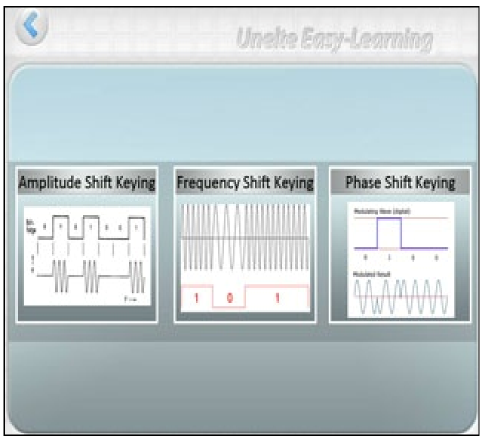


*Fig. 7.* **The Modulations module**

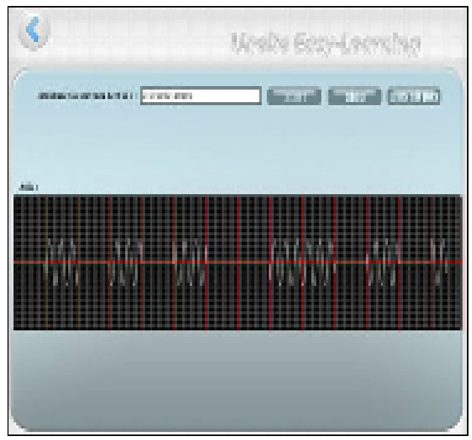

*Fig. 8.* **The ASK modulation**

Each component of the menu is represented by a title and a suggestive image for every type of modulation. Like the other menus, this one also respects the layout that has been chosen for the menus.

a) **ASK** (Amplitude Shift Keying)

In digital communications, ASK modulation is a process that gives to a sinusoid two or more levels of discrete amplitude. These are related to the number of levels adopted by the digital message. For a binary message sequence, there are two levels, one of which is usually zero (see Figure 8).

A disadvantage of the ASK modulation compared with PSK and FSK is the fact that it does not have a constant envelope. This makes signal processing (e.g.: amplification power) more difficult, because linearity is an important factor. The portion of each bit is bounded by one vertical line. Like at the binary encoding, the user can enter a string of maximum 30 bits. A sinusoid represents the 1 value and a continuous line (0-amplitude) represents the 0 value. The user is given the opportunity to automatically run the entire sequence (by pressing the start button) or bit-by-bit (by pressing the step-by.step button).

b) **FSK** (*Frequency Shift Keying*)

As the name suggests, a FSK transmitter has its frequency modulated by the message. Although there may be more than 2 frequencies involved in a FSK signal, the designed application only supports a stream of binary data, so that two frequencies are involved. The spectrum of FSK signal is difficult to obtain. Considering the case in which the message consists of a binary sequence of 0 and 1, it can be represented by a periodic function (see Figure 9).

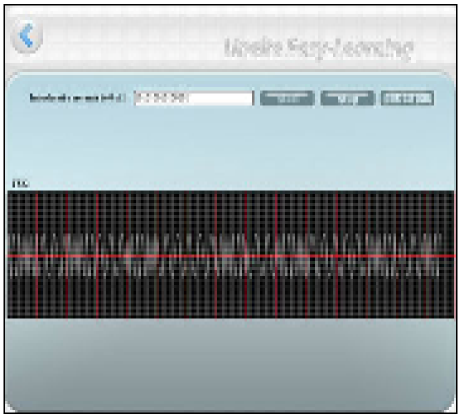

*Figure 9.* **The FSK modulation**

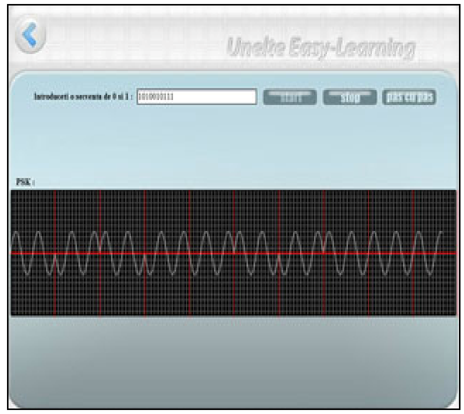


*Figure 10.* **The PSK) modulation**

c) **PSK** (*Phase Shift Keying*)

PSK is a digital modulation system that transmits data by changing or modulating the phase of the reference signal. Any digital modulation scheme uses a finite number of distinct signals to represent digital data. PSK uses a finite number of stages, each stage having assigned a unique pattern of binary digits. Usually, each phase encodes an equal number of bits. In this case, the 0 bit is assigned a sinusoid of 0 phase, and the 1 bit is assigned a sinusoid of $\pi$ or 180° phase.

As shown in Figure 10, the introduced bit string is modulated in phase. It is also observed that the phase modification of 180°from the bit transition, each signal afferent to a bit is delimited by a vertical line.

## 3. Conclusions

The Easy-Learning platform started as a simple project, but as years go by it has become extremely useful from the point of view of the student. During the 7 years of development and maintenance, it has undergone major changes. In 2009, this platform has been restructured and has started using Symfony's framework. The Easy-Learning platform is very useful not only for students, but also for tutors. The platform has reached a stage where we can say that it has many useful parts, but it can be sustain the addition of new modules and features.

The Tools module is proving very useful in the study of waveform, coding and modulation, which requires for learning a well-defined and suggestive graphic display. Adding new functionality and new tools tailored to specific types and disciplines and to applications at which these graphic tools are used can also expand this module.

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# Second Life – a Virtual Learning Environment

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**Abstract**

*A continuous concern in education field is to discover new technologies and methodologies in order to increase the quality of intellectual capital. In present, virtual technology expends learning opportunities and draws many participants. Software agents are met not only in real life, but also in virtual reality. Second Life environment enables its users to create/ design intelligent software agents (called avatars) that may interact. To these avatars, there may be attributed certain behaviors by means of an adequate Second Life language, called LSL (Linden Script Language). Avatar-based virtual world education is highly interactive comparing to distance learning and providing the same convenience of not having to travel while providing a more effective and more enjoyable experience. In this paper, the authors describe Second Life virtual life environment and illustrates LSL's use on a robot called RoLyvEdu acting in a virtual classroom.*

**Keywords**: Second Life, agent technology, virtual learning environment

**Introduction**

The education environment is changing simultaneously with technological trends. New pedagogical methods appear, new resources are available and new experiences are made. An ongoing concern in education field is to discover new technologies and methodologies in order to increase the quality of knowledge.

The continuing growth in the amount of computing power, the widespread availability of 3D graphics software and the development of natural language processing are considered the main factors responsible for rising to the new area called intelligent virtual environments.

The use of virtual environments for training is an option for educational activities to cover the learning process in those situations where traditional pedagogical methods are not convenient. These environments allow the students to navigate through and interact with a virtual representation of a real environment in which they have a certain job. Virtual characters representing the tutoring component of virtual environment are known as pedagogic agents, designed as intelligent software agents.

In this paper, the authors describe Second Life virtual life environment and illustrates Linden Script Language (LSL) (Moore, 2008) use on a robot called RoLyvEdu acting in a virtual classroom.

**Second Life**

Second Life (Rymaszewski, 2008), is a 3D online virtual world developed by Linden Lab (since 2003) and allows registered users (called Residents) to fulfill several social activities and interactions, events, games, electronic commerce, collaborations, education etc.

Second Life provides significant tools for parting and designing multimedia content, streaming included, some of the most frequent uses being e-business, e-learning, virtual events planning, simulations of various types, social games etc. Some important services developed by Second Life are: Teen Second Life, Second Life Library 2.0, New Media Consortium Campus, Exploratorium's SPLO Museum (Wiki, 2009).

Avatars (the intelligent software agents) may take any form users choose (human, animal, vegetable etc.) and can communicate via local chat, group chat, global instant messaging (known as IM), and voice (fig.1).

Second Life is used as a platform for education by many institutions, such as universities, libraries and government entities and continuous gains popularity (Second Life, 2011):

*Fig.1.* **Avatar in Second Life**

- ECU Early College Second Life Program - The Early College Second Life Program (ECSLP) provides rigorous coursework, including science, technology, engineering, and math, using a variety of Web 2.0 technologies.
- University of Southern Denmark - Second Life campus of the University of Southern Denmark;
- Indiana University Second Life Campus;
- NUS - virtual campus designed, built, and operated entirely by students and faculty from the National University of Singapore to enable learning, teaching, sharing, and social interaction;
- Volkshochschule - Germany's large education institute;
- Open University - the Open University was the world's first distance learning institution. It still offers courses and adult education to people everywhere via BBC television, the Internet, and Second Life;
- The University of Western Australia – the Second Life campus of the University of Western Australia, a place for teaching, research, art and architecture;
- Stanford University - a virtual library developed by Stanford University's Libraries and Academic Information Resources (SULAIR);
- Harvard Law School - the Berkman Center for Internet & Society at Harvard Law School has held multiple classes within Second Life.

Also, Second Life gives companies the option to create virtual workplaces to allow employees to virtually meet, hold events, practice any kind of corporate communications, conduct training sessions in a virtual learning environment, simulate business processes, and prototype new products (Wikipedia, 2011).

In Romania an experts team developed Virtual Bucharest, the virtual replica of the city center and as a future projects are mentioned The Bran Castle, The Danube Delta, followed by the cities Brasov, Timisoara and Constanta.

In the next section the authors present the designing of a robot in Second Life and the associated scripts using Linden Script Language (LSL).

**Building a robot in Second Life**

The avatar designed by authors is called RoLyvEdu and belongs to the virtual environment Second Life. The user can control objects and avatar behaviors using LSL, an internal, even-driven, C/Java-style language (Moore, 2008).

A script represents an item that contains instructions associated to avatars. A script is organized into states and functions. States consist of a series of events and each object may have as many scripts on it as memory allows. Usually, scripts have a length limit.

The main steps to create a new script in LSL are:

- selecting the object to whom a script is about to be attached;
- editing the body of the script by going to the "Content" tab of the object's "Edit" box and clicking the "New Script..." button. The script editor appears with the example script and the user can add his own code.

The text of the script is compiled into an executable byte code, similar to Java. Then the resulted byte code runs within a virtual machine on the simulator. Each script receives a time slice of the total simulator time allocated to scripts. Each script executes within its own chunk of memory, preventing scripts from writing into protected simulator memory or into other scripts, making it much harder for scripts to crash the simulator (Dashboard, Internet2 Wiki, 2009).

The figure 2 refers to the script editor which allows writing the code for avatar behavior.

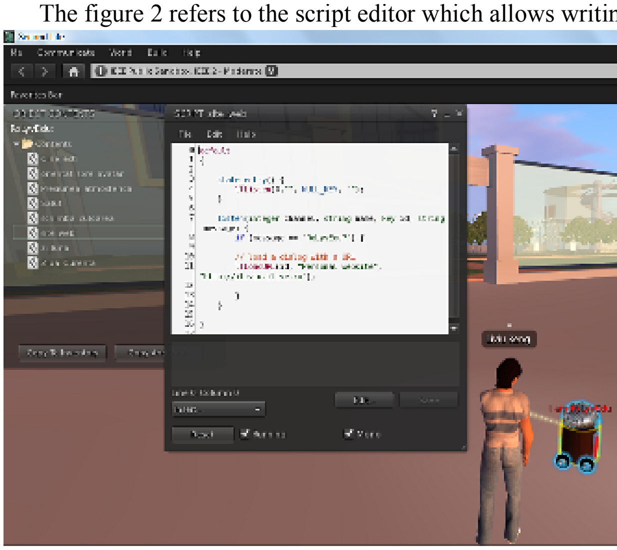

*Fig.2.* **The script editor in Second Life**

The following scripts are attached to RoLyvEdu:

- „Cine_esti"– displays the name of the robot wherever in the chat window one types the text "Who are you?";
- „Orientat_spre_avatar" – orients the object to the avatar;
- „Salut" – displays a greeting message;
- „Schimba_culoarea" – changes the robot's color at every 2 seconds;
- „site_web" – displays a connection/ link to the owner's personal page whenever in the chat window one types "RoLyvEdu?";

In figure 3 are presented several examples of scripts written in LSL and associated to RoLyvEdu.

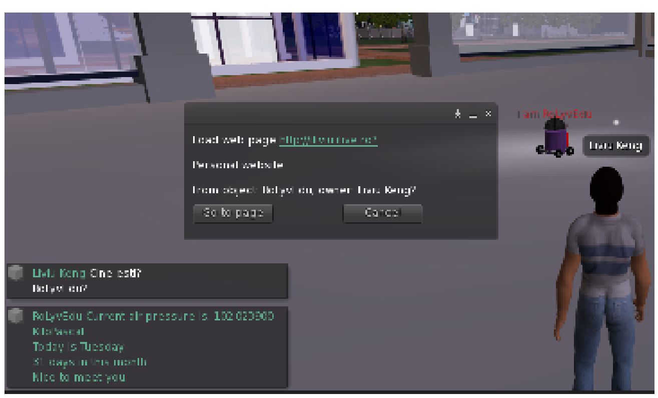

*Fig.3.* **Scripts examples**

The designed avatar can participate to learning process into the virtual classroom every time the user is connected to the virtual environment (fig.4).

*Fig.4.* **The virtual classroom**

Some benefits of using virtual learning environment are mentioned as following (Alvarez, 2006, Coffman, 2007):

- the three-dimensional virtual world makes it possible for students taking a distance course to develop a real sense of community;
- students interact with each other as well as into college campus;
- various class-related events are open to all registered users;
- virtual worlds also kept the students engaged with technology.

As a conclusion, virtual learning environment could be a valuable teaching tool in any classroom.

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Second Life

# A software application for modeling the pipeline transportation process

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## Abstract

*Pipeline transportation can benefit from a large suite of automation techniques, which can help to monitoring, controlling or optimizing the process. This paper deals with the modeling of the fluid flow in pipelines and presents the results obtained from the model. The software application developed from the model allows designing a pipeline system, computing the properties of a fluid in any point of the pipeline and producing the reports needed for interpreting the results. The model is using the transfer function to convey the dependencies between the process parameters (temperature, pressure, flow) using the computation based on momentum conservation, energy conservation and flow equations from the fluid mechanics and hydraulics.*

**Keywords**: Pipeline, Transportation process, Modeling, Automated system

## Introduction

Although liquids or gases are transported also in other ways (rail train, cars, ships), the transportation through pipelines is the method most used and most profitable. Obviously an important issue is to ensure continuously the safety of pipelines against damage.

DOT-OPS (U.S. Department of Transportation Office of Pipeline Safety) recent research indicate that, despite technological advances and more stringent rules, the rate of occurrence of incidents in the pipeline system (cracks, leaks, etc.). Not changed significantly in recent decades. Statistics show that in the case of the small (short) pipes is reported at least one incident during the lifetime (20 years), and for pipelines (1,200 km) is expected every year to see a significant incident. (API, 2000)

Studies indicate that the best ways to reduce the number of cases of cracking and leakage prevention are such as better training of service personnel or perform monitoring and control systems more efficient.

## The Transportation Process – a Systemic Approach

The concept of system has a very wide use, in all areas. The system is defined as a set of elements which interact with the outside towards a goal.

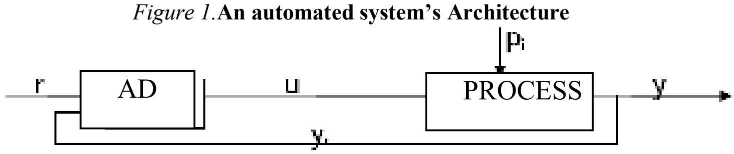
Automated controlling systems, automated systems in short, are a particular type of system, whose purpose is to operate without human intervention.

The automated system consists of two subsystems: the system technology or the automated process (P) and the automation device (AD) which sets out the law governing the process or algorithm, according to a schedule.

In Figure 1 is presented an automated system's architecture. The elements involved are:

r – mărimea de referință sau programul prescris sistemului;
u – control or management of the process;
y – output;
yr – the main reaction;
pi – disturbance.

*Figure 1.***An automated system's Architecture**




Pipeline transportation can benefit from a large suite of automation techniques. The concepts presented below refer to the process of transport, as a subsystem of an automated system.

Process parameters are physical quantities related to the process. These are of three types: input parameters, state (intermediate) parameters and output parameters. The main parameters of the transportation process through pipeline are pressure, flow and temperature.

The transfer function is an expression of dependencies between process parameters. It models in analytical terms the behavior of the process and it is also called mathematical model of the process. For the pipeline transport process, it is used advanced modeling of fluid mechanics and hydraulics (calculations based on momentum conservation, the energy conservation and numerous equations of flow).

Given the classification of automated systems (Cirtoaje, 2003), the one for transportation process has the following characteristics:

- Sampling system (discretized system) - continuous signals are sampled (discretized), resulting in digital signals;
- Dynamic (with memory) system - characterized by transients, as a consequence of its structure that includes elements able to accumulate and transfer significant amounts mass and energy;
- System with distributed parameters - associated physical quantities (pressure, temperature etc.) have different values along the pipeline route; often given the complexity of mathematical formalism, distributed parameter systems are treated in the manner of the concentrated parameters, choosing as input-output variables local physical quantities associated with points (usually extreme) of the physical object (in this case, the ends of a pipe segment);
- Non-stationary system (with variables) - at least one variable parameter over time;
- Multivariable system - at least two inputs and two outputs;
- System with dead time - between the size of the output and input quantities can be highlighted a pure delay of "dead time" during which the effect is imperceptible to the exit;
- Deterministic system - with no parameters to vary randomly;
- Open system if we are talking of monitoring the process (by measuring and signaling) or a closed system if it includes controlling also.

**Modeling the Transportation Process**

***Nonstationary (unsteady) motion of liquids through pipelines***

Usually, flows in pipelines are in an unsteady state. Modifying the rate of flow can cause large pressure fluctuations, called pressure transients. The state of flow in which they occur is called transient flow. In the unsteady motion modeling are two basic equations: the equation of continuity and equation of motion. Since flow and pressure depend on both time and distance, these equations are partial differential equations.

The next chapters use the following notations:
$p$ – pressure;
$x$ – distance;
$\lambda$ - hydraulic resistance coefficient proportional to the length
$d$ – internal diameter of pipe;
$\rho$ - density;
$v$ – flow velocity;
$q$ – mass flow;
$\beta$ - isothermal compressibility coefficient;
$t$ – time;
$L$ – length of pipe;
A – area of pipe;
g – gravitational constant.

**Equation of motion**

To study the transfer function of the transport process (ie developing the mathematical model) starts from the equation of motion:

[1] $$-\frac{\partial p}{\partial x} = \frac{\lambda}{d}\rho\frac{v^2}{2}$$

By introducing the mass flow:

[2] $q = \rho v$,

the equation [1] becomes:

[3] $$-\frac{\partial p}{\partial x} = \frac{q}{2\rho}\frac{\lambda}{d}$$

Considering the equation of state (pressure below 500 bar) relative to reference conditions:

[4] $\rho = \rho_0[1+\beta(p-p_0)]$

and notating $P = 1+\beta(p-p_0)$, the equation [3] becomes:

[5] $$-\frac{\partial p}{\partial x} = \frac{\beta q^2}{2\rho_0 P}\frac{\lambda}{d}$$

**Equation of continuity**

Equation of continuity is:

[6] $$-\frac{\partial p}{\partial t} = \frac{\partial(\rho v)}{\partial x}$$

To obtain the model it is used also the definition of sound speed:

[7] $$c^2 = \sqrt{\frac{1}{\rho\beta}}$$

Using [2] and [4], equation [6] becomes:

[8] $$-\frac{\partial p}{\partial t} = \beta c^2\frac{\partial q}{\partial x}$$

**The Mathematical Model**

Eliminating the mass flow in relationships [5] and [8] is achieved a partial differential equation of second order. Equation [9] is called the fundamental equation of pressure in unsteady motion:

$$[9] \quad \frac{\partial P^2}{\partial t} = c^2 \sqrt{\frac{\rho_0 \beta d}{\lambda}} \frac{\partial^2 P^2}{\partial x^2} \sqrt{\frac{P^2}{\frac{\partial P^2}{\partial x}}}$$

The mathematical model adds the following conditions:

- initial condition - the distribution of pressure along the pipeline in steady

$$[10] \quad p(x,0) = p_1 - (p_1 - p_2)\frac{x}{L}$$

where $p_1$ and $p_2$ are the pressures at the ends of the pipe.

- boundary conditions

At the head of the pipe pressure remains constant:

$$[11] \quad p(0,t) = p_1$$

$$[12] \quad P^2(0,t) = P_1^2$$

At the end of the pipe the mass flow decreases to the value $(\rho q)_1 < (\rho q)_2$. For $x=L$ results:

$$[13] \quad \frac{\partial^2 p}{\partial x^2} = -\beta(\rho q)_1^2$$

Equation [9], together with the conditions [10], [12] and [13] is the mathematical model of (unsteady) nonstationary motion of liquids through pipes.

**Solving the mathematical model**

As stated above, the mathematical model of unsteady motion through pipeline consists of quasi-linear equations, hyperbolically, partial differential equations. It is not available a closed-form solution for these equations. By neglecting or with linearization of the nonlinear terms, several methods have been used for numerically integrating nonlinear, hyperbolic partial differential equations, such as method of characteristics, finite-difference method, finite element method, and linear element method.

Many studies show that the advantageous method in this case is the method of characteristics. (Tullis, J.P., 1989; Scott A., 2003). This transforms the two partial differential equations in four total differential equations in first order. These total differential equations will then be integrated to yield finite difference equations, and furthermore algebraic equations, which can be conveniently handled. For the analysis of systems having complex boundary conditions, this rnethod has proven to be superior to other methods in several aspects, such as its stability, accuracy, easy of programming, and efficiency of computations. (Tianhe Wen, 2001)

Model equations are rewritten as:

$$[14] \quad L_1 = \frac{\partial q}{\partial t} + gA\frac{\partial p}{\partial x} + \frac{\beta q^2}{2dA} = 0$$

$$[15] \quad L_2 = c^2 \frac{\partial q}{\partial x} + gA\frac{\partial p}{\partial t} = 0$$

It is considered a linear combination of equations [14] and [15], where k is an unknown multiplier:

[16] $L = L_1 + kL_2$

It comes in two pairs of characteristic equations in unknown t, grouped under the name $C^+$ si $C^-$ .

[17] $$C^+ : \begin{cases} \frac{gA}{c}\frac{dp}{dt} + \frac{dq}{dt} + \frac{\beta q^2}{2dA} = 0 \\ \frac{dx}{dt} = a \end{cases}$$

[18] $$C^- : \begin{cases} -\frac{gA}{c}\frac{dp}{dt} + \frac{dq}{dt} + \frac{\beta q^2}{2dA} = 0 \\ \frac{dx}{dt} = -a \end{cases}$$

The $C^+$ and $C^-$ characteristic equations may be transformed into other forms in which time is a subscript, and in which the charcteristic lines extend to more than one reach, generally the full pipe length. The equations are called Algebraic Equations.

The complete solving of the model by characteristics method is presented in (Tianhe Wen, 2001).

**Software Implementation of the Model**

To implement the model was chosen CBuilder - a visual environment that allows object oriented programming and implementation of a graphical friendly user interface. It is important that the application can be used for process modeling and simulation of pipeline without the need for writing any code.

Purpose of the application software is to set a pipeline system and to simulate the transportation process for a period of time. The application will determine the values of process parameters (pressure, flow) at any point on the pipeline and after the simulation will produce reports for interpreting the results.

As with any problem solved using the computer, the first step consists in fixing the input and output data.

Input data entry refer to the pipeline system configuration (number of pipes, the connection mode, settlement), pipeline characteristics (length, diameter, friction coefficient), product features throughput (in condition, pressure, composition and chemical reactivity) etc.

Output data are of two types: file and graphics. The file refers to the parameters values into the pipeline at some point. The graphic refers to the development of graphics representing the flow vs. time and pressure vs. time.

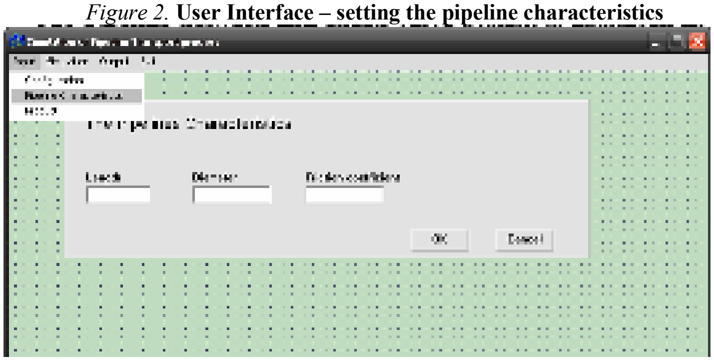
The algorithm underlying the application can be described as follows:

*Start*
*Read input data*
*Design (construct) the pipeline system*
*Determine initial parameters*
*While t<Tmax*
    *Calculate the flow using the model*
    *Calculate the pressure using the model*
    *Store the parameters values*
    *Write the parameter values of the indicated location*
    *t = t+dt*

*End while*
*Graphics display*
*Stop*

Application interface is a friendly one, easy to use. In Figure 2 is presented an example how to input information on the characteristics of a pipeline: length, diameter, friction coefficient.

*Figure 2.* **User Interface – setting the pipeline characteristics**



After entering all input data, from the Simulation menu is selected the **Start** option. At the end of the simulation is build a report containing the parameter values in different parts of the pipeline. These data are written into a text file that can be opened and read with any text editor (Notepad, Wordpad, etc.).

In Figure 3 are presented the results obtained by simulating the transport process through a simple pipe with diameter 0.7 m, length 45 m, friction 0.55. There were considered three control points for measuring parameters and simulation time of 20 sec, with dt = 0.3.

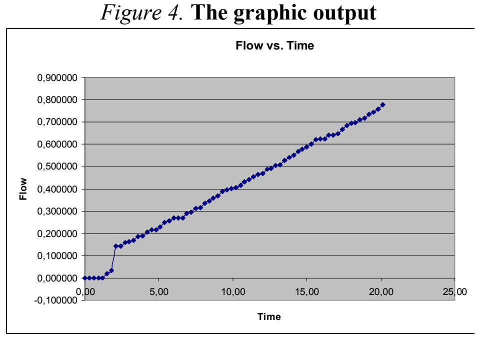
*Figure 3.* **The simulation results**

output - Notepad

File Edit Format View Help

| t | q1 | q2 | q3 | p1 | p2 | p3 |
|---|---|---|---|---|---|---|
| 0.00 | 0.000000 | -0.000800 | 1.459830 | 62.000000 | 62.000000 | 60.000000 |
| 0.30 | 0.000000 | -0.074573 | 1.505430 | 62.000000 | 68.084730 | 60.000000 |
| 0.60 | 0.000000 | -0.074573 | 1.505430 | 62.000000 | 68.084730 | 60.000000 |
| 0.90 | 0.000000 | -0.074573 | 1.505430 | 74.132400 | 68.084730 | 60.000000 |
| 1.20 | 0.000000 | -0.074581 | 1.505430 | 74.132400 | 68.084730 | 60.000000 |
| 1.50 | 0.018826 | -0.074581 | 1.505430 | 74.500487 | 68.084730 | 60.000000 |
| 1.80 | 0.031536 | -0.074581 | 1.511177 | 74.684804 | 75.082560 | 60.000000 |
| 2.10 | 0.142224 | -0.004234 | 1.525939 | 75.127014 | 75.082560 | 60.000000 |
| 2.40 | 0.142634 | -0.004234 | 1.544909 | 75.496587 | 75.267340 | 60.000000 |
| 2.70 | 0.157754 | 0.004357 | 1.561885 | 75.709894 | 76.256300 | 60.000000 |
| 3.00 | 0.163672 | 0.018706 | 1.573870 | 75.933987 | 71.154800 | 60.000000 |
| 3.30 | 0.168838 | 0.022896 | 1.578790 | 76.271704 | 71.184560 | 60.000000 |
| 3.60 | 0.185688 | 0.040665 | 1.593819 | 76.761066 | 70.245525 | 60.000000 |
| 3.90 | 0.189501 | 0.061926 | 1.612718 | 71.426500 | 71.211464 | 60.000000 |
| 4.20 | 0.207294 | 0.083404 | 1.629641 | 70.972738 | 71.359015 | 60.000000 |
| 4.50 | 0.215499 | 0.085120 | 1.638339 | 70.223370 | 71.589383 | 60.000000 |

*Figure 4.* **The graphic output**



In Figure 4 is presented a graphic output representing the flow vs. time. We can see how flow increases in time, with a sharp increase after the first second.

**Conclusions**

The purpose of this paper was to design and implement a software application for modeling the pipeline transportation process.

In the first part it is presented a systemic approach of the transportation process, useful in obtaining the mathematical model of the process.

The model is based on two equations (the equation of motion and equation of continuity) and describes the dependencies between the process parameters (pressure, flow).

The model was solved using the characteristics method, the most suitable in this case.

The software application was developed using CBuilder and it allows designing a pipeline system, computing the properties of a fluid in any point of the pipeline and producing the reports needed for interpreting the results.

The application can be integrated into a complex solution for automated monitoring of the pipeline transportation process.

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# Verification of the web applications using sink web pages

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## Abstract

*In this paper, we will introduce a new algorithm used to determine the sink web pages in a web application. The sink web pages are defined by using a partial order relation among the web pages of a web application. Using only these web pages, we will describe a method of determining all the web pages in a web application, containing errors.*

**Key words**: Verification, Relation, Web Application, Graph, HTML, Java

## Introduction

The web applications contain many files that consist of tags. Next in the paper, we will name these files web pages. In [6.4] a partial order relation has been defined among the web pages, which allows us to select from the set of web pages of a web application a subset that reflects the behaviour of all the components of the web application. These web pages are called sink web pages. In order to verify the web application, it is sufficient to verify only the sink web pages. In order to verify and test a web application, several methods have been developed ([6.1], [6.7] and [6.8]), as well as applications ([6.9], [6.10] and [6.11]).

In section 2, we will introduce a partial order relation among the web pages of a web application and then we will define the notion of sink web pages.

In section 3, we will introduce an algorithm (different from the one in [6.4]), which determines the sink web pages in a web application and a method of verification and testing of a web application, based on this algorithm. The algorithm also determines the relations of the other web pages which are not sink web pages, related to the ones that are sink web pages. The results of the tests and the verification of the sink web pages are valid also for the other pages that are in relation with the sink web pages.

In section 4, we will introduce a few results, obtained by using the method described in section 3.

The high number of web pages that are built using other web pages, through different changes in a web application, lead to the necessity of determining a special type of web pages such as the sink web pages which, through their behaviour, provide information about the behaviour of other web pages. Using only these web pages in the process of testing and verifying reduces, most of the times, the number of the verified and tested components with more than 60%.

## A relation among the web pages of a web application

Let P={p1, p2,…, pn} be the set of web pages in an web application and T be a set of unimportant tags. Below, we define the relation R on the set P.

*Definition*

We say that p R q, when p and q are from P, if:

a) all tags in p which are not in T are in q in the same order.

b) for any tag <Tg> from p and q, which are not in T, if <\Tg> is in q, then <\Tg> is in p.

For this relation, we construct a directed graph like below:

- the vertices of the graph are the indices of the static web pages: p1, p2, …, pn.

- the edges of the graph correspond to pairs of pages for which the R relation applies, such that edge (i, j) exists if pi R pj.

We call this graph DGR (directed graph associated to the relation R).

The DGR can have circuits of length 2, i.e. circuits of the form (i, j, i). In this case, the web pages for i and j, meaning pi and pj, have the properties:

pi R pj

pj R pi.

Thus, pi and pj consist of the same scripts and tags.

Because it suffices to verify only one of pages pi or pj, we will fuse the vertices i and j in DGR. The graph obtained after fusing all the pairs of nodes with the above property will be named RDGR (reduced directed graph associated o the relation R).

*Example*

Let us consider the following DGR for a web application:

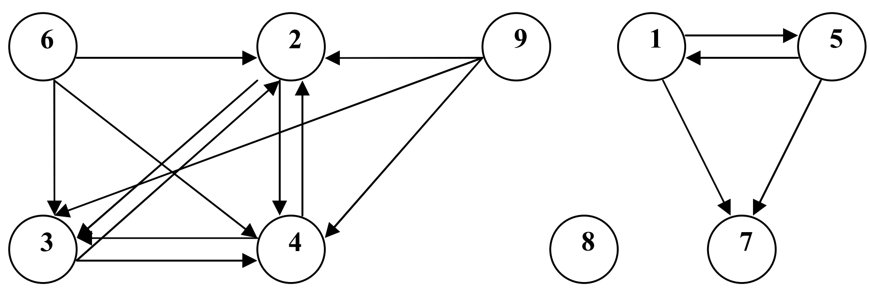



*Figure 1*

After fusing the nodes of the DGR, we obtain the RDGR:

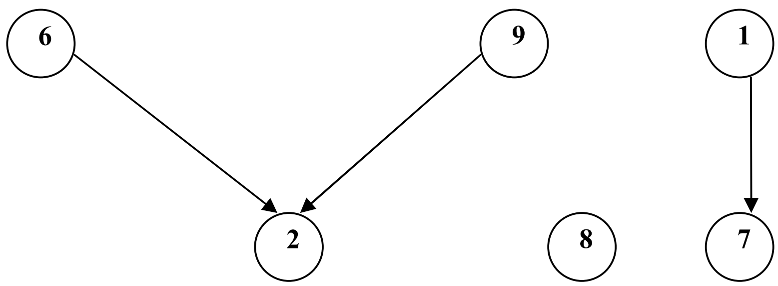



*Figure 2*

*Observations*

1. In the previous example, the vertices 2, 3 and 4 have been merged and the node 2 has resulted, similarly to the way the vertices 1 and 5 have been merged for the node 1 to result.
2. If in a web application there are no web pages involved in the relation, then the DGR and RDGR are the same as the graph formed only of n isolated vertices.

*Definition*

Let a web application Let P={$p_1$, $p_2$,…, $p_n$} be the set of web pages in an web application. We say that $p_i$ is *sink web page* if, exterior degree for vertex i, from RDGR is 0.

For the web application with the web pages in figure 1, the sink web pages are 7, 8 and one of the web pages 2, 3 and 4 (these web pages can be considered as identical, except the tags from the set T). In figure 3, we have chosen the vertex 2 as a sink web page and only the relations between the sink web pages and the other web pages have been represented.

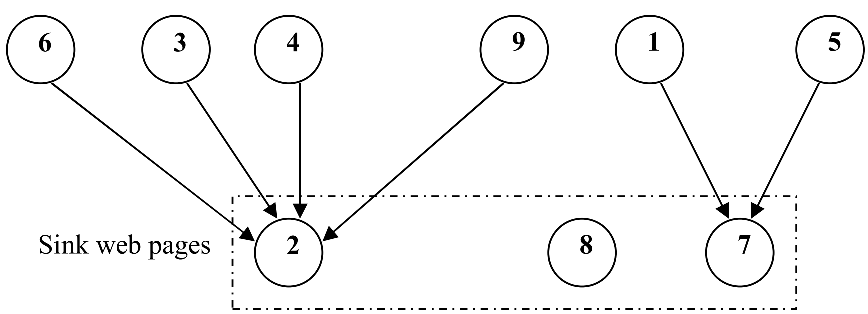



Figure 3

*Observation*

If in a web application there are no web pages involved in the relation, then the DGR and RDGR are the same as the graph formed only of n isolated vertices.

**Algorithm for determining the sink web pages in a web application**

In this section, we will introduce a simpler and more efficient algorithm, different from the one in [6.4] for determining the sink web pages and of the relations among these with the other web pages.

Using the notations in section 2, for a web application which contains the web pages $p_1$, $p_2$,…, $p_n$, we will construct with the algorithm the following string of numbers s=(s1, s2, …, sn) with the following meaning:

$$s_i = \begin{cases} 0, \textit{if } p_i \textit{ if } \text{sink } \textit{web page} \\ \text{k, if } p_i \textit{ is not } \text{sink } \textit{web page and } p_i R\, p_k, p_k \textit{ is } \text{sink } \textit{web page} \end{cases}$$

**Input data**
n, the number of web pages of the web application
the name and the path where each web page can be found, memorised in $p_1$, $p_2$,…, $p_n$
**Output data**
the string of numbers s=($s_1$, $s_2$, …, $s_n$) with the above described meaning

```
1:  for i=1,n  do
2:          si←0
3:  endfor
4:  for i=1,n  do
5:          for j=1,n  do
6:                  if (sj=0) and (pi R pj) then
7:                          si ←j
8:                  end if
9:          end for
10: end for

11: repeat
12: ok←true
13: for i=1,n do
14:         t←si
15:         u←st
16:         v←su
17:         if (t ≠ 0) and (u ≠ 0) and (v = 0) then
18:                         si ←u
19:                         ok←false
20:         end if
21: end for
22: until ok
```

*Observation*
In the first part of the algorithm (lines 1-10), the sink web pages are being determined (corresponding to the pages pi, with si=0) and for the other web pages, a binding through the relation R with another web page (pi R si), not necessarily a sink web page.
In order to realise a binding among the web pages that are not sink web pages with this type of pages, we will use the sequence of instructions from the lines 11-22. Consequently, bindings similar to the ones in figure 3 are being obtained.

An algorithm for verifying the condition pi R pj is presented in:

Using the string $s=(s_1, s_2, \ldots, s_n)$, determined by the previous algorithm, the verification and testing of a web application can be realised by verifying and testing (using the methods and the applications specified in section 1) only the sink web pages, meaning the web pages pi, with si=0. If a sink web page is being determined, pi, which contains errors, then there have to be verified for errors also the web pages pj, with sj=i (which can contain the error from pi or not, depending on the area where this can be found).

**Implementation**

Using the results from previous sections, I have realized a Java programme which determines the sink pages of a web application existing in a given folder.

The programme does the following:

- Creates a text file containing the names of the files with the extension .htm or .html, using a depth first search through the folders. These files will be coded using the numbers 1, 2, ..., n, where n represents the number of these pages.
- Determines the sink web pages and the web pages that these ones solve.

The execution time is $O(n^2 \cdot m)$, where m is the maximum number of characters of a HTML file.

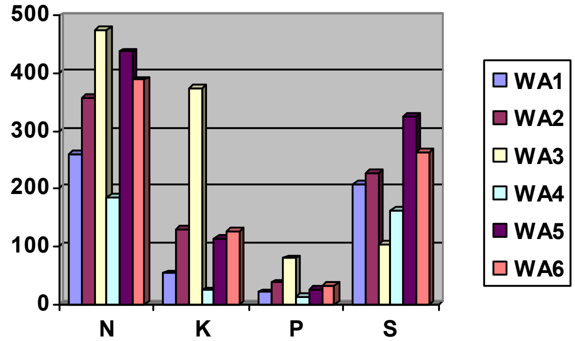
The program created the INFO.TXT file with the following information:

1) Number of files from web application
2) Number of .html and .htm files from web application
3) Web pages for verification (sink pages)
4) Web pages solve for any sink pages.

The following table present some results:

| web site | Number of .html and .htm files from web application (N) | Number of sink web pages (K) | Percent sink web pages in web application (P) | Number web pages solve with sink web pages (S) |
|---|---|---|---|---|
| WA1 | 260 | 53 | 20 | 207 |
| WA2 | 357 | 129 | 36 | 228 |
| WA3 | 476 | 374 | 79 | 102 |
| WA4 | 184 | 23 | 13 | 161 |
| WA5 | 438 | 112 | 26 | 326 |
| WA6 | 389 | 126 | 32 | 263 |
| | SumN=649 | SumK=817 | AverageP=34 | SumS=1287 |

*Tabel 1*




**Conclusions and future work**

In order to realise a web application, a high number of web pages is being used. Many of these web pages are derived from other web pages through changes in the content; in this context, the sink web pages have an important role in simplifying the verification and testing of the web application. We consider that using these web pages can lead to simplifying some models of testing and verifying the web applications.

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***Internet Sources:***
W3C Markup Validation Service: http://validator.w3.org

# Macromedia in Physics experiments

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## Abstract

*The new technologies are changing our world and our life. At their Lisbon summit, EU leaders acknowledged that future competitiveness depended on a renovated education policy including e-learning. Europe-wide 'eLearning' initiative promotes new online ways of learning throughout the EU. In recent years, many studies have highlighted an alarming decline in young people's interest for key science studies. Digital technologies can help improve the quality of knowledge and life for everybody and information and communication technologies (ICTs) have become 'enabling technologies' in school too. Physics laboratory has been for a long time now an important part of school physics education. Lately, the technique and technologies devices have know an explosive development and pupils, students are fascinated by this. In this context, the audio - video tools have an important impact for the teaching - learning process of Physics. The Computer Assisted Instruction stimulates the visual and hearing memory and transposes the students in the midst of the Phenomena. In first parts, I explained why it is important to use simulated experiments, graphics on computer, and which impact is to use the modern tools. In next step, I propose a Lesson Plan and I illustrated how the teacher can integrate audio - video tools on instruction in diverse stages of learning unit. I have corroborated the real experiments with simulation in real times of the experiments. This way of teaching complete the knowledge of students and make the lesson more attractive.*

**Keywords**: Instructions, Format, Submitting papers, Proceedings

## Introduction

In our times, the developing of a new technologies meet unrecorded progress, forcing us to adapt to these challenges, whose main characteristic is complexity. To cope with continuous change and uncertainty characteristic of market economies, students need strategic skills, such as the ability to learn how to learn, skills to solve problems, assessment skills.

Top-quality education and training are vital if Europe is to develop as a knowledge society and compete effectively in the globalizing world economy (Education, Training, Youth, Laying the foundations for a dynamic future). Politicians at European level have recognized that education and training are essential to the development and success of knowledge society. National government, educational system – universities and schools are responsible for education and training; high quality pre-primary, primary, secondary, higher and vocational education and training are the fundament for Europe's success.

The informative and technologies society needs important changes in educational programs. Learning physics is difficult for many students and, by using the Technologies of Information and Communication, introduces Physics in a modern and attractive way. Computers are used in different ways to teach Physics and can affect drastically the way of teaching Physics (de Jong, 1999; Iskander, 2002; Esquembre, 2002; Almeida Barretto et al, 2003).

The computer can become a tool for all those who wish to find in him a friend and the mysteries will turn into knowledge. This tool is equally useful to student and teacher. Computer used in class aims to develop skills related to communication, procurement, presentation and transmission of information in forms as varied. The Flash program allows simulation of experiments that cannot be completed in class, completion of laboratory experiments, to realize animated graphics, contributing in this way to develop skills to organize specific information and use it to produce new knowledge.

Introduction of the computer in the didactical activities going to increase students motivation in learning physics, offers alternative suggestions for the teaching-learning, the approach to issues of physical phenomena, encourages creative and critical thinking, and the students will be develop skills for processing and presenting of information.

**Theoretical Background**

A frame is rotated in a uniform magnetic field. Ends of framework are supported by two rings, which are connected to a bulb, like in figure 1. We see that the bulb work. Why?

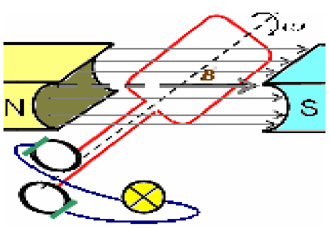


*Figure 36* **N=north pole; S=south pole**

Because appear the phenomena of the electromagnetic induction. Electromagnetic induction is the phenomena of production of voltage across a conductor moving through a magnetic field.

Faraday law: "*The induced electromotive force (emf) in any closed circuit is equal to the time of change of the magnetic flux through the circuit*", or "*the emf generated is proportional to the rate of change of the magnetic flux*"

[8] $e = -\dfrac{\Delta\Phi}{\Delta t}$

e = induced electromotive force

[9] $\Delta\Phi = B \cdot \Delta S$

$\Delta\Phi$ = magnetic flux

B= electromagnetic induction

The flux can change because:

- the magnetic field is changing - B is increasing or decreasing – not in this experiment;
- the area of the loop is changing - it is changing shape – not like this experiment;
- the orientation of the loop with respect to the magnetic field direction is changing - like this experiment.

[10] $P = U \cdot I = e \cdot I$

P= electric power

U=voltage

I=current through resistance

R= resistance

Ohm's Law is:

[11] $I = \dfrac{U}{R}$

The magnitude of the current depends on the emf (voltage) and resistance of the circuit (remember Ohm's Law). The direction of the current is the same as the direction of the induced emf.

Lenz's law: "*An induced electromotive force generates a current that induces a counter magnetic field that opposes the magnetic field generating the current.*"

**Experimental Background**
We will be use the experimental electrical kit. The experiment is carried out on front or groups of pupils.

**Computational Background**
The software that will be used is Macromedia Flash, an industry for interactive graphics and animation.

In the Stage displays, we can create a movie by arranging a series of graphics on the Stage. The Library contains type of symbols which include graphics, buttons and movie-clips.

The simulation will be in front, the teacher will present it on the electronic board or video projector. If the school has a physics lab with a computer on each table, the experiment can be practiced by each student.

**Didactical Methods**
Teaching methods used are: explanation, conversation, experiment, demonstration, discovery and computer modelling.

***LESSON'S PLAN***

**The unit by learn**: Electromagnetism

**The form (gradual level)**: the class-10th grade (the student's age – 17 years old)

**The name of lesson**: Electromagnetic induction

**The type of the lesson:** teaching/ learning

**The didactical tools:** video, experimental kit and after, completed with simulation on the computer (Flash)

**The didactical intention:** to define electromagnetically field, to understand Faraday's Law of Induction, Lenz's Law, and the right-hand rule through simple experiments

**Instructions for teacher and the students**:

- The teacher will verify the knowledge, which the students must learn.
- The teacher will make connection with the new lesson.
- The teacher starts a practical activity. Activities include electromagnetically kit and the students must observe, practice and draw conclusions.
- The teacher must guide the students to draw conclusions, to generalize their observations.
- Teacher and students draw a large, clear diagram to indicate the experiments
- The teacher writes on the board the equations on the board, the Faraday's law, draw the diagrams and the students write it in their notebooks.
- The teacher starts a simulation on the computer (figure 2, figure 3).

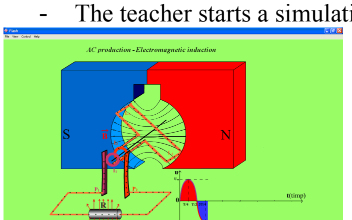


*Figure 37*

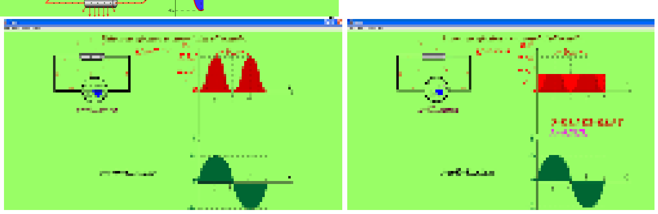

*Figure 38*

- The teacher and the students proceed to the feed-back.

**Discussion**

On computer simulation for electromagnetic induction reveals as follows:

- Working of a simple circuit;
- Diagrams $I = f(U)$ for AC circuit.

The experimental results in this lab are qualitative and quantitative. We are recorded the direction of current flow though the resistance, like figure 2.

Advantages:

- To gain time;
- Completing and fixing the knowledge acquired through classical experiment;
- Experimental data more accurate.

Disadvantages:

- Passive participation in front simulation.

Computer simulation of physics experiments is well come as a complement to classical experiments on laboratory, together leading to a deep learning, for the duration.

**Conclusions**

Multimedia is one of the most powerful tools available in physics education, such as laboratory experiments, modelling, computational activities, chalk and talk presentation, active and interactive home-work. Three main areas are highlighted:

- integration of Multimedia in class work and lab activities;
- the role and contribution of multimedia to teaching/learning of specific physics topics and integrated MM activities such as modelling and on-line measurements in school work, in home-work and in distance learning;
- multimedia as a learning environment and resource for scientific education in any level education in schools.

A good lesson, a successful one is achieved when the teacher and the students work together. The teacher must choose the appropriate teaching methods, types of activities and interaction by taking into account the level of his/her students, the materials he/she has and the goals. Activities can include so experiments and other modern tools, like audio – video tools, when the students must observe, practice and draw conclusions. They can watch training films, make use of maps, cards, pictures, real objects and other teaching tools. Methods used must vary, according to the topic, the students' response or moment of the lesson where they are used. It is good traditional and modern methods as well, like: demonstration, problem-solving, observation, conversation, learning through discovery, modelling on the computer, didactic games on the computer or practical games. The lesson will prove to be successful if the students understand the concepts and use them in exercises and problems. The teacher can avoid improvised or useless activities and stimulate his students to progress gradually, by avoiding boredom and lack of interest, wasting time and effort. The lesson must contribute to their systematic knowledge and to their maturity. The information they learn must be used in everyday life, so that teaching and learning can connect with their life.

The multimedia tools make an interactive lesson, the students haven’t time to bore, and they wake up the interest in a nice manner. It isn’t must insisted, the modern tools must combination with the traditional tools for a dynamical lesson, not monotone.

Pupils learn and understand better the physical phenomena and how data are represented and interpreted from graphs through fun activities on computer modelling. Students discover that the graph is a versatile tool for understanding the meaning of data, for better understanding of phenomena.

The access to the different soft, the access to the Internet or other information means determine that the student's evaluation isn't only traditional also: memory the lesson or resolve the problems. In this time we can assess the student's portfolio or the student's individual paper or team paper.

In this way the multimedia aids have one important impact for the teaching – learning processing of Physics and stimulates visual and hearing memory and transposes the student in the thick of the Phenomena.

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# Software application for fabric material behavior prediction

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**Abstract**

*This work is presenting a software application made for predict the mechanical parameters required in garment simulation. This application is based on neuronal networks. The software "Fabric Material Editor" is based on a relational database "Kawabata-base" that was done by testing the cloth on Kawabata evaluation System. The software application uses a series of equation for calculate the resistance to compression, traction, friction, shear and bend and to give the domain application for the fabric. If the user has the information about thickness, weight and textile structure, then he can create a new article in database and can find the resistances parameters values and the optimal destination for the fabric. The application is addressed to the teachers or students, for specialized courses or for usage in garment product simulation.*

**Keywords**: Kawabata, database, fabric, garment, simulation.

## Introduction

The Kawabata Evaluation System (KES) is used to assess the elastic properties of the fabric based on experimental observations (Kawabata and Niwa, 1989). KES system provides the answer to the question: does the different fibres, yarns, textile structures and finishing treatments to feel comfortable in that our product? And provides the means for predicting human response - comfortable, uncomfortable [2]. This system is applying small forces - to reproduce human achievement.

Kawabata objectively measured mechanical properties related to comfort perception [2]. Kawabata Evaluation System consists of a series of devices that measure the properties of fabrics that allow predictions of how aesthetic and tactile, it is seen to touch a cloth [2, 3]. This system is designed to define the importance of flexion, thickness, softness, drapery and stretch fabric to achieve tactile sensations.

By performing mechanical work on a surface of a textile fabric is made of energy change with an equal amount of work done on the textile surface. Here the work necessary fabric stretching or compression is a form of energy exchange between the fabric and the surrounding world.

The parameters that are using in this work can be usefully for creating the virtual cloth or for generating the optimal destination for the selected fabric (figure 1). By performing the usage of the Fabric Editor Application can allow prediction for fabric simulation.

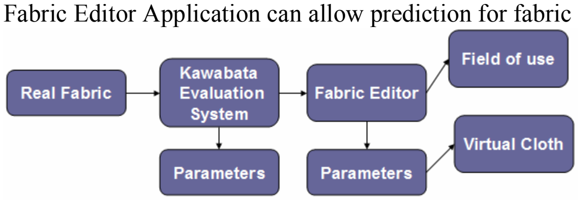


*Figure 1*: **Process for finding the destination for real fabric and for creating virtual cloth**

## 2. Fabric Editor Application

This application was based on the experimental results from Kawabata Evaluation System. The algorithm is based on a series of equations obtained by using the interpolation method based on mechanical parameters. The materials attributes were introduced in a database that contains information about mechanical parameters and 2D texture of the textile materials. From this database the client can choose the material by selecting from combo box and using the button Preview (figure 2). The mechanical parameters refer to the stretching, bending, shearing and compression resistance, but not least to the friction, weight and thickness of the textile material (Aileni, 2011).l. The application can predict the best destination for selected item (figure 3) by using the button Destination. Also it is possible to introduce and save the new material (figure 4)

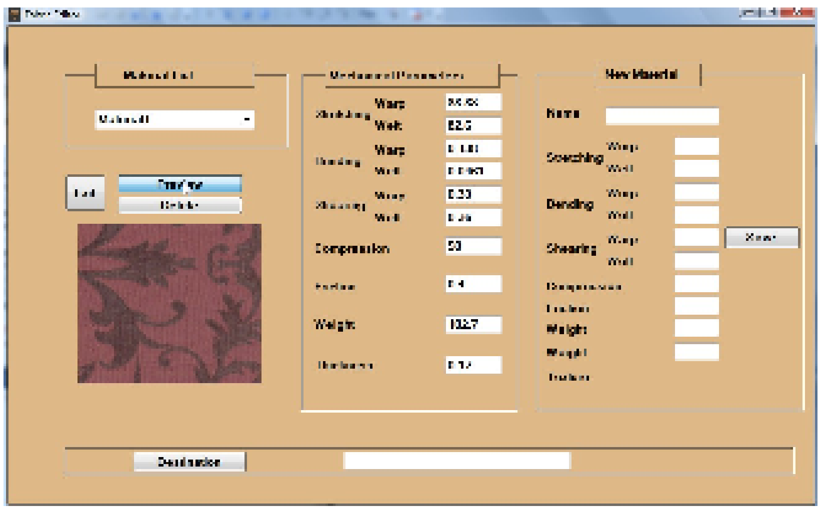


*Figure 2*: **Selecting and preview the material**

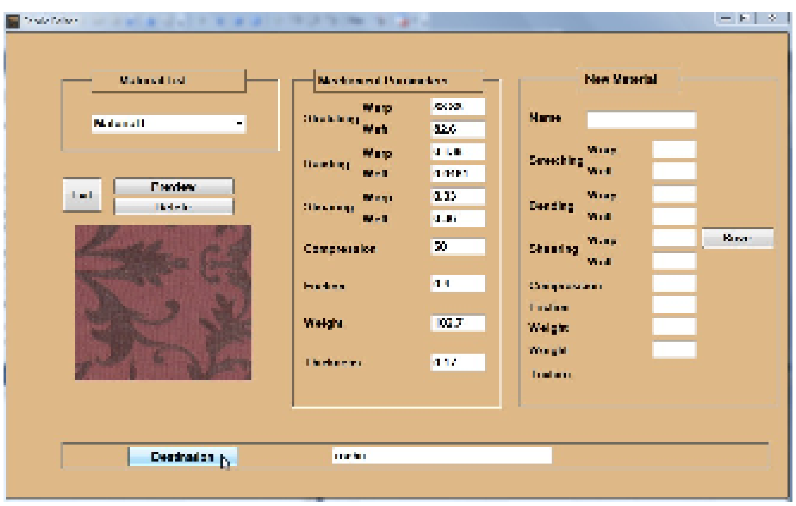


*Figure 3:* **Finding the destination for selected item**

The proper use of fabric is predicted from analogies made between display parameters.

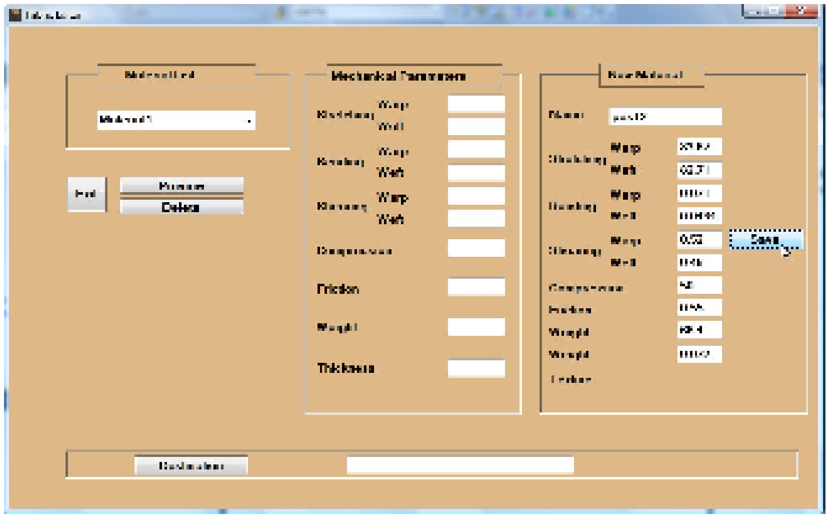


*Figure 4:* **Introducing and saving the new article**

Also the user by using the Delete button can erase the parameters and destination for selected fabric.

The user can’t delete permanently a recorded fabric article from database.

For newly introduced fabric in the database user can find the destination of the material depending on the extent to which physical and mechanical parameters of material it holds fall within the scope of use as standard.

## Conclusion

This application is a useful for production area if the producer hasn’t access to the Kawabata System. The usage of these parameters is necessary for student and teachers at the specialized classes.

The program works as an expert system with a base of true statements related to physical and mechanical parameters values.

The advantages of this application are:

- Finding quickly the best usage for the fabric;
- Large volume of information systematic, orderly;
- Possibility to store information about materials in database;
- Possibility to get the destination for new material saved on database.

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# Refactoring Impact Formal Representation on the Internal Program Structure

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**Abstract**

*Refactoring is a commonly accepted technique to improve the structure of object-oriented software. The refactoring impact on the internal program structure representation may be expressed as the affected node and edge number within the studied abstract syntax tree. New formalisms on refactoring description are approached and applied to an experimental source code case study.*

**Keywords**: Refactoring, Object-oriented programming, Abstract Syntax Tree

**Introduction**

Software systems continually change as they evolve to reflect new requirements, but their internal structure tends to decay. Refactoring is a commonly accepted technique to improve the structure of object oriented software (Fowler, 1999).

In order to formally describe the transformations applied through refactoring, a suitable representation of the object oriented programs is required. In [MVEDJ05] a graph representation of an object oriented program is provided. This representation may be viewed as an abstract syntax tree improved by extra edges. It allows to express in a formal and clear manner the value of graph rewriting when formalizing refactorings.

An abstract syntax tree (AST) is a tree representation of the abstract syntactic structure of source code written in a programming language. Each node of the tree denotes a construct occurring in the source code. The syntax is 'abstract' in the sense that it does not represent every detail that appears in the real syntax.

The refactoring impact on the internal structure representation as AST was investigated here. Therefore, the refactoring impact on the internal program structure representation was expressed as the affected node and edge number within the studied AST, following the proposed formalisms. The new impact-based refactoring description was achieved on several relevant refactorings and applied to an experimental source code case study.

The paper is organized as follows: a new formal representation of the refactoring impact on the internal structure of the source code is presented by Section 2. It introduces new formal notations on the AST node and edge affected number after an applied refactoring. Section 3 rigorously approaches the new impact-based refactoring description for several relevant refactorings, as: ***MoveMethod***, ***MoveField***, ***ExtractClass***, and ***InlineClass***. Formal notations are used for an experimental didactic case study, shortly reminded by Subsection 3.1, where the tackled refactorings where applied. The paper ends with conclusions and future work.

**Formal Representation of the Refactoring Impact on the Source Code Internal Structure**

This section formally introduces new notions on the internal structure representation, reflected by changes on the AST. Based on the notations previously introduced (DuBois and Mens, 2003), additional notations are needed to formalize the refactoring impact on the node and edge types within the corresponding AST of the source code.

***Node and Edge Type-Based Formalisms on AST***

**Definition 2.1**(Chisăliţă-Creţu, 2010) ***(Node type total number)***:

Let $\Sigma_c = \{M, A, P, L, E\}$ be a set of possible node types to whom a $C$ lass node type $c$ may be connected through edges of different edge types and $T(c)$ the corresponding AST. Then, the **node type total number** for a node type $X, X \in \Sigma_c$, denoted by $\# X(T(c))$, is the total number of nodes sharing the node type $X$ within $T(c)$.

Following the **Definition 2.1**, additional notation for specific node types total number may be described as $noX(c) = \# X(c),\ X \in \Sigma_c$.

**Definiton 2.2** (Chisăliţă-Creţu, 2010) ***(Edge type total number)***:

Let $\Gamma_{cls} = \{i, t, c, a, u\}$ be the set of all possible edge types to whom a $C$ lass node type $cls$ may be connected through nodes of different node types, $\varepsilon$ a regular expression over the $\Gamma_{cls}$ and $T(cls)$ be the corresponding AST. Then, the **edge type total number** for an edge type $\gamma, \gamma \in \Gamma_{cls}$, denoted by $\# ET(cls, \gamma)$, is the total number of edges sharing the edge type $\gamma, \gamma \in \Gamma_{cls}$ or the regular expressions $\varepsilon$ over $\Gamma_{cls}$ that contain the $\gamma$ literal, incident to $T(cls)$.

Based on the **Definition 2.2**, additional notations are introduced to express the edge types total number, as:

a. $noET_i(cls, \gamma) = \# ET(cls, \gamma)_{inc}$ is the total number of $\gamma$ type edges from outside node of $T(cls)$ to inside nodes of $T(cls)$;

b. $noET_o(cls, \gamma) = \# ET(cls, \gamma)_{out}$ is the total number of $\gamma$ type edges from inside nodes of $T(cls)$ to outside nodes of $T(cls)$;

c. $noET_w(cls, \gamma) = \# ET(cls, \gamma)_{int}$ is the number of $\gamma$ type edges between inner nodes of $T(cls)$;

d. $noET(cls, \gamma) = noET_i(cls, \gamma) + noET_o(cls, \gamma) + noET_w(cls, \gamma)$.

***Node and Edge Type-Based Formalisms for the Refactoring Impact***

**Definition 2.3** (**Node Type Refactoring Impact Number**):

Let $\Sigma_c = \{M, A, P, L, E\}$ be a set of possible node types to whom a $C$ lass node type $c$ may be connected through edges of different edge types, $T(c)$ the corresponding AST, $r$ an applied refactoring to $T(c)$, $X(T(c), r+)$ the set of added nodes to the $T(c)$ after the $r$

refactoring is applied, and $X(T(c),r-)$ the set of removed nodes from the $T(c)$ after the $r$ refactoring is applied.

Then, for a node type $X, X \in \Sigma_c$ are defined:

i. **addition node type refactoring impact number**, denoted by $\# X(T(c),r+)$, is an integer value that expresses the number of $X$ type nodes added to the $T(c)$, after the $r$ refactoring is applied;

ii. **removal node type refactoring impact number**, denoted by $\# X(T(c),r-)$, is an integer value that expresses the number of $X$ type nodes removed from the $T(c)$, after the $r$ refactoring is applied.

**Proposition 2.1:** Let $\Sigma_c = \{M, A, P, L, E\}$ be a set of possible node types to whom a $C$ lass node type $c$ may be connected through edges of different edge types, $T(c)$ the corresponding AST, $r$ an applied refactoring to $T(c)$, $X(T(c),r)$ the set of $X$ type nodes within $T(c)$ after the $r$ refactoring is applied, $X(T(c),r+)$ the set of $X$ type nodes added to the $T(c)$ after the $r$ refactoring is applied, and $X(T(c),r-)$ the set of $X$ type nodes removed from the $T(c)$ after the $r$ refactoring is applied.

Then, for a node type $X, X \in \Sigma_c$ the following properties hold:

i. $X(T(c),r+) = X(T(c),r) - X(T(c))$;

ii. $X(T(c),r-) = X(T(c)) - X(T(c),r)$;

iii. $\Delta X(T(c),r) = X(T(c)) \Delta X(T(c),r) =$
$(X(T(c)) - X(T(c),r)) \cup (X(T(c),r) - X(T(c))) =$
$X(T(c),r-) \cup X(T(c),r+)$;

iv. $\# \Delta X(T(c),r) = -\# X(T(c),r-) + \# X(T(c),r+)$;

iv. if $X(T(c),r+) = \varnothing$ and $X(T(c),r-) = \varnothing$
then $\Delta X(T(c),r) = \varnothing$ and $\# \Delta X(T(c),r) = 0$;

vi. if $X(T(c),r+) = \varnothing$ and $X(T(c),r-) \neq \varnothing$
then $\Delta X(T(c),r) = X(T(c),r-)$ and $\# \Delta X(T(c),r) = -\# X(T(c),r-)$;

vii if $X(T(c),r+) \neq \varnothing$ and $X(T(c),r-) = \varnothing$
then $\Delta X(T(c),r) = X(T(c),r+)$ and $\# \Delta X(T(c),r) = \# X(T(c),r+)$;

viii. if $X(T(c),r+) \neq \varnothing$ and $X(T(c),r-) \neq \varnothing$
then $\Delta X(T(c),r) = X(T(c),r-) \cup X(T(c),r+)$ and

ix. $\# \Delta X(T(c),r) = -\# X(T(c),r-) + \# X(T(c),r+)$.

Following the **Definition 2.3**, the specific node types refactoring impact number may be defined as $noX(c,r) = \# \Delta X(T(c),r)$, $X \in \Sigma_c$ and $r$ is the applied refactoring to the $T(c)$.

**Definition 2.4** (**Edge type refactoring impact number**):

Let $\Gamma_{cls} = \{i,t,c,a,u\}$ be the set of all possible edge types to whom a $C$ lass node type $cls$ may be connected through nodes of different node types, $T(cls)$ the corresponding AST, $r$ an applied refactoring to $T(cls)$, $ET(cls,\gamma,r+)$ set of added $\gamma$ type edges to the $T(cls)$ and $ET(cls,\gamma,r-)$ the set of removed $\gamma$ type edges from the $T(cls)$, $\gamma \in T(cls)$.

Then, for an edge type $\gamma, \gamma \in \Gamma_{cls}$, are defined:

i. **addition edge type refactoring impact number**, denoted by $\#ET(cls,\gamma,r+)$, is an integer value that expresses the number of $\gamma$ type edges added to the $T(cls)$, after the $r$ refactoring is applied;

ii. **removal edge type refactoring impact number**, denoted by $\#ET(cls,\gamma,r-)$, is an integer value that expresses the number of $\gamma$ type edges removed from the $T(cls)$, after the $r$ refactoring is applied.

**Proposition 2.2:** Let $\Gamma_{cls} = \{i,t,c,a,u\}$ be the set of all possible edge types to whom a $C$ lass node type $cls$ may be connected through nodes of different node types, $T(cls)$ the corresponding AST, $r$ an applied refactoring to $T(cls)$, $ET(cls,\gamma,r)$ the set of $\gamma$ type edges within $T(cls)$ after the $r$ refactoring is applied, $ET(cls,\gamma,r+)$ the set of $\gamma$ type edges added to the $T(cls)$ after the $r$ refactoring is applied, and $ET(cls,\gamma,r-)$ the set of $\gamma$ type edges removed from the $T(cls)$ after the $r$ refactoring is applied, $\gamma \in T(cls)$.

Then, for an edge type $\gamma, \gamma \in \Gamma_{cls}$, the following properties hold:

i. $ET(cls,\gamma,r+) = ET(cls,\gamma,r) - ET(cls,\gamma)$;

ii. $ET(cls,\gamma,r-) = ET(cls,\gamma) - ET(cls,\gamma,r)$;

iii. $\Delta ET(cls,\gamma,r) = ET(cls,\gamma)\Delta ET(cls,\gamma,r) =$
$(ET(cls,\gamma) - ET(cls,\gamma,r)) \cup (ET(cls,\gamma,r) - ET(cls,\gamma)) =$
$ET(cls,\gamma,r-) \cup ET(cls,\gamma,r+)$;

iv. $\#\Delta ET(cls,\gamma,r) = -\#ET(cls,\gamma,r-) + \#ET(cls,\gamma,r+)$;

v. if $ET(cls,\gamma,r+) = \varnothing$ and $ET(cls,\gamma,r-) = \varnothing$
then $\Delta ET(cls,\gamma,r) = \varnothing$ and $\#\Delta ET(cls,\gamma,r) = 0$;

vi. if $ET(cls,\gamma,r+) = \varnothing$ and $ET(cls,\gamma,r-) \neq \varnothing$
then $\Delta ET(cls,\gamma,r) = ET(cls,\gamma,r-)$ and
$\#\Delta ET(cls,\gamma,r) = -\#\Delta ET(cls,\gamma,r-)$;

vii. if $ET(cls,\gamma,r+) \neq \varnothing$ and $ET(cls,\gamma,r-) = \varnothing$
then $\Delta ET(cls,\gamma,r) = ET(cls,\gamma,r+)$ and
$\#\Delta ET(cls,\gamma,r) = \#ET(cls,\gamma,r+)$;

viii. if $ET(cls,\gamma,r+) \neq \varnothing$ and $ET(cls,\gamma,r-) \neq \varnothing$
then $\Delta ET(cls,\gamma,r) = ET(cls,\gamma,r-) \cup ET(cls,\gamma,r+)$ and

$$\#\Delta ET(cls,\gamma,r) = -\#ET(cls,\gamma,r-)+\#ET(cls,\gamma,r+);$$

Based on the **Definition 2.4**, additional notations are introduced to express the edge types total number, as:

a. $noET_i(cls,\gamma,r+) = \#ET(cls,\gamma,r+)_{inc}$ and $noET_i(cls,\gamma,r-) = \#ET(cls,\gamma,r-)_{inc}$ are the number of $\gamma$ type edges added to and removed from outside nodes of $T(cls)$ to inside nodes of $T(cls)$, after the $r$ refactoring is applied;

b. $noET_o(cls,\gamma,r+) = \#ET(cls,\gamma,r+)_{out}$ and $noET_o(cls,\gamma,r-) = \#ET(cls,\gamma,r-)_{out}$ are the number of $\gamma$ type edges added to and removed from inside nodes of $T(cls)$ to outside nodes the $T(cls)$, after the $r$ refactoring is applied;

c. $noET_w(cls,\gamma,r+) = \#ET(cls,\gamma,r+)_{int}$ and $noET_w(cls,\gamma,r-) = \#ET(cls,\gamma,r-)_{int}$ are the number of $\gamma$ type edges added to and removed from inner nodes of $T(cls)$, after the $r$ refactoring is applied;

d. $noET(cls,\gamma,r+) = noET_i(cls,\gamma,r+) + noET_o(cls,\gamma,r+) + noET_w(c,\gamma,r+)$ is the number of added $\gamma$ type edges that are incident to the $T(cls)$, after the $r$ refactoring is applied;

e. $noET(cls,\gamma,r-) = noET_i(cls,\gamma,r-) + noET_o(cls,\gamma,r-) + noET_w(cls,\gamma,r-)$ is the number of removed $\gamma$ type edges that were incident to the $T(cls)$, after the $r$ refactoring is applied;

f. $noET(cls,\gamma,r) = -noET(cls,\gamma,r-) + noE(cls,\gamma,r+)$ is the impact on the $\gamma$ type edge total number, after the $r$ refactoring is applied.

**The Impact-Based Refactoring Description Approach**

In order to formally describe refactorings, an impact-based approach was investigated. The considered refactorings were: ***MoveMethod***, ***MoveField***, ***ExtractClass***, and ***InlineClass***. The studied procedure follows the notations introduced in (DuBois and Mens, 2003) and the refactoring impact expressed as affected node and edge number on the internal structure representation as AST. Therefore, there are several aspects related to the refactoring impact that cannot be computed or expressed in AST terms.

***Case Study: Didactic Activity Management Problem***

Two classes from a larger architecture of a *Didactic Activity Management Problem* (*DAMP*) developed in `Java` are extracted. They contain information related to courses and projects. *Courses* may be registered to *projects* to compete for some research funds.

The `Course` class has the following attributes: name (`courseName`), `specialty`, study `semester`, number of classes per week (`noClasses`), number of credits (`noCredits`), discipline type (normal or optional) (`courseType`), `package` name (for an optional discipline), number of optional courses within the package (for an optional discipline) (`noCourses`), project type to whom the discipline may participate (`projectType`), teacher's name (`teacherName`), didactic `degree`, `experience`. The `Project` class consists of a reference to a `Course` object, with methods that assess the course that participate within the competition, classifies the `score` obtained by each course and set the final `result`.

*Difficulties.* The current extract is somehow hard to manage due to the high coupling between classes. The `assessCourse` method is defined in the `Project` class, though there is a logical dependency with the `Course` class. Moreover, the `Course` class is defined by attributes that may belong to at least two different classes. First, the information about `normal` and `optional` courses may be split between corresponding classes. Second, information about the project and the teacher are mixed with those related to courses. Third, `Course` class attributes are public, allowing clients to directly access them.

*Solutions.* There are several refactorings that may increase the flexibility within the internal structure. Therefore, the *MoveMethod* refactoring may be used to reduce coupling between classes by moving the `assessCourse` method to the appropriate class. The `projectType` attribute may be moved to the `Project` class using the *MoveField* refactoring. In order to separate `normal` from `optional` courses, due to the `courseType`, `package`, `noCourses` attributes, a new class may be created to logically isolate behavior. Thus, refactorings like *ExtractClass*, *ExtractSuperclass*, *ExtractSubclass*, *ExtractInterface* may be used.

***Selected Refactoring for the Formal Impact-Based Description***

The ***MoveMethod***, ***MoveField***, ***ExtractClass***, and ***InlineClass*** refactorings applications were studied for the propoed source code. For each refactoring, a formal definition of the impact on the AST is given, based of the notations presented in Section 2. The identified formulas are applied for each affected class before and after each refactoring application. Due to the space limitations, only the ***MoveMethod*** refactoring formal description is presented here with several results on the approached source code and the effects on the internal structure for the analyzed classes.

**The *MoveMethod* Refactoring**

Roberts (Roberts, 1999) defines the ***MoveMethod*** refactoring as: $MoveMethod(m:M, A:C, B:C)$, where $A, B \in C$ are classes from a set of classes $C$ and $m$ is a method from class $A$ that will be moved to class $B$. The refactoring affects the class $A$ and $B$ as well. Class $B$ functionality is enriched by a method, while the number of methods of class $A$ is decreased by one. Complexity within the $B$ class is raised by the formal parameter list of method $m$, the $m$ method body itself, the number of accesses and updates of the defined attributes within the $B$ class from the $m$ method definition. The $A$ class complexity decreases for the same reasons.

Consequences on the AST for the source class $A$ and for the target class $B$ were formalized. Due to the space limitations, only the impact on the AST nodes number is presented here.

**Proposition 3.1** Let $m$ be a method within an $A$ class that is moved to a $B$ class by the ***MoveMethod*** refactoring application (denoted by $r$). The refactoring impact on the AST number of nodes on the source class $A$ and the target class $B$ are:

i. changes on the **M**ethod type nodes are:

- $noM(A,r) = -\#M(T(A), r-) = -1$, $noM(B,r) = \#M(T(A), r+) = 1$;

ii. changes on the **A**ttribute type nodes are:

- $noA(A,r) = 0$, $noA(B,r) = 0$;

iii. changes on the **P**arameter or return value, **L**ocal variable, and **E**xpression type nodes are:

- $noX(A,r) = -\# X(T(m), r-)$, where $m \in A$ is removed, $X \in \{P, L, E\}$;
- $noX(B,r) = \# X(T(m), r+)$, where $m \in B$ is added, $X \in \{P, L, E\}$.

**Refactoring impact on the case study.**
The ***MoveMethod*** refactoring was applied to the case study presented in Section 3.1. The `assessCourse` method from the `Project` class was moved to the `Course` class. Its move is facilitated by the existence of a reference of type `Course` within the `Project` class. Therefore, calls to the method from the `Project` class are redirected to the `assessCourse` method from the `Course` class, i.e., from `assessCourse` to `course.assessCourse`, as it follows within the `setScore` method body. **Table 1** and **Table 2** show the changes on the AST for the node and edge types of the `Course` and the `Project` classes, before and after the ***MoveMethod*** refactoring was applied.

*Table 1*. **The node types number for the `Course` and the `Project` classes *before* and *after* the *MoveMethod* refactoring application**

| Node type | $\# T(Course)$ | | $\# T(\mathrm{Pr}oject)$ | |
|---|---|---|---|---|
| | before | after | before | after |
| M | 0 | 1 | 3 | 2 |
| A | 12 | 12 | 3 | 3 |
| P | 0 | 1 | 1 | 0 |
| L | 0 | 1 | 1 | 0 |
| E | 0 | 19 | 68 | 43 |

*Table 2*. **The number of the edge types for the `Course` (C) and `Project` (P) classes *before* and *after* the *MoveMethod* refactoring (r) application**

| Edge type($\epsilon$) | $noET_w(cls, \epsilon)$ | | | | $noET_i(cls, \epsilon)$ | | | | $noET_o(cls, \epsilon)$ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | before | | After | | Before | | after | | before | | After | |
| | C | P | C | P | C | P | C | P | C | P | C | P |
| I | — | — | — | — | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| T | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 12 | 5 | 14 | 3 |
| C | 0 | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 20 | 7 | 11 |
| A | 0 | 22 | 8 | 13 | 7 | 0 | 1 | 0 | 0 | 7 | 0 | 1 |
| U | 0 | 8 | 2 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Conclusions and Future Work**
This paper introduces a new formal representation of the refactoring impact on the internal structure of the source code. The studied procedure follows the notations introduced by (DuBois and Mens, 2003) on the internal structure representation as AST. It advances new formal notations on the AST node and edge affected number after an applied refactoring.

New impact-based refactoring description for several relevant refactorings, as: ***MoveMethod***, ***MoveField***, ***ExtractClass***, and ***InlineClass*** are rigorously approached. Formal notations are used for an experimental didactic case study where the tackled refactorings were applied.

The research focused on the refactoring impact may be driven by the several aspects in the future. A new catalog with the formal refactoring impact on the internal structure representation as AST for a set of relevant refactorings, from different categories may be build. It may be used as a starting point to build a refactoring strategy based on different internal quality attributes. Different compound refactorings may be further analyzed in order to identify the basic refactoring impact.

Moreover, such analysis may reveal that primitive refactorings that are a part of a larger one may reverse the impact on another refactorings applied. The current AST representation limitations in describing complex refactorings may be removed by extending it with appropriate notations.

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# S e c t i o n

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# Learning Chemistry through Puzzle Based Game: Atoms to Molecule

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**Abstract**

*This paper highlights the design of a chemistry based puzzle game. The design of the game is meant to teach basic concepts of chemistry related to covalent bonds. The area of Educational Technology is still not so developed for young learners. An interactive technology is required for learning effectively and efficiently. The result is Atoms to Molecule (A2M). In A2M the environment of the levels are designed as such a player will have complete feel of chemistry lab. This game tries to intact fun with education. In this paper we are trying to highlight the features of chemistry objects which are used in our game. While teaching the basic concept of Chemistry, like bonds between atoms and how molecules are formed teacher usually gives examples to define the formation of bonds. However, the concepts of atoms and molecules are difficult for students to imagine. This game A2M has clearly presented the concepts lying behind the formation of bonds, game rules and simple game levels is chosen as the teaching aid along with a fun puzzle game.*

**Keywords**: Chemistry, Game Based Learning, Game Design, Puzzle

## Introduction

Game designing is becoming very popular now a day. This is because now a day's games are not made only for fun and entertainment but also for education [1]. Digital games (video games or computer games) are positively accepted among children and teenagers [2, 3]. Multimedia based learning environment are more efficient than reading contexts. It can easily grasp interest of students. However it is generally found Digital Games Based Learning (DGBL) cannot maintain the fun element up to that level. It is becoming very challenging to combine education with fun in equal ratios. Computer games with exciting interactive activities and interesting multimedia provide a way to motivate students to learn actively and interestingly. Normally the time period of classes are 45 – 50 minutes, so it is very important to design simple, short and interesting games. Education games, which take 20 hours to teach, can become boredom again. Some educational games are very complex. Educational technology still lacks in research on how to design game environment that foster knowledge construction and deepen understanding and problem solving while engaging and entertaining the player at the same time [4].

Teachers usually need to explain the concepts of formulation of molecule from atom, which can be very difficult to demonstrate. It motivates this paper of applying the game-based learning approach to assist students in manipulating and observing the relationship of atoms to form molecules [5]. Research data also showed that the use of games in education is perceived as a useful tool for learning and helped to engage students in educational experiences towards achieving specific learning goals and outcomes [3, 6, 7, 12].

The game A2M is interesting and more acceptable for students to realize the abstract concepts through the fun and interactive world of the game. With our survey, some practitioners used the puzzle games as a teaching tool [8, 9, 10]. It seems that the game is interesting and more acceptable for students to realize the abstract concepts through the real world examples.

This paper is organized as follows. First we discuss the Game Description. Second, we discuss the details of the different objects used in the game. Third, we introduce the design of different levels used in the game and scoring patterns. Last, we report the qualitative and quantitative findings from a user study with three groups of students.

***Game Description***

Atoms to Molecule (A2M) is a single player puzzle game where player is in a Chemistry lab. Each level consists of lab equipments and atoms. The levels start with the atoms entering from the top of the screen. The number of atoms in a level is constant and the type of atoms is generated randomly. Player can drag and drop the atoms to make bonds with nearest atom [11]. A player can easily replace the atoms by joining them to form molecules, this molecule disappears and new randomly generated atoms replace the used atoms.

A player can make molecule by joining different atoms. The task of a player is to make molecules and solve different puzzles of Chemistry lab. Player can arrange atoms to make ring, linear, small or big molecules. The lab equipments in which A2M is played can be test tube, beaker, conical flask and other (see Fig. 1). The basic goal in each level is to make different kinds of molecules with different objectives. To make a complete molecule all the atoms in the molecule must be sleeping which can be achieved by using all their bonds (see Table 2).

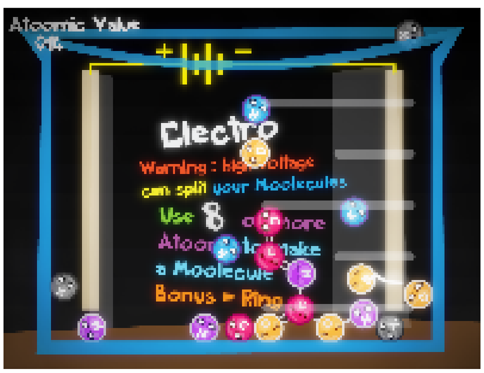

*Fig. 1.* **Atoms to Molecule game**

A2M is a puzzle based game base on the covalent nature of atoms. Here the atoms are used as a puzzle piece and to form a molecule is to solve a puzzle. While solving these puzzle students learns to make molecule from atoms using covalent bonds, which can be single, double and triple.

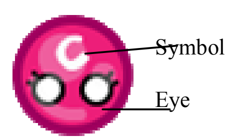


*Fig. 2.* **Details of Carbon Atom**

**Basic Game Objects**

***Atoms***

The main character of the game is atom. The look of the atom is developed to be more attractive to the young learners. The symbol in the head and the circular body color suggest the type of element (see Table 1). The four elements with different number of bonds used in this game are Hydrogen, Oxygen, Nitrogen and Carbon. ElementX is an element, which can make variable bonds with maximum of three, designed to add fun in the game.

*Table I* **Atom Detail Chart**

| **Element** | **Symbol** | **Color** | **Total Number of bonds** |
|---|---|---|---|
| Hydrogen | H | Blue | One |
| Oxygen | O | Orange | Two |
| Nitrogen | N | Violet | Three |
| Carbon | C | Red | Four |
| ElementX | X | Black | Variable with maximum of Three |

We have assigned the gender depending upon the total number of bonds an atom can make. The intension behind assigning the gender is to distinguish between odd and even number of bonds (see Table 2). For odd number of bonds in atom we have assigned boy e.g. Hydrogen. For even number of bonds in atom we have assigned girl e.g. Oxygen.

This assignment of gender leaves deep impact on children mind to easily figure out between odd and even number of bonds an atom can make. Thus this assignment serves both the purpose of education and entertainment.

The different eye states are connected with different state an atom can have (see Table 2).

### *Bond*

When an atom dragged and dropped near an atom a bond forms between them. Bonds can be Single, Double or Triple. The atom always tries to make the highest number of bonds. When an atom is dragged it shows the bonds left to be formed and when it is brought near another atom it show the possible number of bonds that can be formed (see Fig. 3).

*Table II* **Atom Eye State Chart**

| State | Look (Girl) | Look (Boy) | This happens when |
|---|---|---|---|
| Normal | | | The atom in the free state. |
| Open | | | The atom is bonded with some other atom but all its bonds are not satisfied. In this state the atom jitters. |
| Cross | × × | × × | It comes in contact with some enemy causing it to break all its bond. It changes back to normal. This is a short time effect. |
| Happy | | | All the bonds of the atom are satisfied. This is a momentary effect; it automatically changes to sleep after some times. |
| Sleep | | | All the bonds of the atoms are satisfied. |

### *Bond Angle*

Bond angle define the angle in which the newly attached atom will arrange itself. The angles in which an atom can be attached are 0, 120, 240, 60, 180 and 300 degree. The angles are chosen so that no two atoms are very close to each other.

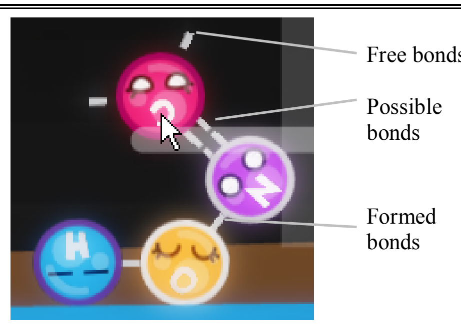


*Fig. 3.* **Different kind of bonds**.

### *Game Enemy*

#### Radioactive Atom

This used as an enemy in the game. It has a radioactive sign on its head and the expression of the eyes shows anger. In the game it emits green smoke (see Fig. 4). It

*Fig. 4.* **Radioactive Atom in action**

moves randomly in the level area and breaks all the bonds of the atom that comes in contact. To make it inactive we can drag and drop it an empty space of the level area, but the moment it come in contact with other object it becomes active again. As radioactive substances are very harmful for our environment, similarly we tried to demonstrate that radioactive substances are enemy to our molecular structure in the game.

### Electrode

They are static enemies, they can't move around like the radioactive atom. When the atoms come in contact with the electrode it gets a heavy shock and its bonds get split (see Fig. 1).

### Game Modes

#### *Adventure*

Adventure Mode is the primary mode, and it allows a player to learn the ways to make molecules and then advancing to the expert levels. Adventure Mode is divided into 8 stages. The stages and how it is related to learning objective are as shown on Table 3.

*Table III* **Atom Detail Chart**

| Level | Description | Learning Objective |
|---|---|---|
| Tutorial | This is an introductory level here the different atoms used (see Table 1) in the game are introduced. The molecule a player has to make is shown as a hint in the background of the level. | The player learns the game controls and tries to make some basic molecules. |
| Ring-O-Ring | In this level a player have to make 8 ring molecules to move to the next level. | The player learns to make ring molecules. |
| Absolute Zero | This is a fast-paced level the bonus in the level is ring bonus. In the level a Kelvin scale thermometer showing the temperature is constantly increasing. A player must make molecule to drop the temperature to Zero Kelvin. The molecule with rings gets a bonus and the temperature decreases quickly. | The player learns to make bigger ringed molecules within specific time. |
| Clear All | In this level a player has to make a single molecule using all the 10 atoms present in the level for five times. | The player learns the trick of using all the bonds to form a single molecule. |
| Electro | The level contains an electrode which decreases the level area. The objective of the level is to make molecule having 6 or more atoms, which increases up to 16 at the rate of two atoms at a time. (see Fig. 1) | The player learns to make bigger molecules efficiently using less area in the screen. |
| pH Scale | This is a fast-paced level too; the bonus in the level is Hydrogen Bonus. A pH meter showing a constant increase, a player must make molecule containing more hydrogen to drop the level in the pH meter. | The player learns to make a molecule utilizing maximum number of hydrogen. |
| Clipboard | In this level is player must make the simple molecular | The player learns to make molecule |

#### *Lab Setup*

Lab Setup is a sand box mode where a player can setup a lab (see Fig. 7). Lab Setup is divided into:

**Equipment mode:**

In this mode player can add, move, rotate and clamp lab equipments in the lab area. The equipments are under physics simulation in this mode, but the atoms are not simulated and are kept transparent, i.e. no collision takes place with the atoms.

Lab Equipments that are provided are electrodes, thermometer, pH scale, funnel, test tube, conical flask, measuring cylinder, beaker and clipboard.

**Atomic Mode:**

In this mode a player can add or remove atoms in the Lab area. Molecules can be formed using the added atoms. The types of atoms added are generated randomly. But the molecules formed will not be removed automatically in this mode as it happens in case of Adventure mode. In this mode atoms are under physics simulation but equipments are static.

**Scoring**

The scoring pattern is chosen to suit the chemistry environment. When a molecule is formed and it meets the level objective "Atomic Value" (AV) is awarded in the form of scores (see Fig. 5). Sometimes AV is associated with a bonus multiplier, which gets multiplied with the AV and the total is awarded. The total AV obtained in the level is summation of all the AV of the molecules; it is displayed in the top left corner of the game screen in the levels of the Adventure mode (see Fig. 1).

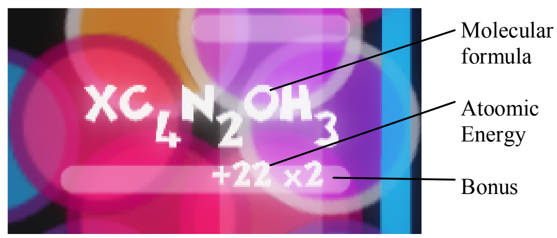


*Fig. 5.* **A molecule disappearing showing up Molecular formula, Atomic Value and a bonus multipler**

**Atomic Value**

Atomic Value (AV) of a molecule is the sum total of all atom's AV present in it. AV of an atom is the number of atoms it is bonded to. So more atoms it is attach to, more is the AV and more is the score. For Example: A carbon attached to an oxygen and two hydrogen atoms, Molecular formula CH2O, AV of the molecule = 3 (for carbon) + 1 (oxygen) + 1 (hydrogen) + 1 (another hydrogen) = 6.

**Ring Bonus**

In most of the levels if a player can form ring molecule the AV gets multiplied with a factor. The factor depends upon the number of rings in the molecule. For Example: If a molecule have 2 rings AV will be multiplied with (2 + 1) = 3 times.

**Hydrogen Bonus**

With Hydrogen bonus the AV is multiplied with the total number of Hydrogen present in it. So a player needs to attach more hydrogen to a molecule to get more bonuses.

**User Study**

**Goals**

A user study with 15 student of different age group was made, to understand the play experience and improve the game design [15]. The research questions were designed to gather the feedback to improve A2M and see how the design was helpful in learning the basic concepts of chemistry. It also determined how the characterization of the chemistry elements helped to grab the attention of the young learners. Our main goal is to realize how learning games can grasp the interest of the player and how much knowledge they gain after playing the game. We hoped to understand the patters of learning among children through games.

**Participants**

We selected fifteen participants varying from age group of 10-20. We categorize them according to their age Group 1 (10-13 years), who are still not introduced to very basic concepts of chemistry, Group 2 (14-16 years) who have started with learning chemistry, Group 3 (17-20 years) who want to explore new things out of this subject. Few of them have never played any educational game before. Four of them were girl. Three of them were very poor in bonding concepts of Chemistry. Five were very curious about game play.

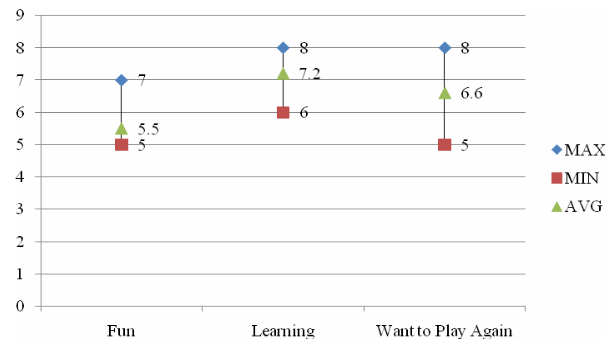


*Fig. 6.* **Feedback Scores**

**Findings and Discussion**

**Feedback About The Game**

We interviewed the students about what they like and dislike. We got positive feedback about the graphics which included characterization of atom, bonding system and the different lab equipments which build up the whole atmosphere of the game. They were comfortable with the controls of the game play which simply uses mouse to drag and drop. They found it very simple and effective way of learning covalent bonding. The negative feedback which we got about the game was that the types of atoms used were limited, only concepts of covalent bonds were shown.

**Chemistry Concepts Learned**

The feedback about the Chemistry concepts they learned while playing the game varied according to the age group. Students belonging to first group find it more entertaining rather than educational (2.3/5). The second group students find it quite educational (3.5/5), they find A2M an interesting way to learn covalent bonding (4.1/5). The third group students find the lab setup (see Fig. 7) very useful (3.8/5). They like the synchronization of chemistry concepts with different levels of the game (4.6/5).

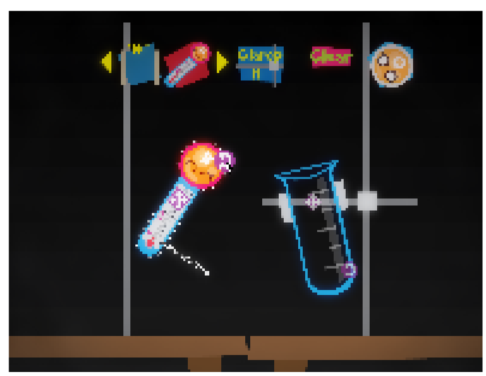

*Fig. 7.* **The game in Lab Setup mode**

**Interesting Aspects**

This user study had some initial findings on the interesting aspects of the game. In the questionnaire, the students found the game enemies to be well designed (4.4/5); they liked the breaking of bonds with the help of electric shock in Electrodes (3.8/5). They find the lab setup to be really interactive and well designed (4/5). They liked the eye state of atoms to define their states (4.8/5). They preferred more levels in the game (2.4/5). They felt the difficulty of the level moderate (3.2/5).

We also observed that when the students Drag and Drop to join the atoms of Hydrogen for the first time to make a molecule of Hydrogen, they get the feel how molecules are formed and they started to create all kinds of molecules which they have came across in their text book. After making the first molecule of Hydrogen most of the student wanted to create Water (H20) molecule as it is a very basic molecule. As they familiar with the game play they were exited to move to the next level before completing one.

The user study of A2M showed that it can be used as educational tool which helped us in learning through games.

## Conclusion and Future Work

We have discussed the basic design of A2M and how it is related with the basic concepts of covalent bonding. We have already discussed about the design of atom, and other details like what elements are used, how many bonds an element can form, and their eye expressions (see Fig. 3). We have tried to explain type of bonds it can form. Details of different levels are discussed. Though A2M is educational game but to add fun we have used enemies which are related to other concepts of chemistry.

The score is given in the form of Atomic Value and other bonus is added in the game. Our main contribution is to demonstrate a practical approach of covalent bonding. In the meantime, we hope to explore more interesting concepts of Chemistry which can be added to our game.

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# Remote experiments in Moisil e-lab

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## Abstract

*Today we are living in a digital world: every student use to stay many hours a day in front of the computer's monitor, linked on the internet. All the science teachers around the world are trying to do their best in what concerned the experiments approaching. A new challenge appears in the Romanian educational landscape: remote labs for high schools. We have developed some remote experiments in the Physics lab of the Grigore Moisil National College from Bucharest like: the distance dependence of the light intensity of a source, the distance dependence of the sound level of a sound source, the I-V characteristics of a photovoltaic cell, the time dependence of the coordinate of a car etc.*

**Keywords**: Remote lab, Physics teaching, Physics experiments, Virtual interaction with real objects.

## Introduction

The major goal of learning with e-lab is to bring our students closer to the real world, to give them a chance to apply their theoretical knowledge in practice in an integrated manner and from a different point of view comparing to the outcomes of the curricular standards (Garabet, M., Neacsu, I., 2010).


*Figure 1* - **Main window of the e-lab**

The idea of using remote labs in high schools is one of the attempts to streamline learning by focusing the activity on students, by differentiating it into a flexible teaching and learning environment, oriented toward the students needs. When students interact with the graphical interface, they actually operate real instruments that exist in the remote laboratory through Internet. The results obtained and viewed on the instruments output from the graphical interface are not simulations, but the actual data read from the instruments in real time (Garabet, M., Miron, C., Popescu, F., Neacşu, I., 2011).

The remote lab we are developing consists of a set of interactive experiments, an archive of recorded signals, being able to download data from experiments for analysis. The documentation of each experiment contains theoretical outlines, tasks, footage with a demonstrative role etc.

Access to Moisil remote laboratory is made through the high school portal: http://portal.moisil.ro. We also use "Moisil live", a system of web cameras integrated into the portal: http://portal.moisil.ro/Pages/moisil_live.htm.

At this point we can perform here experiments such as the study of light intensity distance dependence on the source, the study of sound intensity distance dependence on the source, the study of distance dependence on time in rectilinear motion.

Conducting remote experiments is based on virtual instrumentation LabVIEW. We found some advantages of using clients based on virtual instrumentation (Gillet, D., Salzmann, Ch., Gorrochategui, E., 2000):

- Remote control and interactivity easily obtained, everything happens in LabVIEW;
- Increased flexibility in user interface design;
- Increased security – only the users who access the VI can use the desired experimental system.

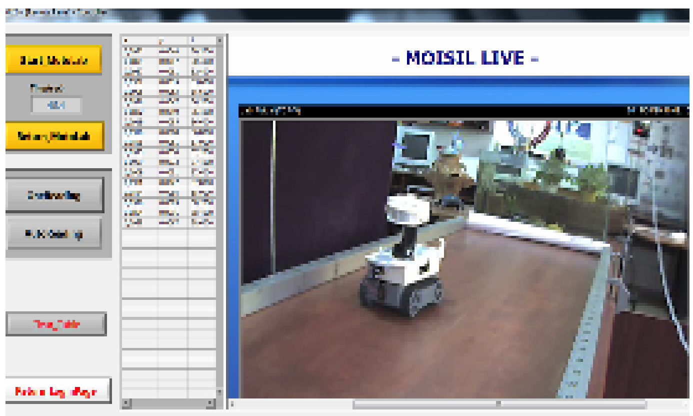


*Figure 2* - **View during an experiment**

Among the most cited disadvantages are included (Gillet, D., Salzmann, Ch., Gorrochategui, E., 2000):

- The need for remote users to use the current version of LabVIEW or to be able to distribute large executables to everyone. Many remote users should access the source code;
- System maintenance is more expensive due to its complexity; a change occurred may require downloading the new client by all users.

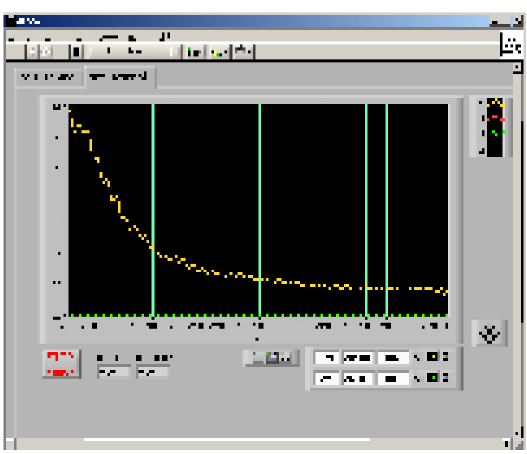

*Figure 3* - **The window for analyzing the signal**

**Change in light intensity with distance from the source**

Light intensity decreases in direct proportion to the square distance from the light source. We invite you to verify this law.

In this experimental set-up version you will use as source an incandescent light bulb, with a power of 150W, powered by 220V alternating current (AC), and for monitoring the light intensity depending on the distance from the source you will use a light sensor. By removing the light source at constant speed from the sensor you will obtain a similar signal to the one in figure 3. The digital-analog converter used will be the acquisition board NIDAQ 6013, and the software is developed in LabVIEW.

**Tasks**

Explain the appearance of undulations (fluctuations) in the signal acquired by the light sensor! (http://education.inflpr.ro).

Save the signal generated as a file which you will open with Microsoft Excel so that you can analyze and process it. After that access the saved file and do the following:

- Represent graphically the illumination expressed in lx, depending on the time t expressed in s. Use XY Scatter chart type!
- Represent graphically the illumination expressed in lx, according to the inverse square of time t expressed in 1/s2. Use XY Scatter chart type!
- Explain the checking of the reverse proportionality law of light intensity with the square distance in this experiment!

**Study of distance dependence on time in rectilinear motion**

The purpose of this experimental work is to study the real movement of a vehicle located on the laboratory table, like in figure 4. The vehicle is the carrier of a small photovoltaic panel that will function as a light sensor. The vehicle moves straight with the help of guidings, passing by sources of light placed at equal distances, at 10 cm, parallel with the guidings. The signal is recorded through the acquisition board NIDAQ – 6013 connected to the terminals of the photocell mounted on the vehicle.

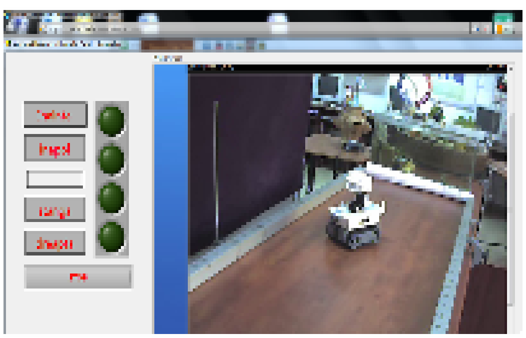

*Figure 4* - **Image of the control panel on the screen of the remote user**

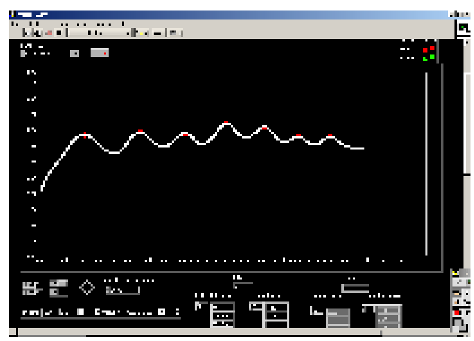

*Figure 5* - **Image of the acquisition window of signal generated by the photovoltaic panel**

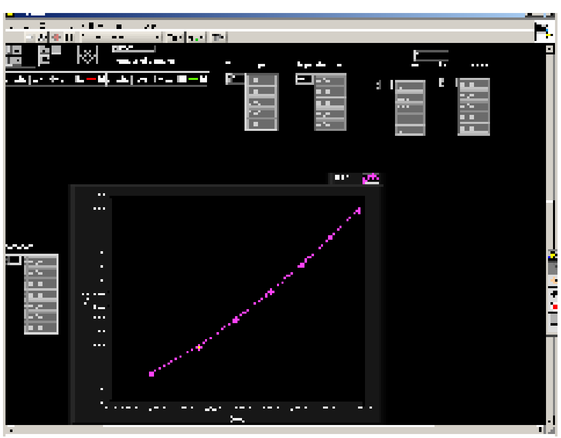

*Figure 6* - **Image of the window of signal processing – drawing x=x(t)**

During passing by the light sources voltage pulses appear on the photocell terminals like in figure 5.

These voltage pulses determine the moments the vehicle passes through the points whose coordinates are known because they have been measured and introduced in the program through a control.

VI for signal acquisition allows selecting these moments of time and the graphical representation of time dependence on the vehicle coordinate as shown in figure 6.

- Save the generated signal in a file that can be accessed with Microsoft Excel so that you can analyze and process it. Access the saved file and do the following:
- Represent graphically the dependence of the vehicle coordinate, depending on time (t) expressed in s. Use XY Scatter chart type!
- Represent graphically the dependence of the vehicle coordinate, depending on the square of time (t) expressed in s2. Use XY Scatter chart type!

Calculate the value of the vehicle's acceleration from the slope of the last graphic!

**Acknowledgements**

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# You Too Can Search For The Higgs Boson!

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**Abstract**

*The main goal of the authors is to describe an unconventional teaching-assessing way, an alternative for the classical teaching-assessing process: conferring new meanings to the traditional assessment as an add-on to the classical assessing methods. We make our point by appealing to a number of specific educational computer games. The aim of these educational computer games is to support student's hands-on learning of science and inspire the next generation of engineers and scientists, by delivering hands-on activity resources to educators. Learning more about Modern Physics could make a fun way to spend some great and informative time!*

**Keywords**: Computer Game, Higgs Boson, Cosmic Rays,

**Motivation**

Being what we are, namely a teacher and a former student in a computer science high school, we settled ourselves on devising a scenario for a 3-levels computer game.

This computer game is entirely interactive, and we could use this opportunity to try to become active promoters of curriculum changes in Romania.

In our opinion it's a really good opportunity, because in Romania, the 10 graders study electricity, and our textbooks present everything in a dull, unattractive way. Of course, the game will be developed in a rigorous manner.

**Introduction**

Tremendous progress has been made in the field of assessment in the last 30 years. (Gierl, et al, 2007). We have witnessed the introduction of the concept of criterion-referenced assessment for assessing competencies, and now that concept is now well developed (for everything from defining the competencies to developing the assessments and validating them for use), and widely applied today in education, industry, and the military. (Hambleton, 2003) We have seen the transition from classical to modern testing theory, methods, and practices (perhaps the theory is better known as "item response theory" and the impact has been world-wide and highly significant, (Hambleton, et al, 1991). We have noticed the expanded use of computers in assessment, and this use holds great promise.

Modern test theory was introduced by Georg Rasch from Denmark and Gerhard Fischer from Austria, along with Fred Lord and Allen Birnbaum from the United States in the 1950s and 1960s (Mills, et al, 2002).

The transition to computers for educational assessment represents another major trend. Computer-based testing has some very definite characteristics (Van de Linden, et al, 2009):

**A.** It permits more flexible scheduling of test administrations.

**B.** With automated scoring available, it means that reporting of test scores can be immediate.

**C.** New test designs can be put in place, including adaptive tests, which may reduce testing time to 50% with no loss in measurement precision (Sakurai, 1994).

**D.** It provides the basis for new item types, for instance, computer games.

**Target**

This educational software is aimed at students of up to 12 years and to anyone who's looking to seize any opportunity in order to improve his knowledge and at the same time have fun!

**Objectives**

The main objectives of this educational game project are:

- Supporting students' hands-on learning of science;
- Inspiring the next generation of engineers and scientists;
- Delivering hands-on activity resources to educators;
- Offering online training in the aria of design process to educators;
- Learning more about Physics in an unconventional way;
- Pointing out of anchor-knowledge necessary in the teaching of new concepts, and training the students in the field of conceptual and operational structures constructions;
- Equal treatment of all the students, without any discrimination and prejudice, regarding their individual self-esteem and respect, their candid and systematic evaluation, their commitment toward the duties in the line of work, and so on;
- The integration of the achieved knowledge and intellectual strategies into a derived general scientific frame.

**Content**

As mentioned earlier, the game has a 3-level structure.

**The First Level**

The first level introduces some basic concepts regarding elementary particles, such as:

- quarks (http://www.daviddarling.info/encyclopedia/P/pion.html)
- cosmic rays;
- matter/antimatter;
- dark matter;
- dark energy;

At this level, the student gathers information and coins. The coins can be transformed in energy, and used at the next level, to buy hints, answers or different goodies (useful information for the next levels, and so on).

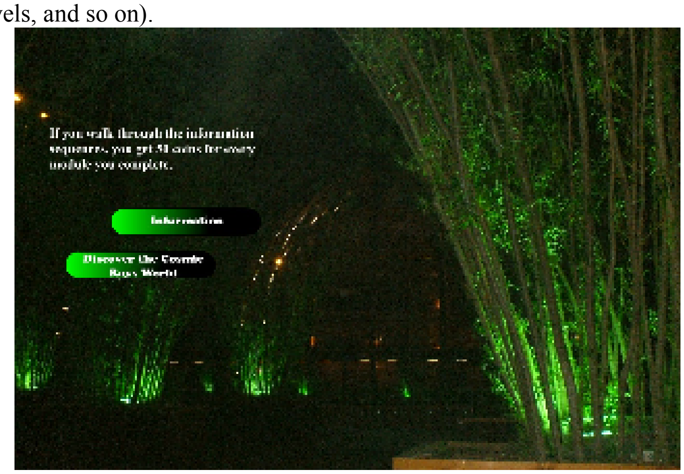


*Figure 1.* **The opening page of the "You Too Can Search For the Higgs Boson" educational software**

Upon completing this module, the student will receive a reward in coins and additional information sources.

At this first level, we want the student to get acquainted with elementary particles. In order to reach this goal, the majority of the modules will be developed accordingly:

**The Second Level**

The second level treats rather simply things regarding:

- detectors,
- accelerators,
- components assembling.

There are simulations involving notions regarding the movement of charged particles in electric and magnetic fields.

The student has to vary the parameters influencing the movement of the particle. In order to gain access to the next level he/she must determine and set the parameters so that the particle be accelerated to a given energy, and exit the field through a given point of coordinates (in our opinion, math is playing a main part in Physics).

Also, by drag-and-dropping, the student will assemble particle accelerators: LINAC, Syncroton, and Cyclotron (http://web.mit.edu/8.13/www/JLExperiments/JLExp14.pdf).

**The Third Level**

The third level provides a virtual tour of the CERN.

- At the end, the student will find out what energy does the Higgs boson have and whether he or she managed to discover it or has to start the game all over again.
- When the final energy is converted into mass, if the student gets a value between 124 and 200 GeV/c2, he or she will receive the message: “Congratulations! You found the Higgs Boson”.
- If the energy is lesser than the first value, the message will be: “Sorry! Keep searching!”

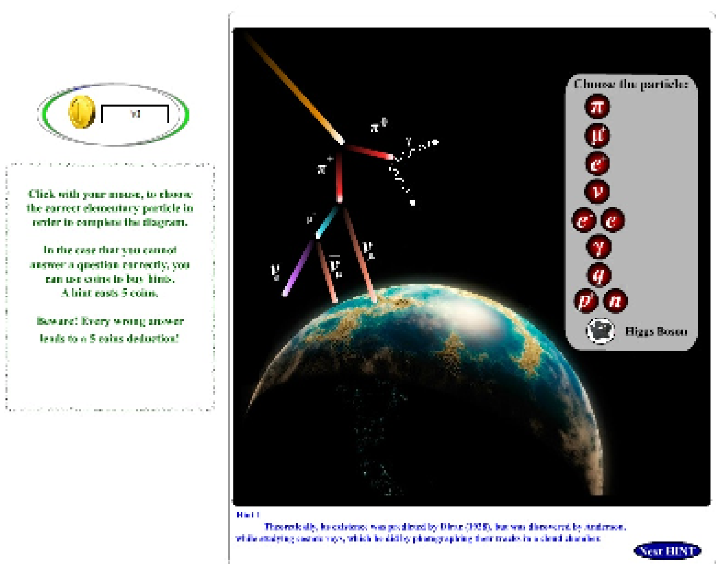


*Figure 2.* **Finding the right answers in the “You Too Can Search for the Higgs Boson” educational software**

**Design**

Each moment of the game contains key words pertaining to the basic concepts, work tasks addressed to the student, goodies and/or clues (hints), and lovely animated simulations (in the working zone).

**The Advantages Of Educational Software Usage**

The use of computers and software ICT tools in classrooms and laboratories provides much more effective and efficient environments for teaching and learning, making physics science easier to understand. The advantages of using simulation software in conjunction with classroom teaching are well known. It is generally accepted that the use of interactive teaching tools, which provide instant feedback to the student's inputs, improve and accelerate the learning process. The use of simulation and ICT tools as secondary education is not a new concept (Hadjerrouit, 2008). However, the traditional teaching methodology used in secondary education is based mainly on oral speech and use of blackboard.

In line with a number of researchers in ICT education (Mayes, 1999) teaching approaches that are based on the understanding of software principles for problem solving involve three major components:

**A.** It is important to generate understanding using specific examples, visualizations, and dialogues

**B.** Students use software principles to construct solutions to the problem through involvement in realistic task-based activities

**C.** Students get the opportunity to raise questions regarding the specific problem solving process or more general problems related to software use.

The advantages offered by the educational computer game include:

- unconventional tests allowing for an optimal feedback;
- user-friendly working environments;
- individual and/or team work;
- stimulation of the creativity and of the competitive spirit by pursue of different modules;
- visual support which gives rapid understanding of even the most subtle and complex scientific themes.

For a more intense involvement of each student into the learning process, the educational computer game provides animation and the possibility of replay. This kind of activities allow the student to learn by playing, by varying different parameters and quantities in a rigorous, mathematical way, because mathematics, creativity, logic, and originality are all needed to improve technology (Moraru et al, 2008).

Also, this computer game allow the students to present a sensible and revolutionary subject such as elementary particles Physics in an attractive, accessible, yet rigorous manner.

This way of learning has a big advantage: the flexibility, the fact that each student can set his or her own pace of study. One the other hand, it invites the students to find out more by individual study, exploring the interactive lessons and taking the challenges.

**Conclusion**

We are not pleading for a rebuttal of the traditional teaching methods, especially in the first years of school, when the personal touch of the educator remains of utmost importance, but we strongly believe that the usage of modern technologies and educational software is a must of the educational process, an addition to the classical methods, appealing to the individual character of each student.

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# Assuring the Motivational Climate in the Process of Learning Physics by Using Blogs

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**Abstract**

*The fundamental activity of a society is learning. The informational model organized around the cognitive paradigm of processing information places the student in the situation of acquiring his own knowledge, which becomes therefore a permeable, open reality. The virtual character of education leads to a decentralization of the multiple bases of informing and knowing. Beside the internal sources, of the school, the trainee can connect to some alternative sources, from his cultural area, which he will reassemble according to the logic of his own interest. The new communication formulae modify the traditional scheme of the didactic communication, turning the individual or the learning group into a knowledge generator. They make exchanges and validate their own products of knowledge, amplifying the wish to learn and the motivation for a well-done thing. This paper presents the way in which the use of blogs as a non-formal educational and studying Physics environment contributes both to students' cognitive motivation, and to the restructuring of the relationships within school groups, the emphasis moving from the class of students to the team who collaborate in order to achieve a common goal.*

**Keywords:** Blogs, Cognitive motivation, Cooperative learning

**Introduction**

Social changes and the evolution of human knowledge in the digital era are so fast, that make further education and training a necessity for many professionals. (Andreatos, 2007)

The society based on information is the product of the interaction between computer and telecommunications, and this thing has cancelled the traditional distinction between the knowledge elaboration and the knowledge communication. The use of new means determines a modification in receiving and transmitting information, in storing and organizing it, in the way of communicating with the exterior. The subject develops new abilities, experimenting a different way of relating himself to the reality. The old relationship between mind and world must be rethought according to the contraction of knowledge time, which consequently implies a rethinking of learning modalities. The computer is not only a didactic opportunity for learning and self-learning, but also an instrument which allows the interaction between different levels and contexts of knowledge. Instead of dominating man, it increases his creative potential. (Chiosso, 2007)

The internet facilitates to anyone, anywhere and anytime the access to the cultural contents from all over the world, becoming a social network. The pedagogical potential of the Internet derives from the possibilities offered to teachers and students of documenting themselves "up-to-date", of exploring both a real and a virtual world, of multiplying the possibilities of manifesting imagination and creativity, of exercising communication skills, of developing the strategies for processing information. (Cerghit, 2008)

The virtual character of education leads to a decentralization of the multiple information and knowledge bases. Beyond the internal sources, of the school, the trainee can connect to some alternative sources, widely spread in his own cultural area, which he will acquire and reassembly according to his personal interest or dictated by the formal space he mainly attends. This state leads to a new personal and institutional time management, to prioritising the individual rhythm up against the collective one. (Cucos, 2006)

In order to have success in school, but especially to assure the efficiency of learning, it is necessary to exist an optimum motivational level for involving in such a type of activities. In most cases, the lack of motivation for learning is caused by the inappropriate education offered by adults or by the missing adequate learning solutions. The school motivation depends on the way in which the student considers the respective activity to be relevant, on the extent he considers himself competent enough to do it, but also on his perception on the freedom degree he has in choosing the means for accomplishing that task. (Popenici and Fartunic, 2009)

The class of students forms into a group whose members have the same values, goals and behaviour standards and within which the interpersonal contacts are frequent. Each person is responsible of reaching the common goal and becomes a resource for his pair, thus contributing to animating and supporting the working team through his motivation, participation, ability, knowledge, skills and qualities. (Nicu and Contiu, 2010)

The first and most important element in structuring cooperative learning is positive interdependence. Positive interdependence is successfully structured when group members perceive that they are linked to each other in a way that one cannot succeed unless everyone succeeds. Group members need to be responsible for their educational process and for the group and individual achievement. (Countinho, 2007)

The nature of blogs, excellent communication tools for small teams or groups, gives a space via the Internet where students share ideas and work together to jointly express their ideas. Benefits of learning using weblog networks are learner autonomy, cooperative learning and time management. (Wang and Fang, 2005)

The perspectives of capitalizing the non-formal and informal education within the didactic process are linked to the students and teachers, taking into consideration the high potential of sustaining motivation for those involved in realizing the educational act. (Singer and Samihaian, 2009)

In non-formal and informal settings, the learning objectives assume that learning is heterogeneous, as the work and life experience of individuals are. Progression in learning has a strong individual dimension as work and life experience vary from person to person. Learning is independent from the teaching premises. Teaching duration is not considered. The transfer is assumed to take place between one work or social context and another. All prior learning and/or experience can be acknowledged (Colardyn and Bjornavold, 2005)

The motivation for learning activities in non-formal and informal environments is supported by the opening towards acquiring new knowledge or skills, by the initiatives for searching new learning experiences, by a good collaboration with the people offering learning opportunities and by the collaboration with the colleagues or friends sharing the same passions. (Popenici and Fartunic,2009)

Teachers can utilise blogs in order to increase the communication level among the participants at the course, as well as the level of their participation and the depth of engagement. (Fessakis et al, 2008)

What makes blogs so attractive, in both the educational community and the internet at large, is their ease of use. In the teachers' and students' hands, blogs become something more again. The web is by now a familiar piece of the educational landscape, and for those sites where personal publishing or chronologically organized content would be useful, blogs have stepped to the fore. (Downes, 2004)

**The Use of Blogs in Studying Physics**

An inhibiting factor of students' motivation for studying a certain subject, especially Physics, is the evaluation activity. The use of traditional assessment methods, correlated to a low weight of the modern, active-participative didactic strategies within the instruction process, and to the lack of some attractive and relevant didactic means, reduces the students' interest in this subject, fact reflected in the students' difficulty in obtaining school success.

This paper presents the way in which the use of blogs as a non-formal Physics instructing environment contributes both to the students' cognitive motivation and to the restructure of the relations within the school groups. The study describes the activity realized by 10th-grade students from seven technological classes.

At the very beginning of the school year 2010-2011, the students were consulted in order to establish the alternative evaluation activities for the whole period. Given the experience gained from the frequent use of Internet and social networks, the students proposed the creation and use of a class blog, with a theme from Physics. When they were asked to bring arguments in favour of their choice, the students mentioned the following:

- a less mathematized approach of the phenomena which should offer everyone a bigger chance to accomplish their learning tasks;
- the wish to continue working in a team outside school, without being restricted by the formal environment inside the Physics laboratory;
- the possibility to explore the virtual space in order to fathom what they are really interested in, not only what they are told they should be, since the teacher's presentation, the textbooks and the didactic materials reflect a unique and often out-of-date vision.

The students' wish to have a class blog can be explained both through the feelings of security and capitalization offered by belonging to a smaller group, and through the need of affirmation in the school, need encouraged by the competition-based education, which has been promoted by the Romanian school for a long time. The home pages customization of the blogs reflects to a certain extent the group's self image and the status they claim for within the school community.

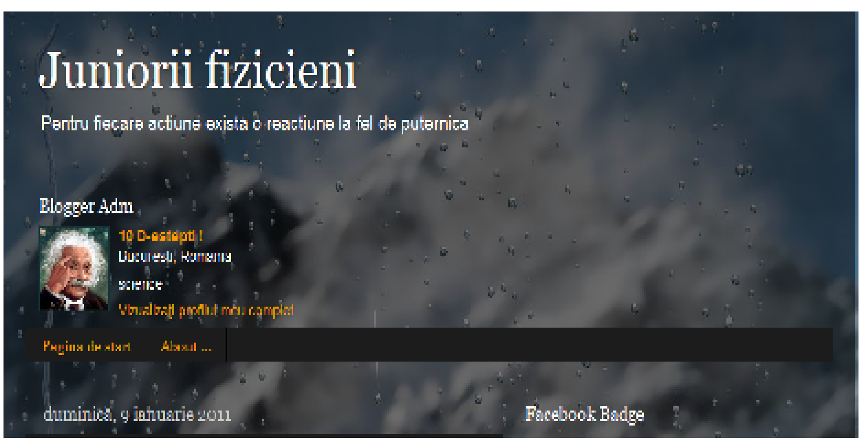


*Figure 1.* **10th D Class Blog – Site Customization**

It was established that students would receive a certain theme monthly, theme that should offer them a thoroughness of the knowledge acquired while studying Physics, but also some themes that incite their curiosity, given the fact that in the last high school years these students do not study Physics anymore and many of their questions remain without an answer during the inferior high school cycle. The proposed themes were: Thermic abnormalities, Alternative fuels, The effects of electricity, Discoveries in electromagnetism, Applications of Physics in Medicine and Physics and Religion.

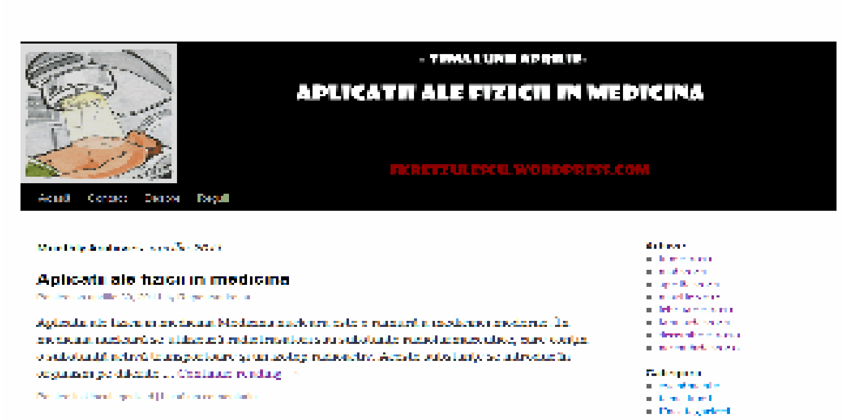


*Figure 2.* **10th F Class Blog – Monthly Activity**

It was noticed that from the moment of posting the articles on the blog, the interest for the activity developed in class increased significantly, the students' tendency being to make some analogies or complete the information received during courses with their own cognitive acquisitions. A debate was organized by five different students at the end of each month.

Yet, the students did not involve in this activity in the same way. Since the blog activity represented 40% of the final mark, the debate organization 30% and the active participation in discussing these themes 30%, some students did not post anything on the blog. The number of these students differed from one class to another and decreased as new themes appeared. (Until the end of May 61 students out of the 10th-grade 194 students did not have blog activity). This can be also interpreted as a reaction to the proposed themes, which might not coincide with these students' interests and preoccupations.

The theme that raised many discussions in each class, both on the blog and face-to-face, was Physics and Religion, proving one more time that students do ask questions, do want to have access to knowledge, but from an integrating and transdisciplinary perspective, different from the one offered by the traditional school.

The necessity of debating the themes face-to-face derived from the way the proposed themes had been approached and more than that, was a consequence of the deficiencies appeared while managing the resources offered by the Internet. Wishing to extend their knowledge, students overtook information which was whether incomplete, or it went far beyond their understanding. The teacher's role was to make those notions accessible, to conduct the epistemological intercession and to capitalize the newly acquired capacities.

Each student's creative profile reflected in the original approach of every single theme and in the blog design. We can talk about a group creativity regarding the information presentation.


*Figure 3*. **10th C Class Blog – Integrating Media Facilities**

This personalized approach of themes, as well as the illustration of the ideas through images and films increased the attractiveness and interactivity of the blog. New relations were established between students who shared an objective, therefore the class cohesion intensified. Students' perception on other colleagues or even on themselves changed, this kind of non-formal activities pointing out some skills and competences less manifested in a formal environment.

These observations were confirmed by the answers students gave to the questionnaire applied at the end of the school year, which asked for a feed-back of the entire activity run at Physics.

At the question: *Which of the following activities run during this school year stimulated your interest for studying Physics: a) the blog, b) the laboratory work, c) the visits at institutions, d) the science sessions, e) the school contests?*

the following answers were obtained: 46,91% the blog, 21,65% the laboratory work, 17,52% the visits at institutions, 9,28% the science sessions and 4,64% the school contests.

At the question: *To what extent did the blog activity develop your cooperation relations with your classmates: a) to a very large extent, b) to a large extent, c) to a small extent, d) to a very small extent, e) not at all?*

the following answers were obtained: 31,45% to a very large extent, 37,11% to a large extent, 10,82% to a small extent, 7,21% to a very small extent and 13,41 % not at all.

These results confirm the fact that the virtual space can be successfully used as a pretext for establishing cooperation relations between groups of students, and also for increasing the learning motivation.

**Conclusions**

A defining characteristic of learning through cooperating is the school climate where the experience takes place. This climate is mainly created by informal and hazardous events such as the behaviour which expresses esteem, respect and mutual acceptance attitudes. The success of cooperation depends on the development of appropriate social competences which contribute to the adjustment and improvement of interpersonal relations within a group, and refer to behaviour based on a fair collaboration. They facilitate the task achievement and maintain a good climate, at the same time encouraging the sense of individual responsibility. (Chiosso, 2007)

The advantages offered by using blogs as a non-formal learning environment cannot be exploited within the formal environment but by a responsible involvement of the teachers, by their opening towards integrating new technologies in the educational process, as well as by a remarkable psychopedagogical training which should allow them identify and capitalize for their students as many capacities and competences as possible, regardless of the environment students activate in. Thus, it is desirable that teachers should show interest for their students' preoccupations outside the formal educational environment and find ways and methods to capitalize these preoccupations. (Singer and Samihaian, 2009)

Overcoming the difficulties imposed by the standardization of assessing such activities, we consider that these assure the convergence of the formal education and the non-formal and informal one, which leads to a harmonious development of students' personality, without hiatus between the education given by school and the offers of the actual society, highly digitized.

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# The Stimulation of Students' Creativity by Using Multimedia Platforms

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**Abstract**

*The creative activity is related to the previous acquired knowledge and the use of it in new situations. The student's originality consists in personally living an already existing direction. An important role in creation is played by the associations and recombination of cognitive data. The personality factors also have a significant weight in creation. By using some multimedia platforms in the educational process, it is stimulated the students' interest in studying a subject and in applying the acquired knowledge to practical situations. In this way, their cognitive system is developed and the manifestation of their creativity in as varied as possible contexts is favoured. We have described here the way in which glogs may be integrated in some projects regarding Physics and we have analyzed the influence of multimedia posters on students' school success and on their creative potential, too.*

**Keywords:** Creativity, Multimedia learning, Glogs

**Introduction**

The human being has a natural predisposition to creativity, which through education and culture can become an effective capacity of creation and a defining feature of personality. The formation of creative behaviour, as one of the species of acquired behaviour, will be the primary need of the future society. (Moraru, 1997)

The characteristics and the exigencies of contemporary life, the more and more acute necessity to solve the problems having an increasing complexity which appear in all domains of activity, have changed the creativity education into a priority, into a stringent necessity for society, for all the domains of activity. The strategy of promoting creativity imposes some measures regarding the discovery of the creative potential and the promotion of some modalities that should stimulate the transition from the potential creativity to the manifested one. (Ionescu, 2011)

Creativity is the result of a complex assembly of personality factors, normally distributed, and the potential (latent creativity) is inherent to the ordinary human being. (Stoica-Constantin, 2004)

The creativity phenomenon is situated at the confluence of intrinsic motivation, abilities and knowledge revealed in a domain, and significant creative skills. (Amabile, 1983)

The creativity pedagogy starts from the premises that stimulating and educating creativity depends on the total social relationships in which an individual is engaged, on the multitude of influences exercised upon him. (Ionescu, 2011)

Creativity has a wide sphere of content, significant at both the individual and social level, which points to many domains of activity. Creativity does not only require motivation, but it also generates it. The school performance increases when the creative students' results are evaluated according to their creative capacities. (Sternberg, 2005)

At the school age, a more diagnosed and predictive value is held by the concept of potential creativity. This concept is operational in educative activities which will be oriented towards stimulating and developing the components of the creative potential. Any preoccupation for the child development, whether cognitive, affective, volitive or psychomotor, implicitly has beneficial effects on creativity stimulation. (Stoica-Constantin, 2004)

Each and every subject can be taught routinely or creatively. At the social level, individual creativity can be cultivated with a maximum of efficiency by introducing it in school, under several forms. Preparing the student creatively in school, he will also manifest creativity in society. (Moraru, 1997)

**Multimedia Learning**

The development of the multimedia systems and of the possibilities offered by the Internet experiments new possibilities of achieving an interactive learning between student and informative products specifically carried, due tot the fact that the student has the control over the wished dialogue, in terms of duration, extent, thoroughness, concretization, combination. (Joita, 2006)

The integration of computerized informational technologies and of multimedia into the learning and self-learning strategies, offers today promising solutions for the concretization of the applications in cognitive psychopedagogy, for educational practice.

Multimedia represents the assembly of software and hardware, capable to simultaneously use media sources such as films, videos and music combined with text and numbers, simulations and electronic communication.

Multimedia learning is an interactive and quasi-autonomous form of accessing knowledge, which does not require the teacher's mediation, which is based on informing, observing, experimenting, discovering and information processing intercessions, due to the use of multimedia.

Multimedia allows a multimodal education, adapted to different psychological profiles of those who study, a perceptive multimodality, coherently articulating image, word, colour and sound in composed representations. The trainee is asked for an active and interactive attitude, personal reflection, critical thinking, imagination, creativity; he is put in situations of elaborating, and applying personal projects, of doing research in which freedom of action is maximum. (Ionescu, 2011)

Multimedia offers exciting possibilities for meeting the needs of 21st-century learners. Research has shown us that the brain processes information using two channels — visual and auditory. When information is presented using both channels, the brain can host more new information. By taking advantage of this multimodal processing capability and technology-based tools, we can dramatically enhance student learning through multimedia instruction.

Multimedia Learning Principles are:

1. Words and pictures are better than words alone.
2. Multimedia learning is more effective when learner attention is focused, not split.
3. The presentation of multimedia content should exclude extraneous and redundant information.
4. Multimedia learning is more effective when it is interactive and under the control of the learner.
5. Multimedia leaning is most effective when the learner is engaged with the presentation.
6. Multimedia learning is more effective when the learner's knowledge structures are activated prior to exposure to multimedia content.
7. Multimedia learning is most effective when the learners can apply their newly acquired knowledge and receive feedback. (SEG Research, 2008)

In multimedia projects students do not learn simply by using multimedia produced by others; they learn by creating it themselves.

Multimedia certainly has the potential to extend the amount and type of information available to learners. Multimedia can offer layers of beneficial resources, provide gratuitous information leading to frustration and overload, or anything in between. Well-designed multimedia helps learners build more accurate and effective mental models than they do from text alone. (Shank, 2005)

Glogster is a fun and innovative tool for creating collage-style multimedia posters and allows users to interact with content. Digital posters (glogs) go beyond standard presentation mediums such as paper posters or PowerPoint. Glogster allows teachers and students to share knowledge with others while expressing their creativity.

The benefits of electronic posters are excellent: colour, movies, animation, sound and true interactivity are now possible; the presentation can be archived and made available on the Internet; easy searching for particular topics of interest during the limited time at the conference is easy; expensive and often time-consuming printing in large formats is no longer needed. (Haar Romenij and Barentsz, 2003)

**Study**

157 9th-grade students were involved in this study, from technological classes, specialization services.

The paper presents the way in which electronic posters are integrated in some projects at Physics and analyzes the influence of multimedia learning on the students' school success, as well as on their creative potential.

The concept of mechanical energy is studied both during the gymnasium and high school years. Since we assume that during gymnasium the students understood this notion and now they have become capable to operate with it in varied contexts, during high school the respective notion is fathomed, interdisciplinary connections are made and a wide range of applications are approached.

During the first lesson of the unit "Mechanical Energy", students' knowledge was tested. Since the results indicated gaps in the way to define and apply this notion, a project-based multimedia learning was applied as a strategy. The projects had a common task for all the classes, that was creating an electronic poster (glog) by using the Edu Glogster platform (http://edu.glogster.com), but also some tasks that differed from one class to another: making a PowerPoint presentation, a portfolio with solved problems, a cardboard poster, a scale model and an experimental shaping. All these tasks were related to the theme of energy or to some derived notions (mechanical power, potential energy, kinetic energy, alternative energies).

The students of each class were divided into groups. The time given was two weeks.

The advantages offered by these different required products are consequent to their characteristics:

a) problems solving permits forming and enriching the notions, developing the logical thinking and developing the intellectual abilities to apply knowledge in practice.

b) a poster is any piece of printed paper designed to be attached to a wall or vertical surface. Typically, posters include both textual and graphic elements, although a poster may be either wholly graphical or wholly text. Posters are designed to be both eye-catching and convey information.

c) a scale model is a physical model, a representation or copy of an object that is larger or smaller than the actual size of the object, which seeks to maintain the relative proportions (the scale factor) of the physical size of the original object.

d) the experiment represents the knowledge source and the research method in Physics; it is the main way of forming students' concrete representations

e) PowerPoint presentations consist of a number of individual pages or slides. Slides may contain text, graphics, sound, movies and other objects, which may be arranged freely.

After presenting and analyzing the students products, each class was applied an assessment test in order to establish if any progress had been made in acquiring the notion of mechanical energy and especially in connecting it to other notions and applying it.

**Results and Discussions**

The results obtained after applying the pre-test confirm the fact that in this study statistically equivalent classes were involved.

The results obtained at the two tests are compared in the graphic in Figure 1.

It is noticed that the project-based multimedia learning has led to school progress for each class. The creation of glogs has favoured both the motivation for learning, and the stimulation of students' creativity.

Yet, the exclusive use of multimedia facilitators does not favour a significant increase of school results. Being a science, underlain by shaping and experiments, it is necessary that these specific learning methods always be integrated in the students' learning activities. The best results at the post-test were obtained by the classes at which the projects had included the scale model and experimental shaping as products.

The problem solving still remains a method that proves its efficiency only when the students have assimilated a notion and are motivated to fathom it. Even if it is a very appropriate method for consolidation, during the formation or correct acquisition of a notion its efficacy is reduced.

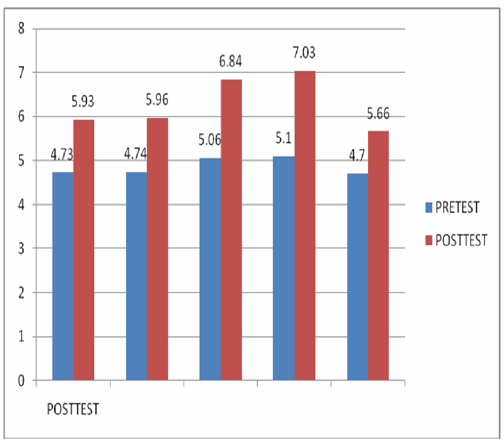


*Figure 1.* **A Comparison Between the Results Obtained by Students at Pre-Test and Post-Test**


*Figure 2.* **Electronic Poster**

*Figure 3.* **Scale Model**

*Figure 4.* **Experimental Installation**

**Conclusions**

Use multimedia to help learners find their way around it. If multiple types of media and content are required, use position and prominence to direct learners' attention to the most important information. Consistent-looking and consistently placed navigation elements clarify what to do next. Help learners determine how to proceed but don't restrict their choices unless it's absolutely necessary. Although multimedia offers designers enormous opportunities for making learning environments meaningful and effective, multimedia by itself does not assure a good learning environment. (Shank, 2005)

The use of multimedia platforms while studying Physics creates the conditions for obtaining school success by reaching the motivational optimum required for each sequence of the learning process. Still, it is not the audio-visual message that has beneficial educative influences, but its integration in a learning-self-learning strategy done by the teacher.

A heuristic education is recommended, which should base the formation of students' independent and creative thinking, which should activate their spontaneity and initiative, their whole intellectual, affective and motivational potential. What is acquired by personal effort and by creative learning has big chances to fix and to become operational, through a transfer in other learning situations. (Ionescu, 2011)

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http://edu.glogster.com

# New Technologies in EFL:
# Why Learning in the Public Space Matters

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**Abstract**

*Working and collaborating in the public space through employment of the new technologies has undeniable benefits for EFL adult students whose language learning is basically confined to the 2 hours/week artificial class environment. The paper will reflect on the results of employing asynchronous writing (blogs) and speaking tools (Voki, Fotobabble, Showbeyond, etc.) in Higher Education EFL, underlining that virtual environments represent a potential real, effective strategy of extending their exposure and use of the language in an engaging, memorable, and authentic way. In this two-year project students started with collaborating in writing and speaking on the Class Blog in the first year and continued with creating and working on individual blogs during the second year. We will demonstrate that by engaging students to write on a regular basis, for a real audience and in novel ways, language exposure and production are enhanced. Furthermore, through employment of asynchronous oral tools which allow preparation, repetition, and re-recording, speaking confidence and use are likely to improve.*

**Keywords**: EFL, New Technologies, blogs, asynchronous tools

## 1. Premises

Many Higher Education (HE) EFL adult students may feel frustrated and lack confidence to speak in class for fear of face loss in front of more proficient peers. This situation, which inevitably leads to inequality to speak in class, is further complicated by the limited opportunities EFL students have to be exposed to and speak the foreign language outside the classroom walls. Writing is an even more difficult skill to form as it needs extensive practice (Enkerly, 1997), let alone that students can be resistant towards it, perceiving most of the writing tasks as artificial, unattractive or simply irrelevant for their future profession.

In order to bridge the gap between what adult students want to communicate and what they can communicate in their mother tongue (L1) versus the foreign language (L2), speaking and writing activities with Web communication tools were introduced as an optional, supplementary activity to traditional HE-EFL classroom practice in a continuous degree of autonomy:

a) Work on a class blog in the first year;
b) Creation and work on personal blogs in the second year, with integrated speaking/listening activities in both.

Although all the activities were supplementary and optional, students received credit according to the quantity and quality of their input.

## 2. Working on the Class Blog

The main objective of writing communicatively on a class blog was to nurture students to take small steps towards writing meaningfully and communicatively, and therefore enhance their writing skills.

The premise of this initial stage of the project was that frequent writing, writing for a real audience, in a novel and engaging way, will conduct to greater exposure and production and will, therefore, enhance writing. Secondly, the comment moderation feature (comments that had too many errors or did not conform to the requirements were not accepted by the teacher, had to be re-written and re-sent), public visibility, and meeting pre-set deadlines for each writing and speaking task were supposed to further improve writing as well as speaking.

Not least, working on a class blog was conceived as an opportunity to offer students a CHOICE to learn English in a different manner. Therefore, not all blog activities were necessarily high-yielding in terms of grammar and vocabulary but they had to be captivating and engaging so that students would feel motivated to spend more time in the L2 environment.

**2.1. Blog as conversation**

Unlike traditional writing which has a one-way, monologic character, blog writing is dialogic. When students go public with a class blog, they do not write for the teacher who corrects the mistakes and then the writing slips into oblivion. Writing on a blog means reading the others' messages (Richardson, 2004b), answering the original post or subsequent comments, expecting a reply, in a kind of exchange that resembles conversation. This process goes back and forth, is always visible and can be resumed and continue at any time. The greatest challenge for the teacher when working on a class blog remains to encourage students not only to publish their ideas and opinions but to initiate and participate, to interact with one another and comment not just on the original post, but communicate with each other.

Furthermore, on a blog, students have the chance to extend their communication (Richardson, 2004a) beyond the classroom walls, with potential visitors (fig.1). This is extremely important since, if feedback in blog writing comes from a real audience not just the teacher and colleagues, higher expectations are engendered in students and they prepare with a real audience in mind.

This sense of real audiences can be materialized by inserting country counter widgets in the class blogs. Seeing people from different world countries online while working on the class blog or how many of them have already visited is extremely reassuring for the teacher and highly motivating for the students who thus become aware that their work is visible and interesting for the real world.

But conversation with outside audiences does not immediately and automatically occur. As an alternative, teachers can resort to inviting blog guests or arranging intercultural exchanges with students from other countries with whom communication of ideas is crucial and tasks have a more real character.


*Fig. 1* – **World Audiences of the Class blog as of August 2011**

Students will be excited to reveal and find out information about what it means to be a student, how easy it is to find a job upon graduation, how to juggle between work/university and family, etc., in the respective countries. Alternatively, economic, IT, engineering, medical issues in the specific field of study can represent engaging topics of conversation across classes and even national boundaries, which is such a fantastic opportunity, especially if students had never had the chance to visit that country before (fig. 2).

*Fig 2.* **Blog Exchange with Students from Grenoble, France**

Asynchronous voice tools such as Vocaroo and VoiceThread were integrated in the class blog in order to allow students to practise their speaking and listening skills on subjects of immediate relevance to them such as rating their experiences as first-year students or creating a voiced guide for international Erasmus students.

Photopeach and Wallwisher, AcapelaTV, FunPhotoBox, were additional tools used in order to make learning an enjoyable and fun experience so that students were always looking forward to the next week's post as something attractive and unique.

### 2.2 Outcomes

The class blog in year one was followed by 68 students and 70% of them contributed the 910 comments for a total of 32 posts. These outcomes are clear evidence that more students had the chance to be active and engaged than it would have ever been possible during the two-hours-a-week class activity. Although students are usually reluctant to put in extra work and write assignments, their end-of the year reflections showed that they felt extremely enthusiastic to do them on the blog:

It is a great pleasure to write, learn and create in English. I enjoyed every moment on the blog and I hope that in the future we will still be able to post on the blog because it's a good and easy way to learn and develop our English skills. (RaMony)

Blogging is an opportunity to exchange our ideas with the rest of the world not just people in our immediate environment. (Adriana)

This is the way I love to learn English. (VildA)

I love this way of learning English because I find it very funny and interactive. It is a lot better than just sitting around and reading some old books. (Sergiu)

By integrating voice tools in the class blog, students had the chance to do speaking assignments, which is classically impossible. Moreover, speaking with asynchronous tools is transparent and it leaves students time to prepare in advance, to listen to their production and re-record until they are satisfied. Having a recorded production is convenient for the teacher as it represents a springboard for feed-back, correction of recurrent errors and evaluation, which can be done either in asynchrony or in class.

Working on the class blog was these students' first encounter with technology enhanced learning. Although most of them were not 'digital natives' (Prensky, 2001) they became very enthusiastic about blog commenting, creating accounts and having a presence on the Internet.

### 3. Creating Personal Blogs

Giving students the opportunity to create their own blogs in the second year was an extremely empowering and brave act. Students took the responsibility of creating, posting, editing, answering comments, inviting comments, and commenting supportively on one another's productions.

Speaking with asynchronous tools was given an even greater preponderance starting from the premise that working in asynchrony allows preparation, repetition, re-recording until satisfied (impossible in real time) and, therefore, improvement.

The teacher's role was now restricted to modelling tasks in a class Wiki which also included instructions and tutorials on the new tools. Writing and speaking activities/tools were integrated in a continuous degree of complexity but again students could choose to do as much as they felt comfortable with and according to their proficiency level or learning style:

**Writing tool** / activity type:
*CC Flickr images* – creative writing;
*Storybird* – story writing;
*Speechable* – dialogues;
*Dvolver movies* – dialogues on product advertising;
*Photopeach* – quizzes (question formation).

**Speaking tool** / activity type:
*Voki* avatars– self presentation*;*
*Fotobabble* – commenting on a virtual photo (enhanced with PicJoke);
*Showbeyond* – narrations of past experiences including cultural information.

For the students, having a personal blog in English was the greatest achievement. They were so captivated by the tools and their colleagues' creativity and sharing of so much interesting information about hobbies, holidays, etc., that they simply forgot they used to consider English a very difficult subject matter. This is not to say that miracles happened but their fluency and disposition significantly improved, which in turn contributed to higher motivation levels, personal enhancement and personal esteem.

**4 Conclusion**

Giving students the opportunity to create individual blogs has generated the most significant enthusiasm for communicating in English. Second year students created 46 personal blogs according to the 13 wiki-modelled tasks, although very creative students chose to post more, discovering the force and power of blog communication and interaction. They were extremely enthusiastic to reveal information about themselves, to write and get feedback to their ideas.

Introduction of web communication tools in a continuous degree of autonomy in order to compensate for the deficiency of real life interaction in L2 had significant quantifiable benefits:

1. Extension of student talking time by over 10 hours with the help of integrated asynchronous speaking tools. As a result, class speaking confidence increased significantly. It seems that focussing on technology was a strategy for reducing fear to speak: instead of talking in front of an audience, students were talking from a safe environment but with a real audience in mind.
2. If writing is fun, engaging, meaningful and memorable, students become rich content creators: more than 150 A4 pages (at 1.5 line spacing) were written collaboratively on the class blog in year one only. We can conclude that students take assignments more seriously when they are exposed to the real world as opposed to a closed classroom environment.

Although dry statistics may not say enough, it was obvious that more students had the chance to participate than in real time and they were excited and proud to have a visible Internet presence. Moreover, their overall exposure and use of the language significantly improved and this was reflected in more positive attitudes towards speaking in class, in their disposition, interest and therefore motivation to communicate in L2 in both speaking and writing.

To conclude, virtual environments represent a potential real, effective strategy of extending students' exposure and use of the foreign language in an engaging, memorable, authentic, and accessible way.

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# Exploring the New Technologies in EFL through Virtual Online Professional Development Workshops – EVO-BAW

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**Abstract**

*The current paper is a platform presentation and dissemination of the five-week, free, international Professional Development workshop Becoming a Webhead (BAW) of the Electronic Village Online (EVO) sponsored by TESOL that takes place online every year. It demonstrates that online workshops represent a viable and sustainable solution for professional development in exploring and exploiting Web communication tools in EFL based on collaborative, hands-on, peer-learning in synchronous (live, in-real-time sessions) and asynchronous modes (YG, wiki, blog).*

**Keywords**: Becoming a Webhead, EFL, New Technologies, ICTs, Online professional development

## 1. Adjusting to Changes

Web 2.0 tools have become a rapidly evolving practice in teaching English as a Foreign Language (EFL) with potential benefits in empowering students and engaging them in relevant authentic tasks while making them responsible for their own learning (Thomas, 2009).

However, employment of Web communication tools is still faced with reticence by many teachers because of more comfort with classical environments or uneasiness with technology.

### 1.1. Identifying Educational Needs

Even though digital technology is increasingly part of our students' lives and they expect it to be part of their language learning as well, more senior teachers face the problem of integrating technology effectively in EFL as they have not received any formal or informal pre- or in-service training in this respect.

Empirical evidence testifies to the fact that Romanian higher education (HE) has to cope with the challenge of updating the knowledge and skills of implementing the New Technologies (NT) for a significant sector of its teaching staff. Surveys point out that one third of the Romanian teachers in general have not attended any personal development (PD) course on the New Technologies (Vlada et al, 2009) and that one of the most frequently perceived needs in Romanian HE-EFL is that of training in teaching/learning with the NT (Pop and Popa, 2009).

#### 1.1.1. Alternatives to Classical PD

Most teachers feel that they are prepared to become part of a PD programme but the development of efficient learning activities based on the NT requires direct experience and a lot of practice (Ceangalau and Irimia, 2010), which is hardly attainable at large scale in the traditional manner. However, we should not overlook the fact that the use of the web-based learning process is recognized as a more promising way of having ready access to knowledge than the conventional (closed) method (Joshi, 2011).

In this context, the current paper presents and proposes a viable and sustainable online PD alternative in exploring and exploiting Web communication tools in EFL.

## 2. Becoming a Webhead

### 2.1. How It All Started

Becoming a Webhead (BaW) is a 5-week online professional development workshop sponsored by the Computer-Assisted Language Learning (CALL) Interest Section of TESOL (Teachers of English to Speakers of Other Languages).

Its first round took place in Jan-Feb 2004 and it's been going non-stop every year since. It's the longest running TESOL EVO (Electronic Village Online) session. BaW is a sibling of the Webheads in Action (WiA), an online community of practice of teachers of English from all over the world that began in January 2002 with Vance Stevens as coordinator. It currently has 1,000 like-minded members interested in integrating "synchronous and non-synchronous text and multimedia CMC (computer mediated communication) tools" (14) in their teaching to generate 21st century practices for the benefit of their students.

Becoming a Webhead was the idea of Teresa Almeida d'Eça and Dafne Gonzalez, two very active members of the "mother" community. Their goal was to continue the original path of WiA: give EFL/ESL teachers basic knowledge and "hands-on practice" in Information and Communication Technologies (ICTs) applicable to language learning. In the past five years the emphasis has been on Web 2.0 communication tools whose main features are participation, collaboration, interactivity and sharing. They include synchronous tools (live and in real time, such as chat and virtual classrooms) and asynchronous tools (delayed in time, such as e-mail, text, audio, video and interactive exercises).

### 2.2. Rounding Up the BAW Team

Preparation of the BaW workshop starts in September. Reviewing the syllabus and choosing moderators are the first tasks of the coordinators, Teresa and Dafne. Moderators are former very active, enthusiastic and knowledgeable BaW members who are invited to join this "extended family". In October they take a 5-week training course sponsored by the TESOL Electronic Village Online Coordinating Team. During the course they are mentored and guided by both BaW coordinators. One of their tasks is preparing everything about the week they will be moderating so that by the end of the training course the workshop site is practically ready.

Moderators work in BaW for at least a year, very intensely during the workshop and irregularly for the remaining of the year, whenever there is mail flowing in and help to be given. Some moderators have been with BaW for a few years. Everyone involved in this program is a volunteer who has to juggle school or university, family and the workshop. It's very hard work, but with extremely gratifying results.

### 2.3. Supporting Tools and Course Content

The "communications center", or the heart of the Becoming a Webhead workshop, is a Yahoo Group (YG) (3), an asynchronous platform that includes, among other things, a mailing list, a Files area, a Links area, and a Members area with a list of all the names and their e-mail contacts. All the e-mail exchanged within the group flows through the YG and is stored there for as long as Yahoo will permit. Naturally, it's an invaluable resource that members can always refer to.

For the past five years, the workshop content has been centralized in a wiki (2), a collaborative asynchronous website that remains available and accessible for as long as the host platform allows. This means that well after the workshop is officially over, participants continue to have access to all the resources and platforms, and can explore things more calmly and deeply after the intensive 5 weeks that hardly leave time for anything else but getting some practice with tools and completing as many activities as possible.

The Wiki includes:

- the Syllabus;
- the Weekly Activity pages with a different topic each week and activities to be carried out;
- the Live Sessions pages with short bios and photos of the guest speakers, and a recording of the session for those who couldn't attend it (with a group that spans most of the 24 time zones, it couldn't be any other way);
- suggested Readings for each week;
- a Resource page with links to many Web 2.0 tools and tutorials;
- a Doubts page with problems experienced along the way and their solutions.

This diversified array of media gives participants "hands-on practice" with different types of platforms and synchronous and asynchronous tools from the very first day of the workshop. Though this may be somewhat daunting for some, the moderators are always there to lend a helping hand and sometimes give a much needed boost. This type of practice, together with the help given by the moderators and more tech-savvy participants, is invaluable in getting people to feel comfortable with tools that they will use in their online or blended learning classes (lessons that integrate online activities in the traditional classroom). On the other hand, experiencing problems along the way, which may be considered as a negative aspect by some, is seen by us as very significant learning moments, thus, an added value, because they give participants very practical know-how and very relevant information that prepares them for the time when "they" will be the ones helping their students.

During the 5 weeks participants explore and use:

- **text tools** (managing e-mail through Yahoo Groups, collaborating in the workshop wiki and creating their own);
- **audio tools** (audio and text chat in Skype; Audiopal, Vocaroo and Voxopop for audio messaging);
- **video tools** (Eyejot and Winkball for video messages, and Voicethread for project work);
- **interactive exercises creation programmes** (Hot Potatoes, ProPofs, Quizlet etc.);
- **virtual classrooms** (Elluminate and WiZiQ).

Web 2.0 communication tools are a boon to language learning, allow students to work individually or in group, in class and at home, and practice the 4 basic skills simultaneously. They also cater to different learning styles and paces, and to multiple intelligences.

The BaW syllabus, the level of e-mail interaction and the immediate support given at all times make up a highly addictive mix. We compare it to a "healthy virus" that invades their system. Active participants get "hooked" from the very first moment with the diversity of tools and their potential for language learning, together with the excitement of meeting and working with colleagues from all corners of the world. Working in groups is encouraged for the exploration and use of tools that are collaborative in nature, and for reflection about their possible applications in class.

**2.4. Course Management**

The workshop is handled basically by the moderators of the week who, among other things, reply to e-mail, have one-on-one or group chats with participants to give timely and in-real-time help, moderate the live sessions, create the session page, enter a post about the session in the blog, and make comments to comments about the weekly readings.

Both coordinators are always in the background ready to give moderators help through a separate Yahoo Group created exclusively for the BaW team, and reply to participants' messages when they have something to add or an experience worth mentioning.

Most of the work is carried out asynchronously except for the weekly synchronous presentation by the guest speaker and live chats that can be pre-arranged or come about on the spur of the moment. Participants follow the activities for each week if and when they have availability, and send messages to the group when facing a problem or in need of some clarification, or to report on an achievement.

Coordinators and moderators promote peer-to-peer learning and support among participants, and encourage the creation of different products. Naturally, there is a page for links to their workshop creations, which are commented on enthusiastically in messages. Participant work is always highly valued and praised

**2.5. Outcomes**

Becoming a Webhead has had around 300 members in each round, though only a small percentage (up to 20%, according to research carried out by Christopher Johnson, 2005) are active. The remaining members are called "lurkers", or more or less active observers in the background. Some read e-mail and/or follow our activities (as told by those who "surface", so to say, when they need help), but they rarely show their accomplishments.

In its eight years Becoming a Webhead has reached close to 2,500 teachers in 98 countries, according to files kept since the first round of BaW (4). A number of them have gone up the career ladder due to skills acquired during the workshop, or have moved on to jobs more directly linked to educational technology rather than language teaching. Others started their own EVO workshops dealing with different topics. Still others won online and offline awards due to the work carried out with their students.

Teresa Almeida d'Eça is the recipient of the EU SchoolNet international "e-Learning Awards 2007", Gold Prize in the category of "School of the Future", with her curricular blog "CALL Lessons 2005-2007" (1). After graduating her first BAW session in 2009, Anisoara Pop was awarded the Business English SIG Grant at the Annual BESIG Conference in Poland in November 2009 and then in 2011 the WR Lee Grant at the IATEFL Annual Conference in Brighton, UK, for presentation of her results in teaching with the NT.

BaW is hard work for all those involved in preparing and implementing it, but it's very rewarding to get feedback from participants about how their teaching practice changed for the better, how they're able to engage students differently and how these students become so committed to learning in a totally different way. The highlight is when they show us their accomplishments.

The most significant and amazing example is Hala Fawzi from Sudan. She took part in BaW 2005 while teaching EFL at the University of Science and Technology in Khartoum. She enjoyed the session so much and became so enthusiastic about the use of technologies for language learning that she went on to do her PhD in blended learning at the same university (Fawzi, 2009-2010), the first of its kind in Sudan, making Hala a pioneer in the field in her country. In October 2010 she moved to Saudi Arabia to teach Educational Technology at Yanbu University College, where she is the e-Learning Coordinator of the female campus. In a message Hala sent to the Webheads in Action on 1 Dec 2010, she ends with these words: "Thank you for everything that you've done for me, for my life, my career. You were there to help me whenever I needed you. For all the dreams you made come true...I'll be forever thankful! It's a privilege to be part of this community." (Fawzi, 2010)

This year there was a very interesting tandem project resulting from BaW11. It was carried out by Maria Ines Bossa from Argentina and Ayat Tawel from Egypt (Bossa and Tawel, 2011 ). Each group of students interviewed the other teacher through Skype, photos were taken and uploaded to Photopeach, information and links were sent by both teachers to the BaW11 and Webheads in Action mail lists, and they were invited by Vance Stevens to talk about their project in a live Sunday session for the Webheads (15).

**3. Reflections of a First Time Participant**

Learning with BAW has dramatically and irreversibly reshaped and enhanced the way in which hundreds of EFL teachers around the globe have been teaching. This section is an endorsement of the course content, management and delivery elements that bring added value to BAW as it was experienced by the first author as participant in 2009 and then co-moderator in 2010 and 2011.

Unlike the fragmented, sit-and-take classical PD courses which presuppose time, space, and budget constraints, BAW is a free, online, and internationally available workshop. It is extremely practical, as participants acquire the new tools through applications in asynchronous platforms which allow sharing, collaborative and experiential learning as well as reflection and feed-back.

Another most distinguishing BAW feature is its enthusiastic team of coordinators (Dafne Gonzalez and Teresa Almeida d'Eça) who are passionate advocates of teaching innovatively and committed to engendering a friendly atmosphere where participants create, reflect, and learn in a fun and engaging way.

The participants, as in any regular class, form a mixed ability group: technology-savvy and advanced teachers share their expertise and learn to apply the Web communication tools alongside the newbies. All participants are encouraged to voice their doubts and questions by sending them to the group so that others can either acquire or reinforce knowledge. Therefore, whenever one sends a question to the group, there is instant feedback from other teachers around the globe.

An important element of BAW culture is 'the Baw spirit' which is synonymous with congeniality and warmth, constant encouragement, learner friendliness, patience and support. Participants come to understand that there is no stupid question, only that which is not asked. They can absorb as much as possible but not more than they feel comfortable with, and be as active as they want or simply lurk and assimilate. E-socializing is an essential BAW value and during the course participants resonate with one another's successes, special events or misfortunes. There are also special get-togethers such as the live kick-off session with representatives from all the EVO workshops, and the BaW Graduation Ceremony that can include impromptu cooperative projects of intercultural awareness such as 'The International Recipe Book' final project, which enhance the general learning atmosphere. During this end-of-workshop live session, participants are invited to join the Webheads in Action, the worldwide community of dedicated professionals who believe in their mission of authentic 21st century learning with ICTs.

Finally, learning with BAW is not limited to gaining knowledge, exploring and applying the Web communication tools, but about making global connections and creating a personal learning network that helps one to stay in touch with the source.

These characteristics entrust me to wholeheartedly recommend BAW to all those interested in facing the challenge of teaching with the New Technologies and rekindling their students' motivation and engagement. For me BAW represented the premiere of a genuine passion for applying the new technologies in order to make my students' English learning experiences richer, more relevant and captivating.

**3.1. From Participant to Moderator**

Many former participants, eager to improve and share their knowledge and expertise, return to BAW every successive year so that new participants can see real examples of integrating Web communication tools and learn from the more experienced. The fact that former active participants may choose to return as moderators testifies to the fact that BAW has been an effective learning experience.

**3.2. A BAW Moderator's Roles**

Besides the coordinators, each BAW week has one or two (co-)moderators, usually from different time zones, who volunteer their time and knowledge and perform different roles.

As first time participant I was hardly aware of the enormous work that goes on and off the stage, both before and during BAW, so that everything runs smoothly and each week is one of learning, creativity and fun. As first time moderator, I came to realize that this means wearing several hats and be a learner, strategist/facilitator, coach and motivator, entertainer and advisor, at the same time.

A moderator is a constant learner who prepares in advance for his role. This involves taking a five-week EVO moderation training during October-November in order to acquire online course managements skills, such as keeping participants motivated and involved in distance learning, as well as technical skills, such as preparing the platforms and adjusting the syllabus for the session, which starts in January.

Moderators as well as coordinators are strategists and facilitators who take timely pre-course decisions of adjusting the weekly programme and liaising with invited speakers for the live sessions (LS) or deciding on the weekly live events. During the course, moderators are in charge of all the administrative tasks, responding to participants' queries, moderating LS while communicating and conferring with the team of moderators on issues that require joint decision. By offering step-by-step instructions to participants about how to do things, how to join different platforms while making them more palatable, the moderator is a coach who stimulates and inspires the participants by appreciating their achievements and giving them constant boosts of energy.

Being a BAW moderator can therefore be a challenging but equally fascinating and most rewarding enterprise. It means being part of an international supportive, encouraging and professional team, finding quick responses to queries or forming lasting friendships - as is the case of both co-authors who are collaborating in this paper and presentation for the first time without ever having met face-to-face - and, what is most valuable, acquiring an amazing learning experience.

**4. Conclusion**

Professional development is a critical factor for the successful integration of technology in EFL practice. Since 2004, BAW has proved a successful PD alternative for close to 2,500 EFL teachers in 98 countries in their endeavour to acquire digital competences, keep abreast of changes and grow professionally, opening for them new perspectives in language teaching while offering just-in-time free access to materials and information, flexibility in time and space as well as worldwide collaboration opportunities.

These are testimonials from participants in 2011:

*"This is my 1st BaW and I'm extremely happy and proud! Not only for the things I've learned but also for the wonderful people I've met." (M.B. Argentina BAW11)*

*"The mixing of the newbies and the experienced turns out to succeed as in the blended teaching, and it is the strongest feature of this course…I enjoyed the whole course. I am sure I met my goals here. I made my first blog/wiki, made links and embeddings in them, I tried Zoomerang, HotPot, Puzzles, will train in Voki and Wallwisher, Voxopop and other available tools."( V.K – Yakutsk, BAW11)*

*"This was my second EVO and my first BaW -and it's been an amazing five weeks! All the passion and the enthusiasm from the moderators and fellow-participants has been infectious to say the least! It's been great to talk with educators from all over the world, not to mention our fabulous guests in the Live Sessions." (A.K, Greece, BAW11)*

Technologies support transformation in education. Why not join the next BAW session and make one of the most exciting learning experiences your own?

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# The impact of Internet use on teacher training, manager training and education

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**Abstract**

*Modern educational management approaches focus on the concepts of efficiency, progress, scheduling, etc.. Managers are required to provide organization and training, monitoring and evaluation skills and competencies. To effectively achieve these objectives the manager can delegate responsibilities to competent people, but he/she can improve his/her own performance so as to streamline the work of the entire school organization. Using the Internet facilitates activities specific to educational management. Thus to draft projects, the education manager can use the Internet to find legal information, curriculum, assessment etc.., consult quickly and efficiently the ministry regulations and proposals used for drafting the school curriculum on the application of national curriculum and regional development / local curriculum, drafting the project for extracurricular activities (extra-class and school) and school competitions, the draft budget and draft purchases of the unit. The educational manager may use the Internet to identify sources of extra-budgetary funding, may get inspiration and may make effective proposals for documentation for school construction and repairs. The Internet supports the dissemination of information, communication and even facilitates the development of human resources for both teachers and non-teaching staff as well. With Internet a manager can identify the educational needs of the local community and opportunities to meet the existing framework and available resources by consulting the websites of institutions in the field. Dissemination of educational establishment needs, students, teachers and even parents' needs and their accomplishments by supervising and managing the school website.*

**Keywords**: education, managerial competencies, Key teacher competencies, Internet

## Introduction – informational and communication competences necessary to teachers for Internet use

The changes brought on by Internet use in the process of teaching and learning require specialized competences from the part of the teacher, educational manager and education in general concerning the use of Internet for effective communication with students, colleagues and parents; obtaining information and teaching resources necessary for preparing lessons and for personal professional development; preparing, presenting and publishing materials in the most professional way; improving the efficiency of the teaching process.

Adequate training of teachers in the use of Internet requires two instruction steps: the first is a thorough technical training, of familiarization with Internet environment and its resources, creating a basic webpage whereas the second step is placing more emphasis on the way in which Internet resources can be valued in the teaching process.

**New requirements for education managers training in the use of Internet**

The education management activity, through the use of new informational technologies, especially Internet, elicits new requirements regarding competences to be exercised within training programs for executives in pre-university education.

Within these programs we suggest that education managers go through two levels of training of Internet use skills: the first level is the initiation during which notions, competences and fundamental attitudes towards Internet use are transmitted/acquired; the second level, more in depth should emphasize the objectives aimed at training and development of knowledge, competences and attitudes towards Internet use to increase the efficiency of schools management.

**The impact of new technologies in the activity of the school principal**

Modern approaches of education management emphasize concepts like efficiency, progress, planning, etc. Managers are required to possess abilities and skills for forecast, organization and training, control and evaluation. To efficiently accomplish these objectives the manager can delegate responsibilities to the competent individuals but the manager can also improve his/her own performance so that the activity of the entire education organization. Internet use facilitates activities specific to education management. Thus, to achieve *design,* the education manager can use the Internet to search for additional information regarding laws, curriculum, assessment etc., he/she can consult quickly and efficiently the regulations and proposals of the ministry for drafting the school curriculum regarding the application of the national curriculum and the regional/local curriculum development, drafting the project of extra-curricular activities (outside class and outside school) and of school competitions, drafting the budget and procurement project of the school. The educational manager can use the Internet to identify sources of extra-budgetary funding, can draw inspiration and can make effective proposals to prepare documentation for school construction and repairs. The Internet supports the dissemination of information, communication and even facilitates the project for the development of human resources regarding teaching and auxiliary staff. With Internet an education manager can identify the needs for education in the community and the possibilities to satisfy them within the existing legal framework and with the available resources by consulting the websites of relevant institutions in the field. The dissemination of the needs of school, students, teachers and even parents as well as their accomplishments by supervising and managing of the schools webpage.

Regarding the *organizing* activity the education manager uses Internet to select and even quickly obtain official curricular documents, textbooks, curricular auxiliaries (exercise books, collection of texts and math problems, drawings, maps, etc.) books for the library and auxiliary tools through online orders. He/she can use certain applications to create statistical analyses and use email to quickly transmit information. In making decisions the manager can connect with the relevant personnel in different geographical location via email and videoconference. The manager can support and organize competitions and other forms of selection according to their own methodology or the ones set at national and county level. The educational manager can use Internet for counseling and vocational orientation for children and youth, for health and safety purposes, to collaborate with local authorities (County Council, Local Council and Town Hall). The manager can act effectively from afar by using Internet concerning the allocation and use of funding for the functioning, maintenance and repairs of education facilities, signing contracts with economic agents, NGOs and other organizations for mutual services.

In terms of *operational management* the education manager uses Internet for: supervising the progress of extra-curricular activities and school competitions by consulting the documents prepared by teachers and sent via email, by disseminating managerial documents of education institutions towards teachers and superior institutions (County School Inspectorate, ministry, etc.), by accomplishing and efficient time management avoiding useless lengthy meetings using the Internet to transmit data and information etc. (job descriptions/role descriptions for staff, disciplinary procedures and solving disputes, dismissal procedures – retirement and redundancy, etc.). The operational management activities carried on by the education manager benefit from the Internet to establish links with local authorities, economic agents, national and regional culture institutions, church and other interested institutions in order to increase the adequacy of the educational supply to the actual demand, to disseminate own programs and projects and in view of the increase in importance of school as civilization focus, establishing formal links with police, fire department and the public guards n order to ensure guard and protection of students and to prevent juvenile delinquency.

The use of Internet at school level allows access for teachers, auxiliary staff and managers to the Educational Management Informational System. The use of specialized tools like PDAs allows access via Internet from every classroom, lab etc. to the school network and implicitly to EMIS and other educational websites.

In terms of the *control/assessment activity,* the education manager becomes efficient by using Internet to consult and learn about other educational offers, by communicating via Internet with relevant institutions (CNC, SNEE, ISE etc.), by disseminating the assessment of the educational offer and educational performances based on monitoring and assessment criteria and/or performance indicators established through the curriculum project or the development projects resulted following the inspection. Educational managers can elaborate proposals regarding the modification of the national curriculum and regional and local developments and can present and disseminate them with the help of web pages. They can draw the attention of institutions able to provide financial support for the progress of certain projects. Especially for students with disabilities or with special educational needs, the national end of cycle exams, like the graduation of eighth grade or twelfth grade (baccalaureate) can be organized online via Internet, thus ensuring a safer climate. Transmittal of documents and of current and special thematic reports requested by the County School Inspectorates, Teachers Resource Centers, Ministry of Education and local authorities and consultations with specialists in the field by chat, videoconference and email. Archiving, keeping and transmitting school documents, financial and legal documents regarding the management of human resources, material resources and official informational resources can be accomplished safely, ergonomically and cheaply thanks to the Internet.

We must not oversee the manager's role in *motivating* the teaching staff and often times this must be made in an individualized way. One efficient method is to send personal appreciations and appraisals to a teacher, parent or student via email.

Regarding the *implication/participation* of school executives, the education manager can use the Internet to encourage, note and transmit to those in right the local curricular developments and the proposals for the improvement of the national curriculum as per the suggestions of the school's teaching staff. Ensuring the transparency of the elaboration of the budget by making it available on the web page. Ensuring the institutional framework for the participation of the teaching staff to the decision making process through the existing assemblies and collective leadership organisms: department assemblies, Administration Council and Teachers' Council by asking their opinions and ideas in solving urgent problems and transmitting the decisions via Internet. Creating an internal communication system that is fast, reliable and transparent using the Internet. Encouraging an organizational culture to stimulate open communication, participation and innovation by setting up communication networks, projects, etc.

Regarding *professional training/development,* the education manager can use the Internet for consultations about curriculum issues for the teaching staff (email, discussion lists for school managers, videoconference) and consultations for the financial and administrative staff. Dissemination of information and effective communication can be ensured by the use of Internet for general and specific counseling for the entire subordinate staff, online participation in the continuous (self)training programs in educational management and also day to day updates in the field.

Educational managers can use the Internet to *train groups/develop teams* by the involving and assigning responsibilities to members of the department assemblies and project teams – according to the necessities of the school and the activities planned - in various local, national and European educational projects.

To accomplish *conflict mediation/solving* the education managers can use the Internet in setting up communication network at institution level, community level etc.

Considering that in order to obtain and develop these abilities the education managers participate periodically in continuous training programs, the expectations of the community are high regarding the qualitative leaps an education institution should undergo if the principal frequently resorts to the Internet to render the management process more effective.

**Education approach levels from the perspective of Internet use**

The changes occurred in the educational field must take into consideration a three leveled approach:

*The "learning-training" level* regards the educational process in which educational and instructional staff are responsible for providing those who study with spaces for this purpose and material and teaching resources to facilitate quality education at the standards required by the labor market. In this sense we can speak of a greater flexibility and openness to new methods by changing the instructional approach to *research or discovery based learning and guidance from the teacher.* Students will *assume educational objectives, tasks and will get the instruments to help them in their implementation.* Internet connection will encourage *collaboration among students and teachers, schools and students from different locations*. Telecommunications shall provide interactions that can neither be controlled nor caused by institutional agents. Real-life issues, collaborative activities active involvement of the students in the learning process, the student-centered educational act trigger a *summative evaluation process* based on portfolios and projects. Learning will no longer be an isolated process but a *team approach* where teams can be located in a certain school or distributed in many places – at national or international level.

***Challenges and problems***

- The successful implementation of new ICT in school education depends on the degree of proficiency of both teachers and students as users. As resulted from our current research, the ne ICT and Internet resources in particular can be used in a variety of purposes. The main challenge is to use these resources within as many learning situations as possible.
- The new ICT are expensive, which requires a major investment in this sense. The investment must be linked to the efficiency and effectiveness of these technologies.
- The increased self-targeting of students learning on their own can degenerate if poorly understood in a "laisser-faire". The result will be that of a poor education for those who need structure and support in processing information.
- Keeping a balance between personal development and school as a stepping stone towards professional life.

*The "school" level* is identified by the organizational unit in which learning and the instructional process takes place. The adoption of new technologies and modern teaching methods are not sufficient for the school to be able to speak of a systemic improvement. Permanent innovations and a high professionalism are absolutely necessary. *Permanent changes in the technology used require a permanent change in the information to be provided to pupils.* This environment should be established, developed and delivered to students and parents. Collaborative projects require collaboration of several teachers and this involves a flexible designing of curricula and relieving teachers of certain administrative tasks to give them more time for research for the project.

The evolution of education by introducing an appropriate hardware equipment and Internet connection will lead to finding new ways of funding from the part of international structures or private organizations interested in supporting the educational process through projects. These funds will be used in order to maintain the technological standard. On the other hand the school will be able to offer more flexibility for adult education by offering a wide range of activities and facilities and through close collaboration with local community. Access to information and communication media will increase cooperation among teachers both nationally and internationally.

***Challenges and problems***

- Involving parents in school's life.
- Curricular development and its approach will slowly be transferred to schools. This will dramatically change the duties of teachers and will change their role from a passive one, applying a pre-defined curriculum in the teaching process, into an active one, generating new curriculum elements to answer the social requirements of the present through cooperation between students and teacher.

  Integration of Internet in the teaching process can be regarded from three perspectives:
  - *Improving school curriculum;*
  - *Expanding school curriculum* by providing new experiences. The new national curriculum allowed the allocation of a number of hours for optional subjects;
  - *Transforming school curriculum* by strengthening its power in ways that involve changes in the organizational structure and the timetable.

Society is becoming increasingly digitized and the volume of information far exceeds human capacity enrollment. The new needs of the educational system could lead to replacing the current system with something more attractive but, perhaps, little understood yet. Therefore, balance preservation should not be overlooked, nor should optimizing educational opportunities for all students, using teaching methods according to certain learning situations, monitoring the effectiveness of teaching, stimulating intrinsic and extrinsic motivation, encouraging socialization and the elimination of isolation that can be triggered by new information and communication technology.

*The "educational system" level* where a task more difficult than management is to lead the educational system and to promote learning and instruction. With enhanced flexibility the problems linked to the quality of learning and training increase. There is a tendency in the educational policy of decentralization and local concentration of responsibilities in local areas that require professional training of school managers for them to be able to deal with directions such as: setting educational goals according to the specifics of the area, developing local educational policy, specifying curriculum, parental involvement, exercising financial control and quality control. All these responsibilities require a specific entrepreneurship education double by access to information.

This trend of decentralization does not eliminate the tasks of those making the central education policy and who should consider the introduction of new information and communication technologies in teaching requires more time, appropriate training of teachers, curriculum changes, appropriate hardware and software, educational communications networking, Internet connection speed to allow concurrent access to 25 pupils, restricting students' access to information that may affect their development by introducing filters on websites.

Increasing investment in new ICTs while reducing the costs of education at central level compels the latter to find alternative sources of funding and instate a growth-oriented collaboration between education and the private sector.

As noted in the project IEARN, increasing access to the Internet increases the possibility of communication between schools that means the institutional template moves from being "a school" into a network of institutions collaborating in the production of new educational resources.

***Challenges and problems***

- Absence of a clear vision on society development and the need for workforce.
- Accelerating technological change leading to high costs of education both to maintain the equipment at a technological level and for training teachers. For the second aspect, the use of the Internet and distance learning system can be a solution to reduce the possible gap.
- The trend towards a more flexible system and facilitation of international cooperation requires a certain kind of understanding between partners, of knowledge of cultural and educational elements that characterize them.

**Conclusions and future directions for research**

From theoretical analysis and the analyses of practical educational issues throughout the paper the following conclusions can be drawn:

Education and training provide the most important contributions to economic development occurring need to better understand how education influences the training resources for a rapid adjustment in the new society.

*1.* Education and training provide the most important contributions to economic development thus occurring the need *to better understand how education influences the preparation of resources for a rapid adjustment in the new society*

2. New technologies lead to major social changes and restructure the economic world. Introducing new information and communication technologies has led to increasing demand for new specialized skills. We can say that education is seen as a key element of the process of adaptation of humans to these changes. This justifies and requires major investments in the introduction of new information and communication technologies in education so that everyone has access to it *in order to avoid social exclusion and polarization.*

*3.* Innovation in education using new information and communication technologies requires a *change in the curricula of teacher training*.

The introduction of new information and communication technologies in education *is not without legal consequences*. One can speak of a new way of allocating funds, of a new school curriculum, new laws on payroll to encourage the introduction and support of innovation in education, a "legislation in information technology and communications" that refers to copyright, information security and business ethics in cyberspace.

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