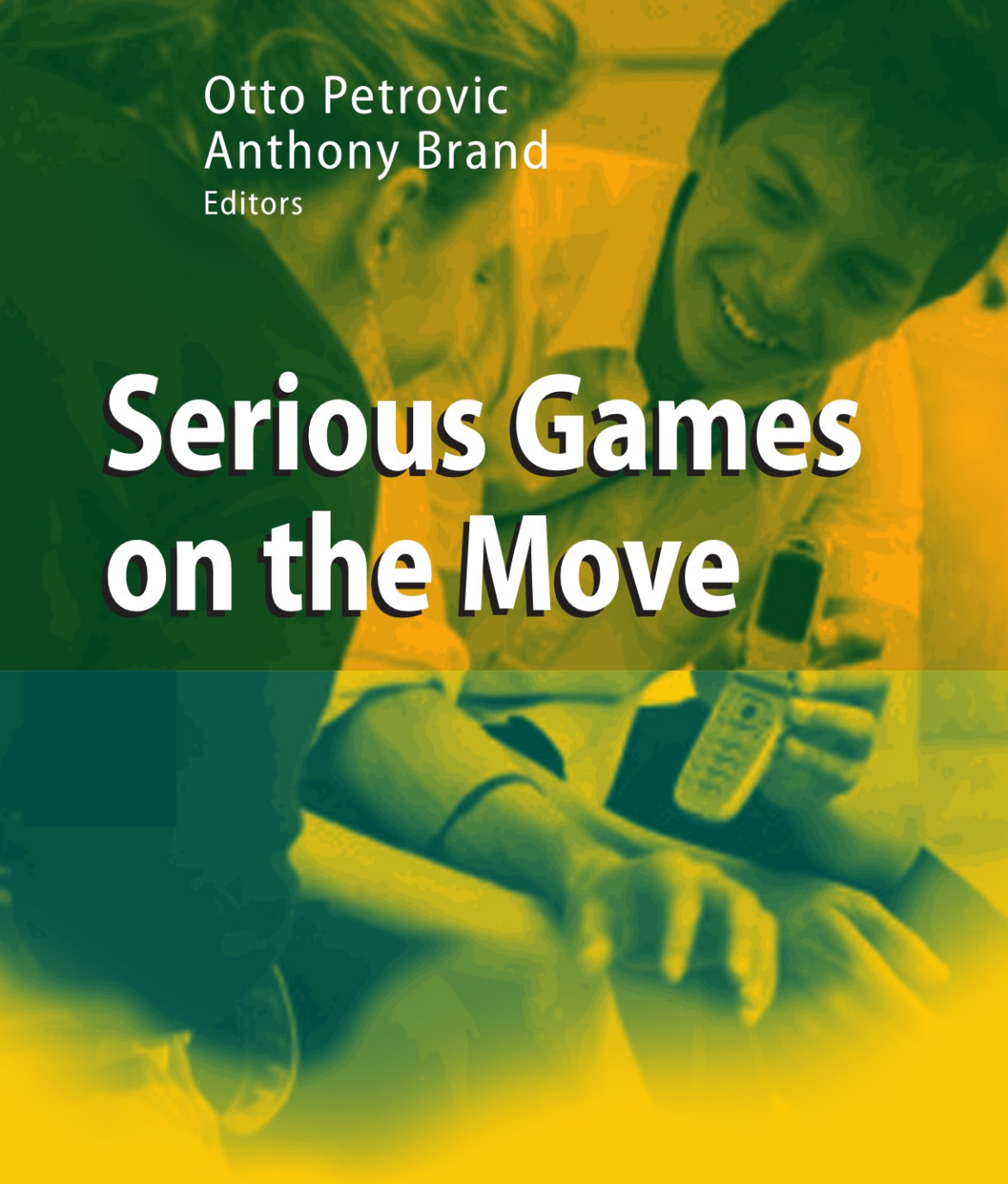
Otto Petrovic
Anthony Brand
Editors

Serious Games on the Move



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Serious Games on the Move

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Univ.-Prof. Dr. Otto Petrovic
Institute for Information Science and Information Systems
University of Graz, Austria

Dr. Anthony Brand
INSPIRE
Cambridge, England

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Thanks also to the mGBL Project Consortium partners and contributors to the Serious Games on the Move '08 Conference and this publication.

Preface

Dr Anthony Brand
Director of Learning and Teaching Development
INSPIRE
Anglia Ruskin University, Cambridge, UK
0845 196 2636
Anthony.Brand@anglia.ac.uk

My academic career has spanned four decades, a variety of institutions and a period in which humankind has moved through the largest number, by range and type, of technological changes than in previous millennia. Upon taking up a new post I habitually spend time in the early weeks opening cupboards. Therein, with the accumulation over time of varying amounts of dust, I would find a range of interesting boxes and apparatus of seemingly alien design. What I was, in fact, finding were the educational equivalents of dinosaurs. They were the remains of 'teaching machines' designed to transform the processes of education. Brave attempts at producing a revolution – but sadly and clearly very rapidly dispatched to be hidden in the cupboard and neglected until I cast the cold light of day upon them once more.

What does this tell us? It speaks of many false dawns and dead ends; valiant attempts at using prevailing and emerging tools and technologies to support and enable learning. Many reasons may have contributed to the short life span of these devices. However, I suspect the primary one may lie in them being top-down devices, developed in a paradigm of the teacher being the centre of the learning process and an implicit, but inaccurate, belief that student engagement would automatically follow. With the technologies and approaches reported on in this publication, my sense is that we have moved into a new paradigm. Engagement with the tools started with the potential users and the (educational) developers have followed on later, clinging, as it were, to the fast moving virtual wreckage.

The education potential for mobile games-based learning (mGBL) approaches is only limited by the scope of our human imagination. Enter this virtual wonderland and we are able to grasp the ability to construct learning opportunity which transcends previous attempts. We are now free

from previous limiting constraints. We can replicate existing worlds and go beyond in regard to analogue and digital modelling. An interesting observation to make about this digital revolution is that it was not driven by desires such as artificial intelligence but rather parallel processing culminates from the gamers. My sense is that in future as I now inspect virtual cupboards I will not so readily find evidence of virtual dinosaurs.

This publication is the culmination of many years of hard and dedicated work by an inspired international group of participants. The more recent dissemination was at the mGBL conference in Cambridge, UK, in the summer of 2008 and this can be sourced at: http://www.inspire.anglia.ac.uk/serious/index.html. The overall successful completion of the project, including the conference and this publication, results from many inputs – here, however, I wish to personally acknowledge the contributions made by two colleagues at Anglia Ruskin University: Alice Mitchell and Jaki Lilly – each providing individual and critically important inputs.

Preface

Doing Justice to the New Realities

Professor Otto Petrovic
Professor of the Institute for Information Science and Information Systems
University of Graz
Universitätsstraße 15
8010 Graz, Austria
Phone: +43 (0) 316 380-7184
Fax: +43 (0) 316 380-9575
otto.petrovic@uni-graz.at
wi.uni-graz.at
www.mg-bl.com

No other technology in recent decades has transformed the economy and society as much as mobile communication. Even though the phenomenon had only just become noticeable 10 years ago, 80% of people living in Europe now own a mobile phone – and the equivalent figure for Japan and Korea has already reached over 90%. Despite having been around for longer, PC-based Internet hasn't even begun to reach such levels of penetration. Currently, it has settled down around the 60% mark in Europe. While the use of mobile phones is largely independent of social status, gender or age, the notion of the mobile phone is probably misleading. Unlike the classic landline phone, calling people is only one of the options available when using this personal companion, which is switched on 24 hours a day somewhere within two metres' reach of 80% of all users. Alarm calls, the built-in camera or the integrated and constantly updated calendar of events are some of the other functions which have also proved highly popular. Yet the real strength of the mobile phone resides in information and communication. In Europe some 190 billion Short Message Service messages (SMS) were sent in 2007, which equates to 520 million short messages per day. In Japan, 40% of sales are concluded using

data services, i.e. functions above and beyond voice telephony. Incidentally, the integration of another mass medium is also worthy of note: over half of all Japanese mobile phones, and almost all of the latest models, feature an integrated TV receiver. And all this started off with people finally being able to do what they have always wanted to do: to call a person, not a place.

The impacts on the economy and society, although clearly discernible, have barely been studied and are barely understood as yet. Mobile phone network operators are among the fastest growing and most profitable sectors of industry. Companies are already organising their communications with customers and staff members in ways that differ radically from just a few years ago. And the social impacts are clearly evident, in the truest sense of the word. A quick look at the Tokyo metro, the Main Square in Graz or the huge audiences at Madonna's most recent concert proves the point. One aspect is the increasing tendency of central social coordination processes to shift from ex ante to ad hoc forms of communication. People no longer arrange to meet up on a Friday evening at a certain place and time. Instead, they casually suggest that they'll probably also be somewhere close by on that date and can always phone each other to agree where to meet.

The nature of this development has little to do with Huxley's *Brave New World* or Orwell's *Nineteen Eighty-Four*. Rather, this increasingly dense and ubiquitous communications network is more like a ball of wool, the strands of which are being wound up tighter and tighter. At the same time, it's worth remembering that you can only knit a pullover by unwinding a ball of wool, not by winding it up. So the question arises: Isn't there a genuine risk that all this permanent, omnipresent information and communication will at some stage squeeze the primary creative force of people ever more tightly, even to the point of crushing it completely? That such strands will smother the creative part of humanity by no longer giving it enough air to breathe? Here, one frequently heard piece of advice is simply to switch off the phone. But Watzlawick was probably right when he said that it is not possible not to communicate. Even if you go offline and even if you switch off your mobile phone you are still communicating and sending out signals – in this case, that you are offline and have switched off your 'mobe'. And there's probably a good reason for this, too. Even if you're sitting among regulars down the local pub you are still saying something even if you remain silent. And once you really start living in the communication society you are still saying something even if you no longer communicate.

These are probably just a few aspects of the new realities. But learners and teachers in the present day also move around in such aspects. And that

is precisely the core idea behind mGBL – mobile game-based learning: to use these new realities in order to do justice to them. In other words, to use young people's form of communication, one used routinely by them, to support their learning processes. This is not a replacement for classic forms of teaching (also – or precisely because – the notion of 'teaching' probably constitutes the antipode on modernity's scale of concepts surrounding learning), but a complementary form in order to make the content of teaching something which can be felt and experienced by them in the long term.

The kind of systems that have been developed in this context, the way they have been embedded in learning programmes and the sort of technologies that underpin this development form the subject of this book.

mGBL: Project Introduction

Professor Otto Petrovic
Professor of the Institute for Information Science and Information Systems
University of Graz
Universitätsstraße 15
8010 Graz, Austria
Phone: +43 (0) 316 380-7184
Fax: +43 (0) 316 380-9575
otto.petrovic@uni-graz.at
wi.uni-graz.at
www.mg-bl.com

Abstract

This introduction provides an overview of the mGBL project (mobile Game-Based Learning). The first section contains a general project description with coordinator contact details and a description of the project consortium. Section 2 includes an overview of the project goals. Section 3 provides an overview of all relevant project results followed by a description of the potential impact of the mGBL project, as well as a summary.

Project Consortium

Around 30 researchers from 11 different project partners from 5 European countries (UK, Italy, Croatia, Austria and Slovenia) joined forces to research and develop new forms of emotionally engaging and playful methods of learning using mobile phones.

Participant name (acronym)	Country	Project role
evolaris next level Privatstiftung (evolaris)	Austria	Coordinator + developer
Verein Schul- und Ausbildungsberatung (SAB)	Austria	Educational and vocational advice expertise
Research Studios Austria Forschungsgesellschaft mbH (ARC)	Austria	Developer
spoon next level technology GmbH (spoon)	Austria	Developer
Anglia Ruskin University (ARU) – INSPIRE	UK	Pedagogy and learning model expertise
University of Rijeka – Faculty of Maritime Studies (PFRI)	Croatia	Pedagogy and learning model expertise
University of Rijeka – Faculty of Arts and Sciences (FFRI)	Croatia	Pedagogy and learning model expertise
University of Trieste – Faculty of Electrical and Electronics Engineering (TRIESTE)	Italy	Developer
ASTER – Societa Consortile per Azioni (ASTER)	Italy	Educational and vocational advice expertise
University of Marburg – Faculty of Organizational Sciences (UM)	Slovenia	Developer
Andragoski zavod Maribor – Ljudska univerza (AZM-LU)	Slovenia	Educational and vocational advice expertise

Table 1. mGBL project consortium

Project Goals

The overall goal of the project was to improve the effectiveness and efficiency of learning in the target group of young people (aged 16-24) through the development of innovative learning models based on mobile games. As the mobile phone is a highly personal communication channel, it was used to establish the link between learners and teachers. This communication channel was also the one most widely used by the target group. The biggest challenge in this project was to communicate content from different fields in a motivational, inclusive and emotional way.

The specific aim of the project was to design, develop and pilot a prototype game platform that might be used to efficiently develop games for m-learning. The focus was on providing support for decision-making in critical situations. Such games are intended firstly to directly support learning via opportunities to develop knowledge and cognitive skills in an

exciting and inspiring, and therefore a highly emotionally engaging, way, and secondly to indirectly motivate users to refer to other media (e.g. 'classic' libraries, scripts, and so on) for learning purposes.

The Vision

The challenge within this project was to relay content from different fields in an involving and emotionally engaging way to younger people aged 16-24. The basic idea was to use the mobile phone to develop games which bridge the real and virtual worlds.

Contribution to European Union (EU) Needs

The mGBL project addressed a two-fold need in the EU. Firstly, it addressed the need to support decision-making in critical situations, both cognitively and emotionally. The examples used in the mGBL project included career-related decisions, business-related decisions, and decisions in the context of a health environment (i.e. epidemics, disasters and so on). Secondly, the project addressed the need to build on cutting edge work in the new field of m-learning with research-based development on interactive game-based learning using mobile devices.

Sub-Goals

The main goals of the project were divided into a number of sub-goals. One of these was to carry out an in-depth user requirement analysis to determine the detailed requirements of all stakeholders (students, teachers, and IT staff, for example) to successfully implement mobile game-based learning. It was also necessary to develop a classification system relating different types of mobile games to the various learning goals, content and target groups. Building upon this classification, a software application was developed which supports the selection of various types of mobile games suited for learning based on these attributes.

Another sub-goal was the development of a platform, which consists of an authoring tool, a module for measuring utilisation and learning success, and a deployment module. This platform enables game authors to develop individual mobile games from existing content (i.e. scripts, books and so on), to use predefined game templates fast and easily, and to distribute them to students.

Once the platform was in place, it was necessary to design, develop and pilot a minimum of two different prototype multimedia learning games and templates, for use via mobile technologies, and to deliver aspects of lifelong learning in the target fields of e-health, e-commerce and career guidance.

Iterative development was facilitated by conducting user trials at different universities and also at institutions providing educational advice services. This yielded both qualitative and quantitative data enabling the measurement of goal achievement.

Finally, the project results needed to be disseminated, both within the m-learning community and the mGBL project consortium, as well as to the general public. The mGBL project has established and maintained a website and an online community of practice, and has developed and applied various other means of communication, including conference papers and poster presentations. The focus of the dissemination strategy was the implementation of mechanisms drawn from marketing and psychology, which trigger an emotionally engaging learning process.

Primary Objectives

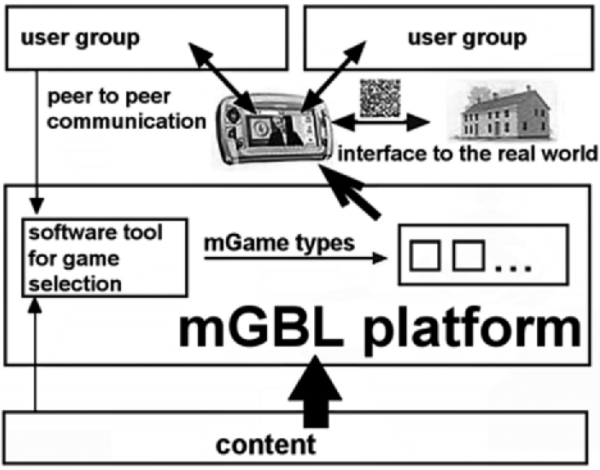
The primary objectives of the mGBL project were:

- The development of an easy-to-use and cost effective method for embedding different types of content into games which run on and through mobile phones
- The development of a game-based m-learning platform
- The development of at least two example games for each of the game models, and learning models to transfer different types of content in an emotionally engaging and playful way to different types of target groups

The results of the mGBL project add new learning models to the market that will use mobile phones as a tool for triggering social interaction between learners and their peers.

The mGBL Platform

Fig. 1. The mGBL platform.



The mGBL platform offers different ways of connecting the real world with the virtual world (see Figure 1).
The mobile phone is the central gateway between user groups, the mGBL platform, and the real world. It is both the medium for, and a part of, the mobile game.

The mGBL platform handles the planning, control and administration of games itself. It contains game templates and a tool that suggests appropriate games depending on the target group, content and learning goals defined by the game author.

The platform also includes reporting modules for the evaluation of user acceptance and the measurement of individual learning success.

Main Target Groups

The mGBL project focuses on a wide target group which, on the one hand, is diverse, as it involves young people from different social groups, regions and countries. On the other hand, however, the target group is homogenous in its preferred mode of communication and affinity with new technologies.

The mGBL project mainly addresses the following target groups and stakeholders:

- Scientific communities in the fields of education, pedagogy, e-learning, and m-learning
- The formal education sector (i.e. professors, teachers, students, pupils)
- Vocational and IT staff (i.e. IT administrative personnel)
- Software developers (i.e. open source communities)
- European projects
- National and international funding programmes
- Commercial marketers

Work Packages and Their Connections

The following figure provides a graphical overview of all work packages and their connections. Work Package 1 (WP1) (Project Management) and WP8 (Dissemination and Exploitation) are work packages which have strong connections to all other work packages. WP1 ensures the overall project management. WP8 ensured the dissemination of all public project results, and that all project results will be used and exploited for future requirements, both commercial and research-oriented.

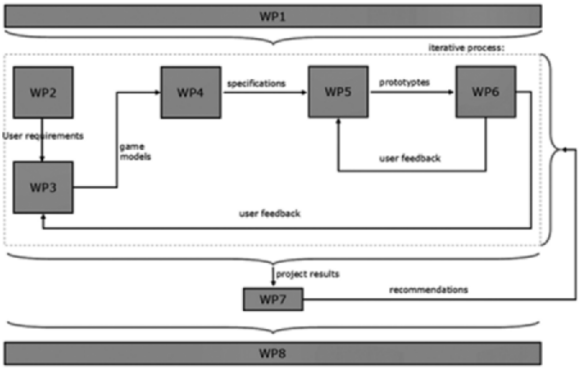


Fig. 2. Work packages and their connections

WP2 (User Requirements) provided definitions of user needs and requirements for WP3 (Mobile Learning and Game Models), which were used by WP3 for the development of the learning and game models. The user requirements and user needs, along with the learning and game models, were used as a basis for WP4 (System Specifications). The research teams used the inputs from WP2 and WP3 to develop the system specifications. The system specifications from WP4 were the basis for the

development teams in WP5 (Technological Implementation). The development teams developed all the software modules of the mGBL platform according to these specifications. The development process was a two-fold iterative process. Early prototypes of the software modules were developed using the WP2, WP3 and WP4 research findings. These prototypes were tested in user trials conducted in WP6 (User Trials). The collected user feedback was used for further input for WP3, WP4 and WP5 in order to improve the prototypes and develop the final version of the mGBL platform prototypes. The main goal of WP7 (Evaluation and Validation) was to evaluate and validate the overall mGBL project. The following dimensions were evaluated and validated:

- the social, psychological and technological aspects of the project
- user acceptability
- added value through transnational project consortium
- the games in terms of effectiveness (learning achievements) and efficiency (time needed and demand on resources in teaching)

Project Results

Overview of Deliverables

Thirty-two deliverables were developed in the course of the mGBL project. All deliverables are available at the mGBL website: http://www.mg-bl.com.

Potential Impact of the mGBL Project

Pedagogical Impacts

It was a main goal of the mGBL project to develop methods and tools that enable learning in a playful and emotionally engaging way. To this end, WP3 developed innovative learning models, which have subsequently been implemented into the prototype game templates. These game templates have been evaluated by both learners and teachers, and proved to

fully support the overall goal. For example, the results of an empirical study (Kittl et al. 2008) with approximately 100 students for Game Template 3 ('Get Real!') reveal that it leads to higher energetic activation, more positive emotions, more positive attitudes towards learning content, and more efficient knowledge transfer than a conventional case study approach.

In addition, for the first time in history, a mobile learning game was used in an exam at the University of Rijeka, with very positive reactions from all involved. This demonstrates the dramatic impact the models and technologies developed during the mGBL project can have in all phases of teaching and learning.

Impacts of Innovative New Services

The mGBL project has shown that it is not always necessary to deploy the most advanced 3D graphics and cutting-edge handsets to ensure a good quality user experience. In contrast, a practical 'low-tech-high involvement' approach is, in many cases, much more suitable in the learning context, especially when considering younger people in formal education. It is of the utmost importance that the systems can be used by all pupils and students, and that it does not require special devices, which may not be available or affordable for some target groups. The mGBL project has therefore developed a platform which is supported by widespread industry standards, and requires only minimal device capabilities on the client side (i.e. Java, http, SMS/Multimedia Messaging Service (MMS)). The flexibility of the platform allows game authors to customise content, and can easily be adapted to individual needs without the need to develop sophisticated technical skills. The platform is available as open source software at SourceForge (http://sourceforge.net/search/?type_of_search=soft&words=mgbl) under the European Public License (EUPL) model, and its modularity and ease of use should give rise to a considerably large community contributing both new functionalities and contents, while at the same time improving the quality of the software.

Initial exploitation activities (e.g. user trials at the University of Vienna and an exploitation workshop with representatives from mobilkom Austria) demonstrated that hosting the platform as an application provider and offering additional services (such as user acceptance research or community building services) are promising business models (where advertising may also play a vital role for revenue generation), which will lead to a broader uptake of the new learning models in the future.

Impacts on Target Groups

The main target group (i.e. young people aged 16-24) benefits greatly from the new learning models developed in the course of the project. As the empirical results show, these models can not only support more efficient knowledge transfer than, for example, a conventional case study under certain conditions, but using mobile learning games also leads to more positive emotions and especially high flow values. The strong flow experience points to a high degree of intrinsic motivation in the learner and shows that the game is being played for the game itself and not due to an external incentive, such as a good grade, for instance.

Summary

With a total budget of around EUR 2.5m the mGBL project consortium has produced new research findings in the mobile game-based learning area. From the software development viewpoint the following project results are the most significant:

- mGBL platform
- mGBL game style selection tool
- mGBL Game Template 1: 'AHEAD OF THE GAME'
- mGBL Game Template 2: 'MOGABAL'
- mGBL Game Template 3: 'Get Real!'

The evaluation of the project (Mininel 2008, Peyha 2008) has shown that the mGBL game templates provide an excellent toolkit for emotionally engaging and playful learning. This assertion has been reinforced by scientific research (Kittl et al. 2008), where traditional learning methods were compared to the mGBL model, with the result that using the mGBL solution leads to much better learning results. The project consortium is now seeking further research funds to ensure further development of the mGBL platform.

References

Kittl C, Edegger F and Petrovic O (2008) Learning by Pervasive Gaming – An Empirical Study. In: Ruy H and Parsons D (eds), Innovative Mobile Learning Techniques and Technologies, Idea Group Publishing, pp 60-82

Mininel S (2008) mGBL Deliverable D 7.5 – Evaluation report on the final test bed incl. content. Available at: http://www.mgbl.com/fileadmin/downloads/deliverables/D7.5_Final_Evaluation_Report.pdf, [accessed 26 January 2009]

Peyha HJ (2008) mGBL Deliverable D 8.5 – Final Dissemination and Exploitation Plan. Available at: http://www.mgbl.com/fileadmin/downloads/deliverables/D8.5_Final_Dissemination_and_Exploitation_Plan.zip, [accessed 26 January 2009]

Contents

mGBL Project Consortium Partners

Andragoški zavod Maribor – Ljudska Univerza: Helena Matavž

Anglia Ruskin University – Alice Mitchell

ARC Seibersdorf research GmbH: Brigitte Krenn

ASTER S. Cons. p.a.: Daniele Sangiorgi

evolaris next level Privatstiftung: Thomas Ebner, Markus Fallenböck, Richard Hable, Christian Kittl, Harald Krassnigg, Emanuel Maxl, Hans-Joerg Peyha, Astrid Tarkus

Filozofski Fakulet u Rijeci: Ivana Ilijašić Mišić, Vladimir Takšić

Pomorski Fakulet u Rijeci: Dragan Čišić, Ana Perić Hadžić, Edvard Tijan

Universita Degli Studi Di Trieste: Sara Gaion, Stefano Mininel

Univerza v Mariboru: Uros Hribar, Gregor Lenart

Verein Schul- und Ausbildungsberatung: Andrei Parvu

Conference and Publication Contributors and Personnel

Ambient Performance: Ron Edwards

Bournemouth University: Andy Pulman, Mark Shufflebottom

CERLIM: Geoff Butters

Charles Sturt University, Australia: David Cameron, John Carroll

Ciberespacio: Daniel Weiss

Cross Czech a.s.: Romana Krizova

European School net: Roger Blamire

FDMX (Film and Digital Media Exchange): Saint John Walker

Illumina Digital: Carlton Reeve

INSEAD CALT: Albert A. Angehrn

INSPIRE, Anglia Ruskin University: Michelle Bernard, Georgios Evangelinos, Dave Fowler, James Kadirire, Jaki Lilly, Ania Norman, Leonie Ramondt, Uwe Richter, Tom Stacey, Emma Warnes, Mark Warnes, Jason Williams, Dominic Righini-Brand

Loughborough University: Mashanum Osman

MDR Partners: Robert Davies

Roundpoint: Trevor Shonfeld

Serious Games Institute: Sara de Freitas, David Wortley

Short Fuze: Matt Kelland

The Royal Veterinary College, University of London: Neil Forrest, Sarah Baillie

Université Paul Sabatier: Jean-Pierre Jessel, Mathieu Muratet, Patrice Torguet

University College, Cork: David Murphy, John O'Mullane, Aidan Sliney

University of Johannesburg: Alan Amory

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University of Vienna: Gerit Gotzenbrucker

University of Wollongong: Helen Hasan

Committee Members

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Theme 1: Designing serious games

Designing Mobile Games for Learning: The mGBL Approach

Dr Jaki Lilly
Anglia Ruskin University
0845 196 2738
jaki.lilly@anglia.ac.uk

Mark Warnes
Anglia Ruskin University
0845 196 2672
mark.warnes@anglia.ac.uk

(Developed from drafts by Thomas Ebner, Richard Hable, Uros Hribar, Brigitte Krenn, Helena Matavž, Stefano Mininel Alice Mitchell and Daniele Sangiorgi.)

Abstract

This paper describes the technological environment and pedagogical frameworks underpinning the development of mobile game-based learning (mGBL) mobile games. A detailed description is given of the pedagogical and technical basis of the three game templates developed within the project, plus design and trialling details of each associated game. Finally, we discuss the development of our game authoring tool, which allows users to customise mGBL games, and locate and develop new games.

Keywords

Mobile game-based learning, pedagogy, game authoring, decision making

1 Introduction

The mGBL project taps into the zeitgeist of 21st-century learning by engaging with the ubiquitous mobile technologies that students already possess. The project is based on the proposition that young people's motivation to engage with education can be maintained through the development of pedagogically sound games, delivered in a manner that is both accessible and approachable. Young people engage with mobile technologies as a normal and natural part of their daily lives and many cannot imagine a world in which these are absent (Prensky 2001) and we propose that their learning needs can be met within this perspective as well.

At the outset of the project, the majority of mobile games had been developed for PDAs, Tablet-PCs, or Pocket-PCs. From a technical point of view this is a great advantage, as most of the functionality of a PC environment is available for application development, including sufficiently large memory, powerful CPUs, advanced programming environments, platform independence, full access to multimedia, large displays, keyboards and so on. These are all properties that do not (yet) hold for mobile phones, leading to radically different requirements on application development, programming and testing of mobile learning games (Sanneblad and Holmquist 2004; Sanchez et al. 2007).

However, the introduction to the market of the iPhone and its clones indicates the pace and direction of the development of mobile technology. The expansion of the capabilities of mobile devices provides the technological framework that permits the construction and distribution of sophisticated learning-oriented games and offers the user the opportunity to engage with learning in a non-threatening and familiar environment.

The mGBL project involved a collaboration between eleven partner organisations from Austria, Croatia, Italy, Slovenia and the UK, led by evolaris Privatstiftung, Graz, Austria. Our challenge: to design exciting learning games for young people (i.e. aged 18-24) who use mobile technologies, which are fun and fit their lifestyles.

The learning focus: the development of decision-making skills for use in critical situations, a key area of concern in the European Community (EC). As Mitchell notes, the mGBL project 'operates within a social-constructivist pedagogical framework where the learner takes centre stage: we are concerned that our innovations are user-led, not technology driven' (Mitchell 2007).

2 Designing Mobile Learning Games

Mobile learning games have been developed for a broad variety of learning contexts, such as role play and multiplayer games (Mohamudally 2006; Sanneblad and Holmquist 2003; Lonsdale et al. 2004; McAlister and Xie 2005), covering such different applications as role-based foreign language learning (Harriehausen-Mühlbauer et al. 2005) or game-based learning (of computer languages such as C++, for example) (Hamid and Fung 2007). Other games aim at collaboration (e.g. Sanneblad and Holmquist 2004; Sanchez et al. 2006).

Whilst a number of proposals for mobile learning games have been presented in recent years, the main characteristics identified for mobile game-based learning applications based on Trifonova's (2003) concise overview of work prior to 2003 remain relevant today. These are:

- learning applications should be self-explanatory and support a playful way of learning,
- the learning content should be split into small units which require only a reduced span of attention so that game play and learning can take place during breaks,
- the learning content should be available any time, and should be integrated in the situational and local context of the learner. Thus, integration of location-based services becomes relevant.

From surveys of eventual users during an early phase of mGBL, we identified some basic rules to be considered when developing mobile games, which concurred with Trifonova's work:

- Do not focus on learning content – instead provide problem-solving activities that require ingenuity. An important aspect of a learning game is the stimulation of learning through activity. Simulation and strategy games should provide a risk-free framework for experiencing critical situations, trying out strategies and thereby offering the potential of arriving at better skills, self-knowledge. In mGBL games, the specific learning activities the user undergoes when playing are based on Anderson and Krathwohl's learning goals – remembering, understanding, applying, judgement and analysing (Anderson and Krathwohl 2001).
- Mobile games should be real games, not learning contents 'dressed' as games. Exploit the fun and informality of games. Provide challenge, excitement and feedback – use short tasks with rewards built-in. Within mGBL, the game concepts were primarily inspired by the work of Fabricatore, in particular his notion of 'edugaming', which focuses on

intertwining learning and gaming (Fabricatore 2000). The concepts also relate to Prensky's views on game-based learning (Prensky 2001), who argues that learning games should firstly be fun and then encourage learning.

- Reflect how learning has developed: peer to peer, agile, project-based, collaborative, built around communication and project-based activities requiring ingenuity. Real-life interaction, not just role-play – players in different locations exchange/trade information, ideas.
- Create learner-centric games. Keep games relevant to the learner's social and learning needs, 'just-in-time' information needs, capabilities and level. Put the learner in control – and keep it simple. Exploit aspects of community learning with activities set up by, not for, users. Game results should be given also after short sessions, which correspond to the travel paths to work/study by bus or train. Provide a sense of audience, give them space to grow and adapt, to follow own passions – use a phone-based approach, e.g. incorporating phone calls, messaging – build around communication, tacit learning, ambient learning.
- Generally, do not replicate PC-style games. Games should be specifically designed to meet the specific affordances and limitations of mobile devices. The battery life of mobile devices is a very important consideration, for example, as is the length of games: the shorter the better. For young users, critical features are the costs of mobile devices, whilst for adult users there may be technological barriers.

The small screen size and limited computation capability of mobile devices, along with the particular nature of mobile games themselves, mean that, at present, the content delivery of m-games is somewhat restricted. From this point of view, the real potential for mobile game-based learning lies in providing flexible access to information through the mobile technologies, in an appealing form represented by the game approach.

In response to this challenge we developed three Game Templates and example games in the fields of e-commerce, e-health and e-career guidance, which are areas of strength within the consortium:

1. Game Template 1 'AHEAD OF THE GAME' (Games: a] *Fastest First!* b] *e-Business* and c] *Crisis!*). Game Template 1 contains two modules, a quiz module and a simulation module.
2. Game Template 2 'MOGABAL' (Game: d] *e-Career Guidance*). Game Template 2 uses an adventure game template to allow ultimate outcomes.

3. Game Template 3 'Get Real' (Game: e] *Digital Economy*). Game Template 3 can be used to model games reflecting real world problem finding and problem solving.

Overall, the game activities facilitated by the three Game Templates include:

- SMS (text messaging) for communicating in team games, e.g. passing on information to team members and the game system and collecting feedback from these;
- Java quizzes and simulation game components to download to colour screen phones;
- Media collection and sharing by teams of students, using a camera phone;
- Mobile blogging using SMS, MMS (picture and audio messages), camera phones, e-mail and the web.

3 Developing and Integrating Content for mGBL Game Templates

Game Template 1 'AHEAD OF THE GAME' (Games: a] *Fastest First!* b] *e-Business* and c] *Crisis!*)

Game Template 1 contains two modules – the quiz module, on which the example games *Fastest First!* and *e-Business* were designed, and the simulation module on which the example game *Crisis!* was designed.

The games are aimed at training the decision-making capabilities of the learners, both on a cognitive and an emotional level. In *Fastest First!* and *Crisis!*, players are forced to make their decisions quickly: in *Fastest First!*, because only the fastest players have a chance to win and reach the next game level; in *Crisis!*, because the situation rapidly deteriorates in the absence of appropriate interventions.

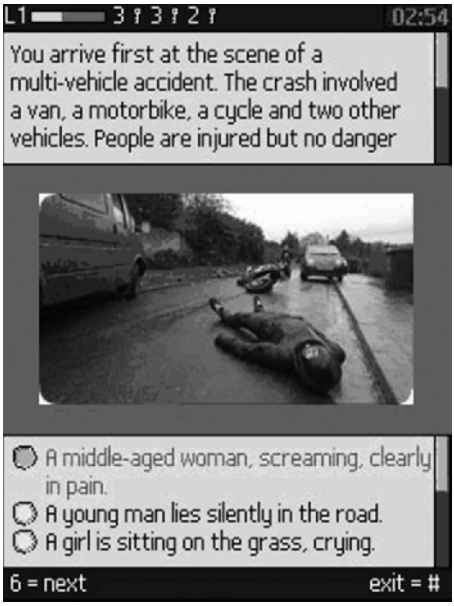
Game a] Fastest First! Each question in the quiz module requires the answer options, which of these are right or wrong, the feedback for both right and wrong answers, any hints, and the number of points available. Once all the questions for one level are entered the author can proceed to the next level. A few additional control options are available for each level. The teacher can, for example, specify a level introduction, a mastery score, and feedback for the level as a whole.

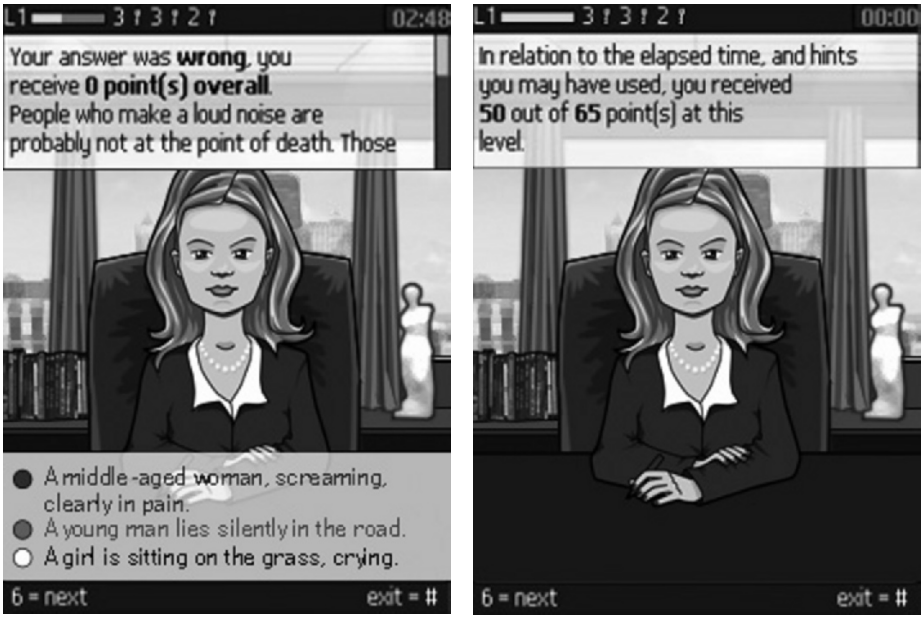
Fastest First! is inspired by TV formats such as *The Apprentice* (i.e. the bad-tempered boss character – players have the opportunity to select either a male or a female boss character) and *Who Wants to Be A Millionaire?* (i.e. multiple choice questions including joker options). Figure 1 (see below) shows some of the key aspects of *Fastest First!*

- Screen 1 is an example of the introduction of the general topic of a specific quiz, the example shown is a first aid quiz. It is also at this stage where the boss tells the player to be quick in order to get the chance to proceed in the game.
- Screen 2 is an example of a multiple-choice question – the system immediately informs the user whether the answer is right or wrong.
- On screen 3, the boss informs the player that the given answer was wrong – right and wrong answers are highlighted in green and red, respectively. Colour coding alone, however, is not sufficient, as colour-blind players may be disadvantaged. Consequently, right and wrong answers may be indicated using icons such as a thumbs-up or a thumbs-down, respectively.
- Screen 4 shows a simple summary given at the end of a game level, where the player is informed of his or her score and the total of points that could have been achieved.

1. Introduction of Topic

2. Question-Answer Card





3. Immediate Feedback on Correctness of Answer

4. Summary at End of Game Level

Fig. 1. Sample screens for the quiz game *Fastest First!*

Game b] e-Business. Covered areas: basics of ICT and *e-Business*; problems and issues of users using *e-Business* applications; Information Systems (IS) development and *e-Business* applications; security and privacy of *e-Business*; *e-Business* strategy.

Scenario: At the first level the learner applies for a job and the first activity represents a job interview where the student has to demonstrate basic ICT and *e-Business* knowledge. If the learner shows enough knowledge, s/he is employed as a helpdesk specialist.

In the second level the learner has to deal with problems and issues that users experience using ICT and *e-Business* applications. Sometimes this job can be very irritating and demanding but sometimes can also be very amusing.

After successfully finishing this task the learner becomes an IS and *e-Business* developer or a development project manager. In this level the learner faces more technical aspects of ICT and *e-Business* application development.

The subsequent promotion and difficulty level focuses on *e-Business* security and privacy. In this level the learner meets an external IS auditor and has to deal with questions about security measures and privacy issues.

The final level covers strategic decision-making about *e-Business* in a selected organisation.

The game consists of five levels with ten questions each. The total number of optional answers is 200, with feedback provided for each answer. Hints have also been developed for each question. The mastery score increases from level to level, so level one is the easiest and level five is the hardest. The learner is awarded points for each answer but must achieve the mastery score in order to progress to the next level. If the mastery score is not achieved, the learner must repeat the level from the beginning.

	Level	Role	Questions/Points	Mastery
1	Basics of ICT and *e-Business*	Candidate at job interview	10 (2) 20	15
2	Problems and issues of users using *e-Business* applications	Employed as e-Commerce helpdesk	10 (3) 30	20
3	IS development and *e-Business* applications	e-Commerce developer	10 (3) 30	25
4	Security and privacy of *e-Business*	Head of IT department	10 (3) 30	27
5	*e-Business* strategy	Board of directors	10 (3) 30	28

Table 1. *e-Business* game levels and scoring

Game c] Crisis! While the quiz module supports learning at a cognitive level, the simulation game module creates very specific, emotionally loaded contexts in order to apply prior knowledge. The simulation module targets contextualisation of the learning game along the lines of real crisis situations (Klein 1996), and modelling of the consequences the user activities in the game have for the user personally and for others (Senge 1998).

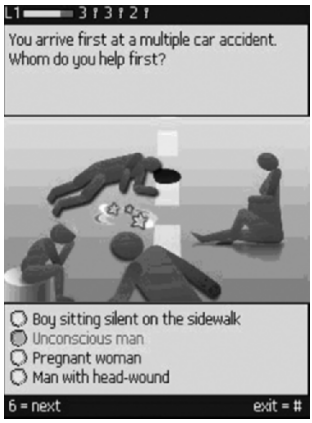
Players of the *Crisis!* simulation game are confronted with critical situations, such as an accident with differently injured people, the breakdown of a computer system, a crisis on the stock market, and so on. The simulation module contains a special scenario, which consists of four critical situations. The students have to prioritise which of the four critical situations is the most important and than select one of the optional treatments. The player then has to master the situation to the best of his or

her ability. The simulation has four steps and in each step the critical situations become increasingly severe. The players' skills will determine how well they are able to do the right things at the right time, and the crisis will either be mastered or will gradually deteriorate. Decisions made at one stage influence all other situations in the subsequent stages. Ultimately, the player is responsible for how the situation develops, and the consequences of their actions for themselves and others.

At the end of the simulation, the player is invited to assess his or her own progress. Points are calculated based on selected situation and treatment option. If the player agrees, the self-assessment is sent to the game server and is then available to be further assessed and discussed with other members of the learning group.

In *Crisis!*, the player is confronted with a situation that changes incrementally from bad to worse. The simulation begins with a description of the initial situation and a multiple choice question, where the player needs to decide which action to take first, in the example, and who to treat first (see Figure 2 below). Here the player has opted to treat the unconscious person first (Screen 1). After the player has made a selection, the game asks a question related to that choice. In the example below, the question is how to treat unconscious people. Again, the player has made the right choice by selecting 'Recovery position' (Screen 2). The situation proceeds step by step until all the injured people have been treated.

1. Initial Situation



2. Question Elaborating on the Player's Choice

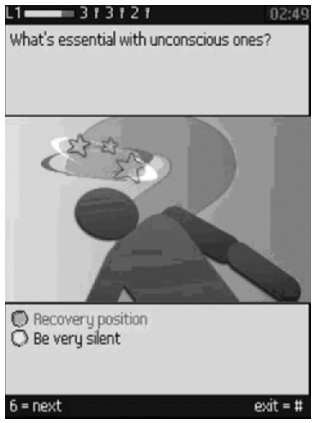


Fig. 2. Sample screens for the simulation game *Crisis!*

Figure 3 shows an example where learner self-assessment and system assessment do not match. In addition, the learner has the option to submit a short self-assessment via SMS. If the system receives clearance from the player, the text is sent via SMS to the server, and can then be further discussed with the learning group.

1. Self-Evaluation

2. System-Feedback

Fig. 3. *Crisis!* player self-evaluation and system feedback

Fastest First! and *e-Business* support learning at a cognitive level (learning and rehearsing of factual knowledge), *Crisis!* creates very specific, emotionally loaded contexts for the learners to apply prior knowledge. The games meet Trifonova's (2003) criteria, as they present small, self-contained learning units (question-answer cards), which can be processed by the learners at any time, as they carry their games on their mobile phones.

Game Template 2 'MOGABAL' (Game: d] *e-Career Guidance*)

The challenge, from the technical point of view, in programming a Java 2 Platform, Micro Edition (J2ME) game in the mGBL framework is that the objective is not to create 'one' game, but the potentiality for an abundance of games. Key issues:

- the game type and style may be highly variable
- the game pedagogical content is highly variable

- both the game type and its pedagogical content are to be created, modified or customised by users (the teachers creating the game as support to their courses) in a relatively easy way.

The solution was found in the simple game concept of movement on a rectangular map, having different graphical layers: background graphics, active elements ('sprites') and possible 'fog of war'.

The player's avatar roams the map. If 'fog of war' is present, initially the map is obscured and revealed only during map exploration. A collision with one of the sprites launches an 'event'. Each sprite is tagged with a code to which a list of '1 to n' events is associated. According to game construction rules, sprites can be programmed to 'disappear' from the game after being collided with, or they can be 'permanent' and launch a random event taken from the list of events with the same code at each collision with players' avatars.

The different 'events' supported include:

- Quiz: A text and one or more options to choose from
- Decision Tree: Similar to Quiz, however, various choices have no immediate reward but link to a subsequent event (which can be any event type). This allows construction of complex simulations of chains of choices or decisions
- Conditional Decision Tree: Similar to Decision Tree, but some of the possible choices are available and visible to the player only under particular conditions
- Simple: Text message that can be used as a 'leaf' of a decision tree or as a simple random event
- Multimedia: Opens a multimedia resource then links to a subsequent event. Can be used to enhance the graphic aspect of the events or to insert audio/visual elements in decision trees
- Null event: Game contents logic may require an 'empty' event
- Game Over: Event overriding the normal 'game-over' rules

Another important concept in the game which we have borrowed from role-playing-games (RPGs) is that the player's avatar is personalised by a set of four to six attributes, or 'characteristics'. The names of these characteristics are fully configurable, so that for a 'typical' RPG they could be Strength, Intelligence, and so on. Alternatively, they may be Linguistic, Logical-mathematical, and Interpersonal for a career guidance game. Players can choose between different 'characters' with varied skills. The player's choices and game events will have an impact on the values of these characteristics.

The Java code runs as a 'game engine', while everything else is contained in 'resource files' within the final 'jar' archive file that will be installed on the mobile phone. These files, i.e. all the graphic resources (for map or multimedia events) and three text files, contain the:

- Game Setup: Defining names of characteristics, game-over conditions, and so forth
- Graphic Setup: Defining how one or more game maps (one per game 'stage') will be constructed from the resources containing the sprites and graphic elements needed
- Event Content: List of all the events that may happen in a game

Game d] e-Career Guidance. mGBL game content development is based on a bottom-up approach, which means that users have been directly involved in the activities from the very beginning of the project. For *e-Career Guidance*, interviews and focus groups were carried out both with users of mobile games and experts in career guidance. Both target groups were invited to share comments and ideas concerning the use of games to support guidance, focusing on the kinds of bias that users may have towards mobile technologies. In this context, content development was carried out, taking into account, firstly, the main suggestions resulting from the surveys and the anticipated benefits of m-games to career guidance and, secondly, that one of the core concepts of mGBL games is to support decision-making in critical situations. Since, in the career guidance field, this concept corresponds to supporting the user's choice in a transitional moment (e.g. between school and employment), two specific topics of career guidance were addressed:

- Career guidance and mobility: for support in decision-making in critical intercultural dimensions both for work and study reasons. A specific target could be university students to be selected for EU programmes such as Erasmus or Leonardo da Vinci, for example.
- Vocational guidance: for support in decision-making in critical situations in the work context or in a transitional phase, especially after secondary school but also after university.

In addition, the game design had to take into account factors such as the adaptation of content to one of the available game templates and the fact that the situations created have to amuse and/or thrill the player, otherwise it cannot be considered a game. Moreover, while a quiz-based game was better suited to deliver contents in the other project areas of analysis (i.e. e-commerce and e-health), this was not possible in e-career guidance, since there are no 'right' or 'wrong' answers and every choice must be available.

As more interaction was needed to address a ‘guidance situation’ and to face up to the different possibilities, an adventure game template was selected.

It is important to mention that the specific storyboard outline has been developed by researching critical situations using the analysis of real cases in collaboration with employment centres, youth information centres and guidance counsellors through surveys carried out in Austria, Slovenia and Italy. Based on that information, the game developed into a simulation of a work placement in a foreign country, where the player is free to move in different game areas, facing different situations, with several tasks to carry out and decisions to make. Particular emphasis was given to the emotional process leading to decision-making, and also allowed players access to a guidance centre where they can find help and extra information about the themes they face. Moreover, in order to increase the longevity of the game, the game has been enriched with several optional ‘quests’ (along the main line of development of the story) with the aim of introducing fun and a wider variety of different situations to be faced.

Finally, as with role-playing games, the aim of this game is not to ‘win’, but to improve the characteristics of the player’s avatar. Specifically, the guidance game has adopted a scoring model based on Gardner's (1983) theory, characterising the player with a subset of ‘Gardner's intelligences’. The game uses those ‘intelligences’ more suited for a work placement simulation, allowing the implementation of a scoring model which links the performance of the player to the improvement of characteristics through game experience.

Intelligences	Capabilities and perception
Linguistic	Words and language
Logical-mathematical	Logic and numbers
Interpersonal	Other people’s feelings
Intrapersonal	Self awareness
Musical	Music, sound and rhythm
Spatial-visual	Images and space
Bodily-kinaesthetic	Body movement control

Table 2. Gardner’s seven intelligences (the first four have been selected as player characteristics)

The selection of game contents was based on the learning goals that the project wanted to achieve. People have different thinking preferences, dominant learning styles and natural strengths, and various personality theories help to determine individual learning needs and, therefore, the contents of the game. Gardner's (1983) Theory of Multiple Intelligences,

for example, proposes that human intelligence is a mixture of several intelligences. His model is a classical one and widely used in education and industry to understand and teach many aspects of human intelligence, learning style, personality and behaviour. His first seven types of intelligence map against all categories in the applicability of mobile games to different learning situations, depending on target groups, content and learning goals. The theory applies to people in general, regardless of sector, country or culture. Focusing on developing individual natural strengths, by selecting the three types of intelligence in which most people are strongest, it increases learning effectiveness. Similarly, there are four main phases in the learner experience in Kolb's (1984) cycle – 'wanting', 'doing', 'feeding back' and 'digesting'. Feeding back and digesting are also important stages in Argyris' (1976) 'double loop' learning process, where players reflect in action by confronting the assumptions and systems behind plans and procedures to consider how far the theory that they are actually using corresponds to their 'espoused' theory.

Game Template 3 'Get Real' (Game: e] *Digital Economy*)

Game Template 3 can be used to model games with elements of real world problem finding and problem solving. This is why this Game Template is called 'Get Real'.

The main element of the system structure of Game Template 3 is a back-end platform that enables communication via mobile phones (sending, receiving, and automatically reacting to SMS and MMS), a mobile blog, as well as supervision and administration of the learning game. Game Template 3 games are highly collaborative, as they support competition between groups of learners who are trying to identify a critical situation relevant to their area of study and to investigate and propose possible solutions. They have to do this as quickly and as well as possible, demonstrating critical use of appropriate procedures for dealing with crises and an appreciation of the underpinning norms.

- The groups receive the tasks via team blog/SMS from their teachers.
- The group reports its work and summarises its discussion and findings in the mobile blog.
- The teacher checks the blogs and awards points for relevance, depth, clarity of argument, etc.

The group that performs the best earns the most points and is the winner of the game. Our Game 3 interpretation sees these phases as part of real world problem finding and problem solving, which is undertaken

collaboratively, using the phone as a tool. 'Feedback' and 'Digesting' are key stages in a 'double loop' (Argyris 1976) learning process, where learners engage and re-engage with a real world critical situation, 'reflecting in action' (Argyris ibid; Schön 1983).

Configuration possibilities provided by the template. The only technical requirement for the mobile devices is that they must be devices with photographic and MMS capabilities.

This game template and these games cannot be downloaded and installed on mobile devices. The platform is installed by the platform administrators on dedicated server hardware. The low-level configuration of the platform is performed directly in a database.

A web interface is provided for users of the platform, which allows controlled and secure access to the platform functionality via a standard web browser. This administrative interface is designed to be accessed by normal PC clients via a web browser with common screen resolutions and data transfer speeds. Authentication with user name and password is required.

The platform contains inbuilt means for automated interactions between the platform and mobile users. Within the administrative interface it is possible to model interactions based on incoming events. This functionality can be used as a game authoring tool to implement complex server-based collaborative games without any additional programming. In combination with other platform features like user set management and message sending, game play can be prepared and controlled via the platform administrative user interface.

The following interactions are currently available for modelling:

- Access Check
- Message Sending
- User Set Assignment
- Log Writing
- Message Content Analysis
- Blogging

Game e]: Digital Economy. At the Karl-Franzens University, Graz, Game Template 3 was trialled in a *Digital Economy* course with over 100 students, comparing two learning approaches: conventional case studies versus pervasive games. The group, which was (randomly) chosen to learn the basics of the *Digital Economy* via the use of the pervasive game, was assigned the following task:

Students had to form ten sub-groups (teams) of six and register via SMS to the game. They then had to identify situations in the real world where

certain potentials of the *Digital Economy* are well or badly implemented, and describe them or make suggestions for improvements using messaging on their mobile phone. Also, a mobile blog was provided by the platform, where students could directly post pictures and explanatory text to a dedicated game website via the platform back-end system. The game website was accessible for all participants and, this way, the results of their own and all the other sub-groups could be constantly monitored.

The following screenshot and activity diagram is an example for the registration process of the game *Digital Economy*.

Fig. 4. Registering for *Digital Economy*

The registration is done by sending an SMS with the keyword 'DER' + team name (e.g. 'DERA' or 'DERB'), where 'DER' means *Digital Economy* registration. A successful registration is confirmed with an SMS.

After an SMS with the keyword 'DERA' has been received, the displayed interactions will be processed as follows:

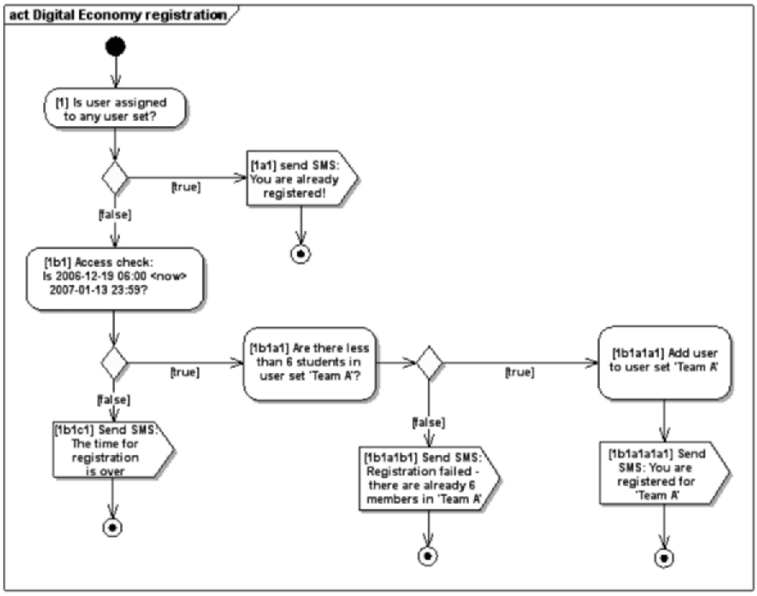


Fig. 5. DERA system interactions

[1]	The system checks if the user is already assigned to a user set
[1a1]	The user is already assigned to a user set. This means he or she is already a member of a Team (e.g. Team C) and therefore cannot register for another Team. » The system sends to the requesting user an SMS with the message 'you are already registered'.
[1b1]	The user is currently not assigned to a team. » The system checks if the registration request has been received in a valid time range.
[1b1c1]	The registration request has been received in an invalid time range. » The system sends to the requesting user an SMS with the message 'you couldn't be reiterated due to the registration time is over'.
[1b1a1]	The registration request has been received in a valid time range. » The system checks if the maximum number of members in Team A has been reached.
[1b1a1b1]	The maximum number of members in Team A has been reached » The system sends an SMS to the requesting user

with the message ‘registration failed. There are already six members in Team A’.

[1b1a1a1] The maximum number of members in Team A hasn’t been reached » The system adds the requesting user to the user set ‘Team A’.

[1b1a1a1a1] The system sends an SMS to the requesting user with the message ‘the registration process was successful’.

All students get an SMS with a task to identify a situation in the real world, where certain potentials of the *Digital Economy* are badly implemented. This SMS is sent by the teacher.

To get points the students have to find a worst-practice situation as soon as possible within a defined time slot. After taking a picture of this situation they have to send this picture via MMS to the server. The MMS must contain a keyword (e.g. ‘DEC1’ for *Digital Economy* Chance 1) and a description of the situation. Only the first postings and only one posting per team is accepted. If the posting is accepted by the system all team members get an SMS with the information that the posting is valid and that they are allowed to send a solution MMS now. All other students get an SMS with the message that team x has posted a chance successfully.

After a team has posted a chance MMS and the chance MMS has been accepted by the system (only the first posting(s) will be accepted), the team is able to send a solution MMS containing a suggestion for improvement. The MMS must contain a keyword (e.g. ‘DES1’ for Digital Economy Solution 1), an image and a description. Only one solution per team will be accepted.

After the time slot has expired or all teams have posted their chances and solutions, the game can be continued with a new chance alarm or can be finished.

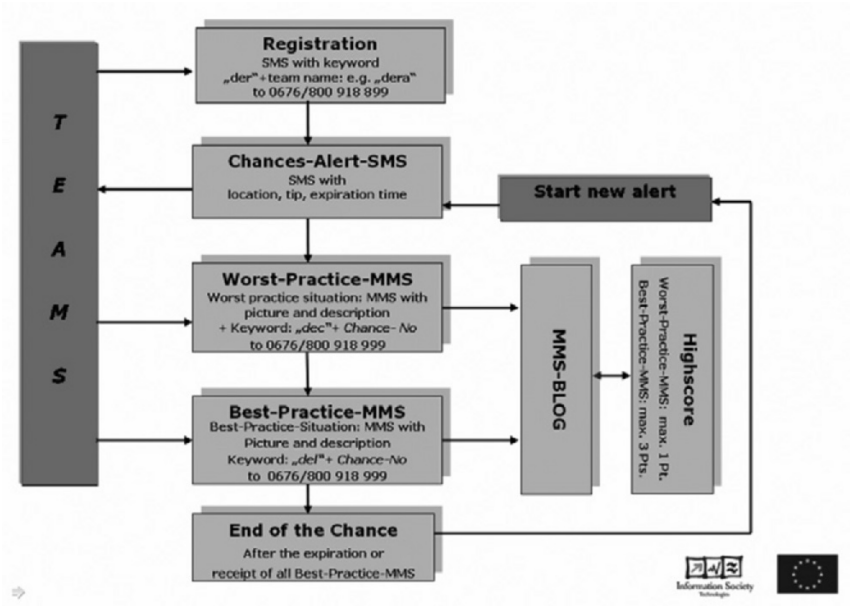


Fig. 6. Game Process

The following picture shows the blog created for team A, containing already one accepted chance and solution (newest first).

Fig. 7. Team A Blog

The participants and lecturer can constantly monitor the activities of all groups via the gaming platform. The system automatically reacted to erroneous SMS or MMS messages (e.g. double registering of a student for different teams, or multiple postings for a certain 'chances alert' by members of the same team) and provided logging and back-up functionalities.

The empirical evaluation results reveal that the pervasive game leads to higher energetic activation, more positive emotions and more positive attitudes towards learning content than the conventional case study approach (Petrovic et al. 2008).

4 Customising and Developing the mGBL Mobile Games

The mGBL templates have been designed to allow teachers (and students) to develop their own mobile games through editing and customising the example games.

However, we recognised that despite the usability of the templates, the development of a new mobile game is not simple. For example, for Game Template 1, which consists of two modules – the quiz module and the simulation module – the game content is much more than just questions and answers. Other information, such as answer descriptions, right and wrong answer feedback, hints, jokers, points awarded and so on, must be provided.

Therefore, we have developed an authoring module containing a special authoring tool for each game template. The authoring module is a piece of software that is integrated into the mGBL platform as a set of web forms. This module helps teachers to develop new games based on their own teaching content and the selected game template. It enables users to become game authors and to focus on authoring the game rather than struggling with software coding. The tool is accessible by web browser from anywhere that teachers would have access to the Internet.

Teachers have to complete two main sections defined in the authoring tool:

- set up a game – specify game characteristics such as game description, the rules, the number of game levels, the number of elements per level, any time constraints, any jokers and so on
- add content to the game structure – the content can either be questions in a quiz format, or a simulation of a scenario, or a task, depending on which element the user selects from the game template

For example, in Game Template 1, the module for the quiz game includes the following type of editing cards: introduction cards for setting the scene, information cards for providing the player with background information, reward cards for editing rewards and penalties to be presented to the learner during game play, and the cards for editing questions and answers. The latter are the central units through which learning content is presented and assessed. Templates for different answer types are available: single click, multiple click, and sequencing. Authors may upload background pictures for each question that provide contextual information, edit hints, and define a point system of rewards and penalties. Each answer can be accompanied by an explanation of why it is right or wrong, and how many points are gained or lost when selecting a particular answer.

The game setup can be edited with a simple text editor. For the graphic setup, a Java tool ('Boardmaker') was developed that presents a graphic user interface to create game maps and the corresponding 'Graphic setup' text file. Events are defined using XML: an ad hoc XML-DTD describes all the possible event structures so that they are forcibly consistent with the game code; an XML-XSL file allows automatic conversion into the text file that must be inserted within the game resources.

A wide range of game styles can be developed using the above elements. Examples include:

- Quiz: Using 'permanent' event-sprites linked each to a long list of random quizzes regarding various topics
- Exploration: Use of 'fog of war' and visible or hidden obstacles/borders can allow creation of labyrinth games for exploration
- Arcade Style: Event-sprites can also be programmed for predetermined or semi-random movement on a map, thus the aim of the game can be to avoid 'negative event' sprites while searching for 'positive event' sprites
- Simulation: An interactive map can 'put' a player's avatar in a situation (e.g. a car accident or a similar crisis situation). Interaction with game elements may force the player to try to make the right decision
- Adventure: With some 'plot creation', the simple 'simulation' game above described can be evolved into a complex 'adventure-game', with several stages (maps). By using the 'Set internal variables value' event it is possible for the game to 'keep memory' of players' choices and have the 'adventure world' react accordingly.

Within all these different 'game styles' the contents are completely customisable. For example, in a quiz game as described above, the lists of quizzes could be substituted for others with completely different topics by

simply changing the 'event content' configuration file without changing the game logic and graphic appearance.

In general, both teachers and students will have access to the authoring tool. Consequently, students will also be able to develop their own games, thereby supporting increased interest in mobile game-based learning, creative thinking and involvement in the learning process.

5 Summary

In this paper we have described the development of the three mGBL game templates, their pedagogically grounded learning games and aspects underpinning their implementation on a web server and on mobile clients.

The learning games have been developed to appeal to young people aged 18-24 and their teachers, and to be played on commonly available mobile phones. The games' ultimate goal is to train the decision-making capabilities of players at a cognitive and an emotional level.

The web server is employed for authoring and distributing the games, as well as for organising and monitoring the learner groups and the learning progress of the individual learners. The web server is also the place where learners communicate with each other and discuss their learning progress with others.

Further, we have described how we developed a game authoring module for each template, to allow the customisation and development of our example games. In addition, we have developed a database to allow users to select a variety of games based on their affordances in terms of learning content, goals and activities; and the number of learning situations and players supported (see elsewhere in this publication).

References

Anderson LW, Krathwohl DR (eds) (2001) A Taxonomy Of Learning, Teaching, and Assessment: A revision of Bloom's taxonomy of educational objectives. Longman, New York

Anderson P, Blackwood A (2004) Mobile and PDA Technologies and Their Future Use. In: Education, JISC Technology and Standards Watch 04-03. Available at: http://www.jisc.ac.uk/index.cfm?name=elearning_innovation [accessed 10 September 2007]

Argyris C (1976) Increasing Leadership Effectiveness. Wiley, New York

Fabricatore C (2000) Learning and Videogames: An unexploited synergy. Available at: http://www.learndev.org/dl/FabricatoreAECT2000.PDF [accessed 21 June 2008]

Gardner H (1983) Frames of Mind. Basic Books, New York

Harriehausen-Mühlbauer B, Rodríguez Prados FJ, Ludwig B, Ott H (2005) Spielend lernen mit dem Handy. Available at: http://www2.fbi.fh-darmstadt.de/~ZFE/sigmastar/art/Querschnitt_20.pdf (Dez. 2005)

Klein G (1996) The Recognition-Primed Decision Model: Looking back and forward. In: Zsambok E and Klein G (eds) Naturalistic Decision Making. LEA

Kolb DA (1984) Experiential Learning. Prentice-Hall, New Jersey

Lonsdale P, Baber C, Sharples M (2004) Engaging Learners with Everyday Technology: A participatory simulation using mobile phones. In: Mobile Human-Computer Interaction, MobileHCI. Springer, Berlin Heidelberg, pp 461-465

McAlister MJ, Xie PH (2005) Using a PDA for Mobile Learning. In: IEEE International Workshop on Wireless and Mobile Technologies in Education (WMTE'05), pp 282-284

Mitchell A (2007) D3.3 Mobile learning game models and exemplars. Public Deliverable of the mGBL Project. Available at: www.mg-bl.com/ [accessed 31 October 2008]

Mohamudally N (2006) A Massive Multiplayer Game Framework for Mobile Learning. In: Fourth IEEE International Workshop on Wireless, Mobile and Ubiquitous Technology in Education (WMTE'06) pp 23-25

Petrovic O, Edegger F, Kittl C and Edegger B (2008) Entwicklung und Evaluierung einer Interaktionsplattform für massentaugliche Pervasive Games (Development and Evaluation of an Interaction Platform for Pervasive Games with Mass Impact). Wirtschaftsinformatik 4, pp 282-291

Prensky M (2001) Digital Game-Based Learning. McGraw Hill, New York

Sanchez J, Salinas A, Sáenz M (2006) Mobile Game-Based Science Learning. Available at: http://apru2006.dir.u-tokyo.ac.jp/pdf/1a-4.pdf

Sanchez J, Salinas A, Sáenz M (2007) Mobile Game-Based Methodology for Science Learning. In: Human-Computer Interaction, HCI Applications and Services. Springer, Berlin Heidelberg, pp 322-331

Sanneblad J, Holmquist LE (2003) OpenTrek: A platform for developing interactive networked games on mobile devices. In: Human-Computer Interaction with Mobile Devices and Services. Springer, Berlin Heidelberg, pp 224-240

Sanneblad J, Holmquist LE (2004) 'Why is everyone inside me?!' Using Shared Displays in Mobile Computer Games. In: Entertainment Computing – ICEC 2004. Springer, Berlin Heidelberg, pp 487-498

Senge P (1998) The Practice of Innovation, Leader to Leader 9. Available at: http://www.leadertoleader.org/knowledgecenter/L2L/summer98/senge.html [accessed 10 September 2007]

Trifonova A (2003) Mobile Learning – Review of the Literature, Technical Report DIT-03-009. Informatica e Telecomunicazioni, University of Trento

Lessons from Applied Drama: Conventions to Help Serious Games Developers

David Cameron
Charles Sturt University, Australia
+61 2 6338 4053
dcameron@csu.edu.au

John Carroll
Charles Sturt University, Australia
+61 2 6338 4349
jcarroll@csu.edu.au

Abstract

This paper draws on more than 50 years of research and practice in applied drama to suggest how some of the conventions developed in this field may be of use to the designers of serious games. The paper outlines the similarities between some educational forms of role-based drama and the epistemic games model proposed by Shaffer and others. At their core, they share an ability to use relatively simple digital simulations as a pre-text for engaging learners in a frame of professional learning and problem solving. Four applied drama conventions are described, with project-based examples of how they can be developed and discussion on what the possible outcomes might be for serious games design.

Keywords

Drama, applied, games, serious, epistemic, design

Introduction

The term ‘serious game’ has emerged to recognise increased use of computer and video game technology and principles for non-entertainment contexts such as learning, training, social change or even advertising. In many ways, this transition is similar to movements that placed drama and theatre elements into the hands of teachers and social activists more than half a century ago (for example, Slade 1954; Courtney 1968; Heathcote 1969). These forms could have just as ironically been termed ‘serious play’, but they are better known among educators and practitioners by terms such as ‘applied drama’ or ‘drama-in-education’. Serious games are an attempt to use the often intangible benefits of video games to engage learners in immersive simulations, and in a similar way, applied drama makes use of the power of the human imagination to engage participants in powerful role-based simulations.

Just as serious games can be a slippery term, the naming conventions for the types of participatory or educational drama forms referred to here are not always clearly defined. We have already touched on one such existing form called applied drama (Nicholson 2005), which has a focus beyond public performance towards educational, social change or therapeutic goals. For some educators and practitioners this has led to the adoption of the form known to them as ‘process drama’ (Bowell and Heap 2001), a form of improvised role-based drama with a history that draws on the educational drama work of Slade (1954), Courtney (1968), Heathcote (1991), Haseman (1991), O’Neill (1995), Bolton (1999), and many others. While the proponents of these dramatic forms may argue points of difference, they are all focused on using improvised role-based drama to engage participants in a process of learning or transformation, rather than focusing on a pre-scripted theatrical entertainment for an audience. This has led to the development of a range of dramatic conventions that allow participants to move in and out of role without the need for elaborate props or deep knowledge of the roles they are going to inhabit.

The comparatively brief history thus far of video game studies saw an early shift away from comparisons to drama and theatre, as there seemed a more logical connection with screen-based artistic forms such as cinema. While this appraisal of video games as being more like Hollywood than Broadway (Frasca 2001) sidelined early considerations of links to theatre conventions, for example, Laurel 1991, the emergence of the serious games field allows an appraisal of the lessons to be learned by game designers from more than 50 years of applied drama theory and practice. There are clear similarities between some forms of serious games and

some forms of applied drama. In examining links between 'epistemic games' (Shaffer 2006) and process drama techniques, for example, Carroll and Cameron (2007) have outlined the shared features of video game and drama approaches that seek to engage participants with solving real-world problems by placing them in a role as trainee professionals, within real communities of practice.

It is in these shared aims of attempting to create opportunities for participants to learn 'as if' they are professionals that the potential benefits of applying drama conventions to serious game design are most apparent. If, as Shaffer points out, professionals use judgement to solve complex problems that can't be addressed by rote formulas, and they learn to think as professionals through exposure to practica (Shaffer 2006), then we would like to suggest that a shift in theoretical perspective might be useful for serious games designers. Serious games may be enhanced by adopting an existing dramatic poetics that is already close to the nature of gaming, rather than designing structures and conventions from scratch, or based on the sometimes only superficially similar conventions of other forms such as cinema.

Parallels between Applied/Process Drama and Serious Games

Participants in these dramatic forms can be protected by the explicit conventions that have been developed to allow the participants to distance themselves emotionally and psychologically from intense situations within the drama. They do this by shifting in and out of role, or moving to roles that are less directly engaged in the unfolding events. Thus, the dramatic conventions developed for role-distance and role-protection (Carroll et al. 2006), when used in an episodic way, allow drama participants to engage in a learning process that is emotionally engaging but not overwhelming. Far from being an obstacle, this ability to shift roles and perspectives becomes a critical tool in the learning moment. There are parallels to be found in the ways that some games allow for episodic engagement, or for players to move in and out of different role distances even by a simple video gaming convention such as changing their viewing perspective on the action from first to third person (Carroll and Cameron 2005). Participants in both games and process drama are protected emotionally and mentally by this ability to adjust role distance.

Process drama describes a dramatic form in which performance to an external audience is largely absent but presentation to the internal audience

is essential (Bowell and Heap 2002). This parallels the basic function of serious games to enable learning or change through personal engagement in the action of the game. In conventional theatre, meaning is made by the combined skills of actors, playwright, director and designers and the material cause or sensory experience (to use the Aristotelian terms) is communicated to a watching audience. Film and video operate in a similar, though mediated, way. In process drama, however, the participants – along with the facilitator – constitute the dramatic ensemble and engage in drama to make meaning for themselves both in the material and formal sense. Process drama is an improvised whole group activity where what happens exists only as narrative *in retrospect*, even though the participants are aware that they are shaping the activity in an artistic manner as they proceed.

Arguably, many video games are in fact process-oriented rather than narrative-driven. The player certainly operates within an environment that is pre-designed, and a storyline may exist to provide context and variety within the gameplay, but ultimately each individual player tells the 'story' of the game in retrospect. This is even more so in the case of playable persistent worlds, such as massively multiplayer games like *EverQuest* and *World of Warcraft* or virtual spaces such as Second Life, where players can in effect set their own goals and create their own stories, quite apart from those intended or designed for them. In theoretical terms, this touches on Bogost's (2006) notion of 'unit operations' as a unique process of discrete meaning-making by engagement with the individual elements that comprise the structure of a text (e.g. a game system). This gives 'us a lever for understanding any form of human production as potentially procedural' (Bogost 2006). In this way, even games that run 'on rails' with heavily scripted paths can be seen to be engaging players in a process of making meaning for themselves.

Process drama has largely been applied in educational settings (Carroll and Cameron 2007) and in training. In serious gaming terms, the practitioners who come closest to the use of this dramatic form are the group investigating a form they have termed 'epistemic games' (Shaffer 2006; Gee 2003). These games focus on identifying and replicating the elements of practice through which professionals in a particular field learn to solve problems. Shaffer describes how a game-like tool becomes a mechanism by which the player/student is motivated to learn and adopt an 'epistemic *frame*' – the skills, knowledge, identity, values and epistemology associated with professional practice. This exciting work is in fact using many of the conventions of applied drama without really contacting the body of research and practice that constitutes the poetics of

this already existing dramatic form. Epistemic games require that players be engaged in solving real and significant problems, using a professional world view (the epistemic frame), and preferably under the mentorship of a professional in that field. This is almost a direct comparison to specific applications of process drama known as 'mantle of the expert' (Heathcote and Bolton 1994), which engages participants in producing works or solving problems as if they are a novice professional in that field. Another version is the 'Commission Model' work of Dorothy Heathcote (2003), which sees participants, even relatively young children, engaged in the production of a commissioned task for a real client, requiring contact with real professionals to solve actual problems.

Pre-Text

Central to these drama forms is the notion of 'pre-text' (O'Neill 1995; Taylor 1995), which initiates dramatic action and provides a firm base for the dramatic encounter. The pre-text operates to define the nature and limits of the dramatic world and also to clearly imply roles for the participants. It also activates expectation and provides group coherence. Many video games operate in a similar way, with the player being given a sense of how he or she fits into a continuum of events and what the expected role is. Game conventions such as cut-scenes are often used to begin or link episodic play, and to give players information about their role. Game ephemera, such as box cover art and instruction manuals, may also be used to establish a game's pre-text (Cameron and Carroll 2004).

As O'Neill and others see it, the pre-text operates as a 'holding form' (Witkin 1974) for the meanings that are inherent in the dramatic content and helps to establish the location, roles and situation of the drama. This holding form preserves the integrity of the initial dramatic impulse. It also sets up expectations about the first moment of interaction that will start the drama, having the power to launch the dramatic world with economy and clarity, propose action and implying transformation (O'Neill 1988).

A dramatic pre-text is, therefore, not the drama itself, but a precondition for entering the world of the drama. Shaffer (2006) similarly argues that a simulation is not an epistemic game in itself, but it serves to plunge the player into the imagined world where he or she will learn to solve problems as if a professional. Both drama and game require thinking and action that is inside the world view presented by the pre-text or simulation. Also, importantly, both applied drama and epistemic games are premised on a shift in the asymmetrical power relationships associated with

traditional teaching. Both these forms of educational drama and serious games facilitate the empowerment of the learner to adopt the role of a trainee professional, gaining real world problem-solving skills. This can be quite a radical transformation of traditional power structures, particularly when the participants are of school age or – as in the following case – in a very clear power hierarchy such as the military.

Conventions in Action – A Small-Scale Applied Drama Session

The application of applied drama conventions to serious game design is one of the methodological goals of an Australian Research Council project linking Charles Sturt University (CSU) and the Australian Defence Force (ADF). This three-year project (2007-2009) is examining the potential use of digital game-based technologies and applied drama conventions to produce crisis management simulation and training tools for use by ADF Public Affairs personnel.

The Australian Defence Simulations Office (ADSO), like similar military and emergency organisations around the world, is exploring more effective role-based problem-solving methodologies that can be delivered using digital technologies. The overarching goal of the project described here is to develop a serious game based on drama conventions that might be used to help participants develop a clearer understanding of personal decision-making processes, a deeper understanding of other team members' perspectives, and a fuller appreciation of the intense and unpredictable nature of communication flow within crises within the military public affairs context.

A number of the drama conventions described above have already been used by the project team to better understand the culture of ADF public affairs, current training methods, and to assist development of initial simulation scenarios. One of the research problems for the project team is to assess how drama-based training simulations might fit within the ADF organisational culture, as a focus on decision-making and interpersonal communication is a shift from the types of simulation more commonly used within the ADF (e.g. weapons training). In 2007 a small-scale applied drama session with undergraduate psychology students as subjects was used to examine whether these applied drama methods are seen as realistic and relevant for crisis management training *by the participants*. The specific methods and outcomes from this study are available in a separate

paper (Arciuli, Carroll and Cameron 2008). However, it provides useful examples of how some of these applied drama conventions work.

The participants were en-roled as members of a fictitious Student Welfare Advisory Panel (SWAP) and asked to provide advice (in their real experience as students) to a university about how best to respond to an alleged drunken rampage through a dormitory by 'guests' of some of the residents. Supporting this pre-text were four facilitators who helped progress the scenario by working in-role as a SWAP Coordinator, an inexperienced Student Welfare Officer, a university bureaucrat and a newspaper reporter. Digital artefacts such as emails and reports were introduced at various stages. Dramatic tension unfolded as applied drama conventions were used to reveal more details about the nature of the incident, and place the SWAP panel under pressure for allegedly giving poor advice. Ultimately, the panel members received a grilling from the aggressive 'journalist', offering them a chance to defend themselves and their decisions in-role as the SWAP team. An outline of the structure of the session and conventions used can be found in Appendix A.

The dramatic conventions within applied drama are well understood within the field. For example, Jonathan Neelands and Tony Goode's widely used book *Structuring Drama Work* (1990) contains a clear explanation of conventions, and provides multiple examples used to establish pre-texts and conduct-improvised drama. Dorothy Heathcote (1991) in her earlier work outlined well over 30 conventions that could be employed in drama. The following examples are largely taken from her work and that of Neelands and Goode (1990), and draw on the small-scale study outlined above to illustrate the relevance of this form to serious games.

Convention 1: Contextual Conventions

This range of conventions enables a group of participants to engage with the dramatic pre-text. They reinforce the simulation and make explicit the situation and roles that will be present within the developing game or scenario. Such conventions also draw attention to the environmental and contextual constraints the participants are operating within. They require group contribution rather than individual performance to develop the context, providing a high level of dramatic role protection for each participant.

Example a: Collective Mapping

The participants make a large-scale collective image, diagram or map to represent the physical location of the simulation pre-text. The image then becomes the concrete reference point for developing the simulation as it is being discussed. This convention gives specific form to the pre-text. It negotiates a common response in relation to the physical site of the pre-text and provides group cohesion as it builds belief. It helps to represent the problems inherent in the simulation diagrammatically and provides a common point of reference for the group.

Within our small-scale applied drama session, collective mapping was used in the form of a security guard's written report that outlined the location of events using real street locations familiar to the participants. Mapping and location imagery are features common to many games, providing visual representation of the simulation pre-text. These provide shared reference points to build group cohesion and belief in the simulation and the game. Geo-spatial data and digital imagery might be used to accurately reflect real-world locations.

Example b: Guided Tour

The pre-text is used as the background for a guided tour. A narrator provides a detailed picture of the environment in which the game or drama takes place. The group is talked though this setting using a highly descriptive commentary, which situates the pre-text and points out key details the group might miss. The facilitator operates in a deliberately pedantic manner copying travel or museum tour guides.

The participants in our applied drama session assumed the role of briefing the Welfare Officer in preparation for a forthcoming press interview. This required an oral 'walk-through' of the events and locations for someone apparently less familiar with the setting. Some games include audio-visual or text tours to establish the context for players. This facilitates a common response to the simulation and produces a common vocabulary for unseen places and locations as well as encouraging collective belief.

Convention 2: Narrative Conventions

These conventions are designed to focus on significant events and incidents that are central to developing the subsequent narrative. This

allows participants to speculate about their possible responses while protected in role by the dramatic convention structure. The cultural origin of such conventions is evident in interaction behaviour found in society where these roles are adopted and behaviour is codified, such as meetings, media interviews, courtrooms and learning institutions.

Example c: Hot Seating

The group, working in an assigned role as enquirer, has the opportunity to question one of its members role-playing a character. The 'hot seated' role is drawn from within the group. This convention requires that the questioners adopt and maintain a low level 'attitudinal' role and the acceptance of the non-naturalistic dramatic conventions that allow the role of questioner and questioned to be altered.

Within our applied drama session the SWAP members were interviewed by a facilitator in-role as a newspaper reporter. The participants in turn were able to quiz the reporter about his story and what other knowledge he may have had about the events. In a serious games context this form might help build narrative momentum as it highlights role motivation and personality disposition. Serious games offering analysis of performance (e.g. at the end of a turn or level) or 'after action reviews' might encourage a hot-seating style of reflection or extrapolation of the relations existing between the attitudes and the events portrayed in the simulation pre-text.

Example d: Telephone Conversations

This convention can be used to break news or feed information to a group as well as move the narration on. It is often used by the facilitator to provide one side of a conversation so the group can be given instruction as to further action. The facilitator may also use it to seek advice or create outside pressure on the project. It has obvious connections to surveillance and the use of the telephone for narration in film.

Within our drama sessions the telephone convention was used to convey the increasing narrative tension of escalating parental complaints about the incident. For serious games this convention is useful for adding tension and time pressure to a situation to move the narrative on. The telephone can of course be substituted for other communication conventions such as email, instant messaging, fax or SMS as preferred.

Convention 3: Role Conventions

These conventions move beyond the naturalistic portrayal of action, and are a way of moving beyond the narrative line to consider subtext and nuance in responses to the developing situation. They are more overtly dramatic, and this stylisation helps provide a high level of role protection for the participants. This mode of representation is highly selective and the boundaries of the conventions to be used are explicitly outlined. The effect of these role conventions is to provide a fresh perspective on the simulation as well as develop alternative channels of communication that work at the level of symbolic interpretation and help increase the emotional commitment of the group participants.

Example e: Overheard Conversation

Members of the group performing in an attitudinal role of participants present in the simulation pre-text provide information, gossip and rumour that should not have been heard by the whole group. The group listeners do not know the identity of the speakers but they are able to traverse backwards or forwards in time to recreate key conversations that illuminate the presently developing situation. This non-naturalistic role convention requires the use of 'double intention' (explicit use of subtext) and encourages active listening on the part of the participants.

This convention was provided in our drama session by an overheard conversation between the student advisor and university administrator discussing legal responsibility relating to advice. This convention provides role commitment from participants and leads to more thoughtful and sophisticated responses from the group in relation to the unfolding situation. In game design, the convention of cinematic cut-scenes often provides a similar function by revealing new subtextual information.

Convention 4: Reflective Conventions

These conventions operate outside of naturalistic time-flow in a more overtly theatrical way where the pace and action of the game is slowed or interrupted to create a space for reflection. They provide a way to review and comment on the action already taken and a way to articulate what characters are thinking. They also provide a way for the group to articulate what it already knows. There is a deliberate placement of objects and

spatial relationships, as well as the use of non-naturalistic time to create a reflective atmosphere.

Example f: Giving Witness

A facilitator operating in-role or a group member in-role delivers a monologue to the group that he or she claims is an objective account of events, but is actually a highly subjective re-telling from the witness' point of view. This convention shares many of the elements present in oral histories.

In our drama session an email from an upset dormitory resident providing her version of events was read by the SWAP manager, which increased the stakes, as it included the possibility of further action. This convention requires serious intent and personal commitment as well as a high level of social cohesion from the group. The individual giving witness is exposed to scrutiny more than with many other conventions, though artefacts such as an item of clothing, a letter/email or newspaper article might be used to provide some role protection. In a serious games context, giving witness may be initiated in situations where players are able to communicate with each other, and can be prompted to report, in-role, to the others while the simulation is paused. Similarly, a facilitator or mentor may be able to report in-role to the players or alter game events 'on the fly', echoing the game convention of 'Dungeon Master' or 'Game Master', who can manipulate elements to produce situations or effects.

Example g: Thought Tracking

This convention involves stopping individuals during an in-role activity and asking them to reveal their inner thoughts at that particular moment. This develops a reflective attitude to action within the drama. The dramatic action can be frozen and the thoughts of the participants tracked by the observers who listen in.

When confronted with the realisation that the SWAP team was now totally responsible for the developing media and university concerns about the incident, the in-role activity was temporarily suspended so the participants could consider this unexpected responsibility and – from their perspective – betrayal. Typical responses were that the incident 'was blown out by the media', 'we've been done over by the media' and more simply 'we got screwed'. This convention requires an analysis of the current situation and the individuals' place within it. Non-naturalistic slowing of the action allows for a more reflective response to the

underlying situation. As with 'giving witness', serious games designers can allow for the use of these conventions by incorporating the ability to pause action, and for players and/or facilitators to communicate with each other. In some multiplayer games, conventions already exist for different types of communication depending on whether the dialogue is in-role (as character) or out of role (discussion about the game system), or whether the communication is private or public.

Conclusion

Specific results of the small-scale applied drama study discussed in this paper can be found elsewhere (Arciuli, Carroll and Cameron 2008). Despite the limitations of this preliminary study, our results demonstrated that applied drama scenarios are perceived to be realistic, enable an understanding of what it is like to make difficult decisions under pressure and shed light on how a single situation can be viewed very differently by different people. There did not appear to be any gender differences associated with these findings. There appears to be clear potential for the methods reported here to deliver a realistic/educational training experience that enhances basic communication skills in a safe environment.

The larger research project described in this paper will provide a point at which to merge two seemingly parallel developments in learning and teaching, epistemic games and applied drama, using digital game-based techniques to develop the pre-text simulation. This will combine the potential benefits of an epistemic game-like focus on replicating practica and professional problem-solving approaches with the proven conventions of applied drama to rapidly engage participants in effective role play scenarios, while protecting them through shifting levels of distance and protection. The conventions described here are but a sample of the potential applied drama tools that are already available to designers of serious games who wish to explore the more than five decades of theory and practice in this field.

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References

Arciuli J, Carroll J, Cameron D (2008) The use of applied drama in crisis management: An empirical psychological study. Emergency Media & Public Affairs 2008 Annual Australian Conference – Excellence in Crisis Communication

Bogost I (2006) Unit Operations: An approach to videogame criticism. MIT Press, Cambridge, MA, p 15

Bolton G (1999) Acting in the Classroom: A critical analysis. Heinemann, London

Bowell, P., Heap, B. (2002), Planning Process Drama. David Fulton, London, p 7

Cameron D, Carroll J (2004) The story so far…: The researcher as a player in games analysis. Media International Australia No. 110, Feb 2004, pp 62-72

Carroll J, Anderson M, Cameron D (2006) Real Players? Drama, technology and education. Trentham Books, Stoke On Trent, p 130

Carroll J, Cameron D (2005) 'Playing the Game, role distance and digital performance'. IDEA/Applied Theatre Research Journal no. 6, 2005

Carroll J, Cameron D (2007) Epistemic video games and mantle of the expert: A communities of practice approach. IDEA conference, Hong Kong, 2007

Courtney R (1968) Play, Drama and Thought. Cassell, London

Frasca G (2001) Videogames of the oppressed: Videogames as a means for critical thinking and debate. Georgia Institute of Technology, p 17. Viewed February 12, 2008 at: http://www.ludology.org/articles/thesis/FrascaThesisVideogames.pdf

Gee JP (2003) What Video Games Have to Teach Us about Learning and Literacy. Palgrave, New York

Haseman B (1991) Improvisation, process drama and dramatic art. The Journal of National Drama, July, pp 19-21

Heathcote D (1969) Dramatic activity. Reprint from Drama, English in Education 3(2)

Heathcote D (1991) Collected Writings on Education and Drama. Northwestern University Press, Evanston, Ill

Heathcote D (2003) 'A Vision Possible: The Commission Model of Teaching', Drama, Winter 11(1), pp 16-27

Heathcote D, Bolton G (1994) Drama for Learning: Dorothy Heathcote's Mantle of the Expert Approach to Education. Heinemann, Portsmouth NH, pp 166-167

Laurel B (1991) Computers as Theatre. Addison-Wesley, Reading, Mass

Neelands J, Goode T (2000) Structuring Drama Work (2nd edn.). Cambridge University Press, Cambridge

Nicholson H (2005) Applied Drama: The gift of theatre. Palgrave Macmillan, Houndmills, p 5

O'Neill C (1988) The Nature of Dramatic Action. NADIE Journal – Journal of Drama Australia 12(2)
O'Neill C (1995) Drama Worlds: A Framework for Process Drama. Heinemann, Portsmouth
Shaffer DW (2006) How Computer Games Help Children Learn. Palgrave Macmillan, New York, p 191
Slade P (1954) Child Drama. University of London Press, London
Taylor P (ed) (1995) Pre-text and storydrama: The artistry of Cecily O'Neill and David Booth. NADIE Research Monograph Series, National association for Drama in Education, Brisbane
Witkin RW (1974) The Intelligence of Feeling. Heinemann, London, p 181

Appendix A

Plan for Applied Drama Session on Crisis Management

Aim: To examine a role-based drama approach to crisis management team training.

Participants: 30 undergraduate Psychology students (3 groups of 10) x 1 hour.

Artefacts: Security report, university welfare policies, student email.

Facilitator roles: Student Welfare Advisory Panel (SWAP) Coordinator, Student Welfare Officer, university bureaucrat, and journalist.

1. Introduction and students placed in-role as SWAP by facilitator in-role as Coordinator.
2. Pre-text provided: Visitors arrived at University House late on Friday night claiming they had been invited to a party by student residents. Noise and alcohol consumption resulted in a request for them to leave by other residents. An argument developed and a Security Officer was called. Police were called when threats were made, but the group had moved on by the time they arrived. A new Student Welfare Officer has been asked to investigate.
3. Welfare Officer asks SWAP for help, as she is new to the university. A Security Officer's report initiates discussion on the location of events using the dramatic convention of 'collective mapping' (1a). SWAP then prepares a brief for the Welfare Officer using 'guided tour' (1b).

4. A parent complains about the SWAP's 'amateurish' advice, and this is shared using a variant of the 'telephone conversation' convention (2d). A graphic email account of events from a complainant arrives using 'giving witness' (4f). The Welfare Officer goes on stress leave, blaming SWAP for poor advice via 'overheard conversation' (3e).

5. SWAP is asked to meet with a newspaper reporter. A university bureaucrat is available for consultation on official policy if desired. A variation of 'hot seating' (2c) then allows the journalist to question SWAP, while participants may also explore the reporter's motives and knowledge. A facilitator then encourages out-of-role reflections on the experience using 'thought-tracking' (4g), and the session ends with a debriefing and survey of participants about the role-based drama approach.

A Virtual Infection Control Simulation: The Development of a Serious Game in the Health-Care Sector

Andy Pulman
Bournemouth University
01202 962749
apulman@bournemouth.ac.uk

Mark Shufflebottom
Bournemouth University
01202 965947
mshuffle@bournemouth.ac.uk

Abstract

National Statistics Online (2005) note that the number of death certificates mentioning Staphylococcus aureus (S. aureus) infection increased each year from 1993 to 2005 in England and Wales. This increase in infection rates highlights the importance of encouraging greater education concerning washing with soap and water or using an alcohol-based hand rub.

This paper reflects on the creative process, production and pilot of a web-based reusable learning object created for educating students concerning the virtual care intervention of one patient being nursed in isolation for possible Methicillin-resistant Staphylococcus aureus (MRSA). The simulation intends to describe standard precautions required for a patient being nursed in isolation for MRSA, identify the roles and responsibilities of the health-care team in relation to an infection control issue, discuss the importance of communication in relation to infection control and discuss the impact on communication when a patient is nursed in isolation.

The paper discusses the thinking behind using simulation within the health education curriculum and considers the challenges involved with taking the simulation from initial concept to pilot.

Keywords

Pervasive games, health education, designing simulations

Background

In 1962, the syllabus for England and Wales called for methods encouraging the active participation of nursing students as a method of stimulating student learning (Bendall and Raybould 1969). This call was continued with both Goodman (1971) and Taylor and Walford (1972) describing the use of academic games for learning as generating excitement and enjoyment, whilst Lowe (1975) suggested games could be used to motivate the learner and aid the acquisition and retention of factual knowledge. In the eighties, French (1980) highlighted an issue which could have been written today:

> *"In the last few years there has been an increasing but limited interest in the use of gaming as a learning method. In common with many new methods of learning, gaming tends to cause a polarization of attitudes amongst teachers who become aware of it."*
>
> French 1980

This polarisation exists between those that feel there is no perceived benefit to games over other forms of learning and those that do. Although their evaluation supported the argument that utilising simulations and games provided an enjoyable and supportive learning environment, Wildman and Reeves (1996) suggested there was little evidence available to confirm that simulated games are any better than other methods of learning and teaching concerning the acquisition of knowledge, and cited Roberts et al (1992) as feeling there was no conclusive proof that the use of simulations or games improved clinical practice. Appositely, in their paper promoting emotional caring in nurses, Graham and Richardson (2006) suggested that the use of games or simulations enabled students to become more engaged with clients. They referenced Ramsey (cited Seelye 1996), who suggested that when games or simulations are effective their application to real life becomes clear. Participants become aware of their

own values in an atmosphere of self discovery and continuous revelation and the experience is fun. This positive view is also highlighted in literature around serious games, suggesting that computer simulations accelerate learning, increase motivation and support the development of higher order cognitive thinking skills (de Freitas and Jarvis 2006). This has led to the development of a number of serious games concerning health education. For example, *Pulse!!* (Alhadeff 2007) is a training tool for nurses and physicians that immerses students in a hospital's intensive care unit and places them in a first-person role as a health-care professional. Another example, the *Virtual Patients* project (Gill 2008) is being created in Second Life, where four information-driven and avatar-driven problem-based learning scenarios will be created and delivered for distance learning students on healthcare courses.

During 2007, NHS South West contributed to three e-learning initiatives proposed by the School of Health and Social Care (HSC) addressing strategic learning and teaching areas. One concerned the creation of a web-based three-dimensional (3D) simulated hospital – Wessexville – aiming to provide an interactive environment for interprofessional education. The virtual hospital concept would allow learners to engage with resources any time, any place, anywhere. A number of scenarios for health simulation were commissioned from HSC academics for the Wessexville project, including ward management, infection control, child health, and acute and rehabilitative events. Of these, three scenarios were developed in depth. Initial full economic costing (FEC) for the interactive development allowed for a total of 77 hours development time to be spent developing a working prototype. Dependent on the success of building the environment, one or more of the scenarios would be integrated into the initial build for completion of the project. The scenario concerning isolation for possible MRSA was taken forward for pilot development, aiming to identify the roles and responsibilities of the health-care team in relation to an infection control issue, discuss the importance of communication in relation to infection control and discuss the impact on communication when a patient is nursed in isolation.

Infection Control Background

Methicillin-resistant Staphylococcus aureus (MRSA) is a variety of Staphylococcus aureus that is resistant to methicillin, and some other antibiotics that are usually used to treat Staphylococcus aureus. National Statistics Online (2005) note that the number of death certificates

mentioning Staphylococcus aureus (S. aureus) infection increased each year from 1993 to 2005 in England and Wales. An increase in the number of death certificates specifying MRSA, from 51 in 1993 to 1,629 in 2005, accounted for almost all of the increase. The increase in infection rates in the UK highlights the importance of encouraging greater education concerning washing with soap and water or using an alcohol-based hand rub. Pratt et al (2005) noted that in the UK, the Department of Health (DH) had focused a number of initiatives on combating Health Care Associated Infection (HCAI), including the development of national evidence-based infection prevention and control guidelines for acute and primary care settings, a research programme to identify a range of effective strategies for combating antimicrobial resistance, and setting out a strategy for reducing HCAI and improving environmental hygiene in healthcare settings. Pratt et al (2005) quoted DH strategy as emphasising the importance of ensuring that infection prevention and control training is included in the induction programme for all NHS staff, including agency and locum staff, and that this training became part of their continuing personal development. For Clinical Skills training within HSC, it is hoped that by utilising a 3D simulation of a typical infection control situation and engaging with the processes and decisions on what should be done at particular points in time, students will gain a much deeper understanding and consideration of hand decontamination and hygiene.

The Infection Control Scenario

The aim of the infection control scenario is to illustrate the roles and responsibilities of the interprofessional team in relation to the care of a patient nursed in isolation as an infection control precaution. By the end of the session it is intended that students should be able to outline the roles and responsibilities of the health-care team in relation to infection prevention and control, and also demonstrate clinical and professional knowledge regarding MRSA. The scenario involves Mary Walker, an emergency admission with circumstances explained in the game meaning she is considered to be in the high-risk category for colonisation of MRSA. Mary has been screened for MRSA and is being cared for in a single room, with the results of her screening due back later on the day of the scenario. Fifteen interactive elements located within a series of incidents on the ward have been incorporated into the routine of a morning schedule, which the student has to complete sequentially in order to finish the scenario successfully. These are a combination of correct procedural behaviour,

which could cover either a staff nurse or student nurse (such as the correct time to gel hands) or selecting a number of items from a list of tick boxes. For example, when collecting equipment from the sluice the user (as the student nurse) has a choice of a number of items, including soap, wipes, talc and linen bags to take into the isolation room. If the user selects the proper equipment he or she is rewarded with an accompanying message – 'Great!' – whilst a failure elicits an 'Oops!' message. On the final screen the incorrect action and the reason it is incorrect are highlighted. It is also possible to direct information to the user via the conversation the interactive characters are having. For example, when the student nurse queries why gloves are not required for entering the isolation room, the staff nurse is able to state that the personal protective equipment required depends on the activity and reason for why the patient is in isolation.

If the user completes the scenario with no errors, he or she is able to print out a certificate that can be used to prove that he or she has successfully completed the scenario. Although the simulation has been primarily aimed at students studying in the field of health care, it is also generic enough to be used in a variety of other contexts, such as:

- A training tool for health-care professionals in the public and private sector.
- Those returning to work in the health-care sector after a career break.
- A revision tool for professionals already working in a high-risk environment.
- Anyone coming into contact with infection control scenarios on a regular basis.

The Gaming Design

The MRSA infection control scenario is intended to be a simulation of a real life health-care issue. Simulations are useful for representing complex relations (Laurillard 1993) and are usually a more simplified or contained version of a real event, which provides a useful environment on which to base an MRSA scenario. The student is able to participate in the care of a patient without the high-risk potential of the real world scenario. Making the wrong decision in the real world could produce life-threatening results, which are nullified in the simulation. This is a tried and tested scenario (Raybourn 2006) for the simulation of dangerous situations in a serious game. To make the learning objective clear to students, when the simulation starts they are presented with a clear, single aim. The

introduction also lists key skills that the student will have gained by completing the simulation:

> *"The design of the interface to the simulation will affect how the particular goal is communicated to the students"*
>
> Laurillard 1993

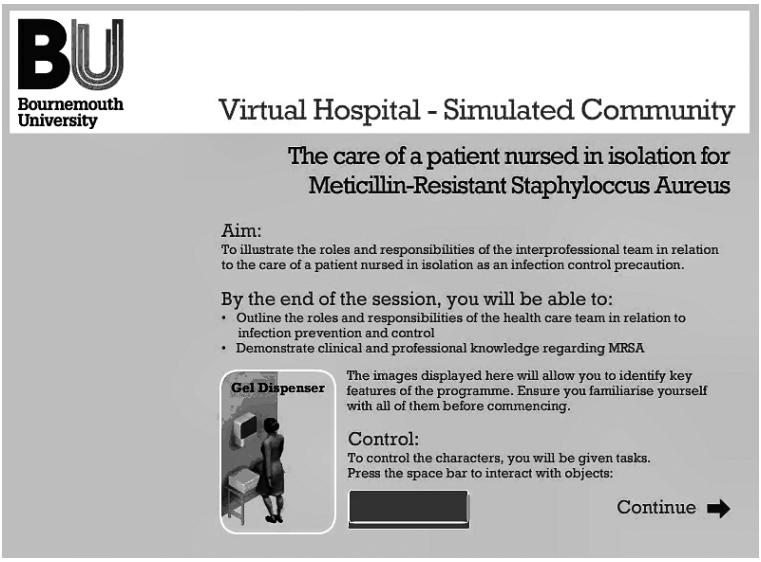

Fig. 1.

Fig. 2.

With the design of the interface, students are given specific instructions on how to interact with the environment on the title screen (Figure 1). Alongside any specific learning outcome as the main goal, there will always be individual tasks or smaller goals for the student to achieve. These smaller tasks are the equivalent of the real-world tasks upon which the student is being assessed as part of the learning simulation. It is important that the student is aware of what he or she will be doing. This is particularly relevant in relation to the assessment (MacDonald 1997) before entering the simulation. Kelly et al. (2007) suggest that players usually skip introductory text (educational and otherwise) and go immediately to game play. As a precaution, prior to the first control of a character in the simulation, instructions are repeated on the screen to reinforce the goal, and students have to click 'Continue' (Figure 2) before they can proceed to take control. Before starting the simulation, students are also given background information on the patient, along with specific clinical terms with which they may not be familiar. Definitions of these terms are available via the web if they click on a word, bringing up background information to the case. It is important for students to be presented with a diversity of differing learning tasks as part of their education, to engage them in finding solutions to the real-world problems they will encounter when working in clinical practice:

> *"Active engagement, imaginative inquiry and the finding of a suitable level are all much more likely to occur if teaching methods that necessitate student activity, student problem solving and question-asking, and co-operative learning are employed."*
>
> Ramsden 1994

The simulation forces students to think about the problem of effective infection control, but decisions have to be made; judgement is required on their part and feedback attained through the interface. Students are given immediate feedback on each judgement they make through audio and video cues. Once the simulation has been completed, students are given individual feedback for each incorrect decision. This enables them to correct their mistakes next time through the scenario or, instead, research further into the incorrect area. An important point for the high level of user involvement is that:

> *"We retain 10% of what we read, 20% of what we hear, 30% of what we see, 50% of what we hear and see, 70% of what we say, 90% of what we say and do."*
>
> Smith 1998

For example, at the start of the shift the Staff Nurse is checking a patient's wristband against the prescription chart. Once the conversational part of the discussion with the patient is completed, the user should stop by the hand gel dispenser and press the space bar (which serves as the action key) to gel the hands of the Staff Nurse, as after handing the patient his or her antibiotics the nurse has briefly put her hands on the shoulders of the patient (seen in the simulation). If the user fails to gel his or her hands at this point and goes to move the drugs trolley straight away, this will be recorded as a failure. In the final screen of the game the incorrect procedure will be highlighted – Staff Nurse did not decontaminate hands before touching drugs trolley – and the reason it is incorrect – cross contamination between patient and his chart to Mary Walker via Staff Nurse. An 'Oops!' message accompanied by a sound also alerts the user at the time to the fact that he or she has incorrectly handled the interaction. By engaging students with the doing, the participant becomes actively engaged with the learning experience (Iverson 2005) and the students are increasing their chances of retaining their knowledge. The simulation is advantageous in being a reusable learning object, allowing students to return and test their knowledge many times, each time refining their actions until the correct procedure has been attained and their certificate granted. This has been termed 'pervasive' or 'ubiquitous' learning (Thomas 2006), in which a simulation or game is 'always on' and available for use, again and again. While this simulation works as a stand-alone experience, it is also a useful pedagogic tool for generating discussion in the classroom. The lecturer can incorporate this as a blended learning tool to enrich seminar discussions or use it as a starting point for examining activities covered by the simulation in much greater detail (Heinze et al. 2004).

The simulation was created in Flash, a ubiquitous web browser plug-in, and is able to be accessed via any web-enabled computer that has Flash Player 8 (or higher) installed. Because the game uses networked media, it was designed to have much of the game data stored extraneously to the game itself – achieved using Extensible Meta Language (XML). The most common aspects of the game created this way were the character conversations, which appear in speech bubbles on screen. Originally, it was hoped conversations would be recorded as audio, but this objective was rejected early on due to the many iterations of scenario writing, which meant this material would have to be frequently changed. The code within the game interprets who is speaking and positions the speech bubble next to the appropriate person, then populates the bubble with text. This means that conversations can be altered by lecturers without requiring any

recoding of the game. The game aesthetics have been inspired by *The Sims*, which helps to give familiarity to the environment for any student who has played this, or for novices provides a simple, easily navigable environment. The game is also displayed using an isometric view of the ward, like *The Sims,* but control of the characters differs. In order to give students complete control they use the cursor keys to move characters around when called into action, whilst using the space bar to interact with objects in the environment (such as gel dispensers). This was felt by the designer to better test students than if they randomly clicked on objects, as this could lead to the correct decision being achieved by chance alone.

Design Problems

The production of the simulation was a learning process for the project team, with none of the academics involved having written scenarios for this type of learning environment before. Due to timetabling problems which did not enable academics to meet up together to discuss their scenarios and a need to ensure that each one was being written to a similar set of intended learning outcomes (ILO's), the project manager was initially the contact between the academics and the designer. This meant much of the allotted academic time was spent setting up correct aims, ILO's and pitch level. The initial aims were to identify and outline the clinical roles of professionals within the scenario:

- Describe the roles and responsibilities of the staff involved in the scenario.
- Demonstrate knowledge in the design and application of a narrative that described the health-professional's role.
- Appraise the development of communication style that identified who and how interprofessional working linked to scenario development.

This focus resulted in the first iterations of the scenarios being too in-depth in terms of characterisation, thoughts and conversations, but not enough consideration given to the interactive element for users of a serious game to become engaged with (for learning). This issue was highlighted in an email written by one of the academics involved:

> *"I was wondering whether there was too much looking and listening for the learner in my scripts and not enough interaction. I am mindful of the fact that the viewer is not watching a film but should be engaging in a learning package; otherwise we could just shoot a DVD in the labs!"*

As the project continued, the lack of interactivity in the early script iterations was resolved as the academic became more aware of the writing style required for an effective educational simulation. In the seventh iteration (compared to the first), the dialogue was crisper and more direct, the style of writing had become more game-based and the acknowledgement of trying to include interactive elements was a lot more identifiable.

On reflection, the project management process would have benefited from using a project management technique such as Scrum (an agile software development method), but timetabling issues for the academics and designer meant that this would not have been possible in practice. The advantages of Scrum, where a small group – made up of an academic, designer and project manager – could work intensively for a short period of time to brainstorm, trial and ultimately create the final version, would have produced a similar product but within a much more structured timeline and efficient use of resources. Due to the scenarios being created by the academics initially in isolation from the designer, it was only after the first scenarios were handed over for comment that it became apparent there was not enough interactivity in them for the production of a serious game. This meant additional meetings between the project manager and academics to suggest ways of incorporating more interactivity into the framework of each scenario. The advantages of using Scrum are that the academics would have become a much more integrated part of the development team. The frequent, intermediate deliveries with working functionality would have provided an opportunity to validate, refine and verify scenarios at shorter intervals. This would have given more time to resolve issues with the scenario, whilst risk and mitigation plans would have flagged up problems with the scenarios earlier in the design process. Once the infection control scenario had been chosen and more regular meetings with the academic, designer and project manager could be arranged, progress was quicker and the shared vision between the team became more integrated and was quickly visualised into the pilot product.

One final issue concerned the limitations of using the FEC model, which dictated that for a 31-week project, overheads for academics took over 42% of the initial budget. Academic time pressures and a desire to ensure that the scenarios were completed to the expected quality dictated that scenario creators (where four academics had each been estimated at 18.6 hours) all spent more time on the project than was estimated. Similarly, the 77 hours estimated for the designer were also exceeded. There was also a problem with ensuring that academic team members complied with good project management practice, such as keeping project logs containing their

time spent on the project. This occurred despite continued requests from the project manager to detail actual time spent on creating individual scenarios.

Pilot Feedback

Piloting the package prior to use was an important step, as a review of literature highlighted there are few examples in the areas of using blended e-learning with infection control (excepting Pratt et al. 2005) or evaluating the experience of using an infection control game for training nurses (excepting De Freitas and Jarvis 2006). The infection control simulation was piloted with three third-year nursing student groups during April and May 2008. Of the 24 respondents, 83% enjoyed using the package and 91% felt that using it was an interesting way of teaching infection control:

> *"It was interesting to find out how much you know."*
> *"It was easy to use and explained well."*
> *"Helps to highlight what is needed for looking after an MRSA patient."*
> *"Made us think about what we would do on the ward – bird's eye view was good."*

Eighty-seven per cent felt that the package helped them to understand how theory concerning infection control applied to their practice, but thought it would be more beneficial to first-year rather than third-year students (where the package is likely to be used). They also thought it should sit alongside rather than replacing face-to-face sessions:

> *"Should still be taught with lecturers in clinical skills."*
> *"Very good I think it will be useful alongside teaching as an assessment tool."*

Sixty-seven per cent would be happy to use packages like this in a home environment, but consideration needs to be given to those students who are not used to or do not enjoy game-based learning:

> *"Not interested in computer games – more frustrating getting it to work."*

Pilot feedback also highlighted a range of areas concerning practice that would help to improve the package before it went live:

> *"Different trusts have different infection control policies, with reference to the gown colours, also things such as talc, I*

> *believe, are banned in some trusts but not in others, maybe have different programmes for each trust to avoid confusion."*

The pilot also encouraged debate about the correct series of procedures that the programme required and the ability to interact with objects at any time (a 'sandbox' option allowing for open-ended actions):

> *"We queried whether gloves should be used for giving medication, if in contact with patient's saliva?"*
> *"I would have liked to have been able to wash my hands when I wanted to not when the computer allowed me to."*

There were also requests for more interactivity, navigational enhancements to avoid confusion, and some of the students also thought that error reporting should be spread throughout the scenario rather than only appearing at the end:

> *"Should be told what the error was when it occurred not at the end."*

Conclusion

This paper provides an insight into some of the issues that arose during the production of a serious game. Whilst the team of people brought together contained experts in the field of infection control, they were not game players, nor did they understand the complex interactions required to make games. The reverse was that the designer, responsible for the production of graphics and game architecture, did not understand the area of infection control required by the simulation. This highlights the importance of careful planning. Even though this production had difficulties creating meetings with the team, limited budget and time allocation, an immersive serious game could be created. A useful inclusion in the game for the development team was using data from an external XML source, which worked successfully for the conversations in the game. In future projects it would be beneficial to widen the external data to control many of the actual interactions that were taking place in the simulation, which would mean that the interactions could be changed without the need for game redevelopment.

What are the perceived benefits of this type of serious game for health education, which will hopefully be explored and identified? Is it able to effectively outline the roles and responsibilities of the health-care team in relation to infection prevention and control? Is it able to demonstrate

clinical and professional knowledge regarding MRSA? Does it enhance different learning styles such as visual, kinaesthetic and auditory? The evaluation of the current pilot was largely positive, although there will always be scope to improve the simulation – some of the most insightful pilot feedback will be incorporated prior to use within the practice skills curriculum of HSC. As ever, positives must be countered by considerations concerning students who might be put off by having to use game-based learning. This factor will help to inform the correct implementation and use of this package within the curriculum.

The simulation is only at the first stage of development. Excluding pilot feedback, there are many enhancements that could not be incorporated into the first version, which could add to the value of the final product, such as adding multiplayer options and including a more detailed hand-washing process. Outside of the infection control simulation it is also possible to add other medical scenarios to the first, which would expand the concept of the virtual hospital. It is hoped that besides being used as a reusable learning object, this simulation marks the beginning of a new way of creating study tools for students in HSC and will also help contribute to research in determining how dedicated serious games could and should be used to best satisfy the learning needs of the medical students and teachers that utilise them.

References

Alhadeff E (2007) *Pulse!!* Serious Game to Be Demonstrated at Clinical Congress. Available online: http://elianealhadeff.blogspot.com/2007/09/pulse-serious-game-to-be-demonstrated.html

Bendall E, Raybould E (1969) A History of the General Nursing Council for England and Wales 1919-1969. Lewis, London

De Freitas S, Jarvis S (2006) Effective Analysis of Learner Groups for Serious Games Development. In: Interservice/Industry Training, Simulation and Education Conference (I/ITSEC) 2006 Proceedings

French P (1980) Academic gaming in nurse education. Journal of Advanced Nursing 5, pp 601-613

Goodman, F (1971) An introduction to the virtues of gaming. In: Tansey PJ (ed) Educational Aspects of Simulation. McGraw Hill, New York

Gill J (2008) Good medicine. Times Higher Education. Available online: http://www.timeshighereducation.co.uk/story.asp?storycode=400253&encCode=396365494BC13908875JTBS737226611

Graham IW, Richardson E (In press) Using games to facilitate cultural awareness. Learning and Teaching

Heinze A, Procter C (2004) Reflections on the Use of Blended Learning. Education in a Changing Environment conference proceedings. University of Salford, Salford, Education Development Unit. Available online: http://www.ece.salford.ac.uk/proceedings/papers/ah_04.rtf

Iverson K (2005) E-Learning Games: Interactive Learning Strategies for Digital Delivery. Prentice Hall, New Jersey

Kelly H et al (2007) How to Build Serious Games. Communications of the ACM 50 (7), pp 44-49

Laurillard D (1993) Rethinking University Education. Routledge, London, pp 132, 133

Lowe J (1975) Games and simulations in nursing education. Nursing Mirror 141 (23), pp 68-69

Macdonald R (1997) Teaching and Learning in Small Groups. SEDA Publications, Birmingham, p 33.

National Statistics Online (2005) MRSA deaths continue to rise in 2005. Newport: National Statistics Online. Available from: http://www.statistics.gov.uk/cci/nugget.asp?id=1067

Pratt RJ, Pellowe CM, Shelley J, Adams J, Loveday HP, King D, Jones SR (2005) Using a blended e-learning model to provide accessible infection prevention and control training for NHS staff: The NHS./TVU/Intuition approach.

Ramsden P (1994) Current challenges to quality in higher education. Innovative Higher Education 18, 3, pp 177-187

Ramsey S (1996) Creating a Context: Methodologies in Intercultural Teaching and Training. In: Seelye HN, (ed) Experiential Activities for Intercultural Learning. Intercultural Press, Maine

Raybourn EM (2006) Applying simulation experience design methods to creating serious game-based adaptive training systems. Interacting with Computers 19, pp 206-214

Roberts J, While A, Fitzpatrick M (1992) Simulation: Current status in nurse education. Nurse Education Today 8, pp 85-95

Smith B (1998) Lecturing to Large Groups. SEDA Publications, Birmingham, p 13

Taylor JL, Walford R (1972) Simulations in the Classroom. Penguin Books, Harmandsworth

Thomas S (2006) Pervasive Learning Games: Explorations of hybrid educational gamescapes. Simulation & Gaming 37, pp 41-55

Wildman S, Reeves M (1996) The utilization and evaluation of a simulation game in pre-registration nurse education. Nurse Education Today 16, pp 334-339

Learn to Play to Learn: Activity System as Reflection

Alan Amory
Mathematics, Science, Technology and Computer Education,
Faculty of Education, University of Johannesburg, Auckland Park 2006, South Africa
+27 (0) 11 559 4319
aamory@uj.ac.za

Abstract

In order to explicate patterns pertinent to educational video game design and to evaluate the relationships between games and learning, Cultural-Historical Activity Theory (CHAT) is used to investigate games and the associated theories developed over the past decade. Analyses show that computer video games are the product of social collaboration and function as Objects (during their design and creation) and as Tools (foundation for the development of other Tools, and as learning and entertainment artefacts). However, the idiosyncratic and homological ideologies of Actors often work against underlying educational principles to advance their own gender, race and belief hegemonies. In addition, educational video games, as part of socially constructed learning, support active, transformational meaning making. The use of the CHAT lens to reflect on game development supports the constructs that CHAT, as prime unit of analysis, is a collective, artefact-mediated and Object-orientated activity; always includes multiple points of view; is shaped over time; and includes contradictions that are the source for all change and development.

Keywords

Educational game design, Cultural-Historical Activity Theory, learning with technology

Introduction

The paper looks at 10 years of research into the design, development and use of computer video games in order to identify design patterns. It includes a number of narratives analysed using Cultural-Historical Activity Theory (CHAT) to identify pertinent design pattern. Firstly, the relationships between games and learning are briefly explored, and thereafter the CHAT is presented in brief.

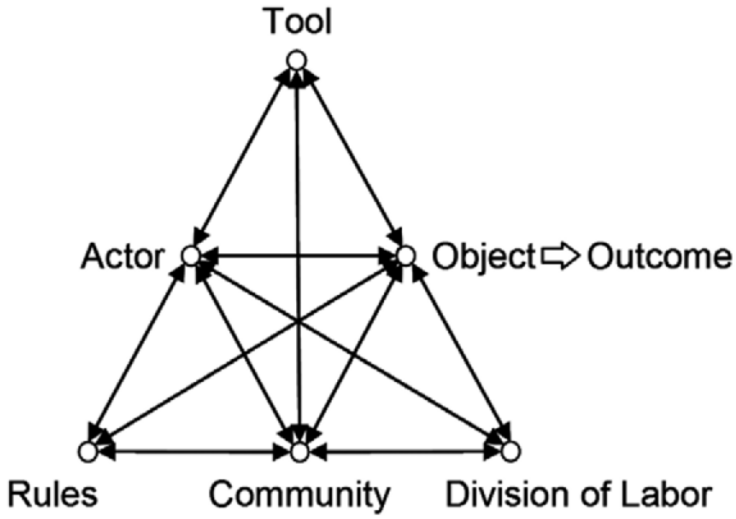

Fig. 1.

While it is accepted that computer video games can play an important role in learning and teaching (Amory et al. 1999; Amory 2001, 2007; Gee 2003; Quinn 1994, 1997, 2005; Rieber 2004), their design and use in the classroom is not fully understood. Becta (2007) suggests that computer games support learning in a number of ways, including the development of skills related to generic Information Communication Technology, problem solving, logic and spatial awareness. However, Amory (2007) argues that it is the use of authentic tasks within realistic environments that offer the most interesting educational avenue for educational game designers. For Reeves et al. (2004), authentic tasks are relevant to the real world and are ill defined, involve complex activities that include different perspectives across numerous domains, allow for reflection and collaboration, result in

the production of polished products that are different and diverse, and include integrated assessment. In addition, educational games as collaborative authentic challenges can embrace Cultural-Historical Activity Theory (CHAT) (Engeström 2000, 2001; Roth and Lee 2007; Stetsenko 2004, 2005) (Figure 1). The Actor-Object-Tool triad of Vygotsky (1933/1978) argues that investigation of any Object by Actors is always mediated through Tools (language, signs and Tools). The principles of CHAT include the hierarchical structure of activity (activity, action, operation-motive, goals), Object-orientated (human beings live in an objective reality), Tool mediation, and development. In addition, an activity system is governed by rules, includes Actors (that are also part of a community where there is division of labour), and interacts on Objects through mediating artefacts to reach outcomes. Stetsenko (2005) writes that 'people not only constantly transform and create their environment: they also create and constantly transform their very lives, consequently changing themselves in fundamental ways and, in the process, gaining self-knowledge. Therefore, human activity – material, practical, and always, by necessity, social collaborative processes aimed at transforming the world and human beings themselves with the help of collectively created Tools – is the basic form of life of people.' Games conceived as microworlds, a model-building constructivist simulation (Rieber 1995), include all activity system components and can support Vygotsky's cultural-historical constructive theories, which form the foundation of contemporary educational practices. However, CHAT is not only a theoretical but, in addition, a methodological lens to characterise, analyse and design educational games, which could be referred to as the participatory unit (Barab et al. 2004).

The aim of the paper is to identify, through the CHAT, pertinent positions that might further clarify the complex issues involved in the creation, design and use of educational games. The paper is divided into a number of narratives and associated CHAT analyses (called vignettes) in order to explicate patterns. The narratives include brief descriptions of complex models to highlight developments that neither explore associated theoretical constructs nor provide extensive descriptions. Readers are requested to examine the original texts to fully explore the models.

Vignette 1 – In the Beginning

Narrative

Over the past decade research groups involved in the developments discussed in this paper include postgraduate students, 3D graphic artists, programmers, project managers, research assistants and me. In the mid-1990s a research team investigated the use of educational games in the teaching and learning of biology. The objectives of the initial study were to identify types of games that undergraduate Biology students would enjoy, evaluate student opinions regarding computer games, develop a game based on student opinions, and evaluate the role of computer video games in teaching and learning. The findings of this study show that students preferred adventure and strategy games and identified a number of useful design criteria for educational games. These were then used to develop an adventure game on human evolution (Amory et al. 1998). Additionally, results suggested that students learned equally from the game and traditional practical material, but found playing the game more enjoyable. Analyses of student opinions and own reflections of game development activities lead to the conceptualisation of the Game Object Model (GOM). The GOM attempts to create a dialectic between pedagogical issues (abstract interfaces) and game elements (concrete interfaces) that are associated with a number of interrelated components, including the Game Visualisation, Elements, Actors and Problem Spaces (Amory et al. 1999).

CHAT analyses

Activity systems associated with the design of games for teaching and learning biology include the community of researchers who took on similar (research) and different (task specific) roles: the division of labour. However, all Actors participated in task-specific discussion. For example, design choices were determined through consensus, where the graphic designer acted as mentor, mediator and expert. The computer video game artefact functions in different ways: 1. As the Object to determine appropriate game attributes and genre; 2. As the Object during the development of the computer game on human evolution; 3. As the Tool during teaching and learning; and 4. As the Tool in the development of the GOM conceptual model that can function as a Tool.

Vignette 2 – Use of GOM

Narrative

Despite the GOM framework, research group members and interested parties found it difficult to exploit the GOM in a functional manner. Amory (2001) suggested that educational game design should be divided into three phases: research, resource creation and software development. The research phase includes content area and associated learning problems identification, puzzle design to overcome the identified learning problems, and narrative construction. Digital resources needed to realise the narrative, and puzzles form part of the resource creation phase. Software development includes the creation of the game and playback engines to support the narrative and puzzles. However, this relationship between the GOM and research, resources and software development did not resolve the GOM-implementation dialectical struggle. Amory and Seagram (2003) therefore designed the Game Achievement Model (GAM) in an attempt to reconcile game design and game development with the GOM. The GAM considers all the concrete interfaces of the GOM and envisages an educational game as a three-act narrative play with embedded puzzles that are the stratagem to attaining learning objectives. Each act includes any number of scenes that embrace act objectives and act narratives, which are not arranged linearly. It was reasoned that such a reductionist model would simplify the conceptualisation of educational video games but also explicate game and puzzle designs. Use of the GAM with large (Amory and Seagram 2003; Seagram and Amory 2004) and small (Baxter and Amory 2004, 2006) teams highlighted a number of rhetorical acts: socially constructed meaning-making through the use of learning objectives supported story development (Amory and Seagram 2003; Amory 2003; Baxter and Amory 2004); puzzles design through reduction is more complex than envisioned by the GAM (Baxter and Amory 2004); writing non-linear narrative is complex and difficult, especially when professional script writers attempt to argue their positions (Amory and Seagram 2003); and dialectical tension exists between the narrative and puzzles, and individual belief systems (Baxter and Amory 2006).

CHAT analyses

The GOM is designed as a Tool to support game development. However, the development of a shared understanding of this model is difficult. Yet, the GOM acting as Object allowed, through reduction, the creation of a socially constructed Tool: the GAM. The GAM, in turn, operates both as an Object (its evaluation) and as a Tool (to support game design). Individual skills, knowledge and attitudes lead to rhetorical struggles within a process to design and develop socially constructed artefacts. The GAM functioning as Tool builds on a shared socially constructed understanding of the learning outcomes concept (an easily understood, or groked, concept) but provides insufficient depth to support puzzle design, leading to individual and group dialectical struggles. The dialectical struggles of non-linear versus linear narratives, and those between narrative and puzzle, are a result of individual, idiosyncratic and homological ideologies. Before a socially constructed Tool can be used it needs to be understood and, therefore, acts as an Object. Therefore, socially constructed Tools act as Objects first and then as Tools. The development and use of the GAM results in interesting dialectical struggles, as each team member holds individual knowledge and justified belief (that is, a team includes multiple epistemologies).

Vignette 3 – Extending GOM

Narrative

Development and use of the GAM highlights that the GOM did not sufficiently address theoretical constructs related to an inclusive ideological position and the puzzle design process. In response, Amory (2007) extends the GOM to take into account the role of authenticity, narrative, gender representation, social interactions and challenges/puzzles/quest. Therefore educational video games are conceived to include: 1. Explorative, emotive, engaging and relevant environments that offer learners difficult, complex challenges with diverse and numerous outcomes; 2. Authentic task-based collaborative learning environments that make use of complex relevant tasks, challenges or problems, which can include model-building simulation where multiple representations (ideologies) and reflections act as transformative opportunities; 3. Narrative spaces where story and plot allow players to

actively construct their own understanding through the use of plot devices; 4. Gender inclusiveness where appropriate role models participate in the narrative; 5. Social interactions where dialogue and social capital works through information flow, altruism, reciprocity, collective action, identities and solidarity to support the development of democracy; and 6. Challenges/puzzles/quests designed as the core of learning activities associated with immersive learning environments, where accommodation, assimilation and puzzlement are supported through access to explicit knowledge, conversations and reflection, and result in the construction of tacit knowledge after a flow state. Amory (2007) suggests that while GOM II is designed to support development of complex computer video games, the model could also be used as a game evaluation framework. The development of such a Tool is not trivial, as individual epistemologies attempted to shift the social constructive theoretical position of the Tool to support current hegemonic practices more closely allied to behaviourism and instructional design. However, a persistent use of the cultural-historical constructivist approach fosters individual transformation to support the development of a research instrument, based on the GOM II, to evaluate computer video games (Amory 2006).

CHAT analyses

The GOM participates as an Object under investigation for revision and as a theoretical construct underpinning the design of a Tool, a research instrument to evaluate the education fit of computer video games. The updated GOM II and research instrument were socially constructed. While the GOM II addresses identified shortcomings, the model is much more complex and therefore more difficult to grok and this invariably leads to dialectical struggles. The individual, idiosyncratic and homological ideologies held by members of the research team often result in system perturbations. Only through the application of a cultural-historical constructivist approach was it possible to socially develop the Tool for game evaluation.

Vignette 4 – Software Development

Narrative

The processes associated with the development of complex software need to make use of software engineering methodologies to resolve the conflict between failure to develop a product and the development of the incorrect product. One approach to solve this problem is to clearly identify who will use the product, what human activity will the software support, and how and with what technology would the product be fashioned (Newman and Lamming 1995). This human computer interaction perspective suggests that the who and what could be defined in terms of a 'persona' (characteristics of a fictitious user of the system). However, persona descriptions are not built from real data and do not allow the use of vigorous statistical Tools during the user evaluation phases of software development. To address the problems associated with a persona, Amory and Seagram (2003) suggest that the persona could be described in terms of educational learning theories and the GOM and developed the Persona Outlining Model (POM) that includes all the abstract interfaces of the GOM visualisation space, the concrete interfaces of the problem space, and a number of properties (age, sex, education and occupation). Today, other solutions to manage the complexity associated with software development, such as agile programming, are available. However, development of POM provides a Tool to directly link game development to learning outcomes. While the use of POM as a Tool to support software development was useful, programmers and graphic designers needed to understand the GOM and POM to participate fully in socially constructed environments. Working with a number of programmers and 3D graphic artists over the past 10 years involved a number of dialectical struggles. Firstly, it is difficult to maintain high coding and design standards. Secondly, despite a multi-cultural team that included many gender identities (gay/straight, female/male), the design and development of software, to support socially constructivist environments where there is no ontological reality, is constantly undermined through the inclusion of hegemonic gender, race and religious belief practices.

CHAT analyses

Here the 'persona concept' and GOM act as Objects to allow the creation of a socially constructed Tool, the POM. The POM, in turn, operates both as an Object (its evaluation) and as a Tool (to support software development and to evaluate learning outcomes). However, the development of shared ideological positions in Actors involved in the creation of complex software to support social constructivist pedagogies became part of a dialectical struggle. High-quality work requires an attention to detail that demands dedication. While CHAT purports that through social construction individuals transform their world view and thereby the world itself, this is not the case in many of the 3D graphic artists and computer programmers. Yet, attention to details and world view transformations are part of postgraduate participants' development, suggesting that building a deep understanding of complex system (design, product and use) requires an investment in conceptualisation of the world we live in that is part of a postgraduate programme, but viewed as unnecessary by employees. The same dialectical struggles, identified through CHAT analyses of the design of educational games, are part of the software development process: individual, idiosyncratic and homological ideologies through rhetorical acts attempt to recreate their often hegemonic, often fundamentalist, world views.

Vignette 5 – GOM, GAM, POM and Learning

Narrative

The use of computer video games in the classroom is not yet common practice, and the experience in developing such learning tools and use in the classroom is far more complex than initially thought. Amory et al. (1999) reports that students find it enjoyable to learn while playing the evolution game. However, if educational games are to act as transformative learning devices, it is necessary to understand the relationship between such artefacts and contemporary learning practices. Adams (1998), using a game designed to address misconceptions related to photosynthesis and respiration, reports that tertiary students playing the game individually developed a better understanding of photosynthesis and respiration and the relationships between the two processes. However, Foko and Amory (2004) find that after playing the same game on their

own learners from disadvantaged secondary and tertiary institutions, the learners showed no improvement in understanding. One of the problems might be related to the use of English in the research instrument that tests understanding. However, on further investigation, they find that participants unable to solve puzzles on their own learnt the solutions by rote from their peers and were thereby able to show that they could complete the game. Therefore, students reverted to their predominant mode of learning. To overcome both of these problems other groups of students from the same institutions played the games in pairs. During play the facilitator asked students to discuss the puzzles, and during assessment allowed students to seek explanations of the questions they did not understand. Under these conditions most students were able to overcome some, if not all, misconceptions related to photosynthesis and respiration (Foko 2006). Seagram and Amory (2006), using qualitative and quantitative methodologies to investigate learning through playing a game created to address serious South African diseases (tuberculosis, AIDS/HIV, cancer and virus infections), report that through conversation, groups of players develop deeper understandings of the embedded concepts. The longer the participants discussed certain knowledge domains, the richer their descriptions were of that knowledge domain. The games based on the GOM allowed student groups to discuss and negotiate mutually acceptable knowledge. Baxter (unpublished) who designed a GOM-based game to address learning problems associated with Mendenial genetics, reports that students working together developed deeper understandings of the issues when the puzzle solving process is social. Playing games in pairs also influences other skills. Using the research instrument developed with POM, Foko (2006) found that students working in pairs improved their 2D and 3D visualisation, logic, mathematical, reading and writing skills.

CHAT analyses

The original Vygotskian construct consists of the Actor, Object and mediating Tool, the upper triangle of CHAT. In addition, Vygotsky's (1933/1978) Zone of Proximal Development describes what a learner is capable of on their own, compared to what he or she can achieve with mentoring from those more experienced. Here, the mentor acts as a mediating Tool. Educational games could function as the more knowing mediator and thereby support learning. Puzzles are the core of the GOM and therefore puzzle-solving may act as the mediating Tool. Therefore, the game provides the context and the puzzles act as the mechanism to move

the Zone of Proximal Development. However, results suggest that it is only when social dialogue and collaboration are part of the process that learning takes place – supporting the statement that 'human activity – material, practical, and always, by necessity, social collaborative processes aimed at transforming the world and human beings themselves with the help of collectively created Tools – is the basic form of life of people' (Stetsenko 2005).

Discussion

This paper, through the use of narrative vignettes, explores experiences over the past decade in the construction, development and use of educational games designed to foster learning. In addition, Vygotsky's cultural-historical constructivist paradigm and associated activity theory is both the foundation of the developments and the reflective lens used in this paper to uncover patterns. This section identifies and explored these patterns and thereafter relates findings to the broader issues related to teaching and learning with computer video games.

Pattern Recognition 1

Computer video games function as Objects (during their design and creation), as Tools (foundation for the development of other Tools, and as learning and entertainment artefacts), and socially constructed Tools function firstly as Objects and then as Tools. However, irrespective of their operation in an activity system, computer games are the product of human social construction by Actors that by necessity includes contradictions. This elucidated pattern supports the concepts that Objects: give the activity system coherence (Engeström 2000), are cultural entities that function as the prime units of analysis within the system (Engeström 2001), and embody communal social practices that lead to further development during human activity (Stetsenko 2005). In addition, it is not possible to separate a socially created Tool and associated activity as proposed by Robbins (2005). Tools and Objects can easily switch in activity systems and Objects influence other parts of the activity system where the inherent contradictions lead to new understanding (Roth and Lee 2007).

Pattern Recognition 2

While activity systems are by nature multi-voiced and therefore a community of multiple points of view (Engeström 2001), the idiosyncratic and homological ideologies of Actors can work against the transformative principles that are normally part of the game design by advancing their own gender, race and belief hegemonies. Such actions are contrary to social justice attributes of the cultural-historical constructivist paradigm. Such positioning may be part of the contradictions within any activity system. However, Roth and Lee (2007) discuss contradictions as dialectical approaches associated with mutually exclusive pairs (individual–collective, body–mind, subject–object, agency–structure, and material–idea) that change over time. Hegemonic beliefs should rather be viewed as conflicts that are part of dialectical struggles.

Pattern Recognition 3

Learning is a social activity. While educational games can function as Tools to support construction of new understanding, and thereby transform world-views, such artefacts offer little potential for transformation when used outside of an activity system. The argument (Gee 2003) that technological artefacts can function as a mediating artefact (Tool) in the absence of social dialogue and can influence the Zone of Proximal Development is spurious. This conclusion concurs with Jonassen and Reeves (1996) who argue that we do not learn from but rather with technology.

The design, development and use of educational computer video games, based on cultural-historical constructivism and analysed using the CHAT, supports the idea that human social collaborative activity transforms individuals and thereby their world and is the basic form of human existence. In addition, the work presented here reaffirms the four principles of activity theory as proposed by Engeström (2001): 1. The prime unit of analysis is a collective, artefact-mediated and Object-orientated activity; 2. An activity system always includes multiple points of view; 3. Activity systems are shaped over time; and 4. Contradictions are the source for all development.

Conclusions

The narratives and analyses presented here show that the design, development and use of computer video games for education have the following characteristics: 1. They are the products of social collaboration; 2. They function as both the Object (their design and development and as the foundation for the design and development of socially constructed Tools) and Tools (to support their further development and in learning activities); 3. They can be influenced by individual hegemonic beliefs of race, gender and religion that are not system contradictions but attempts to perpetuate individual belief systems, which are often not transformative; and 4. They support meaning-making and transformation when they are part of social learning activities.

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References

Adams J (1998) The use of a virtual world to address misconceptions held by students regarding photosynthesis and respiration. MSc. University of Natal, Durban, South Africa

Amory A (2001) Building an educational adventure game: Theory, design, and lessons. Journal of Interactive Learning Research 12(2/3), pp 249-263

Amory A (2003) Another country: Virtual learning spaces. In: World Conference on Educational Multimedia, Hypermedia and Telecommunications (eds D Lassner & C McNaught), pp 708-715, AACE, Honolulu, Hawaii, USA

Amory A (2006) Evaluating computer games: Use of an appraisal instrument based on the game object model. In: World Conference on Educational Multimedia, Hypermedia and Telecommunications (eds P Kommers & G Richards) pp 2242-2249, AACE, Orlando, USA, Chesapeake, VA

Amory A (2007) Game object model version II: A theoretical framework for educational game development. Education Technology and Research Development 55(1), pp 51-77

Amory A, Naicker K, Vincent J, Adams C (1998) Computer games as a learning resource. In: World Conference on Educational Multimedia, Hypermedia and Telecommunications (eds T Ottmann & I Tomek), pp 50-55, AACE

Amory A, Naicker K, Vincent J and Adams C (1999) The use of computer games as an educational tool: Identification of appropriate game types and game elements. British Journal of Educational Technology 30, pp 311-322

Amory A, Seagram R (2003) Educational game models: conceptualization and evaluation. South African Journal of Higher Education 17(2), pp 206-217

Barab SA, Evans MA, Baek EO (2004) Activity theory as a lens for characterizing the participatory unit. In: Handbook of research on educational communities and technology (ed DH Jonassen) pp 199-214, Association for Educational Communication and Technology, Washington, D.C.

Baxter D, Amory A (2004) Development of a 3D virtual learning environment to address misconceptions in genetics. In: World Conference on Educational Multimedia, Hypermedia and Telecommunications (eds L Cantoni & C McLoughlin), pp 1256-1263, AACE, Lugano, Switzerland

Baxter D, Amory A (2006) Educational game design: A game designer's reflective journal. In: World Conference on Educational Multimedia, Hypermedia and Telecommunications (eds E Pearson & P Bohman) pp 2264-2269, AACE, Orlando, USA

Becta (2007) Information sheet: computer games to support learning. Retrieved online on 12 August 2007 from http://www.champlaincollege.qc.ca/gasco/Sim%20&%20games%20resources/Online%20articles/computergames%20support%20learning.htm

Engeström Y (2000) Activity theory as a framework for analyzing and redesigning work, Ergonomics 43(7), pp 960-974

Engeström Y (2001) Expansive learning at work: Toward an activity theoretical reconceptualization. Journal of Education and Work 14(1), pp 133-156

Foko T, Amory A (2004) The use of computer games to address misconceptions held by students regarding photosynthesis and respiration: Playing Zadarh. In: World Conference on Educational Multimedia, Hypermedia and Telecommunications, (eds L Cantoni & C McLoughlin), pp 1766-1772, AACE, Lugano, Switzerland

Gee J (2003) What Video Games Have to Teach Us about Learning and Literacy. Palgrave MacMillan, New York

Jonassen DH, Reeves TC (1996) Learning with technology: Using computers as cognitive tools. In: Handbook of Research on Educational Communications and Technology (ed D:H Jonassen), pp 693-719. Macmillan, New York

Newman WM, Lamming MG (1995) Interactive System Design. Addison-Wesley, Reading, Mass

Quinn CN (1994) Designing educational computer games. In: Proceedings of the IFIP TC3/WG3. 2 Working Conference on the Sign, Implementation and Evaluation of Interactive Multimedia in University Settings: Designing for Change in Teaching and Learning (eds K Beattie, C McNaught & S Wills), pp 45-57, Elsevier Series B.V., North Holland

Quinn C (1997) Engaging learning. Retrieved 30 January 2008, from http://it.coe.uga.edu/itforum/paper18/paper18.html

Quinn C (2005) Engaging learning. Designing e-learning simulation games. Pfeiffer, John Wiley & Sons, Inc, San Francisco

Reeves TC, Herrington J, Oliver R (2004) A development research agenda for online collaborative learning. Educational Technology Research and Development 52(4), pp 53-65

Rieber L (1995) A historical review of visualisation in human cognition. Educational Technology, Research and Development 43, pp 45-56

Robbins J (2005) Contexts, collaboration, and cultural tools: A sociocultural perspective on researching children's thinking. Contemporary Issues in Early Childhood 6(2), pp 140-149

Roth WM, Lee YJ (2007) Vygotsky's neglected legacy: Cultural-historical activity theory. Review of Educational Research 77(2), p 186

Seagram R, Amory A (2004) Designing effective stories for educational games. In: World Conference on Educational Multimedia, Hypermedia and Telecommunications, (eds. L. Cantoni & C. McLoughlin), pp. 162-167, AACE, Lugano, Switzerland.

Seagram, R, Amory, A (2006) An assessment of learning through the use of a constructivist learning environment. In: World Conference on Educational Multimedia, Hypermedia and Telecommunications (eds E Pearson & P Bohman), pp 2165-2172, AACE, Orlando, USA

Stetsenko A (2004) Tool and sign in the development of the child. In: The Essential Vygotsky (eds L.S Vygotskiaei, RW Rieber, DK Robinson & JS Bruner), Kluwer Academic/Plenum Publishers, New York, pp 501-512

Stetsenko A (2005) Activity as object-related: Resolving the dichotomy of individual and collective planes of activity. Mind, Culture, and Activity 12(1), pp 70–88

Vygotsky L (1933/1978) Mind in Society. The development of higher psychological processes. Harvard University Press, Cambridge, MA

Narrative-Based Serious Games

Carlton Reeve
Illumina Digital
+44(0)2086009300
carlton.reeve@illumina.co.uk

Abstract

The relationship between story and activity in games is complex. The nature of traditional dramatic narrative implies passive consumption of content. Games, however, require active participation where the player undertakes a series of tasks to pursue some overarching goal. This paper explores the narrative models available to game designers and examines in detail the approach taken for a recent serious game.

The objective of any learning resource is the development of skills within its given area. Many games deploying an encompassing narrative offer the player a role as a character within the dramatic storyline. However, this artificial projection can undermine the validity and transferability of the experience out of the representational universe of the game, thereby reducing its educational value.

In spite of this, the compelling nature of a good story is recognised as an efficient motivator and can provide a useful structure for activity. Axon is a science-focused serious game developed for the BBC by Illumina Digital. Rather than create a fictitious conceit, Axon overlays an absorbing drama on plausible scientific mysteries that the player, as himself, must investigate. All the science is real, even if the context is constructed; therefore, the exercises and processes engaged are worthwhile facsimiles of actual scientific experiments.

This model combines linear storytelling with free exploratory activity by the user. The user becomes a witness to an unfolding drama but maintains his or her ability to act independently, thereby benefiting from both a high quality story and genuine interactive freedom.

Keywords

Narrative, storytelling, drama, video, serious games, learning

Introduction

The relationship between narratives and games is well documented (Simons 2006) yet it remains contentious. At the heart of the relationship is the apparent contradiction between predetermined storytelling and user control (Soulban 2005) and existing and emergent storylines. At one end of the scale, the use of traditional narrative structures within games takes its inspiration from classic literature and Hollywood and delivers finely crafted, but largely fixed, storylines, in which the player has a walled garden of opportunity. At the other end, hypertext narrative suggests stories that emerge entirely according to the user's interactions with the game environment.

Commercial single-player computer games rarely choose one of the extremes when approaching narrative. Instead, they seek to balance participation with presentation. This judgement is not purely artistic, there are serious pragmatic considerations with delegating control to the user or not. Given storylines provide context and player-character motivation, as well as helping to control the pace of the user experience and providing respite in the activity. However, almost all single-player games structure play around a narrative containing a clear goal, some ultimate triumph and a defined finale.

'Serious' games have clear objectives for player achievement that are transferable to spaces outside the game world; they are rarely ends in themselves but mechanisms to improve skills in other domains. Serious games tend to provide virtual facsimiles of their target environment and its behaviour to facilitate easier transfer. Central to this portrayal is the structured, and therefore restricted, presentation of events, actions and consequences. Within serious games, the role of the narrative becomes more pronounced because of the requirement to deliver specific learning outcomes.

Axon is a BBC commission produced by Illumina Digital to deliver a compelling and innovative experience of science for 11-14 year olds. Aimed at learners at home, unconnected to classroom lessons and therefore competing with usual recreational activities of young teenagers, Axon seeks to engage users through an unconventional mix of story-telling and serious game. As a BBC resource, Axon has to marry two of the key

public service characteristics for which the Corporation is known: high quality drama and genuine learning activity. As well as being engaging, the resource has to be educationally useful. The combination of these features requires a plausible game environment, a factually accurate portrayal of science and an engaging conceit to encourage both uptake and perseverance. Axon adopts a novel approach to game-based storytelling that mixes science fact and dramatic fiction, individual activity and passive presentation, in one encompassing mechanism.

Background

Storytelling and narrative are central components in many forms of entertainment. In traditional dramatic media, the authored story engages the viewer emotionally through a set sequence of predetermined pieces of information, like beads on a string. If the term 'story' describes characters, events and plot, 'narrative' describes how the story is told. The literary theorist, J Hillis Miller, defines narrative through its constituent parts:

> *"There must be, first of all, an initial situation, a sequence leading to a change or reversal of that situation, and a revelation made possible by the reversal of that situation. Second, there must be some use of personification whereby character is created out of signs – for example, the words on the page in a written narrative, the modulated sounds in the air in an oral narrative. However important plot may be, without personification there can be no storytelling... Third, there must be some patterning or repetition of key elements."*
>
> Miller 1990

These elements clearly exist in established kinds of storytelling, but they are also present in emerging forms of production. Although games do not conform to the classic definition of story by not necessarily containing *a* beginning, *a* middle, and *a single* ending or a traditional three-act structure, they clearly portray a recognisable sequence of events and elicit an emotional response from the partakers. Jesper Juul describes an intrinsic connection between narrative and games (Juul 2001). He suggests that we use narratives to describe all aspects of life, that most games feature introductions and back-stories and that games inherently share some characteristics with traditional narratives.

As Roland Barthes argues, narrative is already present in written literature, oral conversation, drama, film, painting, dance and mime but it is not a phenomenon restricted to the Arts (Barthes 1993). In fact, it is an

inseparable part of our understanding of life. Narrative helps us process information and make sense of experience; it is the account of connected events and exists in every genre and cultural form.

The introduction and back-stories of games both provide context and establish how the player's actions affect and relate to the encompassing story. This contextualisation occurs from the start of the relationship with any media, even the physical presentation and packaging initiates an affective response from the potential audience but begins in earnest with the opening sequences. As well as providing tutorial guidance on interface design and functionality, the introductory sections identify the role of the player within the narrative world; they provide orientation both in terms of gameplay and storyline.

Like established narrative forms such as novels, games are experienced linearly, develop quest structures, offer reversals of fortunes and generate conflicts needing resolution. Although they are played prospectively, narratives are delivered and presented retrospectively and describe a story of linked events and characters. The emotional behaviour of an avid gamer is not dissimilar to that of an engaged reader – both 'read' the signs from the narrative presented to them in the same way and the effectiveness of the story is measured by their suspension of disbelief, visualisation of implied detail and association with the emotions, personalities or situations described.

The narrative presented in traditional media directly represents the author's 'vision'. It is an experience that is largely out of the hands of the viewer. The reader is an external observer travelling along a path already trod. However, in games the user is an immersed participant and his role as a central character alters his emotional investment in the form – he doesn't simply watch, he participates, not just on an intellectual and emotional level but physically and practically. Indeed, his activity can provide or prove to be a distraction from the given storyline for the majority of the experience.

Narrative gives a game a level of sophistication that promotes greater engagement and encourages longer participation. The emotional attachment manifest in the desire to know what happens hooks a player's attention and makes each instalment a reward for progress in its own right. The need to actively resolve the plot, become a character in the story and make a difference are powerful motivators. However, offering the user genuine choice about the direction and outcomes of the storyline is limited by the practicalities of generating a sufficiently flexible engine to cope with every eventuality and crafting equally attractive and plausible options and consequences: inevitably one decision branch will be more engaging

than another. JP Gee describes the use of storyline within games as a mixture of four elements (Gee 2003):

- The choices of the game designer;
- The player-generated sequence of discovery;
- The player's own actions;
- The player's personal imaginative projection.

Within a commercial, off-the-shelf computer game, the experience is a construction created by the decisions of the design team. Every aspect of the representational universe presented in a game is the outcome of a decision by the production team. The designers and developers establish everything from the colour of sky to the possible range of movement. Although the design offers space for the player's activity, it is within tightly defined boundaries.

However, the player's exposure to the game elements is a unique experience for each individual and his or her organisation of the information is a consequence of that unpredictable discovery and player perspective. The player's own actions become part of the story itself and the player a central character: he or she becomes embedded within the narrative rather than a passive observer, thereby becoming a co-creator of the story.

Finally, all players project their own emotional experiences onto the characters to provide a personally affective back-story and outcomes. This identification with the protagonists creates a richer imaginary environment and effectively 'fills in the gaps' to provide motivation and explanation for behaviour and consequences. It is more than simply making up for a lack of detail, however. The player's projection creates a relationship between onscreen characters and the human at the controls. This relationship provokes the empathy of the real player for the imagined characters and improves the sense of presence for the user: it is emotional synthesis.

Having recognised that players develop emotional attachments to their avatar it is important to understand that it is a different relationship to that between a reader and a character. In a novel, when a character dies, especially when it is a lead character, the reader may feel genuine sorrow and loss – he has witnessed a tragedy that he could not prevent. In the game world, however, when a player's character dies, he is more likely to feel frustration than grief. The untimely demise of the avatar is a setback in the user's attempt to complete the game, but, while infuriating, it is not the end of the character's existence, rather, the death simply returns the game to its last save point and the player has to try again.

The first and last points of Gee's analysis apply equally to traditional narrative forms (if you replace 'Game Designer' with 'Author'), but it is the player's direct involvement in the telling of the story that challenges the historical model.

Narrative Forms

The use of story lines within video games is an established mechanism to improve engagement and provide structure for play. There are various forms of narrative prevalent in games (Bateman 2005):

- Linear Traditional
- Branching Narrative
- Parallel Paths
- Threaded
- Dynamic Narrative
- Implied Narrative

Linear traditional narratives reflect the historical, single path and single conclusion storyline of novels, theatre and film. Even though there may be periods of user activity, the audience is a passive receiver of information crafted by another's hand. It is the most common and understood form of narrative where all users travel the same path and come to the same ending.

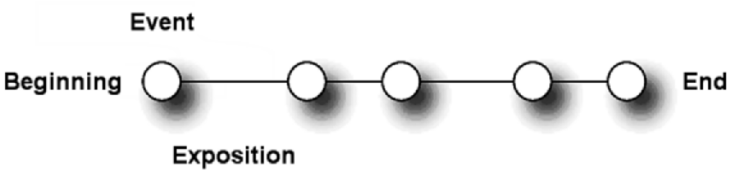


Fig. 1. Linear Traditional

The linear narrative predominates in single-player video games, exemplified in titles such as *Halo* and *Metal Gear Solid*. Within this model, users must successfully complete a stage before receiving the next episode of drama. These stages of player activity exist within envelopes of freedom that offer the illusion of control between set pieces. The dramatic elements of these cut scenes provide both a reward for progress and a motivation for continued participation. These games emphasise the pivotal role of the player in the story by establishing a role-playing scenario – the user plays the central character. Yet the loss of player control, however

temporary, during these cut scenes undermines the notion that the user determines the game's outcome; as a consequence these dramatic interludes are not universally appreciated. *Joystick Nation* author J Herz comments:

> *"Just watching video sequences, even if you pace them yourself, is not fun. It's not even really a videogame. It's just stupid remote control tricks."*
>
> Herz 1997

Herz identifies the challenge of managing expectations. At one moment the game is reliant on user participation, the next events are out of his control. Indeed, if gameplay is 'a series of interesting choices' (Rollins 2000), then without this interactivity, the resource ceases to be a game at all. However, even in games that offer a single plot line delivered through cut-scenes, there is opportunity for 'interesting choices' and each user's experience is still slightly different because of the differing pace and depth of exploration. Some users will explore every corner and avenue of each stage, determined to discover every element of the environment. This slow and methodical procedure is in marked contrast to players who race through stages, intent on completing each one as quickly and as efficiently as possible. By choosing the critical path through the resource and charging across the game world at breakneck speed, these lightning players inevitably will miss elements and subtleties of the storyline and context, although this may not necessarily affect their personal enjoyment.

In many respects, branching narratives represent the opposite end of the spectrum to traditional linear narratives. Branching narratives are the most common attempt at truly unconstrained and interactive drama where the player's behaviour materially influences the conclusion. Instead of a single continuing storyline, branching narratives offer the user consequential choices. Each decision offers a unique path in an ever-diversifying array of options. Although the total outcomes will be finite, branching narratives give the user control over the course of the action. Rather like changing the points on a railway line, branching narratives allow the user to determine the direction of the train, and therefore its destination, but not the path between points. The game designer determines all the available options but the user decides the route through them.

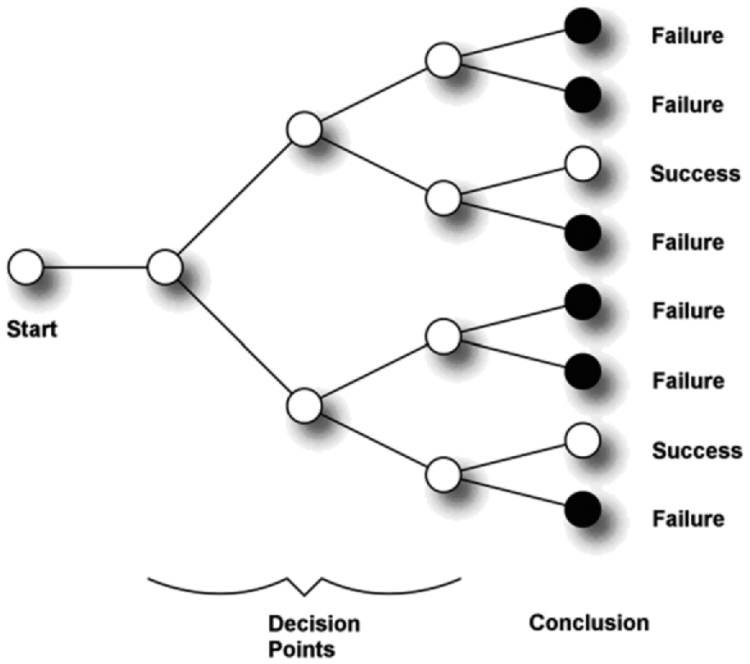


Fig. 2. Branching Narrative

In a truly branching narrative, every decision has a unique set of consequences. This reflects real life, where every choice provokes an avalanche of outcomes and where future options are a direct result of an individual's behaviour. There are circumstances in reality when an individual's choice is illusory and, just as when this occurs in real life, the *facade* of control in games is quickly obvious and can be deeply unsatisfying. The opportunity to genuinely choose the path of discovery offers the user real control, but every true option generates at least two outcomes. The combinatorics quickly become unmanageable from a production perspective. Even offering the minimum of two choices per decision at each stage, the number of outcomes multiplies exponentially, according to the simple equation $o = 2^s$, where S is the number of stages. In Figure 2, for example, it is clear that three stages result in eight possible outcomes.

Obviously, with this method of interactive drama, as well as effort required to generate each possible path, there is a large amount of redundancy – the user only explores one of the total number of paths through the material (n). This means every user misses the majority ((n-1)/n*100%) of the content unless he revisits the story multiple times.

Revisits can offer rewarding alternatives and genuinely new insights into the game world but this assumes that each option is equally well thought out and credible.

The key differences between the branching narrative of a computer game and the chaos of real life are richness, flexibility and predetermination. In life, there are no certainties of outcome or total control over parameters – it is intrinsically unpredictable. Games, on the other hand, are, at the current time at least, entirely human constructs with little, if any, artificial intelligence. Every decision and outcome is, if not totally predefined, the consequence of predetermined models and rules. The constraints of the production mean that narrative cannot be entirely free. Instead, producers regularly draw the narrative back to shared nodes. These nodes appear as the consequence of possibly unrelated decisions and provide a means of limiting the range of outcomes.

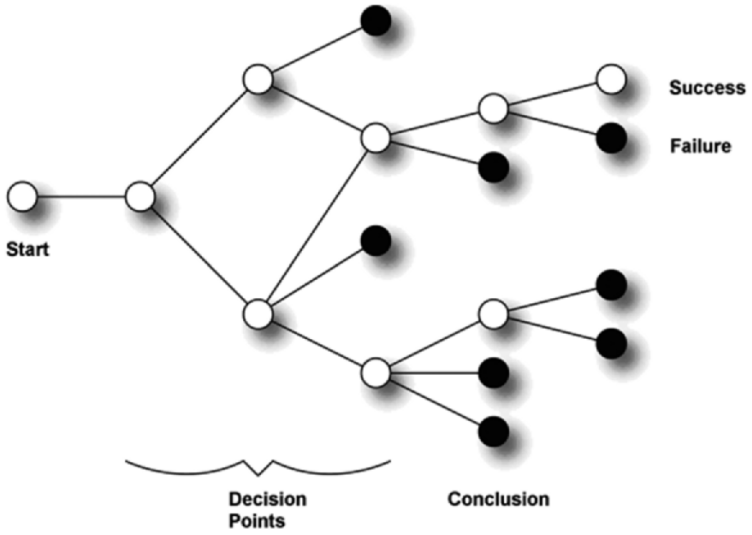


Fig. 3. Typically Constrained Branching Narrative

Parallel paths overcome some of the production challenges of a strict branching narrative by reducing the total number of tracks even further than the constrained model but still allowing a level of user choice. Parallel paths offer 'junctions' where two or more tracks combine. This allows the user to experience consequences of his actions but returns him to predetermined points where the story can advance in a more managed way. By hopping from node to node like this, the user has a high sense of control, even if his experience shares much with that of other users. For

example, *Knights of the Old Republic* allows users to switch between 'good' and 'evil' paths at key points in the game.

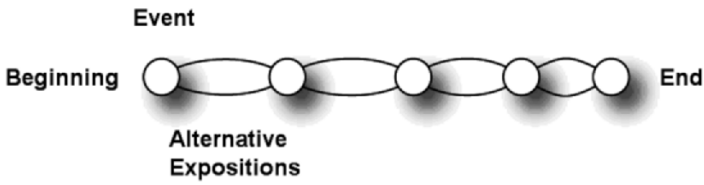


Fig. 4. Parallel Paths

As an alternative to different routes between narrative 'stops', threaded narratives offer the user the chance to control the order of the stages between the beginning and the end of the experience. Again, all the content is predefined but the user can sequence the material in a manner of his or her choosing, rather like connecting assorted lengths of pipe. Although all viewers receive the same introduction to the narrative and, in most cases, the same ultimate successful conclusion, they choose their own route through the elements. Each story segment is self-contained but collectively works like a jigsaw puzzle to present the full picture. Puzzle adventures such as *Myst* demonstrate this approach by offering a free roaming experience through related challenges.

Dynamic narratives offer object-oriented storytelling. These experiences may contain discrete storylines but have possible connections to other event nodes built into them. This allows the user to construct a narrative at will, where the relationship between characters or the plot revelation unfolds unpredictably.

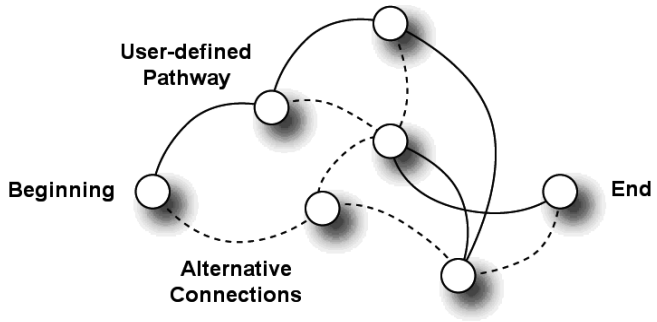


Fig. 5. Dynamic Narrative

Finally, in games without declared goals, such as simulations like *The Sims*, there can be an implied narrative as stories evolve from a dynamic play environment. These open-ended experiences develop a continuing story through the behaviour and interactions of characters and forces within the milieu. Although simulations and game worlds may not contain pre-authored dramatic events, they induce 'tellable events...which would retrospectively make good stories.' (Klastrup 2003)

Regardless of the method used, the experience of narrative-based games can still disappoint both producer and player. Traditional writers are often disappointed by the in-game visualisation of their efforts. This is partly due to the different natures of authorship – traditional writing is generally a solitary affair, while video game production is sometimes impossibly collaborative. By its nature, group work accommodates the views of many and absorbs the contributions of all. As such, it has a tendency to settle on the least objectionable solution. The compromises required to embed a user into the events also contribute to this disappointment.

Narrative is more than the portrayal of the dramatic elements, though. Critical to the player's reading of the game is his or her physical perspective on it. Many games, such as *Halo*, adopt a first-person view for activity but resort to a more familiar (and controllable) third-person camera for storytelling. This loss of control can undermine both the user's sense of presence and his suspension of disbelief. It is as though the user is suffering an out-of-body experience just when the drama reaches a climax.

Axon

Axon, Illumina Digital's science resource for the BBC, uses a novel approach to narrative that combines a traditional linear storyline with genuine periods of user activity, activity that by definition is undefined if not entirely unconstrained. In the game, the early teenage players of Axon adopt the role of an investigative scientist, collaborating with virtual colleagues across the net to solve a series of scientific conundrums while a compelling drama unfolds around them. Crucially, the player's success or failure within the missions does not interfere with ongoing, broader game-world events. Axon presents a world where the user is an important participant but not its centre. Instead, the drama the user enters revolves around Sam, the 18-year-old leader of the secretive organisation and the player's recruiter.

Although the main story focuses on Sam's search for her father, it is a tale delivered largely second-hand. Dexter is the player's primary source

of detail about the overarching narrative. He is both Sam's best friend and the learner's. Dexter provides the bridge between the central conceit and the user's experience by becoming a confidant and gossip. He is, like the player perhaps, not a natural scientist but someone drawn into the unfolding drama. The familiarity of this expert-peer is a key device in supporting the user's learning because he becomes a trusted source of both intelligence and criticism. That is to say, as Dexter is the principal and irreverent gatekeeper for news about Sam, his feedback is more acceptable.

Driven by the objective to facilitate science learning, the content design of Axon aims to create as real an experience as possible by combining user choice with events outside of his or her control. To achieve this balance, the system offers users, once initiated, a free choice of mission. All users have to undergo the Training Mission that serves two purposes: to provide a tutorial of the resource's functionality and tease the participants with a glimpse of overarching mystery. However, once 'accepted' through the successful completion of the training mission, users can choose their own path through the six material episodes.

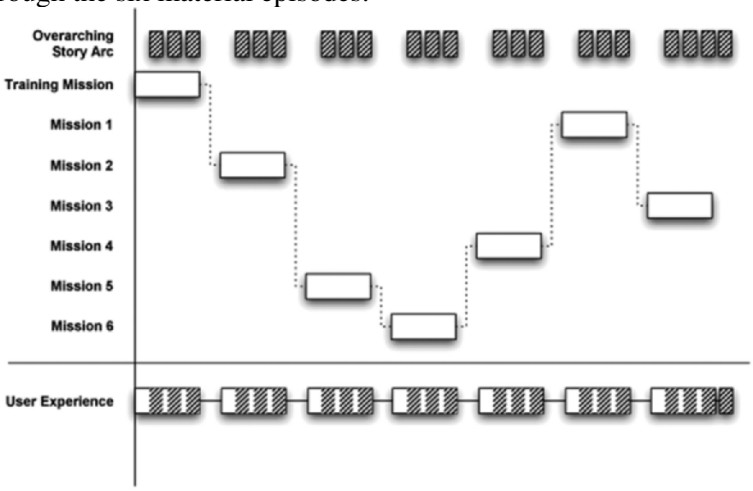


Fig. 6. Users' Structural Experience

Each episode tackles a separate scientific investigation, ranging from the sinking of a container ship to the discovery of a bog body. Within each of these self-contained units, the learner receives information from field agents and staff back at Axon's base. This information comes in video, text, image and activity form and the player is charged with coming to reasoned conclusions. It is important to remember that Axon's primary objective is the development of scientific understanding and skills, so,

while the investigations themselves are fictitious, all of the enclosed science is legitimate.

Within Axon, user activity is superimposed over a defined story. Although many examples of revealing story development exist, what makes Axon interesting is its 'real-time' revelation using a recognisable news-feed approach. As users are engaged in true open-ended missions, they are 'fed' updates on an unfolding storyline involving other members of the game cast. Axon never raises expectations that the main plotline is about the user and therefore does not need to wrench control away at critical events.

McLuhan's 'equation' (McLuhan 1964) helps describe the influence of the presentation of information on the user's understanding: the news feed medium changes the user's comprehension and emotions towards the game characters – the mechanism affects the story being communicated. The apparently random nature of the updates helps instil a sense of presence in a world not entirely controllable by the player and inhabited by autonomous characters. However, these are more than incidental updates in the style of *Championship Manager*, these updates are central to the user's experience.

Although the updates arrive in a fixed sequence, from the user's perspective they come uninitiated. Unlike other narrative forms, Axon does not wait until a successful conclusion of a task before revealing the next instalment of the story. In other words, events outside the player's first-hand experience continue regardless and at a pace that suggests real (or at least 'in game') time. Users receive bespoke feedback and responses for their particular involvement but are engaged bystanders in the drama enveloping protagonists in the narrative. The sequencing of primary story exposition and free user activity can be described as a Comb narrative.

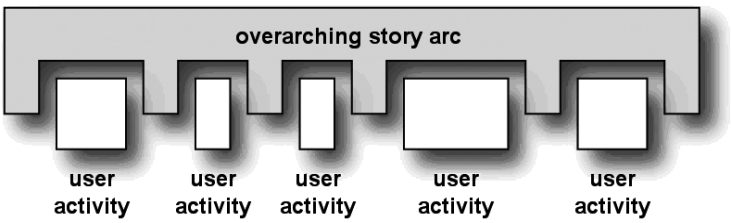


Fig. 7. Comb Narrative

Axon demonstrates that while genuinely interactive narrative, as described in the branching narrative model, is extremely difficult, it is possible to

superimpose 'free exploration' of puzzles over a fixed back-story. This combination of storyline and 'Easter Egg' hunt allows the strategic placing of characters and objects to reveal a predetermined back-story. The activity of the present, in the form of problem solving and investigation, enables the users to discover more about the past. Piecing together bits of 'history' can provide the illusion of interactive storytelling. The gradual unlocking of the puzzles slowly reveals the system rules and draws the player to the game's conclusion. However, the Comb Narrative breaks the user's own activity flow to deliver instalments of the overarching story arc. These interruptions can create discontinuities that undermine the player's suspension of disbelief.

Axon's news feed approach minimises these clumsy storyline interruptions. Rather than stopping player activity at the designer's chosen point in time, Axon simply alerts the user to the arrival of new information. It means that the player decides when, and if at all, he sees the latest update. This integration of uninterrupted activity and narrative can be described as a Mesh Narrative.

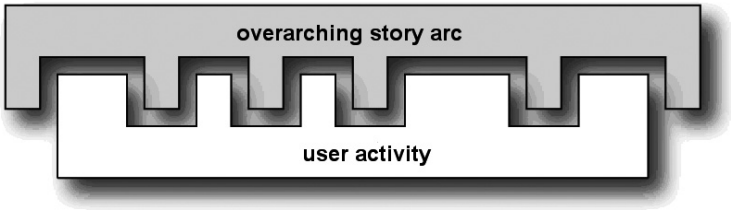


Fig. 8. Mesh Narrative

User engagement occurs by being party to 'secrets' and discoveries made by other cast members. As the user progresses through the activities, so the trust placed in him increases. As the user proves himself 'worthy' of confidences, so the information given becomes more intimate. It engenders the sense of being let in on a secret and privileged society. The narrative structure of Axon reflects the real-world reality of being witness to unfolding events. Moreover, just as is the case in real life, the intimacy with main characters determines the richness and depth of the developing drama. A distant observer will achieve a certain perspective on a situation that is wholly different to a confidant, although the events are the same. This variation in connectedness provides a multitude of outcomes in terms of the user's experience, that is, the closer emotionally one is to events the lower the likelihood of objectivity of witness.

As stated, narrative is more than the various elements of content, it includes the manner of presentation. The representational universe that

Axon constructs does not attempt to recreate a 3D environment for users to explore; rather, it builds a fictive layer on top of plausible events using familiar Web 2.0 mechanisms. This 'real world' interface provides the window into the Axon world. Although apparently contradictory, the decision to avoid rendering an immersive world aims to increase the authenticity of the experience and encourage a sense of meaningful participation. The approach recognises that the target users are technically literate young people at home after a long day at school. The teenage audience is a sophisticated consumer of online media but jaded by its experience of 'educational games'. Rather than attempt to compete with multi-million dollar console and PC games, Axon takes a tangential approach by consciously acknowledging the player's real life environment. Hence, the young teenagers are not being encouraged to play a character 'part', rather they are being recruited as themselves to use and develop their own scientific investigation skills. The learners join an existing team that includes both novice and expert scientists. This mix of personified expertise, with its built-in equalities of understanding, facilitates in-game dialogue which, in turn, provides opportunities for conversational, that is social, learning and scaffolding. The personal role of the user and the unmediated first person perspective on the Axon system interface reinforces the impression that it is the player who is engaged in the game rather than some secondary character.

In addition to the interface design, the style of presentation for story elements affects the credibility of the game with the user. In many games, the unfolding drama occurs in high quality animated cut scenes. Because these scenes can be pre-rendered they enjoy much higher visual acuity than the in-game scenes generated on the fly – they look better than the actual game play and therefore can appear 'outside' the player's experience – they are clearly different. In Axon, however, video is the primary delivery format for both mission information and story. Unlike the wholly animated graphics in most computer games, Axon's video-based drama does not appear incongruous because the video medium and its quality are consistent throughout the experience.

Conclusions

Recalling the definition of narrative, that it is the manner in which an experience is structured and presented, it is clear that a form of narrative exists in computer games of all kinds but there remains a tension between activity and storytelling. This tension manifests itself in both sequencing

and portrayal. In many games, the presentation of dramatic elements completely interrupts play, and while this can prove a respite from exertion, it reinforces the separation between user input and plot outcome. Similarly, the insinuation of the first person perspective is that the player is in control of events, so any break in activity can feel more abrupt. Axon does not mediate activity through an avatar or in-game persona, but 'takes over' the user's screen interface instead and the player plays himself, rather than adopting a fictional character.

There are many models for adding a dramatic storyline to gameplay, choosing the most appropriate depends on the audience, user context, resource objectives and production realities. Axon presents a hybrid of fixed and fluid storylines that give a mix of passive and active engagement. In spite of the meshing lines of existing and emerging narrative, the user is still a passive observer to Sam's fate. This inability to affect the main protagonist's story could create a sense of alienation and impotence if the model raised expectations of influence unrealistically. Instead, Axon highlights the vicarious nature of the player's involvement, letting him in on a secret and indulging in juicy gossip. By separating the user from the drama in this way, Axon provides a compelling context for science learning.

Moreover, Axon focuses on developing conceptual immersion rather than relying on a purely visual approach. Its overriding educational objective of putting science into context uses the attractive drama to engage but relies on real tasks, using plausible software tools and actual science, to communicate the key messages. This real world interface helps make the experience feel more authentic and the learning, therefore, more transferable.

For serious games, where the objective is an improvement in skills, the ability to recognise real-life information from within the fictional story world is crucial to the user's future ability to transfer it into new contexts. Within Axon, the user plays him or herself in the unfolding events and has clear, and plausible, experiments to conduct. Although the resource presents a seamless integration of authored storyline and user activity, it uses established signs to separate fact from fiction. The presentation of the drama unfolding around Sam is largely delivered through a retrospective retelling by Dexter, a typical user's peer. Scientific understanding, however, comes from recognisable experts in the field, and although the organisation has accepted the user as an agent, it does not assume full scientific understanding, so provides support and scaffolding as appropriate.

Axon presents one approach to adding the spice of story to a learning recipe. What it demonstrates is the relationship between activity and drama

is not contradictory but needs careful management and consideration: getting the balance right creates a suitably rich texture for any user's experience and, most importantly for serious gaming, ensures that there is a strong but clearly differentiated structure for learning.

Bibliography

Arnseth, HC (2006) Learning to play or playing to learn – A critical account of the models of communication informing educational research on computer game play. http://gamestudies.org/0601/articles/arnseth

Barthes, R (1993) Image-Music-Text, New edition. Fontana Press, London

Bateman C (2005) Diversity in Game Narrative Only a Game. http://onlyagame.typepad.com/only_a_game/2005/08/diversity_in_ga.html

Elrod C (2007) Games and Storytelling. http://www.pjsattic.com

Gee JP (2003) What Video Games Have to Teach Us about Learning and Literacy. Palgrave Macmillan, New York, p 81

Hertz JC (1997) Joystick Nation. Abacus, London, p 147

Juul J (2001) Games Telling Stories, Game Studies: The international journal of computer game research Volume 1, Issue 1. http://www.gamestudies.org/0101/juul-gts/

Klastrup L (2003) A poetics of virtual worlds. MelbourneDAC 2003 http://hyprtext.rmit.edu.au/dac/papers/Klastrup.pdf

McKee R (1998) Story. Methuen Publishing Ltd, London

McLuhan M (1964) Understanding Media: The extensions of man. Routledge & K Paul, London, p 7

Miller JH (1990) (eds Lentricchia F & McLaughlin T) Narrative in Critical Terms for Literary Study. University of Chicago Press, Chicago, p 77

Rollins A, Morris A (2000) Game Architecture and Design. Coriolis, Scottsdale, p 39

Rouse III, R (1998) Embrace Your Limitations: Cut-Scenes in Computer Games. Computer Graphics Volume 32, Number 4, Gaming and Graphics http://www.paranoidproductions.com/gamingandgraphics/second.html

Salen K, Zimmerman E (2004) Rules of Play: Game Design Fundamentals. MIT Press, Cambridge, Massachusetts

Simons J (2006) Narrative, Games and Theory Game Studies: The international jounal of computer game research Volume 7, Issue 1 http://gamestudies.org/0701/articles/simons

Soulban L (2005) So You Want to Write for Videogames II. http://lucien-soulban.livejournal.com/21284.html

Definition of User Requirements concerning Mobile Learning Games within the mGBL Project

Emanuel Maxl
Astrid Tarkus
evolaris next level Privatstiftung
+43 316/351111
emanuel.maxl@evolaris.net
astrid.tarkus@evolaris.net
http://www.evolaris.net

Abstract

The EU's mobile Game-Based Learning (mGBL) project provides for the development of a platform for developing learning games for mobile phones. A crucial part of the development process consists of gathering user requirements from the target group. Consequently, qualitative and quantitative research studies were conducted in all participating countries (i.e. Austria, Croatia, Italy, Slovenia and the UK), in which experts in specific fields and, in particular, young people (the potential future players) were asked about mobile game-based learning in order to support the pedagogical framework and to establish appropriate game types and applications for the mobile learning platform.

Keywords

User requirements, mobile learning, game-based learning, learning styles, game types, career guidance

Research Background

In the three-year EC-supported mobile Game-Based Learning (mGBL) project, researchers from the five countries Austria, Croatia, Italy, Slovenia and the UK were engaged in creating a platform for the cost and time-efficient development and deployment of mobile learning games.

In general, designing games for mobile phones has great potential for supporting cognitive and socio-affective learning with regard to young adults (Mitchell 2004). An important goal of our games was to enhance young people's decision-making skills in critical situations, especially in the fields of e-health, e-commerce and career guidance services. In order to do this, we integrated Klein's theories about decision-making processes into our game development (Klein 1997). Furthermore, the support of lifelong learning was a key issue taken into account in our study, since game-based learning is proving increasingly attractive as a method to engage people interested in lifelong learning as well as university students (Anton Ellis et al. 2003).

As Seong (2006) points out, learner motivation, learning styles and skills in using mobile technologies have a great impact on the success or failure of mobile learning portals. A user profile (i.e. user characteristics such as computer literacy and levels of experience) is, therefore, an important element in determining user requirements to establish an effective and well designed application (Mayhew 1999). In addition to users, as Galitz (1993) reminds us, applications must be adaptable to take account of varying tasks and environments. However, Wood (1998) explains that user-centred design techniques focus on potential users (including their characteristics, their tasks, and their environment) whose work is to be supported by an application (i.e. [the] functional requirements [of the application] were developed from a user's perspective and are referred to as user requirements). It should be noted that a critical aspect of user-centred design is that it is iterative (emphasis in the original) (1998).

Hence, experts from different fields such as education, mobile business and educational science were interviewed to determine their impressions of user requirements. The game prototypes were iteratively evaluated by groups of end-users consisting of students, pupils, teachers and IT experts. The findings of the research into user requirements form the basis of the design of the mGBL game platform and prototypes.

First Requirements Analysis

Methodology

The main objective was to obtain in-depth knowledge on mobile users' behaviours and expectations in order to identify key success factors for the design and implementation of innovative mobile solutions from an expert's point of view.

In order to do this, 50 experts in the fields of technology, market research, learning and didactics, e-learning, sociology, youth culture, new media, and journalism were consulted from all of the project partner countries. These fields were those considered to be of relevance to mGBL. Respondents were recruited from organisations to which partners had access via their networks of contacts. Recruitment was carried out using a screening questionnaire supplied by the managing partner, evolaris.

The method of semi-structured interviews was chosen due to the advantage of adaptability, in that interviewers are able to follow up and probe responses (Herrmann and Homburg 2000; Gubrium and Holstein 2001). A conversation tool was developed by evolaris, which contained pre-determined but open-ended questions to allow more detailed and extensive responses. The interview focused on audiences' preferences and usage of mobile services and applications, game-based learning in general, successful and unsuccessful learning games, general prognoses of teacher and learner acceptance, as well as marketing and technology perspectives. Further important questions were designed to determine the definition of the target audiences and key enablers in terms of pedagogy and technology, the potential in the pre-determined sectors of e-commerce, e-guidance and e-health and the likely future development of mobile technologies. The interviews were conducted either face-to-face or via Skype and lasted about one and a half hours each.

The study was conducted in March 2006 and the results of all five countries were aggregated into one final report. In addition, the results of an insight workshop that took place in Austria with 14 experts from the fields of advertising, education, marketing and gaming were also integrated into the report.

Results

mGBL Target Audience

The typical user of mobile game-based learning appears to be a teenager with an appropriate mobile phone, i.e. a device which supports the common technologies that are necessary for playing current mobile games. Furthermore, the user likes games and is open-minded towards new technologies, a curious person who likes challenges and collaborative problem-solving activities. He or she is comfortable with mobile technology, but is neither a heavy user nor user of basic voice services only. Furthermore, members of the target group appreciate social events and generally enjoy playing with their friends.

Success Factors

The mobile learning games have to meet players' needs, which are fun, excitement, respect, challenge, feedback, social experiences, allegiance and enhanced knowledge. It is essential, therefore, that game titles and descriptions avoid using the word 'learning', as this term is perceived to be incompatible with the concept of fun games. Consequently, any learning should be implicit, and involve tacit and ambient learning only.

Feedback should be easily and quickly available, to help users to realise the value of their gaming skills. mGBL games should reward users, for example, by giving them the feeling that they have gained new information or approval in their peer group.

Experts also mentioned the importance of offering a social experience, and users should be given an opportunity to play in communities. As mobile phones can be used to play multiplayer games, it was suggested that collaborative and competitive options could be offered as part of the games. A crucial aspect in this regard is the simulation of real-life communication. A convergence platform – a system combining the game world and real life based on different technologies – was recommended, and also the links to external (learning) resources should be allocated.

Although challenge and competition were viewed as key motivational drivers, users should not be frustrated by being 'knocked out' too early in the game. Playful competition within peer groups appears likely to increase interest.

In the literature about learning games (Prensky 2001; Fabricatore 2000) it is strongly emphasised that educational games have to be entertaining and 'real' – experts interviewed for the mGBL project also pointed that

out. Game flow should be thrilling, dynamic and fast, as well as offering excitement and fun. This can be achieved through the incorporation of an element of peril, time constraints and quick reactions. User-specific language (i.e. teenage 'jargon') should be adopted to meet the target groups' needs. Users should also be able to personalise the games.

Experts also recommended that games should be comprised of short, self-contained units that can be completed in short time periods, so that users can play each unit while waiting for the bus, for example.

Another factor identified was cost, and the experts proposed that the provider offered compensation for costs (e.g. free minutes) when users play the game, or that they guaranteed cost-free gaming.

Basic Conditions and Requirements

The basic conditions and requirements that were identified from the research are shown in the table below.

Condition	Requirements
Ubiquity	Mobile phones are available any time, any place. They offer quick and easy access
Context-sensitivity	Reminders of personalised settings should be included in the game
Location-based services	Location-based use within the context of real time/reality makes mGBL unique. Context-sensitivity is possible
Mobile devices	Devices should be obstacle-free. They should have a battery that is sufficient for gaming, and include all necessary features such as portability and connectivity
Accessibility	Most young people own a mobile phone
Simplicity	The games should focus on core information and avoid information that is irrelevant. The interface should be simple and easy to use
Full functionality	Full functionality of mobile phones means devices that can use photo, video, audio and text. A combination of audio and video is crucial
Usability focus	Games should have an appealing interface and be easy to use. They should also be attractively designed
Continuous information flow	The target audience needs to be kept informed about game developments in an appropriate manner (e.g. via 'guerrilla marketing'). Viral campaigns give the impression of the voluntary participation of the target audience, rather than

	having information forced on them. Furthermore, the importance of presentations in locations which are close to the lifestyle of the target audience should be exploited (e.g. clubs, schools and so on)
Customised content	Teachers should be able to customise the content based on their educational requirements
Convey procedural knowledge	The emphasis should be on conveying procedural knowledge (i.e. problem-solving skills) rather than declarative knowledge (i.e. facts and objects)

Table 1. Basic conditions and requirements

Potential Application Areas: e-Health, e-Commerce and Guidance

The following table indicates target groups and the possible content of potential applications in the fields of e-health, e-commerce and guidance.

	e-Health	e-Commerce	Career guidance
Target group	Everyone/of all ages High school students/health care students Health-care workers/medical and ancillary workers Retired people Sick persons	Older than the usual target groups Economy students/ MBA students/pupils or students from commercial and business schools Adults: brokers/managers/ people in e-business	Adolescents age 12-20 facing a vocational or educational choice Adults with an interest in further education Elementary school pupils, high school pupils, students, unemployed people
Possible content	Treatment of diseases/health advice Prevention/lifestyle/ personal trainer/ fitness First aid course	How to save money Simulation of the stock market Information about security in e-commerce and how to deal with it	To make clear the 'tree' of choices, general information General

	Sex education/ Contraception Anatomy Healthy nutrition advice Weight/smoking check Drugs/addiction in general How to best use health services e.g. a trip through the human body as a red blood cell encountering white blood cells or the heart (possible integration of community into the game)	Pocket money – plans as to how much one can spend in a month e.g. expenses and budget of students Business communication: negotiation, player in manager position Shop simulation: A simulation to open own shop: The player decides about products, price of products and offers, personal management, financing etc.	information, first-hand information regarding occupational fields and relevant links to guidance centres Presentation of schools and teachers Small tests to detect personal skills/abilities Help with looking for an apartment Simulation game or role-playing: player opts for job, simulation of interviews or simulation of careers Provides additional support, does not replace face-to-face guidance talk

Table 2. Potential application areas: e-health, e-commerce and guidance

Subsequent Requirements Analysis

Methodology

The findings of the interviews with the experts were used to develop an online questionnaire to obtain quantitative data from our target audience of

young people. Participants were recruited using a screening questionnaire in all countries, with the goal of consulting a total of at least 150 (i.e. 30 from each of the 5 countries) people (i.e. employees, students and pupils), with equal numbers of males and females, aged between 16 and 24. The screening questionnaire was used to identify young people according to specific characteristics: they had to spend a certain amount of time on the Internet; they had to play games; and they had to use more than the typical mobile phone options such as voice-calls, SMS or photos. These participation criteria were guaranteed by a screening questionnaire which was conducted in each country.

The questionnaire was developed collaboratively by all five partner countries. The method of web-based questionnaires (Theobald et al. 2003; Broda 2006) was chosen because it offered the most effective means of accessing the target group. The young people were asked about their needs concerning mobile learning games and the e-career guidance game in particular. Young participants were asked to state which kind of career guidance information they would find appealing and the ways in which they would like to get this information. Furthermore, we were interested in the skills that young people would like to acquire, such as skills in communication, applied numeracy, applied design and creativity, task management and problem solving, for example. Another important topic covered by the survey was the integration of real-world elements into games. The target group was also asked to indicate their level of interest in different types of games, such as knowledge quizzes, simulations or strategy games, and so on, and for which purpose they would use such games – as exam revision, as a complement to existing real-world courses, or for the purpose of individual, independent learning. In addition, the target group was asked about their willingness to use technologies such as SMS or MMS and about their preferred registration process.

The survey was completed in April 2007, and, ultimately, 169 young people of the target group completed the questionnaire. The data revealed interesting differences between countries, gender, age and occupation.

Results

The following sections present a summary of the most relevant results concerning motivation to play mobile learning games in general; the application to career guidance; possible content; learning styles, situations and types; and the attitude towards costs and registration conditions.

The findings were also analysed by social characteristics of gender, country, occupation and age group. These characteristics are presented in

the tables below. Frequencies of less than 20 respondents are marked with an asterisk, and analysis using these data should be interpreted very carefully due to the small number of cases.

Social Demographics

Gender:

Female	106
Male	63

Country:

Croatia	23
Italy	19*
Slovenia	32
Austria	62
UK	33

Occupation:

Secondary School	23
Students	131
Employees	15*

Age group:

16 to 18 years	16*
19 to 24 years	153

Playing Mobile Learning Games

Seventy-four per cent of all respondents would play mobile learning games. This was especially true in the UK and Slovenia, where mobile learning games were seen as very popular, with more than 90% of the respondents indicating a willingness to play learning games. In Austria, young people were less enthusiastic about mobile learning games, with only 53% saying that they would play them.

Content, Styles and Situation concerning Mobile Learning Games

Sixty per cent of young people were interested in developing communication skills, but only 11% were interested in applied numeracy. The average proportion of participants who expressed an interest in managing and developing themselves was 53%, with Austrian participants displaying an above-average interest of 72%.

Gendered interest in different skills was similarly distributed, with one exception: twice as many male participants (43%) were interested in applied technology skills compared to females (21%). Pupils were more interested than students and employees in communication skills and less in 'managing and developing themselves' or in 'applied design and creativity'.

More than the half of the young people favoured a combination of real people in a real world and game characters in a virtual world – especially the younger group in the 16 to 18 age group, and participants from the UK, with both groups approaching 70%.

Seventy-two per cent of respondents indicated that they would use mobile learning games for independent learning, simply because they were more interested in the subject. Female respondents (81%) were more interested in mobile learning games for independent learning than male (58%).

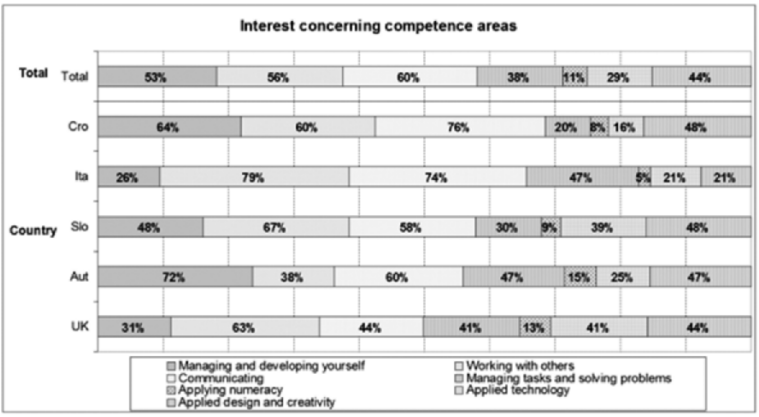


Fig. 1. <Interest with regard to skills areas>

Preferred Game Types

The most popular learning types are games that use multimedia elements combining photo, video and/or audio. Also popular are customisable games and games involving a number of short sessions. Strategy and simulation games were also rated as likeable.

Female respondents preferred quiz games, whereas all types of other games (i.e. strategy games, real-world team games, and turn-based games) were favoured by male participants.

Croatian participants especially liked knowledge quiz games, whereas respondents from the UK preferred strategy games. Knowledge, strategy and customisable games are favoured among the Italians, while Slovenians found knowledge quiz games, real-world team games and games with multimedia elements very interesting.

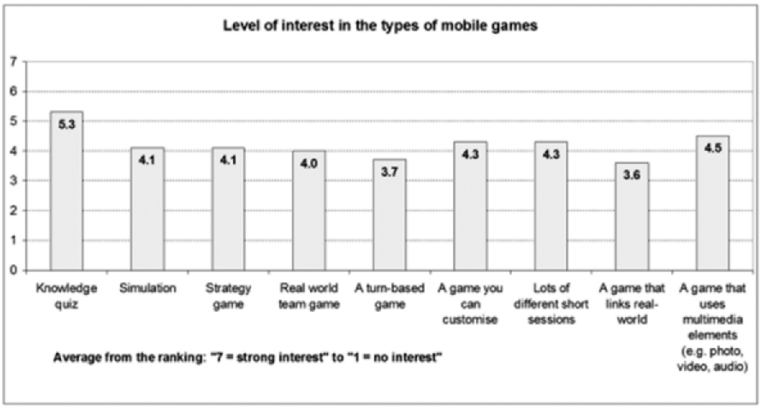


Fig. 2. <Level of interest in types of mobile games>

Costs, Organisation and Registration

Cost plays an important role for 62% of young people. The majority was not willing to pay for SMS (57%) or MMS (76%). However, 39% were prepared to pay for 1 to 5 SMS messages per game and 26% for the same number of MMS messages. In general, fewer people were willing to pay for MMS than SMS. Users were asked how many characters they would be prepared to type per message and 39% of respondents would type up to 50 characters and 25% would be willing to type up to 100. Austrians would type the least, Croatians the most.

Of the different methods of registration available for mobile games, almost all respondents would like to use the Internet browser of their computer or send an SMS message to register for a mobile game, with roughly half of the respondents preferring either option. However, 21% of Italian participants favoured the browser of their mobile for registration, whereas the total average was 4%. Italian respondents (68%) and those from the UK (69%) would choose the computer browser, while approximately two-thirds of Croatians (64%) and Slovenians (61%) would prefer to register via SMS.

The male participants, the age group 16 to 18, employees and pupils would like to use the computer browser, while female participants and students preferred an SMS registration.

Mobile Learning Games in the Area of Career Guidance

Ninety per cent of the participants stated that they needed some sort of career guidance, which we considered to be a strong demand for career guidance.

In Croatia, the majority preferred seeking careers guidance from their tutor, while visiting a guidance centre was more popular in Slovenia and Austria. The data showed a difference in approach for men and women, with female respondents more interested in studying or gaining work experience abroad than their male counterparts. Half of the respondents in the 16 to 18 age group wanted to clarify what study options were suitable for them. They were, however, less interested than the 19 to 24 age group in setting goals and defining steps to achieve them, or in working and/or studying abroad.

Although, overall, 12% of respondents said that they would prioritise using mobile games for obtaining career guidance, more participants in the younger age group preferred mobile games for career guidance than the older participants (i.e. 25% of the 16 to 18 age group and 11% of the 19 to 24-year-olds). More than twice as many people from secondary school would play a mobile game based on career guidance compared to employees or students.

Conclusion

The results of the interviews with the experts and the online questionnaire completed by the target group complemented desk research to create a pedagogical framework and, in particular, support the iterative development of content and the game set-up. User requirements will affect the overall development process of the mobile game platform and the mobile game prototypes. Specific tests were conducted at specific stages of the development process to assure the quality of the target group. The most important points for establishing the pedagogical framework with regard to user requirements are:

- Young adults' preferred mobile technology is the mobile phone
- The preferred use of a mobile phone is as a phone and the preferred application is SMS, largely for communication with friends

- In the main, young men enjoyed mobile gaming to pass the time ‘when their mates aren’t texting’
- The use of camera phones and MMS is increasing; cost, however, remains an issue
- The literature indicates a huge need generally for financial literacy, for advice on health aspects and for guidance on career choices. There are also signs of the potential success of mobile game-based learning in these sectors, especially where games are integrated into existing programmes
- An educational game will not work unless it is a real game first and foremost
- Our research shows that knowledge-testing games would be useful. Also, that simulation games could be used to support flexible access to experiences otherwise difficult to achieve
- There is strong potential for games that use a mix of technologies and which are playable on multiple devices and multiple platforms
- There is a trend towards collaborative games, with scope for networked games that use social software

References

Antonellis I, Bouras C, Poulopoulos V (2003) Game Based Learning for Mobile Users. Available at: http://www.stanford.edu/~antonell/papers/Antonellis_CGAIMS2005.pdf [accessed 15 April 2008]

Broda S (2006) Marktforschungs-praxis: Konzepte, Methoden, Erfahrungen. Gabler Verlag, Wiesbaden

Fabricatore C (2000) Learning and videogames: An unexploited synergy. Available at: http://www.learndev.org/dl/FabricatoreAECT2000.PDF [accessed 15 April 2008]

Galitz WO (1993) User-Interface Screen Design. John Wiley & Sons, New York. Cited by Bonner JVH (1998) Towards consumer product interface design guidelines. In Stanton N (ed) (1998) Human Factors in Consumer Products. CRC Press, London

Gubrium J, Holstein J (2001) Handbook of Interview Research: Context and Method. SAGE, London

Herrmann A, Homburg C (2000) Marktforschung. Gabler Verlag, Wiesbaden

Klein G (1997) The Recognition-Primed Decision (RPD) Model: Looking Back, Looking Forward. In: Zsambok C, Klein G (1997) Naturalistic Decision Making. Lawrence Erlaum, Mahawah, NJ

Mayhew D (1999) The Usability Engineering Lifecycle: A Practitioner’s Handbook for User Interface Design. Morgan Kaufmann, San Francisco

Mitchell A (2004) Exploring the potential of a games-oriented implementation for m-Portal. Learning with mobile devices. LSDA, London

Prensky M (2001) Digital Game-based Learning. McGraw Hill, New York

Seong D (2006) Usability Guidelines for Designing Mobile Learning Portals. In: 3rd International Conference on Mobile Technology, Applications and Systems – Mobility 2006. ACM, Bangkok

Theobald A, Dreyer M, Starsetzki T (2003) Online Marktforschung. Gabler Verlag, Wiesbaden

Wood L (1997) User Interface Design: Bridging the Gap from User Requirements to Design. CRC Press Inc, Boca Raton, Florida

Rapid Prototyping and Usability Problem Identification Using Low and High-Fidelity Prototypes

Andrei Parvu
Ausbildingsberatung
0316 / 689310
andrei.parvu@ausbildungsberatung.at

Dr James Kadirire
Anglia Ruskin University
0845 196 2896
james.kadirire@anglia.ac.uk

Abstract

This research was about the design of educational games using rapid prototyping, for mobile devices. Designing content, games included, for mobile devices is a very difficult task because of the limited resources, like the screen size, memory, processor speed, and so on, but this research has shown that using low as well as high-fidelity prototyping techniques, games on mobile devices can be quickly designed and tested using paper-based designs as well as simulation tools based on Adobe Flash (formerly Macromedia Flash), represented mainly as graphics to convey the scenario being enacted in the game.

Keywords

Mobile games, prototyping, graphics, Adobe Flash, m-learning

Introduction

This research formed part of the mobile Games-Based Learning project (mGBL) (mGBL 2008). The goal of the project is the development of a platform for the presentation of educational content in a playful and emotional way (i.e. game-based), on mobile devices. The overall goal of the project was to improve the effectiveness and efficiency of learning in the target group of young people through the development of innovative learning models based on mobile games. The objective of this research, within the mGBL project, was to design and develop games for mobile devices based on graphics rather than words, using rapid prototyping. Mitchell (2004) posits that games for mobile phones have great potential for supporting cognitive and socio-affective learning (i.e. learning relating to moods, feelings and attitudes). Playing games can also support valuable skill development in strategic thinking, planning, communication, application of numbers, negotiating skills, group decision-making and data-handling (Kirriemuir, McFarlane 2004; Kadirire 2009).

We set out to identify which type of game was more effective for the target users that consisted mainly of undergraduate students, as well as a small group of academics. We decided to produce a number of prototype games for use in user trials. There are essentially two types of prototyping: low-fidelity prototyping and high-fidelity prototyping. According to the Usability First website, a low-fidelity prototype is 'a proto-type that is sketchy and incomplete, that has some characteristics of the target product but is otherwise simple, usually in order to quickly produce the prototype and test broad concepts' (Foraker Design 2005a). A high-fidelity prototype is defined as 'a prototype that is quite close to the final product, with lots of detail and functionality. [From a user testing point of view,] a high-fidelity prototype is close enough to a final product to be able to examine usability questions in detail and make strong conclusions about how behaviour will relate to use of the final product' (Foraker Design 2005b).

Rapid (i.e. low-fidelity) prototyping allows developers to quickly build a working model of their concept without allocating too many resources early in a project, and a decision can be made as to whether or not the project is viable after a short period of time. It was decided to use rapid prototyping from the outset of the project, as it is much cheaper to change a product early in the development process than to make changes after you program the site. A prototype is often the best way to gather feedback from users while you are still planning and designing your product. It is a quick way to find out if you are on the right track with your plans and design (US DHHS, online). In addition, as Nielson (2003) explains, prototyping

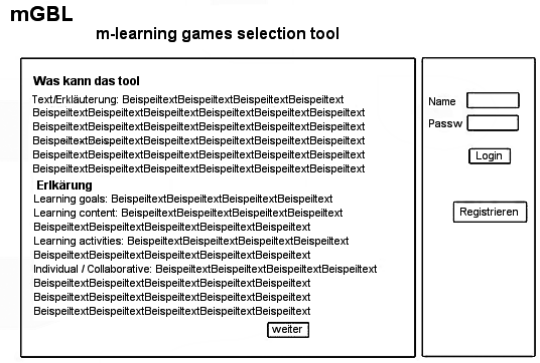
has ‘Ten times the impact if you discover a needed design change early, and [it is] 100 times cheaper to make the change’ (2003 online).

Methodology

M-Learning Games Selection Tool

A low fidelity m-learning games selection tool was developed to enable users that are not familiar with games to find the relevant games they need with relative ease. Once the essential features of the m-learning games selection tool were decided, it was necessary to design and develop a database that could contain the games. Each game required a description to facilitate searching of the database. The system users would also be able to find out what learning content, learning goals and learning activities were supported by these games. In addition, it was decided that both the number of players and the learning situations supported by the games were very important features. These considerations influenced the design of the first version of the user interface. This low-fidelity prototype of the game selection tool showed how it would work, what possibilities it would have, and it enabled feedback to be obtained fairly quickly from the users and developers of the game. An example of the m-learning games selection tool is illustrated in Figures 1 and 2 below. (NB ‘Was kann das Tool’: ‘What does the tool do?’; ‘Beispieltext’: ‘Game Text’; ‘Erklärung’: ‘Explanation’; ‘Lerning’: ‘Learning’; ‘Registrieren’ = ‘Register’)

Fig. 1. An illustration of the login screen of the m-learning games selection tool



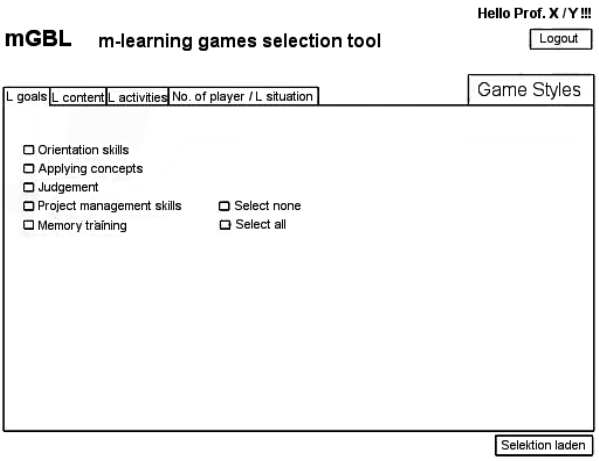


Fig. 2. An illustration of the game styles of the m-learning games selection tool, after the user has logged in

Interactive Prototype of the M-Learning Games Selection Tool Using Microsoft Excel

The next level of prototyping development was the design of an interactive prototype using Microsoft Excel. This tool provided the opportunity to see what was possible and at the same time provided a location to collect information about the many kinds of games that existed. The games were categorised and marked with descriptions and comments. This was the basis of the development of the final version of the m-learning games selection tool (see Mitchell 2007). After designing and implementing the m-learning games selection tool, we then proceeded to test whether the discussed ideas and concepts were practicable.

Once the game contents that were suitable for the learning goals had been developed, graphics were designed for the various games scenarios. The graphics that were created allowed the players to imagine what the topic was about, giving the users a higher-level game experience. It was also much easier to explain a topic using graphics than words, especially when all that was available was the screen on a mobile phone.

On the Edge Game Design Using Adobe Flash

On the Edge was an early prototype game developed for Game Template 2 (see elsewhere in this publication) and was based on the principles of the board game, *Monopoly*, but was extended and adapted to fit our objectives. It was an iterative process of creating a game concept that would be fun, engaging and provide an intrinsically motivating instructional environment. According to Malone and Lepper (1987), there is a relationship between learning and intrinsic motivation. As it was unclear whether the game concept would work on the small screen of a mobile phone, it was decided to create an interactive prototype that would show not only the possibilities, but also the limitations of the game.

Consequently, a small phone simulation tool was designed and developed using Adobe Flash (see Figure 3), which was designed to be played on a PC. This made it possible to make rapid changes, and to test the new version with users of the system. It was crucial at this stage to have a working prototype of the game, as it showed the most important problems that players would have if implementation went ahead.

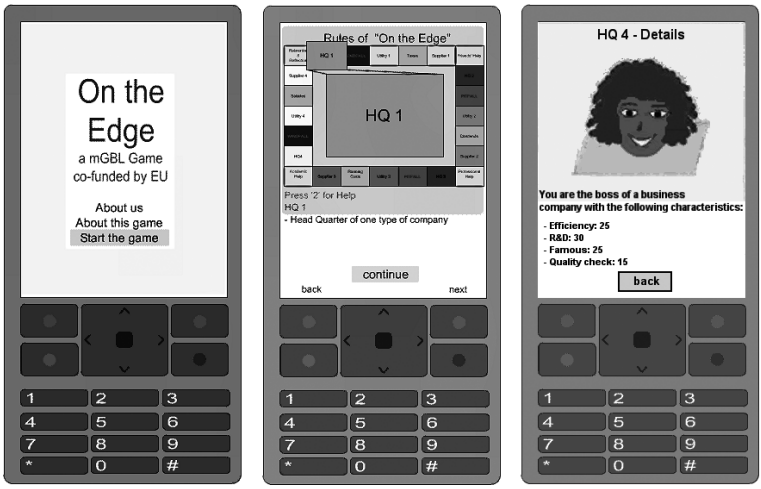


Fig. 3. Screen grabs from the Adobe Flash simulation tool for *On the Edge*

User trials of the *On the Edge* design interface showed, for example, that an alternative display method was required, as the player could not see the board properly because of the small size of the mobile phone display. It was also possible to check how understandable the concept was. An

important issue that arose was that the game was too much like *Monopoly* and users identified it as 'one more *Monopoly*-style game'. Another important finding was that the game was too simple and not funny or engaging enough for the users. The Adobe Flash simulation tool provided the opportunity to show the concept of the game to users and to see their reaction while playing it. As the programmers had not written any code, it was possible to avoid mistakes in the concept. User feedback about the user interface of the game helped to identify important usability problems, and it was possible to correct the game concept before the programmers had begun their work.

Crisis! Game Design Using Adobe Flash

Table 1 contains text descriptions of the various scenarios for the game *Crisis!*, which needed to be interpreted or represented by graphics only.

Table 1: Developing scenarios for *Crisis!*

4 cases (accident victims)	Stage 1	Stage 2	Stage 3	Stage 4
Case A	Young man lies twitching on the ground.	Young man is now lying motionless on the ground, barely breathing.	Young man is now quite motionless on the ground; no apparent breathing.	Young man is quite motionless on the ground; face is grey.
Case B	Boy is sitting on the ground, holding his foot and crying in pain.	Boy is rolling about on the ground, holding his foot and crying, clearly in pain.	Young boy is crunched up on the ground, holding his foot. He is now silent, but is looking round anxiously.	Young boy is crunched up, holding his foot. Silent but looking anxious.
Case C	Pregnant woman is staggering about in distress.	Pregnant woman is now sitting, quietly sobbing.	Pregnant woman is sitting, phoning someone on her mobile.	Pregnant woman is sitting, phoning someone on her mobile.
Case D	Old man is slumped in driving seat of his car, moaning, with some slight bleeding from his upper arm.	Old man, now bleeding heavily, is getting out of the car.	Old man is still bleeding heavily. Is now sitting against the car, looking very white, with closed eyes and moaning.	Old man is still bleeding heavily. Is now sitting against the car, looking very white, with closed eyes and moaning.

Fig. 4. Graphical representation of 'Case B, Stage 2' in Table 1

Fig. 5. Graphical representation of 'Case D, Stage 2' in Table 1

Figure 4 shows an image of 'Case B, Stage 2' (i.e. Boy is rolling about on the ground, holding his foot and crying, clearly in pain), for example, and Figure 5 shows an image of 'Case D, Stage 2' (i.e. Old man, now bleeding heavily, is getting out of the car) in Table 1. As low-fidelity graphics such as these were implemented in the games used for the user trials, it was possible to develop hi-fidelity graphics in later developments based on user feedback.

Discussion and Conclusions

Although rapid prototyping allows designs to be implemented and tested within a very short space of time and with little consumption of programmers' resources, designing content for very small screens like those on mobile phones still remains a challenge. When content is being adapted for less resource-intensive forms, like mobile phones, it is often the case that the information content of the items is reduced and therefore needs to be accounted for (Kadirire 2005). A good example of this is that images or graphics can only be shrunk so far before they become of no use (Scott 2003). The use of rapid prototyping made the whole process of designing games for mobile phones easier and with a quick turnaround, without making too many serious design errors and using programmers' coding time unnecessarily. Even when the content and graphics for the games is designed well to fit the small devices, as was evident with *On the Edge*, it is still a difficult task to meet users' expectations, as they want an experience comparable to commercially available games on bigger screen devices.

Designing games is a creative development process that also includes creating pictures and graphics. A game design, particularly on mobile phones, is a challenging activity that requires skill. The enjoyment of the player will increase when the action required of the player matches his or her skill level (Järvinen 2002). The player's skill will develop in relation to his or her ability to learn the fundamentals of the game play. The games we designed and trialled in this project only tap into a small part of the huge potential of games-based learning, but the methods of rapid prototyping proved to be invaluable in realising our goals.

References

Foraker Design (2005a) Usability Glossary: Low-fidelity prototype, in usability first. Available at: http://www.usabilityfirst.com/glossary/term_378.txl [accessed 19 October 2008]

Foraker Design (2005b) Usability Glossary: High-fidelity prototype, in usability first. Available at: http://www.usabilityfirst.com/glossary/main.cgi?function=display_term&term_id=377 [accessed 19 October 2008]

Järvinen A (2002) The Elements of Simulation in Digital Games. System, representation and interface in Grand Theft Auto: Vice City. Retrieved October 31, 2008, from http://www.brown.edu/Research/dichtung-digital/2003/issue/4/jaervinen/index.htm

Kadirire J (2005) Learning with Mobile Devices – A Microportal Design Experience. In: Recent Research Developments in Learning Technologies (2005) Volume 2, pp 792-797

Kadirire J (2009) Mobile Learning Demystified. In: RH Guy (ed), The Evolution of Mobile Teaching and Learning. Informing Science Press, http://informingscience.org/ (In press)

Kirriemuir J, McFarlane A (2004) Literature Review in Games and Learning. Nesta Futurelab series, Bristol, report 8

Malone TW, Lepper MR (1987) Making learning fun: A taxonomic model of intrinsic motivations for learning. In: Aptitude, Learning, and Instruction: III. Conative and Affective Process Analysis (eds RE Snow & MJ Farr), Erlbaum, Hillsdale, NJ, pp 223-253

mGBL (2008) Mobile games-based learning. Available at: http://www.mg-bl.com/ [accessed 24 June 2008]

Mitchell A (2004) Exploring the potential of a games-oriented implementation for m-Portal. Learning with mobile devices, pp 105-116), LSDA London

Mitchell A (2007) mGBL D3.2 Report: Software tool for supporting the selection of m-learning games. Available at: 193.72.209.176/forms/document.asp?Q=9086&T=DocAuthors [accessed 3 November 2008]

Nielsen J (2003) Paper Prototyping: Getting User Data Before You Code. Available at: http://www.useit.com/alertbox/20030414.html [accessed 5 July 2008]

Scott SD (2003) Edge-based Algorithms for Determining How Far an Image Can be Shrunk. Proceedings of IEEE's International Conference on Robotics, Vision, Information and Signal Processing (ROVISP), 2003

US Department of Health & Human Services (undated) Prototyping. In: Usability.gov. Available at: http://www.usability.gov/design/prototyping.html#why [accessed 28 May 2008]

Learning from mGBL – Cross Border Legal Implications for the Development of Games for Mobile Phones and Handheld Devices

Markus Fallenböck
evolaris privatstiftung
+43 316 351111
office@evolaris.net

Ivana Ilijasic Misic
Faculty of Arts and Sciences, University of Rijeka, Croatia
+ 385 99 2116585
iilijasic@ffri.hr

Harald Krassnigg
evolaris privatstiftung
+43 316 351111
office@evolaris.net

Alice Mitchell
INSPIRE
Anglia Ruskin University

Abstract

The paper identifies the implications of cross border legal considerations, both for the project itself and for subsequent users of the project outcomes, and how these considerations informed the decisions taken by the project team. The paper covers all the legal aspects related to e-Commerce and m-Commerce European law in the context of mobile phones and handheld devices, and identifies key issues regarding the non-EU partner – Croatia.

We begin with a general overview of legal issues, develop checklists for terms and conditions and Service Level Agreements and provide legal recommendations and tips for the game provider.

Keywords

Mobile phones, handheld devices, legal implications, e-commerce, m-commerce

1 Overview, Key Legal Issues

These include issues of copyright, gaming law and data protection.

1.1 Copyright

The provider of mobile game-based learning necessarily uses different content from different sources, and will use logos and pictures, graphics and other material from third parties that might be protected under copyright law. Copyright laws of EU states usually have an exception for the use of copyrighted material for education purposes. However, these exceptions are narrow and apply mostly to non-digital copying. Therefore, the issue of exploitation rights concerning the content used in the games has to be carefully considered (Ciresa 2006).

In order to find out what kind of exploitation rights are involved, it is necessary to consider two issues: a) the kind of software being offered as a game; and b) the particular business model that the supplier chooses to use to offer the game.

1.2 Rights That Have to Be Acquired

If offering excerpts of software according to Sec 2 (1) No 2 CA (US Copyright Office 2008), as in the mGBL project, various kinds of exploitation rights may be involved. In relation to the complete composition, including texts and instrumental music, the melody, as a single but characteristic element thereof, is also protected by Sec 2 (1) No 2 CA. Under German law, even short excerpts of 5 to 15 seconds of a musical work are protected by copyright law, if the particular excerpt is a characteristic one (Delp 2003).

For all kinds of business models offering gaming software, the supplier needs the reproduction right according to Sec 16 CA in order to electronically reproduce the game, save the game on a data carrier and copy it to the internal storage of the handheld device. The need to acquire further exploitation rights depends on the way the games are being

marketed. If, for example, the supplier offers the games on the Internet, the right to make them available to the public according to Sec 19a CA has to be acquired. If, however, the supplier offers them on a CD-ROM, it is necessary to acquire the distribution right defined under Sec 17 CA (Bechtold 2002).

1.3 Exception for the Use of Copyrighted Material for Education Purposes

Apart from acquiring the exploitation rights – which might be expensive and sometimes impossible – there is an important exception that is relevant to mGBL.

The EU INFOSOC-Directive grants a free reproduction right for some internal non-profit uses taking place in LAMS establishments (Libraries, Archives, Schools, non-profit establishments privileged from the aspect of some free uses), such as publicly accessible libraries, educational establishments operating pursuant to government accreditation, museums, and archives (including the future national audiovisual archive), which are not for direct or indirect economic or commercial advantage.

The same establishments will enjoy the right of free communication and the right to make available, for non-profit purposes, the works contained in their collection via dedicated terminals for individual members of the public on their premises for the purpose of research or private study of the affected rights-owners unless otherwise provided by a licensing agreement. However, members of the public must not be able to make permanent copies by getting access to the works (European Parliament 2001).

Article 5 (3) n) INFOSOC-Directive (European Parliament 2001) provides for a non-obligatory ('may'-type) exception from the exclusive right of communication to the public and/or public performance for a clearly determined scope.

1.4 Communication to the Public Element

Each intranet work belonging to the same category of LAMS-establishments in a country could be interconnected, the result being that a copy contained in the collection of a single establishment can be made available to the members of the public on request using the dedicated terminal on the premises of any other establishment of the same category (e.g. a copy of the work owned by one library could be made available only to the terminals set up in any other library in the same country).

Each intranet work of any LAMS-category establishment can be interconnected, the result being that a copy contained in the collection of any establishment of any LAMS-category can be made available to the members of the public on request using the dedicated terminal on the premises of any other establishment of any category (e.g. the content of a musical CD or literary CD-ROM owned by any library of the country can be made available in any university or museum of that country and vice versa) (Internet4Jurists, undated (online)).

It is questionable whether – under the rules on national treatment – the second interpretation as accepted by the legislator can be extended to all foreign LAMS-establishments (and foreign rights owners) as well (free use can be limited to domestic works).

1.5 Works or Subject-Matter Not Subject to Purchase or Licensing Terms

According to a relevant interpretation of EU Copyright Law the language of the INFOSOC-Directive means that this exception applies in cases only where the original copy of the work is not available in regular commercial channels (Handig 2003).

1.6 Free Use for Illustration, Teaching and Research

The implication of Article 5 (3) a) INFOSOC-Directive on free use for teaching or scientific purposes resulted in the abolition of free reproduction and distribution of shorter musical and literary works for educational purposes if it is for 'commercial purposes' (Warbek 2003).

1.7 Gaming Law

Another related issue is gaming law, which is especially stringent when it involves minors. There should be no problem for the mGBL games, as they are in the form of quizzes and computer games where the result depends solely on the knowledge and skills of the user and not on some 'aleatory element' (Schwartz and Wohlfahrt 2006). Moreover, there is no 'gaming stake' that the user brings in. However, in many EU countries even charges for mobile premium services constitute such a stake that makes certain mobile services a game of chance.

However, since the aim is to make the games available without charge, even via premium numbers, gaming law is not applicable (Hasberger 2003).

1.8 Data Protection

Whenever personalised data are collected or data (e.g. phone numbers) are used to provide commercial information the games also have to comply with the data protection law of EU countries. This especially applies to the provisions of the EU Data Protection Directives 2002/58/EC (European Parliament 2002) and 95/46/EC (European Parliament 1995) and respective local laws that implement these Directives.

It is necessary that the collected data are only used to administer the player database. The data must not be used for commercial purposes, such as advertising on the mobile phone, without the player's consent. Taking into account that the users are young people, the question of advertising should be handled with the greatest diligence (Knyrim 2003).

1.9 Youth Protection Law

This report can only refer to youth protection aspects that might be involved by offering content via or for mobile handhelds. In Germany, for example, the youth protection rules of the *Inter-State Treaty on Youth Protection in the Media* (Bundestag 2002) apply to mobile gaming. Since mGBL content is available via an on-demand offer, youth protection aspects in particular can be implemented by installing special age verification systems.

2 Overview of Potential Legal Issues in Croatia

Since Croatia has adjusted most of its laws to European legislation, potential legal issues in Croatia are not much different to those in other EU countries. The most prominent legal issues for m-learning (learning facilitated via personal and portable technologies), such as copyright and protection of personal data, are outlined below, with particular reference to three laws that may serve as fundamental rules when applying to mobile games in Croatia (i.e. Cybercrime Law, Copyright Law and Personal Data Protection Law).

2.1 Transmission

The security of data being sent to or received from a device:

- Data: whether or not the data on a device is encrypted and well protected
- Physical security: the security of the device itself against loss, theft, damage and so forth, and also the security of information in the presence of other mobile devices

2.2 Laws Relating to Cybercrime

Croatia has signed the Convention on Cybercrime (Council of Europe, 2001), along with 38 other EU and non-EU countries. Elements of the Convention are incorporated in the Criminal Law [Kazneni zakon] of Croatia. Besides the Convention, there are several laws in Croatia whose articles can relate to mobile games. Two of these are:

- Copyright Law [Zakon o autorskom pravu i srodnim pravima, NN 167/03], which protects different material that may be used in mobile games
- Personal Data Protection Law [Zakon o zaštiti osobnih podataka, NN 103/03], which states that any personal data must be protected and used solely with players' agreement

2.3 Protection of Minors

Special attention must be given to the protection of minors.

3. Terms and Conditions for the Games, General Information and Service Level Agreement (SLA)

3.1 Introduction

The games software is located on a server, which in future can be operated by a provider in an outsourcing situation. Games based on the game templates 'Ahead of the Game' and 'MOGABAL' can be downloaded by the user via Wireless Application Protocol (WAP) to his or her mobile device, to play the game locally and thereby offline. The server will

subsequently only be used for SMS purposes, for example, whenever it receives a demand in respect of ranking, user feedback or upload of results.

A User Contract is necessary that describes the terms on which users may access and use mGBL services.

Privacy is a top concern. Therefore, to earn and keep user trust, the user contract will guarantee to adhere to the following principles to protect their privacy:

- We will never rent or sell user identifiable information to third parties for marketing purposes
- We will never share user contact information with another user, without their written consent
- Any sensitive information that users provide will be secured with all industry-standard protocols and technology

Certain information, such as how to install the software and how to operate the game, must be displayed in a prominent place. These instructions can be provided at the beginning of the game, separate from the Participation Terms and Conditions. These can also be included within the Participation Terms and Conditions for later access, and elsewhere as Tips (see below).

A contract concerning the use of the game must be simultaneously included when a user downloads a game template (i.e. 'Ahead of the Game' or 'MOGABAL'). In future, the sale of the game can be the subject of the contract. That is why it is important for a user to agree to the Participation Terms and Conditions in a legally binding agreement.

A Service Level Agreement (SLA) is also to be agreed with the provider, on whose server the games are located, which ensures security for the games provider.

As the 'pervasive' game template 'Get Real!' is not downloadable, the user does not pay for the use of the game template. The cost of the SMS traffic depends on the mobile network provider, and this is the only point which should be identified at the beginning of the game. As no other legal risks can be identified, this report will not deal with this game.

3.2 Tips for the Users

3.2.1 Positioning of the tips

The Tips, explaining the use of the software to the user, must be positioned on a clearly visible place on the website of the games provider. The WAP-

page should include a link to the Internet page, and a summary of the Tips should also be visible on the WAP page from which the download is accessed.

3.2.2 Checklist for user tips

- ✓ The software is cost-free to the user
- ✓ Data transfer fees are payable for the download. These are dependent on the mobile network provider and the tariff of the user
- ✓ Information concerning the bandwidth, the possible download costs
- ✓ Information concerning handset requirements that exist for the games
- ✓ As a trust-building measure it should be mentioned that no premium rate numbers are used for the SMS, neither for receiving from, or sending to, the user
- ✓ The user's SMS costs are dependent on the mobile network provider and the tariff of the user

3.3 Participation Terms and Conditions for the User

3.3.1 Inclusion of the Participation Terms and Conditions

When registering on the website, the user should be required to accept the terms and conditions for participation. These Participation Terms and Conditions are to be made accessible via a link beneath the registration form. The user must check a box confirming that they accept the legal Participation Terms and Conditions.

As noted above, the WAP page on which the download is activated should include a link to the web page containing the Participation Terms and Conditions. Ideally, this WAP page should also include a summary of the Participation Terms and Conditions, in addition to the link to the full text.

3.3.2 Checklist for the content of the Participation Terms and Conditions

- ✓ Exclusion of liability in respect of the technical compatibility of the mobile device of the user

- ✓ Exclusion of liability in respect of the availability of the mobile network, as well as of the download and the SMS facilities
- ✓ Exclusion of liability in respect of the availability of the server on which the games are stored
- ✓ The user must accept the costs for the download
- ✓ The user obtains a right to use the software for a limited specified time
- ✓ The games provider reserves the right to withdraw provision of the service
- ✓ The games provider reserves the right to adapt the service, to carry out changes and to service the software, which means that the service components within the game, which need the server, are not always accessible
- ✓ The user should agree to receive advertising material
- ✓ There should be a means for the user to withdraw from the agreement to receive advertising material
- ✓ If user data are used, the user is to be informed about this, and informed which data are used for which purpose
- ✓ The user must be informed, in the Participation Terms and Conditions, why his or her data are transferred and to whom
- ✓ All recipients of the data must be fully listed

3.4 General Information to Be Provided by the Games Provider

3.4.1 Inclusion of the general information

The user must be able to see the information in respect of the e-Commerce Directive. This information must be listed on the web page of the games provider and must be easily found and accessed via a link. Similarly, a link must be provided to the general information that is on the website on the WAP page prior to the download.

3.4.2 Checklist for the content of the general information

- ✓ The name of the service provider
- ✓ The geographic address at which the service provider is established
- ✓ The details of the service provider, including its email address
- ✓ Where the service provider is registered in a trade or similar public register, the trade register in which the service provider is

entered and its registration number, or equivalent means of identification in that register
- ✓ Where the activity is subject to an authorisation scheme, the particulars of the relevant supervisory authority
- ✓ Any professional body or similar institution with which the service provider is registered
- ✓ The professional title and the Member State where it has been granted
- ✓ A reference to the applicable professional rules in the Member State of establishment and the means to access them
- ✓ Where the service provider undertakes an activity that is subject to VAT, the identification number referred to in Article 22(1) of the sixth Council Directive 77/388/EEC

3.5 Service Level Agreement (SLA) with the Provider Who Makes the Games Available on Its Server

3.5.1 General

When the games provider finalises a contract with a provider, on whose server the software is located, a Service Level Agreement (SLA) is to be included that secures the performance of the provider. The following list provides an overview of the necessary content of the SLA:

3.5.2 Checklist for the SLA

- ✓ The provider often utilises the help of sub contractors. These contract chains should also be taken into account
- ✓ The provider must guarantee that the services offered are adequate to the operation of the system
- ✓ Availability is one of the central points in the SLA. It is usual to reckon with availability of at least 99% of a year, with the exception of service and upgrade times, depending on the contractee
- ✓ A response time must be defined that identifies the length of time in which the provider must respond
- ✓ The provider has to maintain its services in the framework of a system defined with the contractor
- ✓ A Service Hotline must be available that helps the contractor to clarify questions concerning the service

- ✓ The provider should be liable for careless negligence
- ✓ The provider should not have excluded the guarantee in the SLA
- ✓ A secrecy (non-disclosure) clause should be included
- ✓ In the context of Hackers, Worms and Viruses it is always more important to take comprehensive measures to ensure data security

4 Legal Recommendations, Tips and Checklists for Websites of the Game-Provider

4.1 Introduction

4.1.1 General aspects

Operators of Internet portals made for games are responsible for their websites. It is therefore necessary for them to take legal precautions. This is made possible by clearly formulated legal texts that are easily accessible by the user. The following legal texts, suggestions and checklists are generalised; individually and specifically formulated facts are yet to be added. These texts are not exhaustive. Several national norms in the various member states that exist, despite harmonisation, call for legal verification after its realisation.

The following statements partly refer to the various responsibilities of website providers and online-service providers (c.f. General Information to be provided according to Article 5 E-Commerce Directive). They will, however, also include legal texts that can 'only' be considered 'suggestions' (c.f. Copyright Statement). All hints, legal excerpts, instructions and checklists are linked through the fact that their realisation provides a healthy legal starting position for the platform operators. Therefore, it is well advised to include all of the following legal strategies in the gaming portal.

4.1.2 Inclusion of the online legal texts into the portal

The suggested legal texts must be accessible at all times on the website of the portal operator. Accessibility can by established by including a direct link to the legal texts on the homepage and the subsequent web pages.

This could be offered by including, for example, a link to 'Legal Information', which can be placed next to a link to 'Contact'. In the section 'Legal Information', additional links to a section called 'General Information' (according to Article 5 of the E-Commerce Directive) and, if needed, to aspects on media law could be included.

Links to sections such as 'Terms of Use', 'Privacy Policy', 'Copyrights', and the Linking and Framing text may also be included on the 'Legal Information' web page.

To facilitate ease of maintenance of the website, we recommend keeping all legal texts in HTML format, and have them printable at all times.

4.1.3 Tips for online legal texts

For the legal validity of online legal texts the following aspects are to be taken into consideration:

- Links to legal online texts must be clearly visible for the average Internet user on the homepage at all times, even without closer examination.
- An accentuated layout of the link would additionally improve the visibility of these links.
- The legal online texts must be offered in all languages the website is written in.

Apart from the opportunity to print the texts, the users should always have the choice to save the texts on their hard disks. These options should be marked with Flash buttons or icons and adequate labelling. Users should be able to download the online legal texts both as HTML files and PDF files. Both options should include a button that directly leads the user to the print function.

4.2 Terms of Use

4.2.1 The role of 'Terms of Use'

In the section 'Terms of Use' the operator clarifies the circumstances under which the user is permitted to make use of the website and the services provided. The portal-operator must acquire the necessary legal knowledge concerning, for example, warranty or liability, thus attaining a healthy legal position, and informing users about their rights and duties.

4.2.2 Checklist for 'Terms of Use'

The following points should be included in the section 'Terms of Use':
General Aspects:

- The user must agree to the 'Terms of Use' and other legal texts (e.g. Privacy Policy, Copyright Statement, Linking and Framing) as a precondition to using the portal
- Denying access to the site for users who refuse to agree to the 'Terms of Use' and other legal texts
- Withdrawal of the right to use the portal based on the violation against one or several points included in the legal texts
- In cases of terms violation the operator reserves the right to assert all claims whatsoever
- The note that all other legal texts hinted at in the 'Terms of Use' are a fundamental part of these terms
- The note that the operator at all times has the right to edit the legal texts without advance notice
- Service description, features of the portal

Copyrights:

- Regulations under which circumstances the use of the portal is justified
- Comments on copyright matters of the portal's content and their independence from the quality of the service (free or not)
- If desired, all kinds of reproduction, distribution, selling, publication and other ways of usage that need specific written authorisation of the portal's operator, are explicitly prohibited if this authorisation is not provided
- References to possible legal consequences if trademark laws, copyright laws and competition laws are violated
- Specific reservation of the portal's operator in reference to copyright and the respective user rights (rights concerning the utilisation of the work)
- Link to further information on behalf of the Copyright Statement

Data Protection:

- Trustworthy statements concerning the careful handling of personal data
- References to the operator's policy concerning privacy protection, based on the principles of data secrecy
- Reference and link to the section 'Privacy Policy'

Warranty:

- No warranties that the site or any of its functions will be uninterrupted and accessible at all times
- No warranties for a certain accessibility and availability
- No warranties for any content or services provided on the gaming-portal
- The operator is not confined to any given statement and has the right to make changes on the portal at any time without advance notice

Limitation of Liability (Exclusion of Liability):

- Excluding the liability for any direct, indirect, incidental, special or consequential damages that may result from the use of the portal, even if the persons involved in the gaming-portal are (partly) responsible;
- This should include all kinds of damages that may result from the following circumstances:
  - from the use of the gaming-portal
  - from the impossibility to use the portal (e.g. downtime) or limited accessibility
  - from the content itself or any incorrect content, respectively
  - from external contents on the website
- The portal operator cannot be held responsible for any liability in the event of enabling free software downloads
- Excluding any consequential damages
- Liability exclusion should be applicable,
  - regardless of any asserted basis for claim
  - regardless of the level of negligence
  - regardless of whether the operator himself or those persons or companies affiliated with him knew about a possible damage, or should have known about it
- Liability exclusion should cover contractual and non-contractual matters

Hyperlinks:

- Liability exclusion for linked websites and their content
- Statement that the operator has no influence on the design, any possible changes, or content of the linked website
- Information for users to inform the operator if any of those links features problematic material, so that the link can be eliminated
- Information and link to the Linking and Framing Statement

Severability Clause:

(Place of) Jurisdiction and applicable law

If additional services such as a blog or a forum are offered, specific Terms of Use are needed.

4.3 Copyright Statement

4.3.1 The use of a Copyright Statement

The Copyright Statement clarifies that the publication of information on the portal does not include an implied approval to make free use of the content offered. It rather hints at the fact that all rights of utilisation of work remain with the copyright holder. By referring to the existing copyrights the user should be warned about any violation, mainly because the recording, duplication and accessibility of data is facilitated in the digital world. A statement that the portal's operator does not hesitate from taking legal action should prevent potential infringers from violating the given laws.

4.3.2 Checklist for Copyright Statements

The following points should be included in the Copyright Statement:

Copyright laws concerning the website content:

- Statements on trademark and copyright protection concerning all portal contents (e.g. texts, graphs, videos)
- Prohibition to download, reproduce and distribute the entire gaming portal, or parts thereof
- The right to reproduce, distribute, sell and publicise (in whatever way) the website's data has to remain with the copyright holders
- Prosecution in cases of violation of the trademark and copyright laws

Copyright laws of external content must include:

- The note that for all content provided by a third party, an implied approval of the author or the copyright holder must be included in order to make use of the content
- Information of the operator for the author/copyright holder concerning the violation of copyright laws, and what will be done if the operator becomes aware of such violations
- Liability exclusion for the violation of copyright laws for external content

It is necessary for the operator to take all legal precautions by enabling internal approval processes concerning copyright matters. It is especially important to own the rights for external content for the entire World Wide Web, and to reach specific agreements with the respective copyright holders and verify or expand those that already exist. Rights on content, provided by third parties, must be owned by them in order to avoid conflicts with potential co-owners. These issues must be dealt with in the respective contracts.

4.4 Privacy Statement

4.4.1 The use of the Privacy Statement

From the perspective of the operator it is important to consider the regulations of the Data Protection Directive and the respective Data Protection Law of the various member states, who are endorsing specific obligations for data processors.

In this respect, certain obligations concerning data security, data secrecy and notification requirements for data processors arise. Other questions, especially in relation to the user, such as the right to acquire information, to correct or delete person-related data, are also included.

4.4.2 Checklist for the Privacy Statement

The following points should be included in the Privacy Statement:

General Aspects:

- Privacy protection of each and every client (user)
- This statement only refers to person-related data, received by the users of the website
- Person-related data will only be collected if necessary for the operation
- Statements about reasons why these data are collected
- The reason for this privacy statement is to inform users about the website's policy concerning person-related data

Service-Oriented Processing and Utilisation of Data:

- Data will be processed by the operator to provide users with the best service possible
- The operator may provide users with information about the portal. Users should always have the option to refuse this kind of information and declare their wish not to receive such information in advance

Forwarding of Data:
- Seeking confidence by confirming that person-related data will only be forwarded to third parties with the written consent by the person concerned or on the basis of a legal obligation

Purposive Use of Cookies:
- Information why cookies are being used
- By using the website the user must agree to the fact that cookies are being used
- The note that information resulting from the use of cookies may also be used to further improve the usability of the website
- User information about the browser configuration, which allows to inform the user automatically before he accepts a cookie or enables him to refuse cookies and delete them whenever he/she wishes

Data Protection Committee:
- Registration at the data protection committee
- Registration in the data processing register
- Receipt of a data processing number
- In terms of data protection, the user should always have the opportunity to contact the respective data protection delegate via e-mail

Data Security:
- The operator should strive to protect person-related data by keeping the system up-to-date
- Information about the encoded storage of critical data

Data Secrecy:
- Information concerning the protection of data by staff members and the operator, even after the consumer does not use the platform any more

4.5 Linking and Framing

4.5.1 The purpose of a Linking and Framing Legal Statement

The main problem with hyperlinks is that they originate on external websites, where they may be edited by the site's operator at any time, and may therefore suddenly contain delicate legal content. The operator is unable to regularly supervise all these hyperlinked web pages and thus cannot control the legitimacy of their content. This can also be said about websites linked to the portal. That is why the operator has to take legal precautions.

A fundamental rule of law for Linking and Framing is that the average user must at all times be able to see who the real service provider of the actual link is. That is why only the command <target='_blank'> should be used.

4.5.2 Checklist for a Linking and Framing legal text

The following points should be included in legal texts concerning Linking and Framing:

Links of other websites to the gaming-portal
The operator may allow links under the following conditions:

- The contents on the portal may not be changed
- The origin of all content must be clear
- It is prohibited to present contents of the portal by using frames
- Links to websites with illegal, offensive or controversial content may be prohibited by the operator
- The content of websites linked to the portal must correspond to the current legal standards
- The linked websites may not present their connection with the portal incorrectly, disproportionally or illegally

Links of the gaming-portal to other websites

- External content of the linked websites may not be edited
- The origin of these external sources is known
- The linked website will be displayed entirely
- External content will be presented in a new window without using frames
- The liability for the legitimacy of external content of the linked websites is disclaimed, especially when the content will be edited afterwards
- The links themselves, the service provided and the information given on the linked pages cannot be seen as recommendations
- Links to other websites can only be seen as an additional service for the users in order to facilitate the access to related sites

4.6 General Information to Be Provided

4.6.1 The purpose of this information on the website

According to article 5 of the E-Commerce Directive the operator shall render easily, directly and permanently accessible to users, at least the following information mentioned in the checklist below.

It is necessary to respect the information requirement of article 5 of the E-Commerce Directive, since a violation of these guidelines would be an infringement of competition law and may result in legal actions on the side of a competitor.

4.6.2 Checklist for the 'Legal Notice'

The following points must be included in the general information to be provided according to article 5 of the E-Commerce Directive:

- The name of the operator, who is the service provider
- The geographic address at which the service provider is established
- The details of the service provider, including his e-mail address, which allows rapid contacted and communication in a direct and effective manner
- Where the service provider is registered in a trade or similar public register, the trade register in which the service provider is entered and his registration number, or equivalent means of identification in that register
- Where the activity is subject to an authorisation scheme, the particulars of the relevant supervisory authority
- As concerns the regulated professions:
  - any professional body or similar institution with which the service provider is registered
  - the professional title and the Member State where it has been granted
  - a reference to the applicable professional rules in the Member State of establishment and the means to access them
- If available, the sales tax identification number

4.7 Declaration of Consent concerning the Use of Data

4.7.1 Purpose of a declaration of consent

A declaration of consent is recommended where a gaming portal needs person-related data for one of its services (e.g. membership registration).

If person-related data are collected, a declaration of consent may avoid issues concerning data protection. The user must actively agree to the declaration of consent by checking a box before sending the person-related data. If the user does not agree to the declaration of consent (by not checking off the box), the transmission of person-related data is not possible (the 'Submit' button is useless).

4.7.2 Example for a declaration of consent

Yes, by submitting this statement I agree that my person-related data may be saved and processed. My data will only be used and processed for registration purposes, for the possibility to contact me and for reason xxx. They will only be handed over to the public authority xxx for reasons of xxx. I can always edit and update my personal information for free by sending an informal email to dataprotection@gaming.eu

4.8 Newsletter

4.8.1 Legal protection concerning advertising and data protection

Users will often be given the choice to subscribe to a newsletter. It is necessary that the users agree to this, as this newsletter is seen as advertising, and person-related data will be saved and processed. The user will be asked to check off a box when ordering the newsletter.

A so-called 'double Opt-In solution' is advisable for registration to the newsletter. After subscribing for the newsletter the subscriber receives an email and the newsletter will be activated only after the subscriber replies to this email or follows a confirmation link. In doing so, any kind of manipulation or abusive handling of personal information by third parties will be avoided. This approach is also helpful to avoid legal complications, since it can be proven that the user has registered for the website's services by replying to the registration email.

In addition, users must be able to cancel their subscription to the newsletter. Subscribers must be given the right to deny utilisation of their

email address. The operator may therefore provide an email address that the user may contact in order to unsubscribe from the newsletter.

Email advertising must be clearly identifiable. A note in the subject heading may help the user to identify the email as a newsletter sent by the provider.

4.8.2 Example of a legal text

I hereby agree that my personal information (e.g. surname, name, email address) will be saved and processed, and I give my approval that I will receive newsletters of the provider xxx on a regular basis.

I will always be given the choice to unsubscribe from the newsletter for free and without any difficulty by sending an informal email to unsubscribe@gaming.eu In addition, every newsletter will contain information on how to unsubscribe from the newsletter service.

5. mGBL Copyright Statements

All mGBL partners have checked that they have not used text verbatim from any source or, if they did use such text, that they modified it and cited it correctly. This is important, as, provided the sense remains the same, this will not affect the translations, unless they too are taken verbatim from another source.

Secondly, each author had to:

- Include mGBL Copyright Statement(s) in respect of scripts and media (e.g. photos, graphics, music and so on)
- For this they must strictly adhere to the mGBL Copyright Statement formats below
- All partners had to ensure that the statement is inserted in the 'Copyright' slot in the metadata section of the game template, immediately following the 'Disclaimer' slot

There are three different kinds of mGBL Copyright Statement format:

1. As all the script texts and associated media (i.e. graphics, photos and music) have been created by mGBL authors exclusively for mGBL, they wrote a Copyright Statement using the exact text below altering it only to supply the specific detail as indicated in italics:
   The text and media used in this game implementation have been developed by (*Author name(s), Organisation(s)*) for mGBL.

N.B.:

- You may re-use/modify the text resources, provided that you clearly and fully acknowledge the mGBL source and any modifications you have made
- Media resources may not be modified but may be re-used 'as is', again with the proviso that you clearly and fully acknowledge the original source

2. If they used modified text from an external source, they wrote a Copyright Statement using the exact text below, altering it only to supply the specific detail as indicated in italics:
'The question and answer texts in this game are adaptations of content from: (*full source: Author Name(s), Organisation, url(s), retrieved on: date*)

N.B.: If you wish to re-use any of these texts you must:

a) Clearly and fully acknowledge the mGBL source
b) Scrupulously follow the requirements of the original copyright holders.'

3. If they used media from an external source, they first obtained written permission to do so. Then they wrote a Copyright Statement using the exact text below, altering it only to supply the specific detail as indicated in italics:
'We have obtained copyright holder permission to use (*all the/x**) media in this mGBL game**

N.B.: If you wish to re-use this media you must first obtain written permission from the original copyright holders and adhere to their instructions.'

* Adapt as appropriate
** Add any references required by the copyright holder

6. References

Bechtold S (2002) From Copyright to Information Law. Bechtold, Vom Urheber-zum Informationsrecht (2002) 207ff

Bundestag (2003) Youth Protection Act and the Inter-State agreement on the protection of minors in the media. Jugendschutzgesetz (JuSchG) vom 23 Juli 2002 BGBl I 2002, S. 2730

Ciresa M (2006) Austrian Copyright. Ciresa, Österreichisches Urheberrecht (2006) UrHG

Council of Europe (2001) Convention on Cybercrime. Available at: http://conventions.coe.int/Treaty/en/Treaties/Html/185.htm

Delp L (2003) The Right of Intellectual Creativity in the Information Society. Delp, Das recht des geistigen Schaffens in der Informationsgesellschaft (2003) 13ff

European Parliament (1995) Directive 95/46/EC of the European Parliament and the Council of 24 October 1995 on the protection of individuals in the processing of personal data and on the free movement of such data. Richtlinie 95/46/EG des Europäischen Parlaments und des Rates vom 24. Oktober 1995 zum Schutz natürlicher Personen bei der Verarbeitung personenbezogener Daten und zum freien Datenverkehr, Nr. L 281 Amtsblatt der Europäischen Gemeinschaften

European Parliament (2001) Directive 2001/29/EC of the European Parliament and the Council of 22 May 2001 on the harmonization of certain aspects of Copyright and the related protective rights in the information society. Richtlinie 2001/29/EG des Europäischen Parlaments und des Rates vom 22. Mai 2001 zur Harmonisierung bestimmter Aspekte des Urheberrechts und der verwandten Schutzrechte in der Informationsgesellschaft, Amtsblatt Nr. L 167 vom 22/06/2001 S. 0010-0019

European Parliament (2002) Directive 2002/58/EC of the European Parliament and the Council, 12 July 2002 on the processing of personal data, and the protection of privacy in the electronic communications. Richtlinie 2002/58/EG des Europäischen Parlaments und des Rates vom 12. Juli 2002 über die Verarbeitung personenbezogener Daten und den Schutz der Privatsphäre in der elektronischen Kommunikation. Datenschutzrichtlinie für elektronische Kommunikation, L 201/37 Amtsblatt der Europäischen Gemeinschaften

Handig C (2003) Copyright Act 2003: The results of significant changes to adapt to the information society. ÖBl 2003, 212. Handig, Urheberrechtsnovelle 2003, wesentliche Änderungen infolge der Anpassung an die Informationsgesellschaft, ÖBl 2003, 212

Hasberger M (2003) Value Added Services and the Collection of Network Operators. Hasberger, Mehrwertdienste und das Inkasso der Netzbetreiber, ÖJZ 2003, 52

Knyrim R (2003) Data Protection Law. Knyrim, Datenschutzrecht (2003) 205ff

Schwartz W and Wohlfahrt F (2006) Games of Chance. Schwartz/Wohlfahrt, US Copyright Office, (2008), Digital Millennium Copyright Act 1998, Public Law 105-304, 112 Stat. 2860

Warbek S (2003) Universities and Information Technology: The need to adapt copyright. Warbek, Universitäten und Informationstechnologie – Anpassungsbedarf im Urheberrecht, ecolex 2003, 179

Potential Prejudice against Mobile Learning Games in Croatian University Teachers and Students

Vladimir Taksic
Faculty of Arts and Sciences, University of Rijeka, Croatia
+385 51
vtaksic@ffri.hr

Ivana Ilijasic Misic
Faculty of Arts and Sciences, University of Rijeka, Croatia
+385 51
iilijasic@ffri.hr

Edvard Tijan
Faculty of Maritime Studies, University of Rijeka, Croatia
+385 51 33 84 11
etijan@pfri.hr

Abstract

With mobile phones growing ever more powerful in their scope, availability, power, applications, usability and pure enjoyment, and with the popularity of mobile games applications, mobile game-based learning is an emerging field. Some research findings state that mobile games offer considerable potential for supporting social-constructivist learning (e.g. Mitchell 2003, Mitchell and Savill-Smith 2004). This is in line with a body of research that acknowledges the pedagogical role of fun in learning (e.g. Randel et al. 1992, Doolittle 1995, Dempsey et al. 1996, Fabricatore 2000, Prensky 2001, Wu et al. 2004). Moreover, strategic use of games can contribute a 'flow' experience that is a characteristic of successful learning processes (Csikszentmihalyi 1990).

During the three-year project mobile Game-Based Learning (mGBL), we designed new learning models based on mobile games that can be

integrated into learning programmes, thus enhancing the range of opportunities for connecting with students. This paper presents results from the user trials, focusing on the quantitative data gathered from an initial user survey and subsequent qualitative research conducted on Croatian students and teachers. The user trials took place during summer and autumn of 2006 and 2007.

We conclude that students accept and welcome technology-assisted learning opportunities and prefer a mix of face-to-face and technology-assisted delivery. However, respondents to our survey and focus groups were generally sceptical as to the usefulness and desirability of the use of serious games delivered by mobile phone to underpin learning. Nevertheless, a focus group trial of an early prototype game attracted mainly positive reviews.

Keywords

Mobile learning, user trials, prejudice, game-based learning

Introduction

The mGBL project began in October 2005 and was supported by the European Commission (EC) Information Society Technologies (IST) Programme within the Sixth Framework. Ten partner organisations from Austria, Croatia, Italy, Slovenia and the UK formed the consortium with the aim of developing a series of serious games to be delivered through mobile phones. The target audience for the games were young people aged 16-24. To meet the aim, mGBL developed and trialled three different types of learning games for delivery via mobile phones. The games were designed to provide flexible access to information and experiences that could help people make choices in critical situations.

The Faculty of Arts and Sciences at the University of Rijeka and the Faculty of Maritime (Pomorski Fakulet u Rijeci – PFRI) Studies led the User Trials work package of the mBGL project. User trials were carried out with students from high schools (HS), students in higher education (HE) and their teachers. This paper reports early findings from our initial user survey and subsequent research showing that Croatian students, although not statistically very different from any other partner country, may not readily embrace the concept of mobile learning games.

The Initial User Trial Results

Initial Review Questionnaire Results

Statistical analysis of quantitative data gathered prior to the first user trials showed that there are a few significant differences between Croatian respondents and the respondents from other countries regarding their attitudes to the use and value of mobile technology in learning. However, there was a slight difference between Croatian and Austrian respondents, with Croatian students wanting more technology-assisted learning than Austrian students. Furthermore, Croatian students spent less time using their computer on a daily basis than respondents from other countries.

The learning habits of the respondents were quite diverse. It is interesting, for example, that the learning habits of respondents from high schools in Croatia and Great Britain are diametrically opposed. Croatian students are somewhat conservative due to the still widely present 'ex cathedra' education policy in Croatia. Seventy-eight per cent of Croatian HE students and 90% of Croatian HS students prefer to learn alone, and only 10% prefer to learn as part of a group. Other main learning habits include practice (32%), reading (22%) and speaking to others (21%).

Further analysis of data gathered from the initial review questionnaire showed that although all respondents had little experience with e-learning systems, they did prefer delivery of lectures via technology. The result, which identified a desire for an average of 35% of lessons delivered with technology, showed that students are aware of technology and future trends. However, whilst only 3% of HS respondents would prefer the learning process to be fully delivered via technology, only 11% of HE and 6 % of HS students preferred only face-to-face delivery.

Respondents from all partner countries, including Croatian students, were somewhat sceptical about using mobile phones in the learning process. Forty-four per cent of respondents did not know if mobile phone games could be used for education purposes and 34% thought that it was not possible to use mobile game-based learning for educational purposes, while only 20% thought that it was possible.

Initial Online Survey

Online research was conducted in the five countries of the consortium – Austria, Croatia, Great Britain, Italy and Slovenia. Two groups of respondents were identified: students (age 18 to 24) and teachers.

Research in Croatia was conducted from 26 October to 27 October, 2006. There were 63 respondents, of which 37 were male and 25 female, with one respondent who did not state his or her gender. Two teachers also completed the questionnaires. All the respondents, both teachers and students, were from the Faculty of Maritime Studies.

All respondents thought that mobile game-based learning was interesting as an idea and a concept. Further, the qualitative analysis of the respondents' evaluations of two examples for Game Template 1 (i.e. *Ahead of the Game* and *Maritime Distress*) revealed the following: the games were described as an interesting way to reach young people, although they do not have the traditional game scenario. Overall, respondents considered them to be entertaining, but with some flaws in the game design.

Games were considered to be very dynamic, interesting and also educational. Respondents could see how the games could be used as an addition to the teaching process in order to make the subject more interesting. Respondents assessed the opportunity of competing with other players. The games present a 'normal' situation in the classroom, while the mobile device is just a support.

Negative comments were primarily directed towards the interface and to the playability of the games. The games were described as difficult to understand and not user-friendly; lacking in effectiveness (i.e. progress through the game), or effect: the interaction was considered to be very limited, and players were unhappy with the lack of help facilities. Some of the comments made included the following:

> *"It is very unusual: mobile games in education?"*
> *"Very linear, seems a waste on a digital device"*
> *"It could be easily replicated with paper and a stopwatch"*
> *"The graphic style, whilst cute, was completely irrelevant to the game context – why should I take health advice from a fat cat businessman smoking a cigar??!"*
> *"This game checks just knowledge. The learning process must develop skills"*
> *"Unsuited to a mobile, dull game play, irrelevant scenarios"*
> *"I find this game hard to recommend. It could be more interesting with more options"*

> *"The third game type seemed a much more adventurous concept that would be fun. It certainly seemed more appealing, although the activities would need more support. Also I fear that it is not really a 'game', more an activity. Be careful that the phones do not distinguish among students regarding their or their families' economic status"*

The online research identified that, at this early stage in the project, many of those we consulted, both male and female, appeared to be strongly opposed to the deployment of mobile games within learning programmes, considering them – at best – a waste of time. These early findings were supported by those emerging from subsequent lively discussions that were initiated by students and teachers at the focus groups.

mGBL Focus Group Results

A focus group discussion with 27 students who participated in the first user trials was held on 27 October 2006 at PFRI. Students were asked to consider the user-friendliness of the mGBL platform and suggest any improvements that should be made. Students reported that the design and general characteristics of the games were very low in comparison to commercial games. Students felt that incremental learning would be more effective than a quiz format. They also felt that tutorials and questionnaires should be connected, where possible, in the same game. Respondents considered that the requirement for logical thinking was a key strength of the games, and the simulations were considered as good examples of how gaming could add some value to the learning process.

Other discussions were prompted by mGBL presentations at the University of Rijeka, where the project and the concept of mobile game-based learning were presented (Mitchell 2007). Many students, however, remained unconvinced, arguing strongly on the following lines:

- older teachers will never use mobile game-based learning
- use of mobile technologies will only add to the alienation already perceived as a result of increasing e-learning
- learning games are more suitable for schoolchildren
- students already know how to investigate sources and build arguments – how is playing games different?
- Why does everything have to be fun?

Analysis of the Croatian Focus Group

The Second User Trials

A second focus group was assembled to test the game templates and the mGBL platform in Croatia. It consisted of six participants who were teachers, and students in the subject area of maritime distress (two teachers and four students). All of the participants completed consent forms at the beginning of the focus group and were provided with Nokia N80 mobile phones. They were also given a USB memory stick as a gift at the end of the test.

Participants were asked to complete a short questionnaire before playing the game. This generated insight into the following issues:

- all of the participants owned a relatively new model of a mobile phone, and all of their mobile phones supported mobile games
- while some played games on their mobile phones, others answered that they had never done so, and pointed out that computers are more suited for gaming due to the size of the screen and controls
- participants that do play mainly play logical games, in order to 'kill some time' (e.g. when waiting in queues)
- participants' bias about the game that they were about to play was mainly neutral as they did not expect much

After playing the game there was little difference between the responses from the Croatian students and teachers and the results from the partner countries' focus groups (mGBL 2007). Participants reported a positive attitude towards the idea of mobile game-based learning, and the game in the area of maritime distress in particular. Students liked it because the content was familiar to them and they tried to collect as many points as they could. They were really competitive and compared scores with each other. Teachers thought that the game was an excellent tool for learning, not only for students, but also for experienced sailors who use maritime distress procedures in real-life situations. They all agreed that, considering the fact that this is an educational game, the quality of the graphics was not that important.

Our participants found the game content satisfactory and pertinent to real life. All participants agreed that they would play the game again, both to refresh their knowledge and to learn new facts, and because it contains the type of content that is used in real-life hazardous situations, and could

very well save human lives and property. Some students said they would use games such as this as revision aids after lectures to see how much they have learned. The teachers stressed that this can be an interesting way to facilitate lifelong learning processes, as well as being a useful e-learning tool for any type of distant learning.

The results suggested that teachers thought that a game like this, with multiple possible scenarios, would give them an insight into how the students think, how they make decisions, and how they could apply that thinking to 'real-life' situations. The students thought that the scores and reports would be useful for the teachers, to identify the students' strengths and weaknesses. That way the teacher could develop these areas when giving a lecture. Students would also like to go through the analysis of the game play with their teachers to help them advance. One suggestion from the focus groups concerned the notion of 'group games', so that games would address both collaborative work and team work, in education and real life. Finally, users concluded that the game could be pure fun for the younger target groups, while content for older target groups should include a simulation component.

Conclusion

There were three cycles within our User Trials that relate directly to the iterative process adopted for mGBL design and development. The User Trials were undertaken in September of 2006 and 2007, and the resulting findings informed the construction phase of the mGBL prototypes as well as the final cycle of development that began in September 2007.

The students and teachers who responded to our surveys and took part in our focus groups appeared generally to be sceptical about the usefulness and desirability of the use of serious games delivered by mobile phone to underpin learning. This is despite a further conclusion from our international survey, which identified that students accept and welcome technology-assisted learning opportunities and prefer a mix of face-to-face and technology-assisted delivery. However, a focus group trial of an early prototype game attracted mainly positive reviews that supported our theorising and suggested that the scepticism is unfounded.

References

Csikszentmihalyi M (1990) Flow, The Psychology Of Optimal Experience. Harper & Row, New York

Dempsey JV, Lucassen BA, Haynes LL, Casey MS (1996) Instructional Applications of Computer Games. Paper presented to the American Educational Research Association, 8-12 April 1996, New York

Doolittle JH (1995) Using riddles and interactive computer games to teach problem-solving skills. Teaching of Psychology 22(1), pp 33-36

Fabricatore C (2000) Learning and Videogames: An unexploited synergy. Available at: http://www.learndev.org/dl/FabricatoreAECT2000.PDF [accessed 20 October 2008]

Mitchell A (2003) Exploring the potential of a games-oriented implementation for m-Portal. Paper presented to the MLEARN 2003 conference – learning with mobile devices, 19-20 May 2003, London

mGBL (2007) D6.3 App. 11: Evaluation of Game 3 – Digital Economy. Available at: http://www.evolaris.net/assets/Uploads/mGBL-027607-D6.3-App.11-Evaluation-Game-3.pdf [accessed 20 October 2008]

Mitchell A, Savill-Smith C (2004) The use of computer and video games for learning. A review of the literature, LSDA, London

Mitchell A (2007) Presentations on the mGBL project development and intended outcomes to 3 student groups in the Faculty of Arts and Sciences at the University of Rijeka in Croatia, 4 June 2007 (unpublished)

Prensky M (2001) Digital Game-Based Learning. McGraw Hill, New York

Randel JM, Morris BA, Wetzel CD, Whitehill BV (1992) The Effectiveness of Games for Educational Purposes: A Review of Recent Research. In: Simulation and Gaming 23

Rieber LP (1996) Seriously Considering Play: Designing interactive learning environments based on the blending of microworlds, simulations, and games. In: Educational Technology Research & Development 44(2), pp 43-58

mGBL Ethical Issues and Requirements

Ivana Ilijasic Misic
Faculty of Arts and Sciences, University of Rijeka, Croatia
+385 51
iilijasic@ffri.hr

Alice Mitchell
INSPIRE
Anglia Ruskin University

Abstract

In respect of an emerging field such as mobile games-based learning, extant ethics requirements and guidelines are applicable. However, during the mGBL project we also found ourselves identifying new issues that required appropriate responses and solutions. A key task of this paper is to identify and evaluate the specific risks to participants in research projects that are associated with technology-related issues, such as capture and access of personal data.

In addition, within a collaborative European project such as mGBL, cultural diversity creates an additional layer of complexity. This paper considers what ethically significant risks the research entailed for mGBL users, as well as highlighting the issues for future users associated with the ethical traditions of mGBL users' culture and country.

Keywords

Mobile phones, handheld devices, ethical implications

1 Introduction

With the advent of mobile learning (learning mediated through mobile technologies), there is a need (Nash 2006) to identify the associated ethical issues. What ethically significant risks do the mGBL research and project outputs entail for the participants and future users?

Ethical issues in learning environments include community and equity of access, as well as security, privacy, information and identity. Many professional bodies and associations and research councils have issued ethics guidelines and frameworks that are expected to guide professionals' work and research (BPS 2006; ESRC 2006; BERA 2004; BSA 2002). Similarly, educational institutions develop and implement policies, regulations and disciplinary procedures (see, for example, Anglia Ruskin University Research Ethics Committee (2007) *Policy and Code of Practice for the Conduct of Research with Human Participants*). However, the use of the Internet and mobile technologies introduces additional complexities that go beyond typical questions of what's right or what's fair. When new technologies offer new affordances, do the old rules of behaviour still apply?

The mGBL project sought to take advantage of the unique affordances of mobile technologies such as SMS, MMS and blogs; these include mobility, localisation and personalisation. Any time, anywhere, situated learning is now possible. Hence, the emergence of the terms 'mobile learning' and 'mobile games-based learning', which have been coined to designate education-related activities while on the move. For the mGBL student, teacher or administrator, to some extent ethical issues in mobile games-based learning may be assumed to be fundamentally the same as those one might expect in more 'traditional' digital games-based learning.

However, a high priority in the development of the mGBL learning game prototypes and environments was the need to take into account the related ethical and legal issues. The initial ethical and legal questions that needed to be addressed in this research project included:

- What are the ethical considerations to be made in respect of mGBL researchers, project workers and participating teachers and learners?
- How far do extant legal requirements and ethical guidelines in education apply to future users of mGBL project outcomes?
- How far do extant legal requirements and ethical guidelines in the partner countries implicated in the research apply to future users of mGBL project outcomes?

These questions are crucial in addressing the balance between possible risks to which research participants, including the researchers, are exposed and the anticipated benefits of research.

2. Extant Ethics Guidelines and Their Relevance to mGBL

2.1 Informed Consent, Anonymity and Confidentiality

mGBL game users are required to log in to the mGBL platform, which entails the provision of a user ID and password. As log-in is voluntary, this information is gathered with the consent of users; it is stored securely using encryption, so as to prevent misuse by third parties. Users are asked to log out when they have finished.

To protect users, the system logs out automatically after a period of time. However, the platform should make available User Guidelines that, for example, offer support in choosing a password (British Telecom, 2006).

The mGBL game development is iterative and informed by user requirements, obtained during field research with target audiences. Data collection involves collection and use of personal data. According to Lonsdale et al. (2003) there are five main questions to ask when considering the ethical implications of the use of personal data:

1. What information do we obtain?
2. How do we obtain it?
3. What do we use it for?
4. What risks are there in doing this?
5. What do users think about it?

Where data could involve the use of information that is personal and private to the users involved, it needs to be gathered with the informed consent of users, and must be stored securely so as to prevent misuse by third parties. Heeding advice from Lonsdale et al. (2003), mGBL needed to take the following steps:

- Capture, storage and access of personal data: Digitalisation and storage of mGBL data was undertaken in geographically dispersed units and was led by different work packages. Project coordinators and work package leaders arranged for automated back-up of data, and decided whether it was archived and for

how long and determined which groups had access to what data. Participants received a participant information sheet, which gave details of how data was to be captured, stored and used.

- Informed consent: In a briefing prior to their contributing to mGBL research, participants were made aware of what data is being gathered and its intended use (i.e. in mGBL's case, for iterative game and platform development and trialling purposes). Participant consent was ongoing, through keeping participants informed for the whole time they were using the mGBL games and system and making clear their right to change/withdraw consent at any time. They were also made fully aware that the Internet is not a safe medium and there are potential security risks where data is gathered, stored and used on a computer.
- Security: It was the mGBL researchers' responsibility to ensure that any gathered data was stored securely (e.g. using encryption), and was made available only to necessary parties (e.g. mGBL researchers) to prevent the misuse of data by third parties (such as hackers).
- Control: Where consent was given for the gathering and use of required data, participants were given information, access, and control over their personal data.
- Timing: Participants were approached at the very beginning of research to ask for their informed consent and to protect their human subjects' rights to privacy, confidentiality and autonomy.
- Medium: mGBL researchers used a suitable medium (e.g. handouts, email) for both requesting and receiving informed consent to protect both the participant(s) and their project.

2.2 Access to Data

Access to data is a richly nuanced issue. Horniak (2004) argues that 'concern about privacy raises technical problems, how to design and implement systems which make the information available for the users who are entitled to the specific information at a specific time'.

In the case of mGBL, content developers and technical developers needed to access live personal data records to fully test their work, the support technicians needed access to confidential personal information to service the applications that accessed the data, while teacher-administrator users of the mGBL platform also needed to collect and access data.

This meant that content developers and technicians had access to different sets of data. For example, technicians had access to aggregated data rather than to individual data, while researchers had access to content data but not to personal data, and administrators had access to personal data only (Carmichael and Youdell 2007). This raised the issue of their responsibility in terms of protecting the confidentiality of that data: researchers complied with the ethical guidelines of their organisation (e.g. guidelines to researchers issued by Anglia Ruskin University) concerning research with human subjects, while developers, teachers/administrators and IT managers complied with ethical guidelines for their profession (e.g. Relkin 2006), and IT staff complied with legal requirements (e.g. UK's Freedom Of Information Act (FOIA) 2000).

We had to consider whether mGBL activities would be constrained in any way when cross-referencing internal and external data sources. We identified potential conflicts, for example, between the UK Data Protection Act 1998 and the FOIA 2000. Data management, security, privacy and access issues were clearly matters for legal experts and are therefore dealt with in a separate mGBL paper.

2.3 User Vulnerability

Ess et al. (2002) highlight the need to identify the authors/creators of the material and/or interactions under study. They go on to point out that while all persons have rights, and researchers have the obligation to protect the rights of their research participants, the obligation of researchers is heightened if the research participants fall into vulnerable groups or are considered to be minors according to the legal age of responsibility. In the UK all subjects under 18 are children in the eyes of the law, whereas in other countries subjects between the age of 12 and 18 are classed as minors and inhabit something of a middle ground – legally and ethically – between children and adults.

Frankel and Siang (1999) emphasise that the greater the vulnerability of the research participants, the greater the obligation of the researcher to protect them – hence, the need for projects such as mGBL to ensure that informed consent in writing was given by participants and, in the case of minors, informed consent was received from their legal guardians. Although we recognised there are different cultural expectations and variations with regard to written informed consent, in our target audiences (young adult students) we expected to receive informed consent. (We were not, for example, dealing with participants who were unfamiliar with

Western culture or who had, for example, learning difficulties or mental health problems, as these groups were not part of our target audience.)

2.4 Ethical Expectations Established by the Venue

As Ess et al. (2002) have pointed out generally, the greater the acknowledged publicity of the venue, the fewer obligations there may be to protect individual privacy, confidentiality, right to informed consent, and so on. However, in the case of the mGBL platform, where users are required to register and log on, there was a need to clarify terms of use. Accordingly, the mGBL platform provided access to a published policy that established specific expectations of providers and users. This policy included:

- a statement notifying users that all exchange of information is public, and the possible technical limits that pertain to privacy.
- a statement affiliated with the venue indicating whether discussion/chats, postings and so on are ephemeral, logged for a specific time, and/or archived in a private and/or publicly accessible location, etc.

3 Emerging Ethical Issues for mGBL Consideration

3.1 Capture, Storage and Access of Personal Data

Digitalisation and storage of mGBL data was undertaken in geographically dispersed units and was led by different work packages. Here, consistency was achieved via strong leadership from the project coordinators and close collaboration with work package leaders, who needed to arrange for automated back-up of data, decide whether it was archived and for how long and to determine which groups had access to what data.

3.2 User Training

3.2.1 Supporting users unused to mobile learning, bringing game world into perspective

The rapidly changing nature of technology, norms, and online behaviour means that the risks and safeguards against them will differ from those characterising traditional research and will themselves change over time (Kraut et al. 2003). Learning organisations, therefore, that plan to use, for example, mobile technologies to deliver learning opportunities need to be aware that there are ethical and legal obligations to provide training, mentoring and support to teachers and learners who may not have the background or language skills to succeed in mobile learning. The same applies to mobile games-based learning.

The mGBL project provided user guidelines and agreements for users of the games and for potential game authors. These included guidelines on the use of game-based learning and social software.

For example, the mGBL Game Template 3 allows teams of students to use the mobile phone as a flexible tool, to post messages and video content to individuals in their team and to a personal or group blog. As this game template is intended for use by a class of students, the participants will have a real identity known to the other group members, which should help to combat inappropriate use of the blogs. However, in addition mGBL guidelines were in place to support self-moderation and moderation by the teacher, to ensure, for example, that students were not photographing or recording invasive or offensive items and then posting or sending them to fellow students. We developed a set of rules for participation to prohibit potential harassment, comment, spam and so on.

3.2.2 Guidelines for authoring serious games, simulations

Although mGBL games are intended to be fun to play, the fun comes from challenge – the actual content is potentially serious and can include simulations of real-world scenarios, hence the terms ‘serious games’ and ‘simulations’. mGBL did not simulate crimes and violence, even for educational purposes. Guidelines for potential users of the authoring templates made this purpose clear.

3.3 Issues Related to Learner Diversity

3.3.1 Uniformity of access to mGBL products and services

Frankel and Siang (1999) remind us that ethical constructs that deal with justice and the administration of justice suggest that all individuals who participate in an activity should be able to do so with equal chances of success. In this connection, Rundle and Conley (2007) point out that the single greatest threat that use of new technologies poses to the right to education is the risk of stratification relating to income level and access to technology, i.e. learners who are unable to obtain access to the technology have fewer chances of success. As far as mGBL is concerned, a 'level playing field' for users was achievable only insofar as the games were designed for use with specific kinds of mobile phones that were identified by the developers as being suitable vehicles for the games and deemed by them to be accessible and affordable.

A potential difficulty for some members of the target audiences is, for example, their perception of colour and their receptiveness to text. As a supportive measure, therefore, where possible and appropriate, mGBL used icons as well as text and colour. Use of icons can, however, present its own difficulties. Signs and symbols can be subtle, and people may not be aware that a particular sign, symbol, or content item could be offensive to some groups. mGBL sought to address this via an iterative development process informed by field research that included focus groups engaging target audiences and via formal peer review of Deliverables.

3.3.2 Learning preferences

Anderson and Blackwood (2004) argue that the widespread use of the mobile phone as a social tool, including the physical sharing of phones between teenagers, may provide a foundation for newer forms of intensive collaborative learning. Nevertheless, some students who participated in mGBL may not actually learn or retain content as well through content mediated via mobile technologies as via other modalities and may not realise this. mGBL therefore helped users to make an informed choice of game component by identifying for each the intended learning outcomes, such as Bloom's revised taxonomy of learning objectives (Anderson and Krathwohl 2001) and target audiences such as Gardner's (1983) 'intelligences'.

3.3.3 Issues relating to cultural-linguistic diversity

Work in psychology and anthropology is making clear that all learning takes place in settings that have particular sets of cultural and social norms and expectations and that these settings influence learning and transfer in powerful ways (Keegan 2002). However, according to socio-cultural and historical theories (Vygotsky 1978), the cultural context evolves over time through the introduction of new cultural tools. mGBL games are themselves new cultural tools, designed for delivery within a blended learning framework. They have clearly defined learning goals (Anderson and Krathwohl 2001) and there is an opportunity to gear them to specific audiences, thereby supporting integration of the games within a particular learning context. However, there remain other important issues in designing learning materials for audiences in different countries and from different cultures; we highlight below issues related to language barriers and diverse legal protections and traditions and the mGBL approach to their resolution.

3.3.4 Language barriers

For resource reasons, English was the main language used in the mGBL platform and game implementations. In order to cater for the different languages spoken by the mGBL target audiences, for the user trials the mGBL games were translated into the languages of the participants. However, it must be noted that:

- for many target audiences, e.g. those in the UK, the official language of the country will in any case not be their first language
- delivery of learning content via mobile technologies requires use of short phrases, which might in some cases not provide sufficient context
- language being culture and context-bound means that there is not always direct translation from one language to another. This is particularly so with concept-related terminology

mGBL authors and translators, therefore, made a special attempt to use clear language, using peer review to optimise results.

3.3.5 Diverse legal protections and traditions

Finally, when it comes to mGBL scientific work and data collection, the different nations and cultures enjoy diverse legal protections and traditions

of ethical decision-making. Since mGBL may eventually entail a global scope, efforts to respond to ethical concerns and resolve ethical conflicts sought to take into account the inevitable diversity of national and cultural frameworks. Due to the multiple interpretations and applications of these issues to specific cases, and their refraction through culturally diverse emphases and values across the globe, the issues raised by mobile research are ethical problems because they evoke more than one ethically defensible response to a specific dilemma or problem. Within a pan-European project, a degree of ambiguity, uncertainty, and disagreement, it would seem, is inevitable, unless the stance on issues can be satisfactorily clarified via a broad, 'generic' protocol. Future users of mGBL may wish to develop culture/country-specific protocols that will supersede this. Meanwhile, for the lifetime of the project there was ongoing monitoring and response to any arising unforeseen ethical issues.

4 Summary

4.1 Confidentiality

In research projects, researchers and data technicians need access to data but must respect the confidentiality of that data and at the same time afford appropriate access to that data.

- mGBL response:
  mGBL identified and complied with ethical guidelines and requirements issued by professional and research associations and bodies (BPS 2006, ESRC 2006, BERA 2004, British Telecom 2006, BSA 2002), as well as institutional policies (e.g. Anglia Ruskin UREC Policy and Code of Conduct) and with legal requirements (e.g. the UK Data Protection Act 1998, the Freedom of Information Act 2000).

4.2 Informed Consent

mGBL needed to protect the rights of subjects who were contributing to the research and/or using mGBL products and services to privacy, confidentiality, autonomy, and informed consent. Researchers should agree the medium for both requesting and receiving informed consent that

best protects both the subject(s) and their project. In the case of minors, additional consent should be obtained from a parent/legal guardian.

- mGBL response:
  At the very beginning, when engaging research respondents/potential users, mGBL ensured informed consent in writing (using agreed medium) of participants and legal guardians regarding the project methods and outcomes. mGBL game users were required to log in to the mGBL platform, which entails the provision of a user ID and password. As log-in is voluntary, this information is gathered with the consent of users; it was stored securely so as to prevent misuse by third parties. The platform makes available User Guidelines that, for example, offered support in choosing a password (British Telecom 2006).

4.3 User and Provider Expectations

mGBL users are required to register and log on, therefore, they need access to a published policy that establishes specific expectations, those of providers and those of users.

- mGBL response:
  Statements notifying users that:
  - all the exchange of information is public, the possible technical limits that pertain to privacy.
  - indicating the duration and public/private nature of discussion/chats, postings, etc. are ephemeral, logged for a specific time, and/or archived in a private and/or publicly accessible location
  - were published on the mGBL website.

4.4 Training and Support

There are ethical and legal obligations to provide training, mentoring and support to teachers and learners who may not have the background or language skills to succeed in mobile games-based learning. For example, where blogs are used, e.g. in pervasive games, they may be subject to inappropriate use. Users of authoring templates should also have clear guidelines as to what types of content (e.g. violence) is not appropriate.

- mGBL response:
  - mGBL provided user guidelines and agreements for users of the games, e.g. guidelines on use of social software/a set of rules for participation to prohibit potential harassment, comment-spam, etc.

- mGBL provided guidelines for users of the authoring templates concerning appropriate choice of content.

4.5 Diversity

mGBL needs to cater for a 'level playing field' and for learner diversity.

> *"Accessibility means providing access to products and services to everyone who wants to access the product or service. Accessibility is about removing barriers. Accessible products can be adjusted to meet the needs and preferences of a diverse set of individuals that might use the products."*
>
> Microsoft 2007

- mGBL response:

Technologies used for delivery were easily accessible and clearly specified to potential users.

- Games were designed for use with specific kinds of mobile device that are readily accessible.
- As a supportive measure, where possible and appropriate, mGBL used icons as well as text and colour. Use of icons can, however, present its own difficulties (signs and symbols can be subtle, and people may not be aware that a particular sign, symbol, or content item could be offensive to some groups). mGBL sought to address this via an iterative development process informed by field research that includes focus groups engaging target audiences and via formal peer review.

4.6 Learning Outcomes

Some mGBL learner users may not realise that they do not actually learn or retain content as well through content mediated via mobile technologies as via other modalities.

- mGBL response:

  Participants were helped to make an informed choice regarding learner preference issues by identifying for each game component the intended learning outcomes, e.g. Bloom's revised taxonomy of learning objectives (Anderson and Krathwohl 2001) and target audiences, e.g. Gardner's (1983) 'intelligences'.

4.7 Potential International Ethical Issues

Finally, different countries enjoy diverse legal protections and traditions of ethical decision-making. As mGBL may eventually entail a global scope, efforts to respond to ethical concerns and resolve ethical conflicts must seek to take into account the inevitable diversity of national and cultural frameworks.

- mGBL response:
  The mGBL platform contains a statement explaining our stance on issues to minimise potential ambiguity, uncertainty and disagreement.

5 References

Anderson LW, Krathwohl DR (eds.) (2001) A Taxonomy Of Learning, Teaching, And Assessment: A revision of Bloom's taxonomy of educational objectives. Longman, New York

Anglia Ruskin University (2007) University Research Ethics Committee (UREC) Policy and Code of Practice for the Conduct of Research with Human Participants. Available at: http://www.anglia.ac.uk/ruskin/en/home/central/rds/services/research_office/research_degrees/ethics/urec_docs.html [accessed 18 July 2008]

Anderson P, Blackwood A (2004) Mobile and PDA Technologies and Their Future Use. In: Education. JISC Technology and Standards Watch 04-03. Available at: http://www.jisc.ac.uk/index.cfm?name=elearning_innovation [accessed 10 September 2007]

BERA (2004) Revised Ethical Guidelines for Educational Research. British Educational Research Association, UK

British Psychological Society (BPS) (2006) Code of Ethics and Conduct. British Psychological Society, Leicester. Available at: http://www.bps.org.uk [accessed 19 September 2007]

British Sociological Association (BSA) (2002) Statement of Ethical Practice. British Sociological Association. Available at www.Britsoc.co.uk/user_doc/Statement_of_Ethical_Practice.pdf [accessed 19 September 2007]

British Telecom (BT) (2006) Security Report: Online identity theft. Available at: http://www.webuser.co.uk/news/news.php?id=80488 [accessed 31 August 2007]

Carmichael P, Youdell D (2007) Using Virtual Collaboration Environments for Education Research: Some Ethical Considerations. In: Research Intelligence, News from the British Educational Research Association, August, issue 100, pp 26-29

Ess C, The AoIR Ethics Working Committee (2002) Ethical decision-making and Internet research: Recommendations from the AoIR ethics working committee. Approved by AoIR, November 27 2002. Available at: http://www.aoir.org/reports/ethics.pdf [accessed 10 September 2007]

European Parliament (1995) Directive 95/46/EC of the European Parliament and the Council of 24 October 1995 on the protection of individuals in the processing of personal data and on the free movement of such data. Richtlinie 95/46/EG des Europäischen Parlaments und des Rates vom 24. Oktober 1995 zum Schutz natürlicher Personen bei der Verarbeitung personenbezogener Daten und zum freien Datenverkehr, Nr. L 281 Amtsblatt der Europäischen Gemeinschaften

European Parliament (2001) Directive 2001/29/EC of the and the Council of 22 May 2001 on the harmonization of certain aspects of Copyright and the related protective rights in the information society. Richtlinie 2001/29/EG des Europäischen Parlaments und des Rates vom 22. Mai 2001 zur Harmonisierung bestimmter Aspekte des Urheberrechts und der verwandten Schutzrechte in der Informationsgesellschaft, Amtsblatt Nr. L 167 vom 22/06/2001 S. 0010-0019

European Parliament (2002) Directive 2002/58/EC of the Council, 12 July 2002 on the processing of personal data, and the protection of privacy in the electronic communications. Richtlinie 2002/58/EG des Europäischen Parlaments und des Rates vom 12. Juli 2002 über die Verarbeitung personenbezogener Daten und den Schutz der Privatsphäre in der elektronischen Kommunikation. Datenschutzrichtlinie für elektronische Kommunikation, L 201/37 Amtsblatt der Europäischen Gemeinschaften

Frankel MS, Siang S (1999) Ethical and Legal Aspects of Human Subjects Research on the Internet. American Association for the Advancement of Science, Washington, D.C. Available at: http://www.aaas.org/spp/dspp/sfrl/projects/intres/main.htm [accessed 10 September 2007]

Gardner H (1983) Frames of Mind. Basic Books, New York

Horniak V (2004) Privacy of communication – Ethics and Technology. Master Thesis in Computer Engineering, Department of Computer Science and Engineering, Mälardalen University, Västerås

Keegan D (2002) The Future Of Learning: From e-Learning to m-Learning. ZIFF Papiere 119, Fernuniversität Hagen. Available at: http://www.fernuni-hagen.de/ZIFF/papalle.htm [accessed 10 September 2007]

Kraut R, Olson J, Banaji M, Bruckman A, Cohen J, Couper M (2003) Psychological Research Online: Opportunities and Challenges. American Psychological Association, Washington, D.C. Available at: http://www.apa.org [accessed 10 September 2007]

Lonsdale P, Baber C, Sharples M (2004) Engaging Learners with Everyday Technology: A participatory simulation using mobile phones. In: Mobile Human-Computer Interaction, MobileHCI 2004, pp 461-465, Springer Berlin, Heidelberg

Microsoft (2007) Accessible Technology: A Guide to Educators. Available at: http://www.microsoft.com/enable/education/ [accessed 10 September 2007]

Relkin J (2006) 10 Ethical Issues Confronting IT Managers. TechRepublic. Available at: http://articles.techrepublic.com.com/5100-10878-6105942.html [accessed 10 September 2007]

Rundle M, Conley C (2007) Ethical Implications of Emerging Technologies: A Survey. Geneva Net Dialogue, edited by the Information Society Division, Communication and Information Sector, ed. Boyan Radoykov, UNESCO, Paris, p 92

Vygotsky LS (1978) Mind in Society: The development of higher psychological processes. Harvard University Press, Cambridge, MA [published originally in Russian, 1930]

Theme 2: Embedding serious games and virtual worlds within learning programmes

Exploring the Second Life of a Byzantine Basilica

Kristoffer Getchell, Alan Miller, Colin Allison
School of Computer Science, Jack Cole Building, North Haugh
St Andrews, FIFE, KY16 9SX, UK
+44 (0)1334 463253
{kg, alan, colin}@cs.st-andrews.ac.uk

Rebecca Sweetman
School of Classics, Swallowgate, Butts Wynd, St Andrews
FIFE, KY16 9AL, UK
+44 (0)1334 462600
rs43@st-andrews.ac.uk

Abstract

This paper introduces the Laconia Acropolis Virtual Archaeology (LAVA) project, a cooperative exploratory learning environment that addresses the need for students to engage with archaeological excavation scenarios. By leveraging the immersive nature of game technologies and 3D Multi-User Virtual Environments (MUVEs), LAVA facilitates the adoption of exploratory learning practices in environments which have previously been inaccessible due to barriers of space, time or cost (Collis 2001; Aitchison 2004; Colley 2004).

In this paper we present our experiences and reflections during the development of a virtual excavation based on a Byzantine basilica excavated by the British School of Athens during 2000-1 (Sweetman 2000-2001; Sweetman and Katsara 2002). We consider the benefits of allowing students to collaboratively manage and participate in a virtual excavation of the basilica and highlight how real-world findings can be used to provide an authentic virtual excavation experience. An infrastructure that supports a group-based exploratory approach is presented, which integrates 3D technologies into an existing learning management system to enable location-independent, self-paced access.

Keywords

Exploratory learning, Second Life, archaeology, computer games, *Quake*, collaborative learning

Introduction

Archaeology is a naturally engaging subject which has, as its core, a process of exploration that leads to the uncovering of our past. As such it would seem to be a subject which is particularly suited to the application of exploratory learning. As can be seen with the increasing popularity of films and television programmes dedicated to archaeological discovery, people are genuinely intrigued by the past, how our ancestors lived and the process of detective work that goes in to uncovering archaeological sites. However, the mass-audience appeal of archaeology through mediums such as film (Spielberg 1981), television (2008) and books (Cornwell 2000), does not automatically translate into educational contexts. Indeed, faculty and students are faced with a number of barriers to applying exploratory learning within the context of archaeology. The archaeological process is naturally destructive and unrepeatable, so the opportunities for students

Figures 1 and 2. Photographs of the excavated basilica site

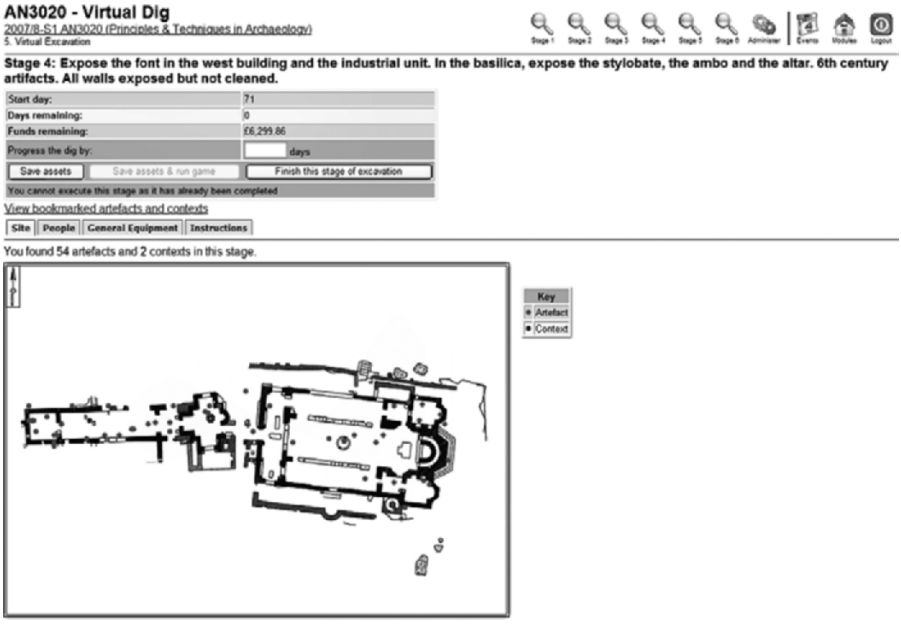
to learn within the context of real archaeological discoveries are naturally limited. In addition, there are significant financial and temporal costs associated with such involvement. Even when access to an excavation site is granted, student participation is limited to undertaking prescribed activities, with few opportunities to experiment with alternative techniques and working practices.

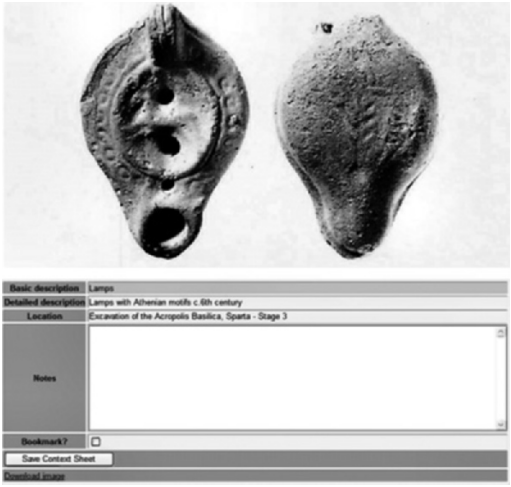
From an educational perspective it is desirable for the excavation process to be opened to a wider audience, with students empowered to assume roles of higher authority, so that they can experiment with working practices in order to more readily understand how archaeological processes impact the environment of the excavation site.

In much the same way as the World Wide Web opened up access to information through intuitive point and click graphical user interfaces, games and Multi-User Virtual Environments (MUVEs) like Second Life (LindenLab 2008) and *Quake 2* (idSoftware 2008) offer new and innovative opportunities for the development of realistic and engaging educational scenarios based in previously inaccessible environments. MUVEs provide a rich multimedia environment where interactions between learners can take place; they can be used to develop group working and social interaction and provide support for problem-based

learning. Consequently, MUVEs offer an environment that is rich in the potential for developing multimedia content, which allows access to realistic models of otherwise inaccessible environments to be developed and explored by students.

An important component of the learning process facilitated by MUVEs is the ability to 'learn through doing'. To support this type of experiential learning, we have developed a virtual excavation which is based upon the excavation of a Byzantine basilica explored by the British School of Athens (Sweetman 2000-2001; Sweetman and Katsara 2002). Realistic learning scenarios containing real world excavation data (as shown in Figures 1 and 2) are presented to students. Using management interfaces delivered through the intuitional learning management system (LMS) (as shown in Figures 3 and 4), and the basilica reconstruction and visitor centre in the MUVE (as shown in Figures 5 and 6), students can manage their excavation and present their findings in an intuitive and creative way.





Figures 3 and 4. Screenshots of 2D Excavation Management Interface

Figure 5. Second Life Basilica Visitors Centre

Figure 6. Second Life reconstruction of the basilica

The Student Experience

The aim of LAVA is to allow students to engage with archaeology and practice archaeological research methods, with students progressively moving through the system as they develop their skills and understanding.

Initially, students are introduced to the Sparta region of Greece and asked to explore the acropolis upon which the Byzantine basilica, which they will later excavate, is located. With the basilica nearly completely in ruins, and the acropolis covered in deep overgrowth, finding the basilica is not a straightforward task. Students, who are grouped into teams, need to look for archaeological clues whilst reviewing a variety of 3D panoramas in order to locate sites upon which the basilica may be located. Following an inconclusive initial search of the acropolis, the teams are faced with a number of possible sites. In order to determine the location of the basilica, they must refocus their efforts, interpreting geophysical data and using other archaeological surveying techniques to further refine their shortlist. Once they are happy that the location of the basilica has been identified, each team needs to submit a proposal to obtain an agreement from a virtual research council to provide funding for a virtual excavation of the site.

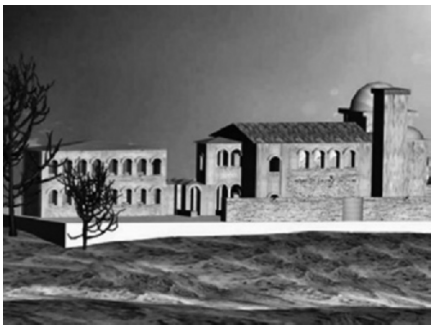
When this agreement, facilitated by the Module Coordinator, has been achieved, teams must develop a firm budget and excavation plan which outlines the type of excavation work they wish to undertake on the site.

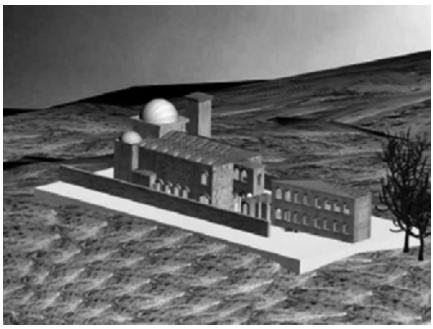
Using knowledge gained from lectures, the LAVA system and third party sources, teams collaboratively draft an excavation plan and budget. With only finite funding resources available from the virtual research council, the teams know that they are competing for funding, with the strength and validity of their applications having a direct impact on the level of funding awarded. Applications for funding are only accepted by the research council during a two-week time period. During this time, teams are given access to a consultant, through the Module Coordinator, who is able to provide advice on constructing a funding application. Teams are free to use this advice service as they wish. However, they must submit their applications within the application period if they wish to be considered for a funding award.

Once the application period has closed, the virtual research council assesses the value of each application, considering its strength and likelihood of success. Funding is then awarded to each student team, and their excavation work can begin.

Using a variety of techniques borrowed from the gaming world, the excavation process is broken down into a series of contiguous stages, with teams progressing to the next level only once they have shown a certain level of competence at the current activity being attempted (Malone 1980).

During the excavation work, teams must manage their finances





Figures 7 and 8. 3D models of the reconstructed basilica

carefully, ensuring that they employ people with the correct skills, provide them with the correct equipment and give them enough time in order to successfully excavate different areas of the site. Throughout the excavation process, the teams are able to adjust the levels of resources that they apply

in order to maximise the quantity of material culture that they discover during the excavation. Remembering that excavation work is destructive in nature, teams should initially draw on knowledge gained from lectures and third party sources to manage their excavation plan, using increasing amounts of their own judgement as they become more familiar with the site and build up an understanding of how the various excavation techniques will affect it. Of course, in the real world, applying the same excavation technique is not guaranteed to lead to the same result each time – sometimes a technique will be successful, and sometimes not. To address this issue within the LAVA environment, a degree of chance is introduced. Initially, chance will play a relatively large role in determining the success of a team's efforts. As they become more adept at fine tuning the personnel, equipment and time allocated to each excavation activity, the impact that chance has on the outcome is reduced. However, there is always an element of chance influencing the outcome of each activity, so even with perfectly set up parameters, each excavation project will provide a different set of outcomes. Not only does this help differentiate each excavation, but it also encourages engagement, as teams cannot reliably predict the outcome of their efforts ahead of time.

Throughout the excavation process, teams will uncover a rich variety of material culture which they must examine. Some of the artefacts found will be of significance and some not. Depending on the resources allocated to each activity, teams will be given one of three levels of information, with the full information about an artefact only being revealed if the team has allocated the correct archaeological expert to the activity:

1. No information, just a photograph of the artefact
2. Basic information accompanied by a photograph of the artefact
3. Full information accompanied by a photograph of the artefact

Of course, teams are free to consult external sources of information when identifying artefacts and can, as they wish, allocate specialists to examine previously found items in order to reveal the full information held on a specific item.

As the excavation progresses, teams will need to maintain accurate context sheets and site logs, just as they would do on a real excavation project, if they wish to make use of any of the information they reveal about an artefact. Should teams neglect to maintain this information, when they come to analyse and prepare their findings for presentation in a virtual exhibition, the team will quickly realise that they have lost all contextual information associated with each of the items. This will force them to rely on external sources of information in order to determine the significance of their findings, just as they would do in a real excavation scenario. Whilst

this process can prove to be successful, it is likely to take longer and require more effort than maintaining the original contextual information gained during the excavation work.

Once the team has finished excavating the site and cataloguing the finds that they have made, they will present their research in a public forum as per their agreement with the virtual research council. To do this, they curate an exhibition of the significant findings of their excavation work in the Second Life Basilica Visitor Centre, as shown in Figure 5. The inputs for this exhibition are sourced directly from the finds they discovered during the excavation process. Consequently, for each team, different sets of artefacts will be available. To enable this, state is created from the excavation game process, and made available to Second Life. The architecture used to achieve this is discussed in the next section.

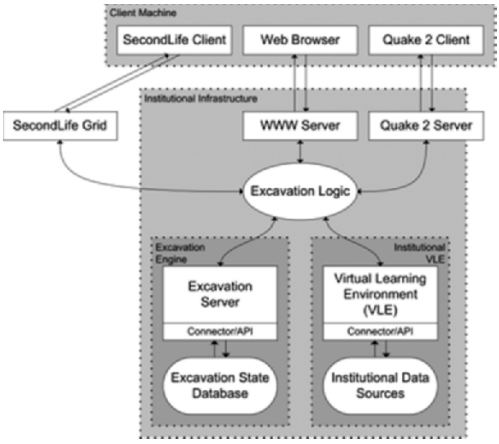


Figure 9. LAVA integration with existing systems

The exhibition is made up of photographs and 3D models of artefacts, maps and drawings of the site, videos of the site pre and post-excavation, as well as other interactive multimedia displays. Each exhibition will be visited by a representative from the virtual research council (in the form of the Module Coordinator), students of the other teams who have undertaken a virtual excavation and members of the public. During the unveiling of a team's exhibition, the team will be available to guide their guests around the exhibits in the visitor centre and reconstructed basilica, answering questions from the audience as required.

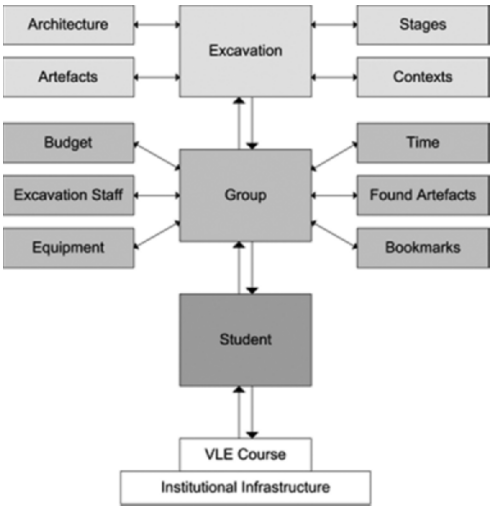


Fig. 10. The internal excavation model maintained by the LAVA excavation logic

To accompany the public exhibition, an excavation report is published by each team, which describes the findings of their excavation work and highlights the successes of the approaches adopted. Following the completion of the exhibition in Second Life, each team meets with staff from the virtual research council to answer any questions that they may have, prior to submitting the excavation report for final assessment.

System Architecture

The LAVA project has used a number of technologies to meet the educational goal of supporting exploratory learning within the context of archaeological excavation. The architecture we present here allows us to integrate these technologies so that each is cognisant of the relevant actions undertaken by learners in other parts of the system. In particular, we borrow from the model-view controller architecture, which allows us to maintain a single set of consistent state, but to have multiple views on that state. Thus, the learner will interact with 2D maps of the excavation site, applying resources and other management functions, with the results of these activities made available to Second Life for the creation of the virtual exhibition. This architecture is flexible and has allowed us to investigate

the value of using other technologies, such as First Person Perspective Games, i.e. *Quake 2*.

Figure 9 provides an overview of how LAVA integrates with existing institutional infrastructure, utilising resources and services provided by the institution (i.e. the *Quake 2* game server and the institutional LMS) and external organisations (i.e. the Second Life grid provided by Linden Labs). By integrating with services both internal and external to the host organisation, LAVA is able to provide a varied interface to students. Not only does this provide students with the opportunity to choose their preferred method of interaction with the system, but it also allows for services from other systems to be utilised in the framework; for example, authentication through the institutional LMS allows individual students to be authenticated so that excavations can be tailored specifically for each team.

From a student's perspective, the framework supports three modes of interaction, with teams able to manage their excavation using a web interface containing a variety of textual, graphical and audio-based resources delivered through the LMS as shown in Figures 3 and 4. The 3D interactive environments offered by the *Quake 2* game engine and the Second Life grid allow students to undertake a more exploratory role, examining the excavation site from a variety of 3D perspectives similar to those in Figures 5 and 6.

Although each mode of interaction is managed by separate systems, a shared model is maintained by a centralised component, the excavation logic, which ensures consistency throughout the framework. Within the excavation logic, each instantiation of an excavation is maintained using a series of database tables as shown in the model depicted in Figure 10. By maintaining a centralised excavation state, coordinating changes to it and providing timely propagation of state changes, the excavation logic ensures that a consistent view of the excavation is presented across a variety of different systems which may span multiple administrative boundaries.

The 3D Environment

In order to enable students to explore and understand an excavation site it is important that they are able to access realistic materials in an environment that encourages self-motivated discovery. When developing the excavation simulator, three different types of 3D environment were considered: first person perspective (FP) games, multi user virtual

environments (MUVEs), and virtual reality reconstructions/panoramas. Each category of 3D environment was evaluated against five key requirements:

- Engagement: The use of a 3D environment has a direct impact on the student experience when using LAVA. Providing an environment that students are likely to be familiar with can build a sense of confidence and encourage students to engage with the subject matter by exploring their surrounding environment. An environment that stimulates interest is also far more likely to encourage participation and engagement.
- Realism and Context: In addition to encouraging self-directed learning, the 3D environment should also allow realistic archaeological information to be provided within the context of the site itself. Whilst photographs, videos and textual descriptions embedded in web pages are informative, the visualisations offered by a 3D environment should aim to be more akin to the type of experience a student would have on an excavation site, with avatars interacting with the virtual site in a similar way to humans interacting with a real site. In addition, it should also be possible for contextual relationships between items to be preserved, with artefacts embedded in the excavation site for students to examine in situ.
- Synchronous Access and Collaboration: With multiple members of staff working on different areas of an excavation, collaboration between staff is an important aspect of the team dynamic on a real excavation. The 3D environment should reinforce the importance of such interactions in the virtual setting, allowing students within a team to see each other on an excavation and communicate as required.

When considering each of the three classes of 3D environment, it quickly became apparent that while the virtual reality reconstructions/panoramas could provide realistic and contextual site data, they struggled to encourage engagement owing to their passive nature; they provide only a snapshot of a real environment and as such do not provide opportunities for users to interact with the environment.

In contrast, both FP games and MUVEs are able to fulfil each of the five key requirements. Both provide a familiar first-person perspective (or close approximation thereof) onto a virtual environment that supports interactions between users and the environment. Both allow for undirected exploration, thereby encouraging student engagement and stimulating interest in the information provided. Both allow multiple students to simultaneously access a shared environment, with tools to enable synchronous communication and therefore group collaboration. Superficially, then, the choice between first-person perspective games and

MUVEs seems to be an arbitrary decision. However, there are two subtle differences between the ways that the two technologies operate that has a serious impact on the ways in which the two environments can be used:

Environment: FP games assume a closed, carefully controlled world which consists entirely of the game map in question (in our case an excavation site). Multiple different game maps can be instantiated simultaneously, with users deciding which map to enter when they connect to the game server. Once in a game map, players cannot move to other maps, and as such it is possible for them to be constrained to a pre-determined environment that does not alter the state of any other game maps which have been instantiated simultaneously. In contrast, MUVEs consist of a single environment, hosted on multiple servers, which is shared with all users, regardless of which server they connect to. As such, users of a MUVE are able to leave their designated area and explore other regions at their discretion. They can also interact with other MUVE users which could, in our situation, involve members of other excavation teams who are using the MUVE.

Control: MUVEs are generally hosted on multiple servers, maintained by a single entity that is tasked with ensuring the availability of the MUVE. Users are able to connect, explore and shape the shared environment, modifying it (where allowed) using tools provided by the MUVE client. Individuals and institutions can purchase areas of the shared environment from the entity overseeing the system. This often confers additional controls, for example, allowing the new land owner to control access, edit and otherwise maintain his 'property'. The control model in FP games is substantially different. There is no concept of land ownership in an FP game, and as such no hierarchy of ownership – all users in the environment are treated equally, with the game server operator the focus of control. Unlike with MUVEs, if a user is unhappy with the maps on offer or rules enforced on one server, he can easily connect to different servers which offer a more favourable environment – this is something users of MUVEs cannot do owing to the single shared environment.

When considering the differences between FP games and MUVEs, it becomes clear that each environment has strengths in a different aspect of a LAVA dig and as such two 3D technologies are adopted:

The FP game model more closely fits with the need to allow many simultaneous excavations to be undertaken independently, thus working well as the basis for the excavation undertaken in stage three of LAVA. Not only can the separation enforced by the game engine ensure that students do not 'cross over' into another team's excavation, but it can also constrain their efforts to the site of interest, thus making it more difficult for students to go off course and excavate an entirely wrong region!

When intra-team cooperation is required, and possibly input from the wider community, the MUVE model works well. When considering the reflection process undertaken in stage four of LAVA, the ability for multiple teams to review a reconstruction of an archaeological site is beneficial – teams will be able to share ideas, critique the reconstruction and reflect on how successful their excavation work and subsequent publications were at identifying features of the archaeological site.

Evaluation

The core of the LAVA system has been deployed and evaluated over two consecutive academic years. Students in credit-bearing archaeology modules have completed a number of virtual excavations, both as part of a team and also individually. The trials, usually undertaken during class hours, have been voluntary, with students able to opt out as they wish. The uptake and completion rates of the trials have generally been high, with a sizeable number of students volunteering completing their participation in individual evaluation sessions focusing on specific components of the LAVA system.

When evaluating the system as a whole, a two-pronged approach focusing on the usability of the system and the educational benefits that it offers has been adopted. The opinions of student participants have been collected using questionnaires broken down into three sections that included questions on system usability using the System Usability Scale (SUS) (Brooke 1996), educational aspects of the system and freeform feedback questions designed to allow respondents to give us unsolicited feedback. In addition, group observations and individual interviews have been conducted to gain more specific information about key aspects of the system.

Full details of the evaluation process and the resulting conclusions are discussed in detail (Getchell, Nicoll et al. 2007). To summarise, the initial findings have been positive, with responses to the educational value and SUS sections of the evaluation resulting in distribution skewed to the right as shown in Figure 11.

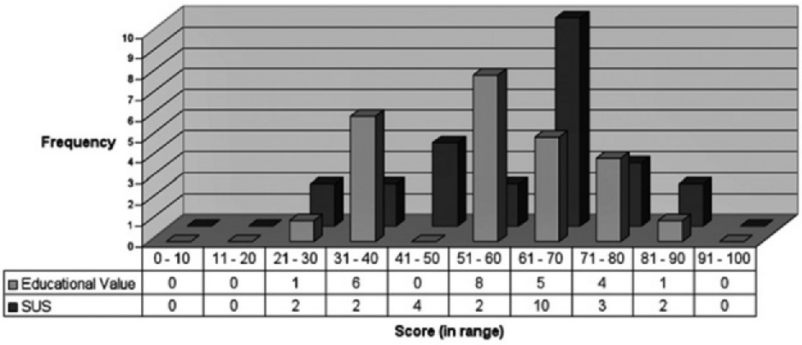


Figure 11. LAVA SUS and Educational Value scores

In addition, a number of encouraging user responses have been obtained:

> *"The personal touches to the employable individuals added a friendly, approachable touch to the system.…Enjoyable session with insight into the excavation process…I liked the photographs of artefacts and gradual revelations made by each stage.…Helpful to understand what is needed in an excavation...I liked the fact that it was interactive…I think it's some way off being a polished application but I think it has SERIOUS potential. The program takes a lot of what we've learnt and gives it a bit of substance and that's got to be good."*

Both course coordinators and domain experts in the field of archaeology agree that the use of LAVA has been well received by students. Indeed, many student respondents have indicated that they feel that the system was easy to use and that it had a positive impact on the courses in which they have used the system.

It is promising that our initial findings seem to indicate that the adoption of gaming methodologies can have a positive impact on the educational benefits of a course. As part of an extended evaluation process, there are plans to undertake further evaluation sessions which will focus on the benefits that the 3D *Quake 2* and Second Life interfaces offer over and above the core LAVA web interface.

Acknowledgements

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References

(2008) Time Team, Channel 4 Television

Aitchison K (2004) Supply, demand and a failure of understanding: addressing the culture clash between archaeologists' expectations for training and employment in 'academia' versus 'practice', World Archaeology 36(2): pp 203-219

Brooke J (1996) SUS: A 'quick and dirty' usability scale. Usability Evaluation in Industry. PW Jordan, B Thomas, BA Weerdmeester and AL McClelland, Taylor and Francis, London

Colley S (2004) University-based archaeology teaching and learning and professionalism in Australia. World Archaeology 36(2): pp 189-202.

Collis J (ed) (2001) Teaching archaeology in British universities: A personal polemic. Interrogating Pedagogies: Archaeology in Higher Education. Oxford, UK, BAR International Series 948

Cornwell B (2000) Stonehenge: A Novel of 2000 BC. HarperCollins, London.

Getchell K, Nicoll J et al. (2007) Evaluating Exploratory Learning in LAVA. IASTED Web-based Education, Chamonix, France, IASTED

idSoftware (2008) "Quake II". Retrieved 15 December 2007, from http://en.wikipedia.org/wiki/Quake_II

LindenLab (2008) "SecondLife". Retrieved 15 January 2008, from http://secondlife.com/

Malone T (1980) What Makes Things Fun to Learn? A Study of Intrinsically Motivating Computer Games. Department of Psychology, Stanford, California, USA, Stanford University, PhD

Spielberg S (1981) Raiders of the Lost Ark, Lucasfilm

Sweetman R (2000-2001) "The Sparta Basilica Project". Retrieved 1 June, 2006, from http://www.bsa.gla.ac.uk/research/index.htm?field/recent/spartabasilica/main

Sweetman R, Katsara E (2002) The Sparta Basilica Project 2000 – preliminary report. Athens, BSA: pp 429-468

Learning Programming with an RTS-Based Serious Game

Mathieu Muratet
Patrice Torguet
Jean-Pierre Jessel
IRIT, Paul Sabatier University
05 61 55 63 13
muratet@irit.fr, torguet@irit.fr, jessel@irit.fr

Abstract

This paper presents a prototype of a serious game that aims to entice gamers to learn computer programming by using a multiplayer real time strategy game (RTS). In this type of game, a player gives orders to his/her units to carry out operations (i.e. moving, building and so forth). Typically, these instructions are given by clicking on a map with the mouse. The goal of this project is to encourage players to give these orders through programming. This game is intended for computer science students in higher education and can be used across both university and professional curricula. The programming languages used are C or C++.

Keywords

Serious games, programming, real time strategy

Introduction

In recent years, students have become less interested in science (including computer science). According to the figures given by Crenshaw et al. (2008) and Kelleher (2006), the number of students registered for computer science courses has decreased. Our university has experienced

the same phenomenon. with a decrease of 16.6% in students studying computer science over the last four years. To recruit and retain students in our university, we have studied the potential of serious games. We believe this kind of software can increase students' interest in computer science. Therefore, we chose to use a serious game to teach programming.

Serious Games

The term 'serious game' is widely used, yet has many definitions. Depending on which definition is used, it is possible to consider e-learning, edutainment, game-based learning or digital game-based learning as serious games (Susi et al. 2007). The critical point of serious games is the relationship between the game and educational content, as Zyda (2005) points out, 'Pedagogy must, however, be subordinate to story – the entertainment component comes first.' If the game is attractive, fun and stimulating, and encourages the user to progress, then the player automatically learns skills and absorbs a lot of information. A serious game is a video-entertainment purchase opportunity, not only for children but also for the general public. It is this approach that has enabled *America's Army* (Zyda et al. 2003) to become the first really successful serious game.

Presently, serious games exist in several fields, such as education, government, health, defence, industry, civil security and science (Social Impact Games 2006). Different types of serious games will evolve depending on the target audience:

- For the general public, serious games can be used for increasing awareness of the main problems of health, safety or environment.
- For universities or companies, serious games must be able to provide a more complete and accurate knowledge depending on the user level. The goal is to enable learners to address problems in their environment in order to solve them.
- For more specific training, serious game-based immersion can provide physically realistic simulations. These games use underlying mathematical models, in order to prepare the people to respond to critical situations.

Serious games must be created according to the needs and expectations of different working sectors and the public, and within the available resources (physical and financial) for their implementation. Blackman (2005) gives a synopsis of the gaming industry and its applications to the general public. Increasingly sophisticated video game graphics engines, for example, may

be used for non-game applications because they often offer real-time rendering and realistic physical models. Applications such as training, and interactive visualisations and simulations already use video game technologies. We think that serious games will play an increasingly important role in education in the foreseeable future.

Thus, developments in serious game applications are booming, but few of them are designed for computer science and only a minority of those are intended to teach computer programming.

Related Work

Computer science is a broad subject with many fields. Learning how to program a computer is a very important element of this subject and various software applications have been created to help students learn how to write programs.

Some of this software uses block-based graphical languages. This programming metaphor allows the student to detach him or herself from syntax and to experiment with programming. For example, *StarLogo: The Next Generation* (Klopfer et al. 2005), *Scratch* (Maloney et al 2004), *Alice2* (Kelleher et al. 2002) and *Cleogo* (Cockburn and Bryant 1998) use this approach.

Another method involves using competition to motivate students, which is the basis of both the Robocode project (Nelson 2001), and the international event RoboCup (2007), and which involve programming Artificial Intelligences (AI) for robots.

Other attempts to hook the player and encourage him or her to learn programming use video games. The WISE (Wireless Intelligent Simulation Environment) project (Cook et al. 2004), for example, is an interactive game environment which combines virtual and physical games. *Colobot* (Epsitec 2007) is the only example, as far as we know, of a complete video game which mixes interactivity, story and programming. In this game, the user must colonise a planet using robots that he or she is able to program.

As noted above, we think that serious games are an effective teaching method. With the exception of Robocode, WISE and *Colobot*, we do not consider the software packages listed above as video games. Moreover, Robocode, WISE and *Colobot* do not fill our criteria: Robocode lacks interactivity, as the player is inactive during the simulation and is merely a spectator of his/her AI; *WISE* requires a number of resources (i.e. space, robots, and so on); *Colobot* lacks a multiplayer mode, which is useful to

motivate players by offering collaborative and competitive options (Johnson and Johnson 1994).

Nevertheless, our work relies on these tools. We propose to teach programming via an entertainment, interactive and multi-user platform. For these reasons, we chose a popular gaming genre and an existing multiplayer video game. We upgraded it to enable control of entities through programming. In other words, our tool is a multiplayer video game where programming is a feature of the game.

Educational Content

Our goal is to use a serious game to provide alternative and/or complementary methods to traditional systems for teaching students how to program. The game is intended for computer science students in higher education. It allows them to implement several styles of coding such as imperative, object-oriented, event or parallel programming using C or C++ programming languages (commonly used in industry nowadays). These characteristics make it possible to use this technique in all types of teaching.

From the user's perspective, the compiled code is dynamically and interactively integrated into the game. The game consistency is kept with a set of linkage and synchronisation mechanisms which are totally invisible to the player. This leaves the player free to concentrate on the game.

The game supports different degrees of abstraction, which allows it to be used at any level of training. Beginners, for example, only have access to a minimal interface, which is used to give simple orders to units. On the other hand, more experienced students can have access to the full engine implementation, and they can, therefore, apply complex concepts to develop a sophisticated application.

System Description

To support our system, we chose to use a type of game familiar to players: Real Time Strategy (RTS). In this game category, the player leads an army composed of units. He or she can interact with the virtual environment by giving orders to his/her units to carry out operations (i.e. move, build and so on). Usually, these orders are given by clicking on a map with the mouse. Our goal is to encourage the player to give these orders through programming.

Since we did not intend to develop a new RTS engine, we looked for an existing game to use as a starting point. Any such game must both meet our expectations and be able to incorporate our improvements. Fortunately, some open source projects exist, such as Open Real-Time Strategy (ORTS) and the Spring project (Spring 2006), both of which are multiplayer 3D real-time strategy games (Figure 1).

ORTS (Buro 2002; Buro and Furtak 2005) has been developed to provide a programming environment for discussing problems related to AI. This game is designed to allow the user to easily program and integrate his/her AIs. ORTS also incorporates a multiplayer mode, which is important to us because, in the future, we intend to focus our serious game on competition and collaboration, as we think that this will increase students' motivation and investment. Eventually, we would like to develop a massively multiplayer online game (MMOG) version, and thereby create a persistent environment where it would be continually possible to do programming in a playful way.

Fig. 1. Left: ORTS. Right: Spring

Recently, we have also managed to integrate our module into another game engine, Spring, in order to ensure its independence from ORTS. This engine is completely different from ORTS, both in its network architecture and in its internal design. However, we were able to transplant our module onto this game with only minor modifications.

Technical Aspects

Our objective is to allow players to write code and to integrate it into the game where it will be run. In this way, the player can observe the implementation of his/her code through the behaviour of his/her units in

the video game. But in ORTS, each code modification results in the interruption of the execution of the program, which is then rebuilt and restarted for changes to take effect. This is a key element of compiled programming languages such as C++, which is used by ORTS. In the first stage of our project, therefore, the first issue to resolve was how to integrate players' code into the game engine without having to stop, or recompile it. This improvement allows greater interactivity because the player is able to modify, compile and integrate his/her code without stopping the game, which consequently maintains its progress and coherence.

Moreover, we also wanted programming beginners to be able to use the prototype. Their main concern is to understand the concepts and principles of this discipline. So, to assist them, we have hidden any additional difficulties related to the complexity of the game engine so that they can focus on their goals.

To solve these problems, we could have chosen a scripting language, but for performance, we chose to use a dynamic library and to design a simple application programming interface (API) to the game engine.

Dynamic Library

The semantics of the term 'dynamic library' defines its purpose. The library provides functions that can be called up and executed by the program that uses it. As for the concept of dynamic, it determines that the library can be loaded, used and discarded during execution.

In our application, the library contains the code written by the player and defines the behaviour of his/her units. The game uses this library to identify which actions to carry out. Each modification of the library triggers the loading of the new AI. If no library is accessible, no automatic processing will be executed. Through this principle, the code containing the behaviour of units is completely independent of the game. In this way, the player can change his/her code and recompile it as a library to be automatically integrated into the game. Although the library is normally sufficient in itself, our application requires access to the ORTS toolbox to manipulate library data. It was, therefore, necessary to modify the game engine to enable the library to access elements of the game.

The library implements the player's code in a thread in order to allow the client to remain active and responsive to the user's (or server's) actions. Thus, complex behaviours can be programmed in the library without influencing the game's performance. As parallel programming introduces additional difficulties in the execution, this programming type

requires the implementation of synchronisation mechanisms between various processes in order to ensure the consistency of shared data. The player, however, is not aware of this.

We have also tried to ensure system reliability by protecting it against players' coded bugs. Since the player is involved in a learning process, it is highly likely that he/she will make mistakes. These errors can cause system failures (i.e. segmentation faults, for example), or raise exceptions. However, as noted above, we have specified that the library is performed in a thread. This feature has been used together with system signals to identify errors triggered in the library. So, when an interruption occurs in the AI, only the thread running the library is interrupted. Information is then given to the user to warn him/her of the error type that stopped his/her AI. In this way, game execution is not dependent on AI malfunctions.

The use of a dynamic library has an added advantage in that it hides from the player the complexity of the video game. As noted above, the player must write the code corresponding to the behaviour of his/her units. As a general rule, to be able to change a part of a program requires analysis of the structure, organisation and operation of the application. The dynamic library helps the player by extracting AI from the game. In this way, the user is not aware of the difficulties associated with the integration of his/her code in the game engine.

Development Environment

The dynamic library gives the player the opportunity to amend his/her code in an interactive way. It assists his/her work by hiding the game's complexity. However, use of the application remains tedious, because of the game's architecture and its file tree. To help the player further, it is necessary to make the software more intuitive. For this reason, we have developed an interface called the Development Centre (DC) (Figure 2).

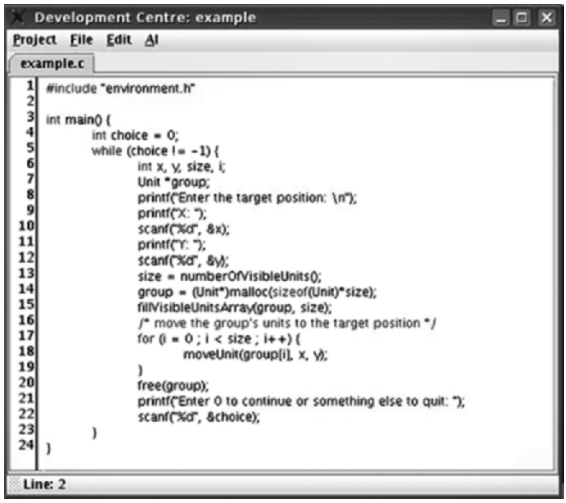

Fig. 2. The Development Centre

The Development Centre is a component that facilitates the design and manipulation of the player's objectives. It is automatically launched at the beginning of the game to manage the projects through a series of menus. However, the DC is independent and is not necessary for the operation of ORTS and vice versa. Its purpose is to hide the mechanisms of synchronisation and linkage between the player's code and the game. Thus, the player starts by creating his/her classic function 'int main (){...}', as if his or her code was independent of the game. He or she can then use one set of functions (defined according to the programming knowledge of the player – the goals, for instance) to manipulate entities in the game. The player can then easily compile and inject his/her code into the game engine and see the results.

Overview

Our application is composed of three entities (Figure 3): the game engine, the dynamic library, and the DC. In order to develop our software, we had to modify the game engine by adding a synchronisation tool ('Monitor'), a class (i.e. a section of Java program) that manages the dynamic library ('Loader'), and a façade class (i.e. an interface) allowing access to the game data (called 'State'). These entities are described in detail below. The dynamic library consists of an interface that allows its use (i.e. the User

Code Management Interface (UCMI), which permits control of the behaviour of the thread), and a thread that executes the player's code.

The 'Loader' is designed to manage the dynamic library. If the dynamic library is created or is changed it reloads it. The 'Loader' is also used to pilot the thread through the UCMI to maintain the same version in both the library and the thread.

The 'Monitor' synchronises the thread and the 'Loader' in a way that respects the integrity and consistency of the game progress. The player's code, carried out in the thread, can access the game information through the 'State' class. This class serves as an entry point into the game data.

Finally, the DC allows the player to modify his/her code, to compile it in a dynamic library, and to notify the game engine that the code is changed and it is time to update it.

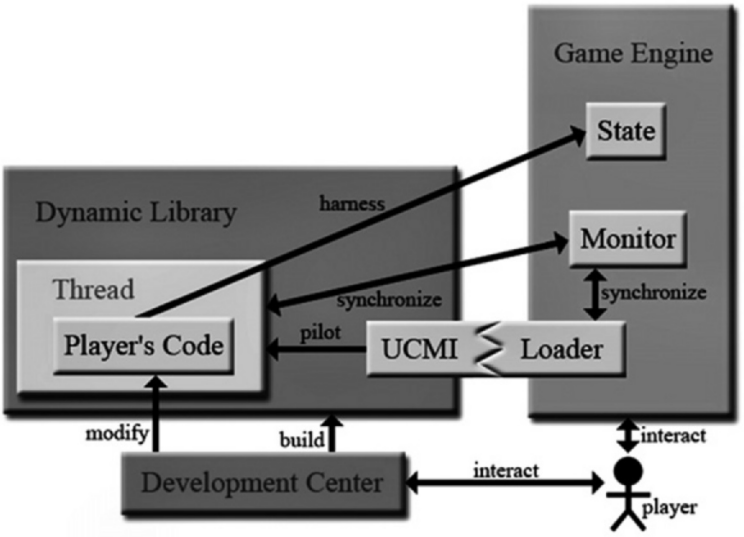

Fig. 3. Architecture

Conclusions and Future Work

In this paper we have described a serious game prototype designed to teach computer programming in a fun and interactive way. This approach is motivated by the decrease in the numbers of students studying computer

science. The application consists in adapting a game engine so that it can integrate some code during its execution. This software allows, unlike other applications for learning how to program, the interactive manipulation of two widely used programming languages: C and C++. This prototype enables novice or experienced students to enjoy themselves while developing computer programs. Furthermore, we have established that our adaptation could be easily integrated in other RTS game engines (such as Spring). This allows the selection of the best game according to the learning objectives, and the development of the game to keep pace with the rapid evolution of video game standards.

However, the serious game, in itself, does not yet exist. We still need to create a scenario which will involve the player so that he or she is encouraged to learn programming.

The next step is to conduct experimental field work. We have started to work with collaborators from our university's learning and teaching support service, a didactic specialist and professors and students. We want to discover the breadth of teaching applications supported by our system, as well as the range of potential audiences and teaching methodologies. Analysis of our experiments will explore and resolve potential issues concerning usability and effectiveness. At the same time, it will be important to determine how users switch between game play and coding elements.

We plan to develop a scenario builder, which will enable teachers to easily create fun lessons, including educational aspects, in order to engage and motivate the students.

RTS mainly work on P2P (i.e. Peer-to-Peer) architectures and the simulation is duplicated at each peer. For every simulation step, each peer synchronises its simulation with other peers. This architecture is not scalable (i.e. is unable to process fast enough the number of updates per second required by large numbers of players to mimic real time) and therefore limits the number of players. However, ORTS has a client-server architecture, which is used in massively multiplayer online role-playing game (MMORPG) systems, that makes it possible for thousands of users to share their experiences in a persistent virtual world for collective training. However, the subject of MMORTS has only been explored slightly, leaving open opportunities for exciting research.

Finally, the DC allows easy use of the software, but it could be improved in order to facilitate interaction with the virtual environment. It would also be interesting to set up an optional system of block-based graphical coding with drag and drop as in *Alice2* or *StarLogo: The Next Generation*. This would help beginners, relieving them of the C or C++ syntax.

All these enhancements will allow our application to become a massively multiplayer online serious game (MMOSG) and, more precisely, a massively multiplayer online serious real time strategy game (MMOSRTS), where the only boundaries are the imaginations of the players' and teachers'.

References

Blackman S (2005) Serious games...and less!. In SIGGRAPH Computer Graphics 39(1), pp 12-16

Buro M (2002) ORTS: A Hack-Free RTS Game Environment. In: 3rd International Conference on Computers and Games. Edmonton, Canada, 25-27 July 2002, Springer: Berlin

Buro M, Furtak T (2005) On the development of a free RTS game engine. In: 1st Annual North American Game-On Conference, Montreal, Canada, 22-23 August 2005

Cockburn A, Bryant A (1998) Cloego: Collaborative and Multi-Metaphor Programming for Kids. In: 3rd Asian Pacific Computer and Human Interaction, Shonan Village Center, Japan, 15-17 July 1998, IEEE Computer Society: Washington DC, USA

Cook DJ, Huber M, Yerraballi R, Holder LB (2004) Enhancing Computer Science Education with a Wireless Intelligent Simulation Environment. In: Journal of Computer in Higher Education 16(1), pp 106-127

Crenshaw TL, Chambers EW, Metcalf H, Thaklar U (2008) A case study of retention practices at the University of Illinois at Urbana-Champaign. In: 39th ACM Technical Symposium on Computer Science Education. Portland, Oregon USA, 12-15 March 2008

Epsitec (2007) Colobot. Available at: http://www.ceebot.com/colobot/index-e.php [accessed 21 September 2007]

Johnson RT, Johnson DW (1994) An overview of cooperative learning. Originally published in Thousand J, Villa A and Nevin A (eds), Creativity and collaborative learning. Brookes Press, Baltimore

Kelleher C (2006) Alice and the Sims: The story from the Alice side of the fence. In: the Annual Serious Games Summit, Washington, DC, USA, 30-31 October 2006

Kelleher C, Cosgrove D, Culyba D, Forlines C, Pratt J, Pausch R (2002) Alice2: Programming without Syntax Errors. In: 15th Annual Symposium on the User Interface Software & Technology, Paris, France, 27-30 October 2002

Klopfer E, Yoon S (2005) Developing Games and Simulations for Today and Tomorrow's Tech Savvy Youth. In: TechTrends: Linking Research & Practice to Improve Learning 49(3), pp 33-41

Maloney J, Burd L, Kafai Y, Rusk N, Silverman B, Resnick M (2004) Scratch: A Sneak Preview. In: 2nd International Conference on Creating Connecting, and

Collaborating through Computing, Keihanna-Plaza, Kyoto, Japan, 29-30 January 2004, IEEE Computer Society: Washington DC, USA

Nelson M (2001) Robocode. Available at: http://robocode.sourceforge.net/ [accessed 17 April 2007]

RoboCup (2007) RoboCup. Available at: http://www.robocup.org/ [accessed 9 April 2007]

Social Impact Games (2006) Entertaining Games with Non-Entertainment Goals. Available at: http://www.socialimpactgames.com/ [accessed 2 February 2006]

Susi T, Johannesson M, Backlund P (2007) Serious Games – An Overview. In: Technical Report HS-IKI-TR-07-001, School of Humanities and Informatics University of Skövde, Sweden, 5 February 2007

Spring (2006) The Spring Project. Available at: http://spring.clan-sy.com/ [accessed 2 February 2007]

Zyda M (2005) From Visual Simulation to Virtual Reality to Games. In: Computer 38(9), pp 25-32

Zyda M, Hiles J, Mayberry A, Wardynski C, Capps M, Osborn B, Shilling R, Robaszewski M, Davis M (2003) Entertainment R&D for Defense. In: IEEE Computer Graphics and Applications 23(1), pp 28-36, 2003

Theme 3: Tools, technologies and platforms for game-based learning, including mobile game-based learning

A Platform for Server-Side Support of Mobile Game-Based Learning

Richard Hable
evolaris next level privatstiftung
+43 316-35 11 11-113
richard.hable@evolaris.net

Otto Petrovic
Institute of Information Science and Information Systems
University of Graz, Austria
Phone: +43 (0) 316 380-7184
otto.petrovic@uni-graz.at

Abstract

mGBL is an EU-funded three-year research project into mobile game-based learning. We considered that it was not sufficient to only create a number of self-contained games which run independently on mobile devices. There had to be a way to deliver different learning content to the devices; teachers have to be able to control the learning progress and react to the results of pupils playing mobile games; and devices have to be coordinated for collaborative games (e.g. to define time limits and the communication between game participants).

This paper describes the technical solution chosen within the project. The mGBL platform (Petrovic et al. 2006) has been developed to meet these requirements based on server-side Java technology. A state-of-the-art three-tier server application has been created which supports all user administration and game management needs. Security and data consistency are adequate to serve a large number of clients independently. The application can be accessed via a web interface for configuration and management of data handled by the platform with the help of extensive reporting and logging support.

In addition to these quite conventional features, the platform facilitates flexibility and communication. The rich diversity of mobile game types requires high configurability and connectivity. Therefore, the platform has been designed to be not just a monolithic application providing a fixed set of features, but to be modular and extendable to a high degree. An innovative game modelling system is available in the platform administrative user interface for handling incoming and outgoing SMS, MMS and email messages and reacting in ways suitable to the needs of diverse game types (Lindt et al. 2006), including pervasive games (Magerkurth and Roecker 2007). In order to further support communication between teachers and game participants, web interfaces for interactive message sending and blogging are provided.

The platform has already been used for diverse game projects in practice, proving high reliability and suitability as a back-end support system for the mobile gaming domain.

Keywords

Learning platform, mobile games, game support

Introduction

At first sight, technological support for mobile learning mainly seems to require creating and distributing small programs to small mobile devices. However, looking at the use and proliferation of existing mobile software, from trivial games to complicated applications, we see that this conventional distribution and deployment method leads to a surprisingly low impact in practice. Use of certain standard built-in data services, especially SMS, is even more widespread than use of the Internet (INTEGRAL 2007). Other software for mobile devices, like personal digital assistants and mobile phones, however, is created mostly by small companies for a small number of customers. No common software in addition to built-in software provided by the manufacturers is established which can be built upon. Third-party applications work stand-alone with little impact on the overall improvement of mobile device-user experience. Many people even completely ignore the option to add third-party software to their mobile devices. This is quite surprising; after all, today's modern mobile devices offer operating systems and hardware performance similar to expensive desktop systems available a few years ago. For example, the widely used mobile-phone operating systems Symbian and Windows

Mobile support and require fast central processing units (CPUs) (hundreds of megahertz clock rate) and large main memory (dozens of megabytes).

This paper describes the applied concepts and implementation of a platform intended to avoid this dead-end distribution of stand-alone applications in the domain of mobile game-based learning. Mobile game applications are considered to be only one type of artefact within an ecosystem of both server and client-based software supporting mobile learning. Similarly, games are not considered solitary applications with fixed features, which can be used for a certain amount of time, with more or less fun and profit, only to be thrown away and replaced by new ones. Instead, support for templates of games and game concepts is provided, which allows experts in the learning domain to create game flow and learning content without the need for additional technical support and implementation.

Technological Design

The main technological design decisions for the mGBL platform were made in the first half of 2006. In order to allow smooth progress of software development, we adhered to these decisions with little adjustments.

Mobile Devices

In 2006, the market for mobile devices was split into devices with very different operating systems and hardware resources. The only common denominator of a wide range of devices was the Java 2 Micro Edition run-time environment (J2ME), which is a limited version of the Java standard environment available for desktop operating systems. Since it was an important goal to allow game-based learning on a wide variety of mobile devices, J2ME was an obvious choice despite its limitations (Broll et al. 2006). A suitable distribution of tasks between the server and client sides was considered an appropriate response to restricted capabilities and flexibilities on the mobile client side.

Now, in 2008, the situation has become even more complex. In addition to the classic mobile phone and smart phone operating systems, new devices with company-specific operating systems like the iPhone are rapidly gaining market share. Also, new Linux-based operating systems like Android, with support from a wide range of companies, are announced for the near future. These operating systems depart from the common

denominator of J2ME, with the intention of attracting developers for their own application programmer interfaces (API). While all these new systems could easily support J2ME, it remains to be seen if company politics will make this possible.

Despite this unsatisfactory situation concerning compatibility of client software on mobile devices, the initial decision for J2ME still seems to be more preferable compared to a decision for a specific operating system. Even more important was the decision to take advantage of existing software and infrastructure for mobile devices as far as possible and to support mobile games on the server side. This proved to be a successful way to support device-independent game play and interaction. Games which are based on messaging and multimedia capabilities like SMS and MMS instead of deployable mobile applications can easily be used on a large variety of mobile devices and do not have to be updated for new devices and operating systems.

Server

In order to efficiently develop server software supporting a large number of mobile games played concurrently, a decision for a middleware (i.e. software that connects software components or applications) standard was necessary (Ferstl and Schmitz 2001). Microsoft Windows operating systems were almost completely dominant on personal computers at the beginning of the mGBL project and are still dominant today, despite the market-share growth of alternatives like Apple Macintosh and various Linux distributions. However, systems hosting server applications are usually based on other operating systems such as Linux or other UNIX derivatives. Therefore, the decision to use an operating system independent middleware platform was made. The Java 2 Platform, Enterprise Edition (J2EE) was selected as the only industrial-strength platform which was independent of a specific operating system. The following aspects, in particular, were critical to the mGBL server software:

- web container infrastructure
- distributed communication
- transaction management
- relational database access.

Consistent with the spirit of the mGBL research project, a lot of open-source software was considered for this platform. The following software, developed by large communities or organisations, was selected in order to ensure sufficient development support and reliable operation:

- Apache Tomcat web server
- Apache Struts web application framework
- JBoss application server
- MySQL database
- Hibernate Object-Relational Mapping (ORM) tool

All development was performed using the Eclipse software development platform, which is the most widespread Java development system. In hindsight, these decisions proved to be correct as, although the competing Microsoft .NET framework has been constantly improved over the last two years, it still does not provide operating system independence. We also benefited from ongoing improvements to the Java platform during this time.

Stationary Clients

A large number of users, including administrators of the server platform, providers of learning content, and, to a certain extent, participants of games, have to be able to access the platform from their personal computers in addition to mobile devices. Therefore, it was important that users of personal computers should only need to install the minimum possible additional software. This goal was achieved by supporting all user interaction via standard Internet browsers using advanced Web 2.0 technology such as Ajax. Special care was taken to create standard-compliant web pages usable on a large number of web browsers, in particular the Firefox web browser of the open-source Mozilla project.

System Architecture

Figure 1 shows an overview of the main modules in the mGBL platform and how they work together.

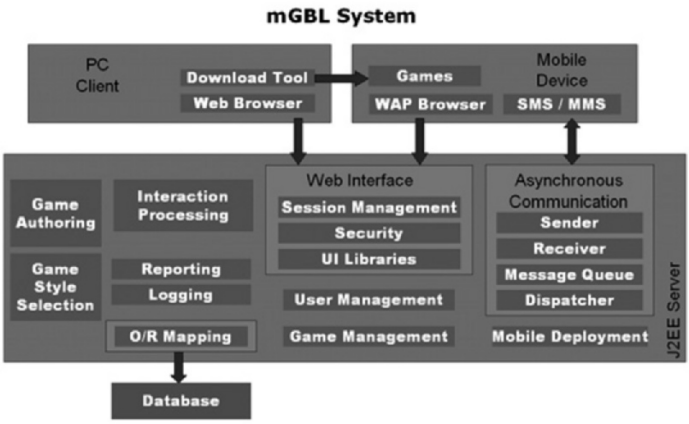

Fig. 1. Architecture of the mGBL platform

Administration

All administrative features of the mGBL platform can be accessed via a web browser. Access rights are handled according to a role-based security concept. Thus, both administrative users and game authors may use the platform and access different web pages depending on the roles assigned to them. Game participants may be provided with the right to access certain pages to check the results of a finished game, for example.

User Management

User data can be examined and modified. Administrative users may assign access rights to other users based on their own rights. Users can also be grouped together in user 'sets', which allow management of teams and, more generally, of users with similar status.

Message Sending

Administrative users can send SMS and email messages to single users or users grouped in user sets. This can be used, for example, to inform game participants about tasks to be performed or the current status of the game.

Both plain text messages and messages containing embedded or linked multimedia elements can be sent. It is also possible to automate game management by scheduling the sending of messages at specific points in time. Figure 2 shows the SMS message-sending page as an example of the look and feel of platform administrative web pages.

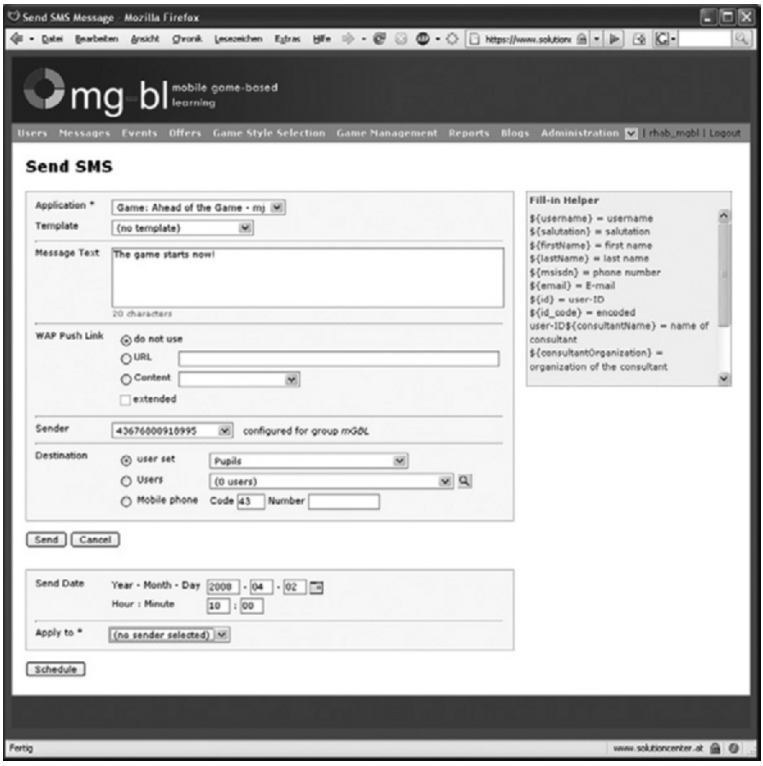

Fig. 2. SMS-sending page

Game Style Selection

The mGBL project intends to support the complete cycle of mobile game-based learning. This includes finding appropriate mobile game types for a range of learning purposes and for different learning modes. Therefore, a game style selection tool was created and included in the platform, which allows specifying desired properties according to the following categories:

- learning content
- learning activities

- cognitive processes
- intelligences
- number of players

After a game type has been selected, information about appropriate games can be displayed, including descriptions, screen shots and user comments. This information is stored in a built-in blogging system which allows users to provide feedback and update information using Web 2.0 technologies. In this way, the mGBL platform is not only the integration point for games and game templates developed in the mGBL project, but can also be used as a starting point for exploring other games and game types known to its users.

Game Management

Games and game templates available within the platform are managed in game management pages, which are also accessible via the administrative web interface. Despite the wide variety of game types supported by the platform, care has been taken to manage games and game templates uniformly, in order to allow the addition of new game types in the platform without having to change any generic components.

Game Authoring

The game authoring area is the place where teachers can enter learning content based on game templates. In a quiz game, for example, this could be questions and proposed answers combined with the configuration of the scores assigned for correct answers. The game authoring tool automatically creates mobile game applications, based on the game templates and learning content, which can then be transferred to mobile devices.

Interaction Modelling

Game play can be coordinated via the common messaging capabilities (i.e. SMS and MMS) of mobile devices. It is possible to create games based entirely on these communication facilities, for example, when pupils receive tasks via SMS and have to reply with answers and results by SMS and MMS. In addition to actions performed interactively by the game administrator, like sending status messages to a group of game

participants, this requires both automated time-triggered actions and real-time responses to incoming events. To make configuring these automatic interactions possible for people without programming expertise, and to ensure usability (Jegers 2004), the platform provides an interactive modelling system as part of the administrative user interface.

Concepts

The platform receives incoming SMS and MMS messages via gateway providers, such as VeriSign and sms.at, who translate messages from mobile phones to HTTP requests and e-mail messages. From these requests and messages the platform extracts the mobile phone numbers of the sender and receiver, the text sent and, in the case of MMS messages, any additional media (i.e. pictures, sounds and videos). Depending on this information, different tasks, such as sending SMS messages and player score changes, are initiated. Similar actions are performed independently of incoming messages at configurable, possibly repeated, points in time.

In order to allow non-technical users to configure these tasks, the platform supports creating lists of prepared interactions to be performed based on incoming messages, the mobile phone numbers used therein, and their text or graphic content. Similar lists of interactions can also be configured to be performed at predefined points in time. Different interactions may be necessary depending on the state of the game; if, for example, a pupil answers a multiple-choice question, his or her game score may only be increased when they answer a question correctly. In addition, different response messages may be necessary and subsequent game play may be altered. Therefore, entries in interaction lists can be configured to be performed only under certain circumstances.

Single Interaction

Since administrative users of the platform, who often lack programming expertise, need to be able to edit interaction lists, we use a form-based ‘create / edit / delete’ user interface for interaction modelling similar to other administrative pages. The user enters information separately into form fields of different types. For example, a game developer who wishes to create an interaction which sends a message to a user can access a page where they can:

- enter the message text into a text input field,
- select the destination user via a selection box and
- select the message type via radio buttons.

Input fields are validated before storing, thus avoiding run-time errors during game play which might otherwise be caused by invalidly configured interactions. Modelled interactions are stored in the database, similar to other administrative platform data. The individual interactions are stored as individual entries in tables corresponding to the interaction types. Table attributes roughly correspond to the input fields completed by the user. This also allows simple technical interpretation of the modelled interactions during game play.

Interaction Lists

The edited interactions are interdependent and must be performed in a predefined order. This is achieved in a database-friendly way by assigning a different label for each interaction entry (i.e. an interaction with label '2' is performed after an interaction with label '1'). Letters are used to indicate conditional interactions. For example, an interaction '2b3' could be the third of a sub-list of interactions, which are only performed if an interaction with label '2' indicated result 'b'. Depending on the type of interaction, this may mean that a pupil is not a member of a specific team, for instance. Fortunately, users of the platform do not have to construct these labels themselves: the platform provides pop-up menus which allow users to insert and delete interactions at specific positions in an interaction list, and the labels are assigned automatically by the software.

Interaction lists are displayed in plain text so that they can be understood by non-technical users. Conditional blocks and loops are visible within the graphical user interface.

Figure 3 shows a typical interaction list for an SMS-based game. The modelled interactions are performed whenever a user tries to join 'Team A' via an SMS message. Most interactions depend on the number of team members.

Fig. 3. Registration Interaction List

Comparison to Script Languages

A possible alternative to this interaction list modelling system would have been to include an existing script programming language in the platform. However, the current solution has the following advantages:

- No knowledge about programming language syntax is required when editing interactions within web forms
- Advanced functionality of general-purpose programming languages like loops and sub-programs is presented to the user in a comprehensible structured form within the user interface
- The resulting interaction lists contain plain text readable by lay persons and translations into languages other than English are supported
- Storing interactions as separate database entries allows for the same role-based access control and transaction-based data integrity as for other administrative platform data
- Referential integrity ensured by the underlying database guarantees that interactions can not be inadvertently invalidated by renaming or deletion of referenced entries, such as user sets.

The approach we chose, however, does not replace fully fledged object-oriented programming languages. Therefore, an extension mechanism has been included, which allows invoking custom Java code within the list. Special functionality not available within the interaction modelling system can be implemented using server-based Java programming.

Practical Experience

The platform has already been successfully used in trials with games developed within the mGBL project (Čišić and Tijan 2008). The biggest trial took place in Vienna at the beginning of 2008 with more than 100 students with an average age of 24 years. In a pervasive game application they were given tasks by SMS which they had to answer by SMS and MMS messages. The platform game administration and modelling features were used to define and control game play.

Students

After the game the following feedback was given by the students:

- Although most students considered themselves highly skilled mobile phone users, individual responses showed that many students had technical problems sending MMS messages.
- The high costs of having to send MMS messages were also criticised by students. Unsurprisingly, therefore, most students generally preferred SMS to MMS messages and also specifically preferred blogging via a web interface to blogging via MMS.
- No such problems were reported with SMS messaging and students eagerly performed the tasks based on this simple text-oriented communication.
- Generally, the students preferred a mixed approach between technology and human interaction during learning.
- The game contents themselves and the learning progress achieved received quite diverse reviews, showing that questions and tasks have to be carefully chosen to satisfy the needs and interests of the target audience.

Teachers

The professor guiding the trial and the tutor responsible for modelling the game provided the following feedback:

- While the professor preferred a mixed approach combining technology and human interaction, the tutor preferred learning methods based mainly on human interaction.

- While the tutor estimated the students to mostly like the game, the professor thought that the students considered the game to be only average.
- Both professor and tutor thought that the game supported the learning process of the students better than classical methods like ex-cathedra teaching.
- Both professor and tutor also would consider using the game again in the future.

Similar Systems

The platform is based on open-source database and application server software. However, the system itself was created from scratch, independent from existing domain-specific software. Some reasons for these decisions are:

- The platform had to be based on state-of-the-art enterprise Java technology. Many other systems are based on script languages.
- A consistent framework for integration of very diverse server and client-based games was required.
- The platform had to support learning on mobile devices. Most other software systems only support learning on personal computers.
- While the platform had to be usable by non-technical persons, it still had to be flexible and extensible enough to support a wide range of human interaction and game play.

No single existing software was found to be sufficiently close to these goals to justify basing the mGBL project on it. A combination of different existing tools, however, would not have led to a consistent framework based on uniform concepts. Therefore, a clean start was preferred, which led to a reliable, extendable system with a consistent user experience.

Conclusions

The mGBL platform is a comprehensive integration system for game-based learning. It supports the full cycle of mobile game-based learning, from the selection of games and game styles, to game authoring with definition of learning content, to the practical administration of game play and its results. Individual mobile game software is replaced by an integrative approach to mobile learning. Different server and client-side

state-of-the-art technologies are utilised according to the needs of different game concepts and user preferences. This has been shown in practice to be very important for acceptance and learning success. The administrative web user interface with its included unique interaction modelling system allows users with little technical know-how to manage games and communities of game players. Users from the educational profession who are interested in mobile game-based learning will find the platform a powerful supporting tool for diverse kinds of learning games and concepts.

References

Broll W, Ohlenburg J, Lindt I, Herbst I, Braun AK (2006) Meeting Technology Challenges of Pervasive Augmented Reality Games. In: Proceedings of ACM Netgames, Singapore, Oct. 30-31, 2006

Čišić D, Tijan E (2008) D 6.4. Final test report, mGBL Project Report [online]. Available at: http://www.mg-bl.com

Ferstl OK, Schmitz K (2001) Integrierte Lernumgebungen für virtuelle Hochschulen (Integrated Learning Environments for Virtual Universities). In: Wirtschaftsinformatik 43 (1), pp 13 -22

Glu Mobile (2006) Glu Challenges Mobile Myths with New Consumer Survey [online]. Available at: http://www.glu.com/about/press.php?press=100106b [accessed 10 March 2008]

INTEGRAL (2007) Austrian Internet Monitor, Kommunikation und IT in Österreich, 2. Quartal 2007 (Communication and IT in Austria, Q2 2007) [online]. Available at: http://www.integral.co.at/dImages/AIM_Consumer_-_Q2_2007.pdf [accessed 3 March 2008]

Jegers K (2004) Usability of Pervasive Games. Position paper at the Pervasive Gaming workshop, PerGames 2004, [online]. Available at: http://www.ipsi.fraunhofer.de/ambiente/pergames2005/papers/Usability%20of%20Pervasive%20Games.pdf [accessed 10 March 2008]

Lindt I, Ohlenburg J, Pankoke-Babatz U, Prinz W, Ghellal S (2006) Combining Multiple Gaming Interfaces in Epidemic Menace. In: Proceedings of the Conference on Human Factors in Computing Systems (CHI '06), Montréal, Québec, Canada. ACM, New York, pp 213-218

Magerkurth C, Roecker C (eds) (2007) Concepts and Technologies for Pervasive Games: A Reader for Pervasive Gaming Research. Volume 1: A Reader for Pervasive Gaming Research, Shaker, Aachen, Germany

Petrovic O, Kittl C, Markovic F, Peyha HJ, (2006) 'mgbl – Mobile Game Based Learning'. In: Proceedings of the Iadis International Conference Mobile Learning 2006, Dublin, July 14-16, 2006

Games and Mobile Technology in School-Based Learning: The Results of eMapps.com

Robert Davies
MDR Partners, 2b Fitzgerald Road, London SW14 8HA
00 44 208 876 3121
rob.davies@mdrpartners.com

Abstract

eMapps.com is a project, completed in March 2008, funded under the European Commission's IST 6th Framework research programme. Its focus has been upon demonstrating how games and mobile technologies can be combined to provide new and enriching experiences for children in the school curriculum and beyond. It is intended to support creativity in the classroom and outside and to contribute to practice for developing new teaching. The work has concentrated initially on Europe's New Member States and school children in the age group 9-12. In the course of this, the eMapps.com games application has been piloted and tested in 17 schools across eight countries. Key target audiences for eMapps.com include policy makers in school education, teachers and other learning providers, parents and children.

The eMapps.com approach enables schools and teachers to design and play multi-level, mixed-reality games which utilise new, popular Web 2.0-style facilities. The main outcomes include a web-based game learning application platform for implementation with schools, libraries and other informal settings, using games that can be played 'live' using a new generation of mobile devices, together with supporting handbooks, evaluation tools, training courses, dissemination and exploitation facilities. All results may be seen on its website at http://emapps.com/.

Keywords

Mobile and game-based learning, schools, children; Web 2.0, mixed reality

1 Introduction

Europe continues to maintain some of the world's best schools and schooling systems. Educational opportunity and quality education appear to depend to a certain extent on the effective deployment of ICT. Many European countries have set out a specific national policy on ICT in education, including projects and actions for implementation. In some countries, government has set up agencies with a specific profile to support strategic development and delivery of ICT in schools.

It has been argued that students who enter school are communicative, curious, creative and capable of learning many things, but that the 'traditional' school tends to diminish these abilities over the period of learning. Effective use of ICT is held to promote student motivation, learning which is driven by curiosity and then reapplied in real life.

However, many students still do not use ICT very much at school. Students more often use computers to send emails and access the Internet than to use educational software or learning platforms. One of the biggest barriers is the capacity of teachers to integrate ICT into their practices, given the limitations imposed by organisational or time constraints or their own knowledge. Cost, conservatism and lack of teacher training are often mentioned as the major barriers to implementation of ICT in schools.

Conversely, many children are immersed in ICT-related activities in their homes and with their friends, supporting the idea of a wide 'ecology' of education, where schools, homes, playtime, the library and the museum all play their part, and in which the opportunities available in a technology-rich world can be exploited. Learning is seen increasingly to occur through the leisure activities that now take place through digital technologies as part of young people's social and cultural lives, such as: children's playing of computer games; use of chat rooms; My Space, YouTube, DVDs; digital television, etc.

At a considerable risk of over-simplification, two longer-term points of view can be identified among stakeholders in school education:

- those who prefer a return to a more structured, teacher-directed curriculum that emphasises basic knowledge and skills;
- those who favour a more child-centred form of education.

The second idea is closely related to concepts such as constructivism, which, in short, suggests that children learn best by creating for themselves the specific knowledge they need, rather than being instructed in everything they must know. Attention to such styles is also inclined to focus more on the experiential nature of learning, involving wonder, surprise, feelings, peer and personal responses, fun and pleasure

In early reports from the eMapps.com project, a clear statement was made that the project saw itself as promoting a constructivist and collaborative pedagogy. Not all games are designed in this way: at least five different pedagogical views can be detected in m-learning activities:

- behaviourist: activities that promote learning as a change in learners' observable actions
- constructivist: activities in which learners actively construct new ideas or concepts based on both their previous and current knowledge
- situated learning: activities that promote learning within an authentic context and culture
- collaborative: activities that promote learning through social interaction
- informal and lifelong learning: activities that support learning outside a dedicated learning environment and formal curriculum (Watson and White 2006)

While acknowledging all these approaches, and espousing elements of each, eMapps.com has remained committed to essentially constructivist understandings of learning, which focus on the need for each child to 'construct' its own understanding of the world through a process of continually comparing experience with prior understanding.

2 Project Background

eMapps.com is a project funded under the European Commission's IST 6th Framework Programme of research. Its focus is upon demonstrating how games and mobile technologies can be combined to provide new and enriching experiences for children in the school curriculum and beyond. The work concentrated on Europe's New Member States and school children in the age group 9-12, involving piloting and testing work in 17 schools across 8 countries.

Key target audiences for eMapps.com include policy makers in school education, teachers and other learning parishioners, parents and children.

The main outcomes of the project have included: a web-based game learning platform for implementation with schools, libraries and other informal settings, using games that can be played 'live' on a new generation of mobile devices together with supporting handbooks, evaluation tools, training courses and dissemination activities, including an international conference in Prague, February 2008. All project results can be seen on its website at http://emapps.com/.

3 Use of ICT

There is a natural alliance between learning and personal mobile technology, so that it is becoming more feasible to equip learners with powerful tools to support their learning in many contexts over long periods of time. However, a major potential barrier to integrating games' use in learning and the school curriculum, or at any level, is the perceived mismatch between skills and knowledge developed in games, and those recognised explicitly within education systems. Many of the skills valuable for successful game play, and recognised by both teachers and parents, are as yet only implicitly valued within a school context. Teachers need to be engaged and to recognise and map the relationships between activities in games and the associated learning before they can embed the use of games within the wider learning context and be enabled to frame tasks, within the game or leading up to or following on from a lesson.

Games have become more complex and sophisticated and a variety of genres have increasingly come to dominate the market: action games, adventure games, fighting games, puzzle games, role-playing games, simulations, sports games, strategy games and games that defy categorisation. Computer games are an important part of most children's leisure lives and increasingly an important part of our culture as a whole. They are, however, sometimes dismissed as a distraction from more 'worthy' activities, such as homework or playing outside. Parents have often been sceptical about potential learning benefits to their children.

Games have always been used in education. But for ICT-based games to take on a meaningful role, the education sector and the wider public and media need to better understand the potential of such tools. eMapps.com has set out to demonstrate how the value of games which combine computers, mobile phones and learning in the local environment can be realistically applied in and with schools. Research shows that people learn best when they are entertained, when they can use creativity to work toward complex goals, when lesson plans incorporate both thinking and

emotion, and when the consequences of actions can be observed. However, this enthusiasm is tempered by the recognition that the majority of commercial 'edutainment' products have been largely unsuccessful in harnessing this potential to effective educational use.

Mobile technologies are also a familiar part of the lives of most teachers and students in Europe. Phones, computers and media devices now fit in our pockets and can connect us to a variety of information sources, and enable communication nearly everywhere we go. They will have a big impact as learning tools by combining the functionalities of a voice and text communication device, a camera, a video camera, a television, a computer and a calculator. Mobile phones are already being used in education, but so far the uses have been fairly modest and represent only a fraction of what mobile technology can potentially achieve in education.

Some other cutting edge technologies, which can be applied in learning, are often categorised as Web 2.0, such as:

- Global Positioning System (GPS)/Location-based services for collaborative work;
- Podcasting: a method of distributing multimedia files over the Internet for playback on mobile devices like iPods and personal computers;
- 'Blogging', which provides an opportunity to express a personal voice on the web in a very simple way, providing potential gains in children's literacy, design, ICT skills, confidence and communication skills, beginning around nine years of age.
- Wikis, which provide a collaborative way for children to share and build knowledge.

eMapps.com has sought to integrate a number of these technologies into its games applications environment.

4 eMapps.com Games

The problem of narrative, of integrating a linear storyline within an interactive game, is widely acknowledged as one of the most intractable problems in the field of games design. eMapps.com has sought to create dynamic narratives where, although the themes and imagery in the world remain consistent, the actions of different players lead to different, credible outcomes. This involves implementing some of the concepts from games that are played on platforms such as PlayStation, Nintendo, PC, and PSP,

but at a much lower cost, and mixing the use of PCs and digital devices with activities carried out 'in the local territory' ('mixed reality').

The advantage of this approach is that learning through performance requires active discovery, analysis, interpretation, problem solving, memory and physical activity and results in the sort of extensive cognitive processing that deeply roots learning in a well-developed neural network. The educational value of the game-playing experiences comes not from just the game itself, but from the creative coupling of educational media with effective pedagogy to engage students in meaningful practices.

To address this problem, eMapps.com has sought to establish a way of designing a new learning game where teachers set the theme, the world-space where the game takes place, and the player can then explore and experience different permutations of that theme as he or she desires, progressing through different game levels, usually on the basis of a set of competitive criteria for game completion. The possibility of different types of interactive narrative that are not bound to specific platforms or stationary mediums, using connected devices, GPS systems or networks, or multiple users seems limitless. The use of location to trigger events, the presence of other users' experience in the near vicinity, even the ability to bring the narrative into the general culture are all possibilities with emerging technology which eMapps.com has sought to exploit.

The eMapps.com approach also requires the participants to draw upon a wide range of contextual content and to use new mobile devices in the creation and use of that content, whilst developing and playing games. Such playful experiments with objects and ideas help develop our understanding of our place in the physical world.

5 Target Audiences

Key target audiences for the results of eMapps.com are:

- policy makers in school education who will gain assurance of the benefits and confidence in supporting and investing in games-based learning;
- teachers who will be engaged and encouraged to recognise and map the relationships between activities in games and the associated learning so that they can embed the use of games within the wider learning context and be enabled to frame tasks within the game or leading up to or following on from a lesson;

- parents who will gain a better understanding of the role which games can play in their children's learning and development;
- children who will be stimulated and whose learning experiences and performance will be improved by exciting adaptations of a technology they already enjoy.

6 Main Intended Outcomes

The main planned outcomes of eMapps.com were:

- a web-based game learning platform for implementation with the target audiences, using games that can be played 'live' in the individual territory on a new generation of mobile devices using Internet, General Packet Radio Service 3rd Generation (GPRS/3G), SMS and MMS technologies;
- school teachers/managers or others from each of the eight participating countries who are qualified to implement and disseminate game training for other teachers through a series of local events;
- evaluation of the need, relevance and practicality of the implemented mobile and game-based learning (mGBL) model and the results made public, on the basis of experience in each of the participating countries;
- a teachers' toolkit;
- a set of recommendations for school education policy makers in the area of mGBL;
- exploitation and replication of the results emerging from the project through an extensive dissemination programme, including an interactive project website and an international conference.

7 Results

In its very early stages, eMapps.com conducted and analysed a survey of the participating schools in order to establish a baseline on current use of games technology by children, as a starting point for its work. Data was collected between October and December 2005 from a sample of some 233 children in the schools selected to participate in eMapps.com in the eight participating countries. Among the key findings of this work:

(http://emapps.info/eng/content/download/427/2607/file/eMapps.com%20D1.pdf)

- PCs (boys 83%, girls 5%) and mobile phones (boys 60%, girls 77%) were by far the most common platforms available among both boys and the girls. Ownership of mobile phones was slightly higher amongst girls. Amongst the available 'proprietary' platforms, Sony PlayStation (1 and 2) and Game Boy were owned by a significant proportion of respondents, although this amounts to under 20% in total. Ownership of other console-based platforms was as yet at a very low level.
- About 90% of children responding used one or more of the platforms listed for playing games. Just over 60% of the children use PCs for playing games. Mobile phones were used for gaming by 43-44% of the children who own them.
- The boys were significantly heavier and more regular players of games than the girls. Fifty-three per cent of boys played games every day as opposed to 27% of girls. Only in Lithuania did a majority of the girls play every day. Only in the Czech Republic did a minority of the boys play every day.
- More than half of the children regarded themselves as playing games at school as part of the learning process. A higher proportion of girls than boys regarded themselves as playing games at school as part of the learning process. There is significant variation between countries, possibly depending upon practice and facilities in the selected schools.

8 The eMapps.com Platform

The original prototype of the eMapps.com platform, used for the purposes of summer school training as well as for development and testing of prototype games in each of the 17 participating schools, was developed originally by Ciberespacio (Spain). The following products were involved:

- Digital repository for the game content;
- A workshop model for teachers and informal learning practitioners;
- A mobile game platform;
- A digital map enabling any kind of map links (e.g. Google).

The prototype application ran on digital devices such as mobile phones, personal digital assistant (PDA), Tablet PC over GPRS and Universal Mobile Telecommunications System (UMTS) networks, and included game control mechanisms, forum, chat and pre-set map-based local scenarios. The games were played on an open platform through multiple networks and devices. Weblogs, podcasts and videocasts were key components.

'Pins' located in a pre-set geographical scenario (map-based) were linked to information placed in independently edited photo, audio, video and text 'blog' folders, using 'drag and drop'. Any mobile device that supported a browser could be used for uploading the content to any folder. The map also supports external links. The map was a Graphical User Interface (GUI) that interacted with objects and could be used for mapping existing objects in a given territory, based on Universal Transverse Mercator (UTM). It also had a route editor and came with a series of tools for zooming and panning.

The GUI supported any language and was independent of the network or software used for uploading. The map supported an unlimited amount of layers, ranking from satellite images, aerial images and maps created ad hoc. These layers were geo-referenced over the original map.

9 Evaluation and Monitoring of eMapps.com

Grounded theory is well-established in the social sciences and particularly suited to novel situations. The central tenet of grounded theory is that the theory (or other conclusions) must emerge from the data which is collected, rather than the theory being presented first and the data used to test it. So the research question remains relatively open and the process is iterative, with different sources of data being examined and allowed to inform the emergent results. Data collection is quite deliberately fused with analysis, so that the questions being explored are influenced by early results.

Such an approach is helpful in a project like eMapps.com, where a series of temporally separated events can be observed by a variety of participants and onlookers, so that understanding of if and how learning is taking place can emerge and then be used to guide later evaluation activity, analysis and theory-generation.

In the early part of eMapps.com, discussions between Manchester Metropolitan University and European Schoolnet (EUN), the two key evaluation partners, led to the adoption of a framework which was

designed to provide a common approach to assessment of the impact of interventions in school systems at all levels, from the individual learner and school to the wider national context. SIPTEC, originally designed by EUN, provided a framework which was capable of being used across the eMapps.com learning evaluation work, including those elements concerned with national policy. SIPTEC structured the evaluation questions into six categories: System, Institutional, Pedagogical, Technical, Economic, and Cultural/Linguistic.

At the same time, monitoring of the progress and results of the test implementation work done by each partner has been assessed according to ten specific sets or stages:

- define the School Curriculum areas which the game supports;
- establish the children's 'cognitive profile';
- develop the game story;
- transform this into a narrative plot with a number of levels;
- upload the game content to the teachers' platform;
- design the interactions involved in the game play;
- play the game at local level;
- provide conclusions and report on problems;
- use game version 2 in out-of-school activities (e.g. with libraries and museums);
- link game content descriptions to the Living Map of Europe on the eMapps.com website.

Given the fact that most of the schools and several of the consortium partners were comparatively or completely new to European project work, their overall performance in carrying out these tasks was found to be quite creditable both in terms of task completion and quality of work. Almost all schools were able to carry out the work to an acceptable standard and some schools exceeded expectations in areas such as:

- producing an excellent, imaginative and carefully elaborated game narrative, closely linked to a sophisticated interpretation of children's learning needs in the curriculum;
- including a strong and varied definition of targeted (cross-) curricula subjects for each level of the game, demonstrating a very close relationship with the narrative storyline through game levels, carefully elaborated in terms of learning content and outcomes;
- making use of inter-partner twinning activities to provide new settings for their games.

The tasks in which the schools as a whole performed best were: the provision of the story behind each game; and establishing the curriculum areas relevant to their game(s). The tasks in which the partners performed least well were: establishing children's cognitive profile (a vaguely defined task); and drawing and reporting on conclusions after test playing each game in their schools.

10 Evaluation of Learning Outcomes

> *"During the few last lessons of this school year they have shown better knowledge … and their analytic skills have improved."*

This comment from one of the teachers involved in game playing within eMapps.com is perhaps a testament to the project's success in demonstrating that mixed reality, 'anytime, anywhere' educational games can be significant contributors to children's learning.

The eMapps.com games were complex in terms of both pedagogy and organisation. They took place in different countries with players using different languages; in different schools with very different curricula; with children of different ages and varying skills and abilities; and with teachers with different experience, training and skills. Despite this, it is clear that both teachers and children found them to be challenging and enjoyable experiences.

eMapps.com games used mobile technologies, including GPS, to enable mixed reality games to be played outside the school boundaries. The games required high levels of teamwork and collaboration, were challenging intellectually as well as technologically and broke new ground in mobile learning.

Among the things which the project's evaluation work on the impact of games on the children's learning concluded were that:

- the children learned: new knowledge, new technology skills, improved generic skills, and improved social skills;
- game playing stimulated other creative work such as artwork, acting, writing and video making;
- teachers believed that games do allow them to achieve their intended learning outcomes;
- in half of the schools involved, teachers cited evidence that children remembered what they had learned through game playing, although other schools were not sure of this or didn't know;

- children who do not respond well in the traditional classroom setting often emerged as positive and enthusiastic learners in the context of the games;
- it is critical to manage the amount of time which teachers have to devote to the development, customisation and deployment of games if their potential for enhancing children's learning experiences are to be realised;
- this issue of time also applies, but in a different way, to the deployment of this type of game: time could not always be found during school hours to play the game – embedding the game in the curriculum proved relatively easy for teachers, but embedding the game into the school timetable was not;
- while there are great benefits to encouraging learning outside the walls of the school it was observed directly and was reported to us that children's safety is a major issue;
- one of the barriers to learning observed was poor design of mobile devices and of applications, and network/geographic information systems (GIS) failures: many small complaints were made during the eMapps.com games about all of these;
- the evidence gathered suggests that, when the concept is carefully explained to them, parents are supportive of this kind of learning;
- it was clear from observations and from the responses of teachers that the children enjoyed playing the games and, as a result, were highly motivated both to participate and to complete their assignments.

All of this evidence suggests that mixed reality games of the type developed by eMapps.com have a significant part to play in encouraging and delivering children's learning throughout Europe and beyond.

Post-Project Exploitation

The options defined for post-project exploitation of the eMapps.com platform may be broadly categorised as follows:

- Access to original prototype platform (through Ciberespacio)
- Modified version of platform
    - open source licence
    - support arrangement (with University of Ljubljana)

- Service-based exploitation (e.g. a TELCO or mobile service supplier)
- Agreements with exploitation partners at national and European level

There are some significant variations between the exploitation issues and business models identified as necessary in each of the eight partner countries. However, some striking commonalities have also emerged. In particular, it is clear that the following issues will need to be addressed in almost every case, if post-project take-up of the eMapps.com games platform is to be successful:

- there should be no, little or direct cost to budgets held by individual schools;
- rights to access the platform should be open and clear;
- everything possible should be done to reduce to a minimum the workload demanded of teachers in designing and administering the games;
- the duration of game play should be as flexible as possible in order to enable a convenient fit with school timetabling and/or extra-curricular or out-of-school activities;
- game 'models' should be made as reusable as possible, although some work will always be required to develop location-specific games;
- eMapps.com games are promising but need to be further piloted through national projects before mainstreaming can be achieved throughout the school education system;
- the potential for playing games in the framework of cultural, tourism, leisure and other organisations, with or without partnership with schools, is high and needs to be exploited.

These and other conclusions and perceptions of the prototype platform led to a new platform, conceptually modified in the light of experience from user testing of the original platform and redeveloped by the University of Ljubljana, using entirely new open source code during the latter part of the eMapps.com project. This work was undertaken in order to address issues raised through user feedback concerning issues such as ease of use, flexibility of timetabling, etc.

This modified version of the platform is now available under two generic options:

- downloadable and reusable by anyone under an open source licence (GPL – General Public License)
- under a hosting and support agreement with the University of Ljubljana

Under this arrangement, there is no restriction for the existing eMapps.com project partners or anyone in constructing business models and conducting further development, individually or in partnership, within their own country or internationally, as long as the software developed is used according to one of these licensing models.

At the penultimate Commission review of eMapps.com in December 2007, the reviewers also raised the prospect of exploring whether a TELCO or other mobile service supplier could be interested in bundling conceptual developments based on the work of eMapps.com within their services, and events have been organised by European Schoolnet to raise this issue with industry.

It is the confirmed view of the consortium group that in addition to any 'central' support arrangements for the platform, effective post-project exploitation requires clearly established and active ownership and marketing of eMapps.com results at national level. It is therefore gratifying to note that the consortium partner responsible for country coordination in each of the eight participating New Member States has indicated their intention to carry out this role. Partners have, without exception, initiated significant dissemination and advocacy work among practitioners and policy makers, involving: conferences, seminars and workshops; meetings and lobbying of officials; publications in the professional and general press; web-based promotion, etc. The organisation responsible for each country can be found on the eMapps.com website.

It should also be remarked at this stage that levels of interest expressed by policy makers and practitioners attending the five dissemination workshops organised by eMapps.com (November 2007-February 2008) in the New Member States which were not full participants in the project were uniformly high, suggesting a much wider potential geographic market for eMapps.com results.

Conclusions

In general, it seems clear that the level of children's engagement and motivation is a key factor in retaining interest in learning. The interactive and multimedia nature of modern ICT systems has provided the

opportunity to create increasingly more stimulating features. Students like to use computers and are likely to develop more positive attitudes towards their learning and themselves when they use ICT. ICT provides the opportunity to create a wide range of interesting learning experiences. This is likely to help to maintain student interest and involve a wider range of students and, in the end, used effectively, can only serve to improve the learning experience.

eMapps.com has provided a means of designing a new learning game where teachers set the theme, the world-space where the game takes place, and the player can then explore and experience whatever permutations of that theme he or she desires. This approach also required the participants to draw upon a wide range of contextual content and to use mobile devices in the creation and use of that content, whilst developing and playing games. It is hoped that the results will have a significant impact in validating new learning paradigms in both school and informal settings and will contribute to strategic thinking about the school and curriculum reform process in Europe.

References

Balanskat, A (2008) eMapps.com Impact on Policy and Recommendations for Policy Makers (ppt) http://emapps.info/eng/content/download/583/3480/file/AnjaBalanskat.pdf

Balanskat A, Brophy P, Davies R (2006) State of the art and requirements study. (eMapps.com Deliverable 1) http://emapps.info/eng/content/download/586/3492/file/PeterBrophy.pdf

Balanskat A et al (2008) Contextual analysis of the impact and potential of eMapps on national policies in relation to strategic elearning initiatives at European level. (eMapps.com Deliverable 13) http://emapps.info/index.php/eng/Results/Public-Deliverables

Brophy R, Markland M (2008) Report on learning impact. (eMapps.com Deliverable 14) http://emapps.info/index.php/eng/Results/Public-Deliverables

Davies R (2008) Exploitation Plan. (eMapps.com Deliverable 16) http://emapps.info/index.php/eng/Results/Public-Deliverables

Davies R (2008) Report on monitoring of test implementations. (eMapps.com Deliverable 11) http://emapps.info/index.php/eng/Results/Public-Deliverables

Secondary Assessment Data within Serious Games

Aidan Sliney
Computer Science Department, University College, Cork, Ireland
021 490 3164
ajs2@cs.ucc.ie

David Murphy
Interactive Medical Computing Lab, Computer Science Department, University College, Cork, Ireland
021 490 3579
d.murphy@cs.ucc.ie

John O'Mullane
Computer Science Department, University College, Cork, Ireland
j.omullane@cs.ucc.ie

Abstract

This paper presents an initial design of an assessment procedure within a personal junior doctor medical simulator (JDoc). It uses time-passed and trigger boxes to give the assessor the secondary information required to evaluate the user's actions effectively. Our objective was to enhance our understanding of the different forms of game design assessment and how relevant secondary information can be obtained from within serious games. Primary information, answers to questions, alone do not provide the assessor with sufficient information to evaluate a user correctly. The paper outlines background information about JDoc and the assessment procedures within that are used to collect and report all the required secondary information. Incorporating secondary information within the assessment process gives serious games another advantage over traditional formative testing.

Keywords

Serious game assessment, JDoc, secondary information, medical serious game, education assessment

Background

JDoc is an interactive, computer-based first and third-person junior doctor simulator. It is used to train and teach junior doctors (Sliney et al. 2007). It is a simple, cheap and easy-to-use development model, where people are assisted by information technology (Stephanidis and Savidis 2001). It can be installed on any home computer that meets the minimal required specification. The user's actions are continuously logged for reviews and revision by either the user or by a senior doctor, depending on which situation is preferred. Interactive prototypes of specific fidelity enable a better understanding of end-users and their tasks, lead to better collaboration and make it possible to produce better software faster (Memmel et al. 2007). Realistic prototypes help resolve detailed design decisions in layout, visual presentation, and component selection, as well as finding points in interaction design and interface behaviour (Constantine 2003).

When the simulator is fully loaded, the user has to proceed from waiting on call to assessing the patient. When the user has finished using the simulator, all actions can be reviewed either by him or herself or the supervisor in an individual txt file. Once a junior doctor logs onto JDoc he or she takes control of a doctor model (an on-call junior doctor). JDoc creates a file under the doctor's name in which all his or her actions are documented.

The user must make his way to the hospital and then find and assess the patient. To accomplish this he or she must talk to other doctors and nurses (Non-Player Characters (NPCs)), ask questions and follow the correct protocol in assessing the patient. Each assessment and every reaction from the in-game doctors and nurses, and factors such as electrocardiograms (ECGs), blood test results, and patient history, can differ as the senior doctors create new scenarios.

This paper looks at how to assess and evaluate each user's actions within JDoc.

Fig. 1. <Scenes from JDoc>

Why Evaluate and Assess?

> *"Entrenched within most education systems is the assumption that we must periodically formally report the achievement of individuals within the system."*
>
> Constantine 2003

User action assessment and evaluation are an integral and fundamental part of many serious games. These actions can be assessed and evaluated by the user (self, novice) or by an instructor (senior, expert). Irrespective of who assesses the actions, be it in a serious game or a structured formal test, much of the same information is extracted and reported to the assessor. The difference, and advantage, serious games have over structured formal testing is the potential of retrieving secondary information. This information can add greater depth and scope to the primary information generally gathered. Below is a list of the five main objectives for assessment. Secondary information can aid in making all five objectives more attainable.

- To pinpoint students' (users') strengths and weaknesses
- To provide a framework of incentive
- To portray a proof of rising
- Provide criteria against which individuals can judge their performance
- To make comparisons among users.

Evaluation and assessment are needed to diagnose and inform.

Assessment within Serious Games

Assessment within serious games has always been problematic, even more so within medical serious games. How do you assess a user concisely and accurately? Assessments need to be made of how the user performed in a variety of tasks. It needs to recognise the user's level of overall knowledge and understanding (Straughan and Wrigley 1980) and these assessments are then evaluated and compared to other assessments, be it the user's past assessments or other users' assessments. Serious games can potentially contain vast amounts of data: environmental, sound, and images, to name a few. This wide spectrum of information can make it difficult to assess a user's knowledge and understanding of a subject area. Within a medical serious game, should a doctor lose marks for being overly cautious? An example is, if a patient has the flu, how does one compare a user who immediately diagnoses the patient with the flu, to another user who first takes the patient's bloods, then an ECG and then diagnoses the patient with the flu. In a simple outcomes-based test both users would be equivalent. However, the first demonstrates an intuitive understanding and performed the task quicker. However, in a systems approach to error and error avoidance, this would be viewed as non-systematic, error prone, and possibly cavalier. This dilemma is one of the many reasons assessment within serious games can prove difficult, but it also highlights the advantages a serious game with a good assessment procedure can have over regular training and testing methods. When comparing assessments, it is the assessor who needs to decide how and what to compare. It is up to the designers to provide the assessor with the tools required for him to provide an adequate evaluation.

> *"It is sufficient to recognise here that the process exists and involves three major decisions. The first is a decision on what information is relevant, the second a decision on how to gather the information, and the third a decision on how to do the reporting, and to whom."*
>
> Straughan and Wrigley 1980

In most cases, where the assessor does not know the user, assessment within serious games may suffer from the lack of a rapport. Wood and Napthali (1975) identify six primary characteristics a teacher would take in to consideration when assessing a student:

- The involvement of the pupil in the learning situation
- The ability of the student at the subject
- Overall ability
- Behaviour
- Quality and tidiness of the work presented
- Interest displayed

Serious games, along with long distance learning, will suffer from the lack of some, if not all, the above characteristics (Wood and Napthali 1975).

Assessment within JDoc

When we began to design the assessment procedure within JDoc we had to make important decisions that would dictate how JDoc's users would be assessed. Who was going to assess the actions of the user? Was JDoc intended as a testing facility or a training facility? The difference is, if JDoc was set up as a testing program, a senior doctor would have to extract and assess the user's actions, whereas if JDoc was set up simply as a training tool then the user would have to assess his own actions. If a senior doctor was to assess a user's action, then he or she would need a lot more information than simply the actions taken and answers given. The doctor would need many other factors, such as time taken at each action, what order the actions were taken in, how many times the user repeated an action, what information the user asked for, and what information was given for each answer, etc.

JDoc set out as both a testing and training program. In order for a senior doctor to correctly assess a user, he or she would need to know everything about the user's performance within the simulator. JDoc is set around a 3D environment, which leads to difficulties capturing all user actions. Trigger boxes are used to overcome this problem. By placing trigger boxes at all significant points of the simulator we can capture relevant secondary information. Examples include, did the user enter a room? and what path did the user take? Three functions are connected to each trigger box, onEnter, onExit and whileInside. With these three functions it is possible to record all the users' input actions. These functions also give enough information to change JDoc testing from basic to adaptive testing. By

knowing exactly how efficient a user is at a task we are able to select test items according to the ability of the student (Salvia and Ysseldyke 1998).

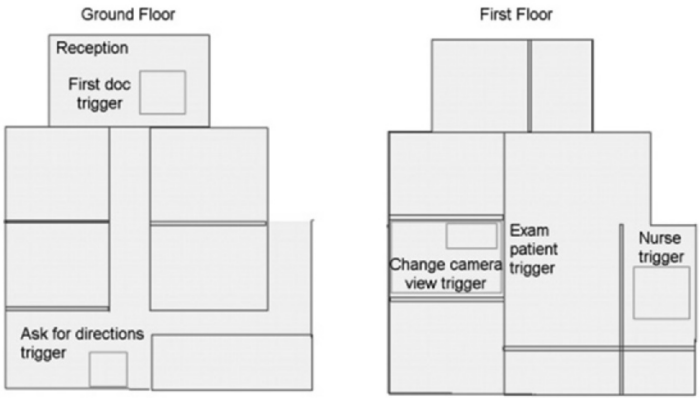

Fig. 2. <Trigger Boxes around the JDoc Hospital>

How many trigger boxes used is decided by the creator of the scenario. The number depends on the quantity and quality of the secondary information required. For example, in Figure 2, where we only use two trigger boxes, we can still acquire a lot of information, such as did the user go to reception, how many times did he go to reception, how long did he stay at reception, did he listen to all of the information relayed by the receptionist or did he leave mid-sentence, did he ask for directions, how many times did he ask for directions, how long was it before he made his way upstairs, did he come downstairs again, to name a few. Other trigger boxes could have been added in one of the rooms downstairs but the extra secondary data acquired by this trigger box (in this scenario) would be irrelevant to the assessment.

It is from these trigger boxes that the sample report below is generated. The creator of this scenario decided what retrieved data should be printed in the report. This method is elastic and easily extendable to add more or less data depending upon the requirements of the report. The creator could print all data captured to the report or simply just a few important elements. Each scenario will differ. With one scenario we could have many different assessment setups, again contingent upon who is looking at the report and what information he or she is looking for. If the user himself is reading his own report, the creator can add redefined correction lines (below). If the user does something incorrect it will appear on the report so he or she can see and learn from mistakes, making self assessment possible.

- *(6.25) He spent 12 minutes at a peripheral nervous exam*
  NO PERIPHERAL NERVOUS EXAM SHOULD HAVE BEEN DONE. TIME WASTED

As well as the trigger boxes, the addition of a timer enables us to meet the five requirements for assessing a student as discussed earlier (Wood and Napthali 1975). Examples of this include the ability to pinpoint students' strengths and weaknesses using selections and trigger boxes, while the inclusion of time spent on a task can be used to infer 'proof of rising' benefits.

------------------------- *Dr. Murphy Results* ---------------------------------

- *Dr Murphy started the Simulator. He then went on to call the hospital*
- *(1.12) After ringing the hospital Dr. Murphy thought the patient could have been suffering from peptic ulcer disease*
- *(2.15) He talked to Dr. Smith but Dr. Murphy left before the doctor finished talking*
- *(4.43) He talked to Nurse Carla (5.02) He walked into the patient's room*
- *(5.30) He asked him did he have shortness of breath.*
- *(5.55) He asked his patient was he feeling sick. He asked for the bloods. He looked at the end of bed notes* +++ *He began to examine the patient* +++

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- *(6.25) He spent 12 minutes at a peripheral nervous exam*
- *NO PERIPHERAL NERVOUS EXAM SHOULD HAVE BEEN DONE. TIME WASTED*
- *(18.32) 45 seconds were used on auscultation of the respiratory system.*
- *(19.05) He did a 20-second auscultation on the cardiovascular system.*
- *Dr. Murphy finished examining the patient.*

<><><><><><><><><><><><><><><><><><><><><><>
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- *When the medical reg asked "What's wrong with the patient and what's your reasoning behind your answer?" Dr. Murphy replied: "**ST Elevation, ECG showed it.**"*
- *When asked "What treatment would you like to start while the medical reg is on his way?" Dr. Murphy replied: "**Give him Panadol**."*

Above is a shortened version of a report generated for an assessor. It contains example secondary information captured by the timer and trigger boxes. It also gives all the primary information seen above in bold.

Conclusion and Future Work

Future work on the Junior Doctor Simulator has numerous possibilities. Many new scenarios could be built and new models and characters can be continuously added. The big step forward for this project would be to add a Content Management System (CMS) for the senior doctors to continuously edit and update the scenarios. Each new scenario built in each hospital can then be added to a database and then made accessible to any user of JDoc on the network, making the number of scenarios potentially endless. Critical pedagogy scenarios will also be built to expand teaching strategies and to prevent the scenarios from becoming static, for example, having actions return incorrect results and letting the user have the option of flagging these inconsistencies. The scenario should adapt to individual needs and levels of expertise in order to enhance cognitive performance.

Secondary data can be a vital part when assessing a user's performance within a serious game. Although sometimes challenging, we have shown that it is possible to capture and report this information. Some of the main problems serious game developers face are distinguishing relevant secondary information, capturing and reporting it.

Some evaluation studies have been done on the effectiveness of JDoc as a serious game for medical learning (Sliney and Murphy 2008). From theses studies the need for more secondary data to advance the teaching capabilities of JDoc was determined. The user actions logged are decided by the scenario creator, hence they should always be appropriate and compatible with the goals of the assessment. That said, further evaluation studies will be conducted with creators and users of JDoc to ensure this can be done in the most effective and appropriate manner possible.

References

Constantine LL (2003) Canonical Abstract Prototypes for Abstract Visual and Interaction Design. In: Jorge, JA, Jardim Nunes N, Falcao e Cunha J (eds) B DSV-IS. LNCS vol. 2844, Springer, Heidelberg

Memmel T, Reiterer H, Holzinger A (2007) Agile Methods and Visual Specification in Software Development, A Chance to Ensure Universal Access. pp 454-461

Salvia J, Ysseldyke J (1998) Assessment. Houghton Mifflin Company, Boston, pp 432-450

Sliney A, Murphy D, O'Mullane J (2007) The Use of Personal Simulators as Medical Decision Support Systems Training Resources. EuroGraphics Ireland Workshop, UCD, pp 75-81

Sliney A, Murphy D (2008) JDoc: A Serious Game for Medical Learning. International Conference on Advances in Computer-Human Interaction, ACHI/IEEE, Martinique, pp 131-136

Stephanidis C, Savidis A (2001) Universal Access in the Information Society Methods, Tools and Interaction Technologies. Universal Access in the Information Society 1(1), pp 40-55

Straughan R, Wrigley J (1980) Values and Education in Education. Harper and Row, London, pp 33-52

Wood R, Napthali WA (1975) Assessment in the Classroom: What Do Teachers Look for?. Ed. Stud 1.3, pp 151-161

inspire

SERIOUS GAMES ON THE MOVE 08
Inspiration Innovation Networking

Anglia Ruskin University
Cambridge & Chelmsford

Serious Games on the Move International Conference

Programme of Events

Day 1

Time	Activity	Location
09.30	Registration and Refreshments	The Street and the Venue Helmore Building
10.00	Welcome Address Dr Anthony Brand, Director of Learning and Teaching Development, INSPIRE	Mumford Theatre
10.15	Opening Plenary Address: EC project mGBL Prof. Otto Petrovic, Professor of the Institute for Information Science and Information Systems, University of Graz	Mumford Theatre
11.00	Introduction to the Themes Chairs: James Kadirire (Theme 1), David Wortley (Theme 2), Prof. Mike Sharples (Theme 3)	Mumford Theatre
11.30	Refreshments	The Venue Helmore Building
12.00	Designing Serious Games, Prof. Dr. Albert A. Angehrn	Mumford Theatre
12.45	**Lunch and Poster Sessions**	**The Street and the Venue Helmore Building**
13.45	Visualising the Future: Using Virtual Worlds and Games for Supporting Learning and Training, Dr Sara de Freitas	Mumford Theatre

Research Papers		
14.30	Definition of User Requirements Concerning mobile Learning Games within the mGBL Project Emanuel Maxl	Dav 014 David Building
	Exploring the Second Life of a Byzantine Basilica Kristoffer Getchell	Hel 251 Helmore Building
	A Platform for Server-Side Support of mobile Game-Based Learning Richard Hable	Dav 016 David Building
15.10	mobile Game-Based Learning: Design of a Specific Game Daniele Sangiorgi, Stefano Mininel, Helena Matavz and Sara Gaion	Dav 014 David Building
	Assessment Using of Secondary Data within Serious Games David Murphy	Dav 016 David Building
	Crash Course – The mobile Academic Revision Game Paul Cox	Hel 252 Helmore Building
15.30	**Refreshments**	**The Venue Helmore Building**

Workshops		
16.00 – 16.45	What We Can Learn from Massively Multiplayer Role Play Games Leonie Ramondt	Hel 118 Helmore Building
	A Strategy Team Gaming Environment to Develop Sensible Organisation Capability Helen Hasan	Hel 251 Helmore Building
	Machinima and Cineliteracy: Learning Film-Making Virtually Saint John Walker and Matt Kelland	Hel 252 Helmore Building
17.00	**Optional Excursion: Scudamore's Punting and Pimms**	**Meet in the Street Helmore Building**
19.00 **20.00**	**Pre-dinner drinks reception, University Arms Hotel** **Conference dinner, University Arms Hotel**	**University Arms Regent Street Cambridge CB2 1AD**

Time	Activity	Location
Day 2 09.00	**Refreshments**	**The Venue Helmore Building**
09.30	Welcome Address Christian Kittl, evolaris Privatstiftung	Mumford Theatre
09.45	The Mobile Metaverse Ron Edwards	Mumford Theatre
10.30	Panel Discussion | Serious Games on the Move: Current Issues and Research Directions Panel Chair: Dr Jaki Lilly	Mumford Theatre
11.15	**Refreshments**	**The Venue Helmore Building**
11.45	Games and mobile Technology in School-Based Learning: The results of emapps.com Robert Davies	Mumford Theatre
12.30	**Lunch and Poster Sessions**	**The Venue and the Street Helmore Building**
Workshops		
13.30 – 15.00	Challenges to Embedding Games into Curricula: How Could a Game Designed with eMapps Platform Be Used in Practice? (Discussion) Geoff Butters	**Hel 251**
	eMapps.com Game-Based Mobile Learning Platform (Demonstration & Discussion) Roger Blamire	**Hel 252**

Research Papers		
13.30 – 14.10	Learn to Play to Learn: Activity System as Reflection Alan Amory	**Dav 014** **David Building**
14.10 – 14.50	Learning Programming with an RTS-Based Serious Game Jean-Pierre Jessel, Mathieu Muratet and Patrice Torguet	**Dav 014** **David Building**
15.00	**Refreshments**	**The Venue** **Helmore Building**
Research Papers		
15.30	Narrative-Based Serious Games Carlton Reeve	**Hel 118** **Helmore Building**
	Lessons from Applied Drama: Conventions to Help Serious Games Developers David Cameron and John Carroll (Digital Presentation)	**Hel 251** **Helmore Building**
	Assessing the Value of mobile Game-Based Learning Dragan Cisic, Edvard Tijan and Ana Peric Hadzic	**Hel 252** **Helmore Building**
16.10	A Virtual Infection Control Simulation – The Development of a Serious Game in the Health Care Sector Andy Pulman and Mark Shufflebottom	**Hel 118** **Helmore Building**
	Fastest First! and Crisis! – Creating Innovative mobile Learning Games on the Basis of Quiz Templates Brigitte Krenn	**Hel 251** **Helmore Building**
	Potential Prejudice against mobile Learning Games in Croatian University Students Vladimir Taksic, Ivana Ilijasic Misic and Edvard Tijan	**Hel 252** **Helmore Building**
16.50	**Closing Address with Drinks and Canapé Reception**	**The Venue** **Helmore Building**