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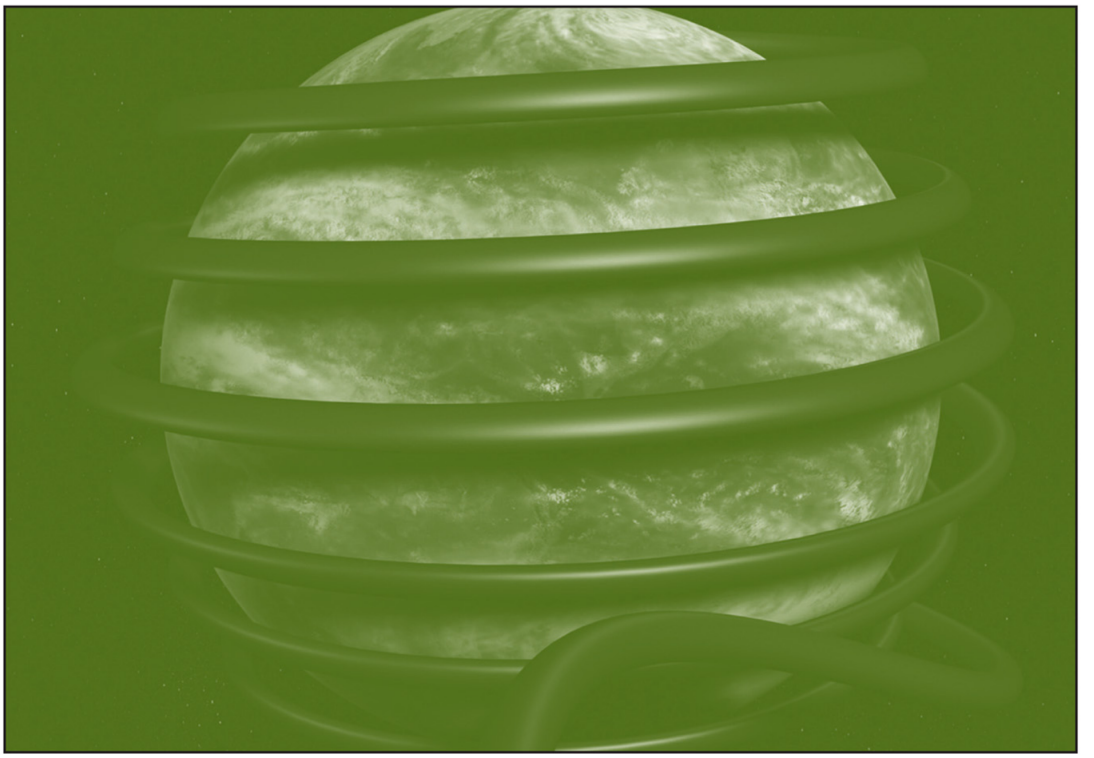

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Table of Contents

International Journal of Virtual and Personal Learning Environments

Volume 10 • Issue 2 • July-December-2020 • ISSN: 1947-8518 • eISSN: 1947-8526

Guest Editorial Preface

v **Special Issue on New Perspectives in Online Education: Environments, Approaches, Authoring Tools**
Laura Fedeli, Department of Education, Cultural Heritage and Tourism, University of Macerata, Macerata, Italy
Pier Giuseppe Rossi, University of Macerata, Macerata, Italy

Research Articles

1 **PLS Model Performance for Factors Influencing Student Acceptance of E-Learning Analytics Recommender**
Kamaljeet Sandhu, University of New England, Armidale, Australia
Hadeel Alharbi, University of New England, Armidale, Australia

15 **Potential of Deployment of Virtual and Augmented Reality in Emergency Management Training via an Exploratory Interview Study**
Valentina Pennazio, University of Macerata, Italy
Michele Genta, SIMNOVA Centre, University of Piemonte Orientale, Italy

35 **Gears in Motion: Changing Perspectives of Interactions Among Online Presences**
Fatemeh Mardi, University of Missouri, St. Louis, USA

50 **Design, Development, and Usability of a Virtual Environment on Moral, Social, and Emotional Leaning**
Samiullah Paracha, University of Sunderland, UK
Lynne Hall, University of Sunderland, UK
Kathy Clawson, University of Sunderland, UK
Nicole Mitsche, University of Sunderland, UK

66 **Avatar-Based Learning and Teaching as a Concept of New Perspectives in Online Education in Post-Soviet Union Countries: Theory, Environment, Approaches, Tools**
Vardan Mkrttchian, HHH University, Australia
Dina Kharicheva, Moscow Pedagogical State University, Russia
Ekaterina Aleshina, Penza State University, Russia
Svetlana Panasenko, Plekhanov Russian University of Economics, Russia
Yulia Vertakova, Southwest State University, Russia
Leyla Gamidullaeva, Penza State University, Russia
Mikhail Ivanov, Financial University Under the Government of the Russian Federation, Russia
Vsevolod Chernyshenko, Financial University Under the Government of the Russian Federation, Russia

83 **The Effect of Using Blended Learning Method on Students' Achievement in English and Their Motivation Towards Learning It: Blended Learning, Achievement, and Motivation**
Dima Ali Hijazi, Yarmouk University, Jordan
Amal Shehadeh AlNatour, Yarmouk University, Jordan

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Guest Editorial Preface

Special Issue on New Perspectives in Online Education:
Environments, Approaches, Authoring Tools

Laura Fedeli, Department of Education, Cultural Heritage and Tourism, University of Macerata, Macerata, Italy
Pier Giuseppe Rossi, University of Macerata, Macerata, Italy

Instructional technologies and e-learning have been radically changing in the last decade. Users' approaches and expectations towards their learning experience are being affected by the different nuances of what being present and active in the process may mean in the current educational ecosystems.

The idea of interaction, collaboration and support during the learning process are acquiring new dimensions in the online and blended solutions. Quality criteria and feasibility in the different educational levels, from childhood to higher education and in-service development, require teachers and instructional designers to face the various challenges of current social and professional landscape.

INSIDE THIS ISSUE

In this regard, the first article by referring to the context of higher education in Saudi Arabia, puts emphasis on the multivariate analyses results of the factors that influence students' acceptance of e-learning analytics recommender systems and how to support students in meeting their learning needs.

The second article, on the basis of an exploratory study, aimed at identifying the strengths and weaknesses and the degree of acceptance of the use of virtual and augmented reality in professional training, refers to the importance of investigating such an opportunity for training in emergency management field. The potentials and advantages of virtual and augmented reality are discussed through the analysis of a qualitative/quantitative survey whose aim is to check how to promote an innovative training through technologies.

The third article, stressing the necessity of understanding the interactions among presences and domains in an online course, discusses and proposes a model that can offers teachers and course designers a new, holistic perspective that underlines the dynamic interactions between the presences and the impact of emotions within an online environment.

The fourth article, by discussing the challenges of participatory design practices to develop moral, social and emotional competencies through virtual learning environments, shows the need for children from early school experience to become successful students, citizens, and workers. Thanks to students' active participation in the educational design they are fostered to develop social and emotional skills critical to face school bullying.

The fifth article is devoted to the design of an Avatar-Based Learning and Teaching (A-BL&T) software system as a concept of control and managing knowledge in modern socio-economic conditions and proposed for the assessment of university's economic efficiency. The article proposes a solution to the problem of storing a plurality of hierarchical semantic networks in a relational database.

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The last article emphasizing the opportunities of enhancing students' motivation and engagement in the learning process, argues that a blended learning solution can enhance students' self-confidence and makes them responsible for their own learning being more actively engaged in the process.

CONCLUSION

Such analysis puts emphasis on different dimensions of the connection between the use of technology, the instructional delivery systems, from presence to blended solutions and e-learning to immersive learning environments, and the involvement of the different actors and their role in the complexity of the teaching-learning process.

The cases described in the present issue show how analysis of effectiveness through automated systems like learning analytics and qualitative tools to gather students' acceptance of technology can represent a valid support for enhancing the course design process and the level of integration of technology.

The co-design solution appears to be more and more referred to as a successful strategy to engage learners in the learning process and be active in reaching the outcomes. Co-design can be embraced for different reasons, to make students responsible in their path and acquire self-confidence, to involve stakeholders in identifying the proper modalities, to let different profiles (designers, teachers, tutors) open a dialogue.

When addressing quality criteria and effectiveness of the instructional infrastructure we do not refer merely to the technological dimension, but also to the pedagogical and institutional ones. School context as well as universities and professional training institutions require the planning and application of strategies that can meet every specific context readiness to include technology in their curricula. Including technology means not only an assessment of its readiness in terms of trained human resources and available equipment, but it also means to have the flexibility to adapt to different audiences with their prerequisites and learning needs.

Laura Fedeli
Pier Giuseppe Rossi
Guest Editors
IJVPLE

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PLS Model Performance for Factors Influencing Student Acceptance of E-Learning Analytics Recommender

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ABSTRACT

The aim of this article is to present the multivariate analyses results of the factors that influence students' acceptance and the continuance usage intention of e-learning analytics recommender systems in higher education institutions in Saudi Arabia. Data was collected from 353 Saudi Arabian university students via an online survey questionnaire. The research model was then used to examine the hypothesised relationships between user experiences of an e-learning analytics recommender system and their intentions for long-term adoption of the system. The research model was primarily based on the Technology Acceptance Model (TAM) developed by Davis (1989) – the variables 'perceived usefulness,' 'perceived ease of use,' and 'acceptance,' particularly – with 'continuance usage intention' added as an endogenous construct, and with 'service quality' and 'user experience' added as external variables.

KEYWORDS

Acceptance, Analytics, PLS, Technology Acceptance Model (TAM)

1. INTRODUCTION

Electronic and multimodal information communication technologies (ICT) are increasingly utilised in education service delivery in countries around the world (Al-Gahtani, 2016). Described as electronic learning (e-learning), not only is it increasingly perceived as an inclusive learning approach, it is acknowledged as a flexible and convenient learning pathway for students and a cost-effectiveness strategy for the management of learning spaces (Al-Gahtani, 2016). E-learning analytics recommender systems fall within the broad suite of e-learning technologies. Characterised as collaborative, content-based system, an e-learning analytics recommender system assist students to access and evaluate learning materials and other information to make informed choices to meet their learning needs and interests (Okechi and Kepeghom, 2013). To facilitate this outcome, the analytics recommender system first predicts and then responds to the students' areas of interest.

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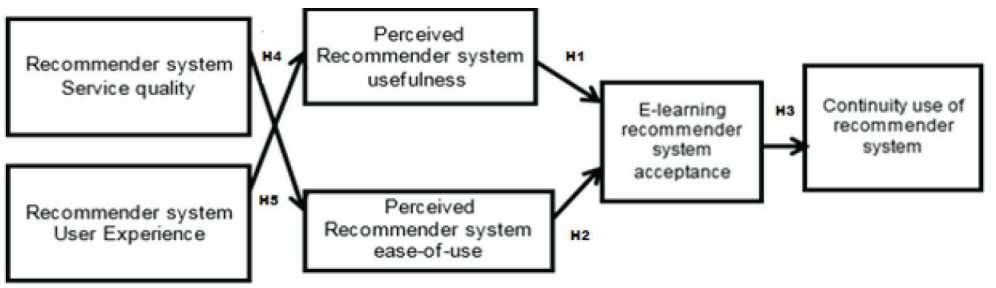
Notwithstanding the potential benefits to student learning outcomes from using e-learning analytics recommender system, their adoption in Saudi Arabian higher education institutions remains limited (Alenezi et al., 2012; Al-Gahtani, 2016). In response, this study investigates the factors influencing Saudi students' acceptance of, and continuance usage intention for, e-learning analytics recommender systems in universities in Saudi Arabia. It is anticipated that the findings from the investigation can help to inform the strategies needed to promote the adoption of analytics recommender technologies in Saudi Arabia.

2. RESEARCH MODEL AND HYPOTHESES

The research model to investigate the factors affecting students' acceptance and the continuance usage intention of e-learning analytics recommender systems is primarily based on the TAM developed by Davis (1988). It incorporates 'service quality' and 'user experience' as external variables; and includes the TAM variables: 'perceived usefulness,' 'perceived ease of use,' and 'acceptance'. The research model also extended the TAM by adding 'continuance usage intention' as the ultimate endogenous construct in the developed model (see Figure 1).

Figure 1. Research model of e-learning analytics recommender system acceptance



Following analysis of the findings reported in previous studies (e.g. DeLone and McLean, 1992; Gorla et al., 2010; Rana et al., 2015) and in consideration of the key issues explored in the literature (e.g. Dağhan, and Akkoyunlu, 2016; Karapanos, 2013; Lee, 2010; Lin 2011), the following hypotheses were formulated:

H1: The perceived recommender system usefulness affects e-learning analytics recommender system acceptance.
H2: The perceived recommender system ease of use affects e-learning analytics recommender system acceptance.
H3: The e-learning analytics recommender system acceptance affects the continuity use of recommender system.
H4: The e-learning analytics recommender system service quality affects perceived recommender system ease of use.
H5: The e-learning analytics recommender system user experience affects perceived recommender system usefulness.

Service quality refers to both the quality of information delivered in terms of accuracy, currency and completeness (Huh et al., 1990), and to system quality in terms of performance and functionality; that is, correctly and performs the required tasks (Chatfield and Al Anazi, 2013). User experience

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relates to user confidence, skills, feelings of frustration, and navigation outcomes. Perceived usefulness relates to performance, productivity, efficiency, effectiveness, and timeliness. Lastly, perceived ease of use relates to the capacity of the system to meet user demands and to facilitate user learning of the system.

2.1. E-Learning Analytics and Recommender Systems

Learning analytics refers to "the measurement, collection, analysis, and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning and the environments in which it occurs" (Long and Siemens, 2011, p. 32). Learning analytics tools such recommender systems enable educational institutions to provide learners with a more personalised educational materials (Dietz-Uhler and Hurn, 2013). In addition, these tools would enhance students' learning experience and increase their engagement, retention and success (Lockyer et al., 2013). Moreover, learning analytics also offers educational institutions valuable insights and improved decision-making for better resources allocation to achieve educational excellence (Macfadyen and Dawson, 2012).

Recommender systems, or recommendation systems/engines, are e-learning analytics tools that assist users to select items relevant to their interest (Almeida, 2013). Recommender systems have been designed to cover the gap between information collection and analysis by improving the capacity and efficiency of the filtering of available data and presenting the most appropriate items to the user (Almeida, 2013). However, the major issue with recommender systems is obtaining the ideal match between those recommending and those receiving the recommendation; that is, indicating and discovering the relation between users' interests. Recommender systems are widely adopted in various fields for the recommendation of research papers, articles, music, objects, videos, movies and even people. Professional databases and portals, such as Facebook, LinkedIn, IBM, Cisco and Amazon, use recommender systems that suggest items (e.g., products and contacts) to their users (Cleomar & Oliveira, 2011).

2.2. E-Learning and Recommender Systems

The advent of e-learning environments has shifted course content from a traditional static model that treated all students similarly to a more fluid approach to content that responds to the individual needs of the student (Berharndi et al., 2016). Recommender systems are designed to facilitate rapid filtering to provide targeted information that matches the needs of the student (Berharndi et al., 2016). Targeted recommender systems avoid information overload that reduces learning time, often associated with unfiltered searches (Tarus, Niu, & Mustafa, 2017). This filtering process allows for the generation of a personalised learning environment, where students are freed from the task of searching for relevant information through browsing or self-filtering, enabling the student to spend more time on learning materials (Berharndi et al., 2016).

Recommender system innovations have seen the rise of systems, such as the new multi-personalised recommender system for e-learning (NPR-eL), that not only filter data, but through a historical examination of previous searches, are able to determine how much information the student is retaining (Berharndi et al., 2016). However, while these systems have benefits to regular users due to their intuitive learning mechanisms, they often have start issues (Bourkoukou & El Bachari, 2016). The avoidance of cold-start issues is critical to user experience and therefore long-term uptake of the recommender system. To avoid this, the use of initial filtering based on peer identification, where a learner profile is generated based on the collaborative filtering, and then use of this starting point to bring forward learning objects that engage the student and enable a more historically reliant guide of student needs to be developed (Bourkoukou & El Bachari, 2016). Further, understanding student learning styles, modelled using the Felder Silverman Learning Styles (FSLS), can generate scales that guide the recommender system algorithm (Bourkoukou & El Bachari, 2016; see Table 1). The FSLS generates a 44-question survey of potential recommender system users to find the learning style and create the correct scales to meet the needs of the student (Bourkoukou & El Bachari, 2016).

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Table 1. The four scales of the Felder Silverman Learning Styles (FSLS) used to inform cold-search recommender systems (Bourkoukou & El Bachari, 2016, p. 1568)

Scale	Student Style	Characteristics
Information processing	Active (A)	Works in groups, prefers to try new material instantly, handles practical stuff.
	Reflective (R)	Works alone, preferring to take the time to think about a problem.
Information perception	Sensing (S)	Is patient with details, prefers senses, facts and experimentation.
	Intuitive (I)	Interested in the overview and broad-scale knowledge, interested in innovations and accepts complications, prefers principles and theories.
Information reception	Visual (L)	Prefers to perceive materials as images, diagrams and films.
	Verbal (B)	Prefers to perceive materials as text.
Information understanding	Global (G)	Prefers to get the big picture first, assimilates and understands information in a linear and incremental step.
	Sequential (Q)	Prefers to process information sequentially.

Once the student scale has been determined, the recommender system is able to formulate a strategy that data mines information to meet the identified student learning style (see Table 1). The role of recommender systems in e-learning is to maximise the time spent by the student learning and reduce the time spent searching. The understanding of the learning style of the student enables student engagement from a cold start, increasing the rates of user satisfaction. Once the hurdle of cold starts has been avoided, the style of recommender system chosen will be able to work most effectively.

2.3. Research Method

This study employed both web-based and personally administered questionnaires. During the twentieth century, technological advances, including the internet, revolutionised the way in which survey research is conducted. In coming years, some experts expect that the majority of survey research will be conducted online (Evans & Mathur, 2005). Several researchers around the world have utilised internet-based surveys, for several reasons. One advantage of using the internet for conducting a survey is saving researchers' time. A web-based survey enables researchers to reach thousands of potential participants in a short time frame, even though possibly being separated by great geographic distances. In addition, this type of survey may save time by allowing researchers to work on other parts of their research while collecting data. Moreover, it reduces the time needed to manually enter the data into the data analysis software (Taylor, 2000; Llieva, Baron, & Healey, 2002; Wright, 2005). The second advantage of using online surveys is saving money. Researchers can save money by using an electronic medium to reach their sample instead of a paper format. The cost associated with printing paper-based questionnaires, mailing them to targeted participants or travelling to personally administer them can be enormous (Wright, 2005). However, if not properly addressed, electronic surveys suffer from potential limitations including low response rates, security and privacy concerns and sampling issues (Evans & Mathur, 2005). To overcome these weaknesses, there was a limited use of hard copies for the convenience of some respondents.

In this research, the survey was designed and organised to ensure the clarity and accuracy of the questions. The researcher used Qualtrics survey software to develop the web-based survey (Evans & Mathur, 2005). The questionnaire design was divided into two sections. The first section was designed to capture the respondents' profiles (i.e., demographic data) using multiple-choice questions. In this section, yes/no questions were also used at the beginning of the questionnaire for the purpose of

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filtering the participants (e.g., based on whether they are using e-learning recommender systems or not). The second section consisted of scale questions used to measure the independent and dependent variables related to the research model. Scale questions were close-ended questions using a five-point Likert scale with end points of 'strongly agree' and 'strongly disagree'. To achieve clarity, each type of question was separated from other types. Thus, the demographic questions and yes/no questions were placed first, followed by the scale questions, which were clustered based on the subject.

The survey utilised the previous literature survey to develop a series of measures suitable for measuring users' acceptance and continued use of e-learning recommender systems in Saudi Arabia using the TAM framework. The constructs of interest in this study were 'perceived usefulness', 'perceived ease of use', 'service quality', 'user experience', 'user acceptance' and 'continuance usage intention'. These constructs were described in Chapter 2. Survey items were operationalised using validated items drawn from prior research (see Table 2 and Table 3).

Table 2. Operationalisation of constructs

Variable Code	Variable Name	Explanation	Number of Items
PU	Perceived usefulness	The degree to which a learner believes that using the e-learning recommender system would enhance his or her performance	5
PEOU	Perceived ease of use	The degree to which a learner believes that using the e-learning recommender system would be free of effort	5
SQ	Service quality	The quality of information that the e-learning recommender system delivers to its users as well as the system quality	4
UX	User's experience	Learners' knowledge and skills in interacting with the e-learning recommender system	7
UA	User's acceptance	Learners' initial behavioural intention to use the e-learning recommender system	5
CUI	Continuance usage intention	Learners' intentions to continue using the e-learning recommender system after the initial adoption	3

The scales of perceived usefulness and perceived ease of use were adopted from Davis (1989) and Davis et al. (1989). Service quality items were adopted from Chutimaskul, Papasratorn, and Wangpipatwong (2005). The measurements of users' experience were adopted from Koufaris (2002), Taylor and Todd (1995b) and Venkatesh et al. (2003). Users' acceptance items were adopted from Morris and Dillon (1997). Continuance usage intention items were adopted from Al-Debei, Al-Lozi and Papazafeiropoulou (2013). Table 3 Measurement scales developed in this survey lists the survey items. There were six constructs and total of 29 items used to measure them: perceived usefulness has one dimension with five items, perceived ease of use includes one dimension and five items, service quality has one dimension and four items, user experience has one dimension and seven items, user acceptance has one dimension with five items and finally, continuance usage intention has one dimension and three items.

All items were measured using a five-point Likert-type scale on an interval level ranging from 'strongly agree' to 'strongly disagree.' The Likert scale's invention was to explain this technique for the assessment of attitudes (Likert, 1931). The Likert scale was selected as an instrument to obtain a participant's preference and degree of agreement with statements (Hair, Black, Babin, Anderson, & Tatham, 2006). This scale can more conveniently show the responses from a strongly positive one to a strongly negative one with the mid-point indicating a neutral response. In addition, Hair et al.

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Table 3. Measurement scales developed in this survey

Construct	Item	Measure	Source
Perceived usefulness	PU1	I would find the e-learning recommender system useful to access educational services.	Davis (1989) and Davis et al. (1989)
	PU2	Using the e-learning recommender system will probably improve my academic performance.	
	PU3	Using the e-learning recommender system would probably increase the effectiveness of my learning.	
	PU4	Using the e-learning recommender system would probably help me to accomplish educational tasks more quickly.	
	PU5	Using the e-learning recommender system would increase my academic productivity (e.g., find information about educational services in shortest time frame)	
Perceived ease of use	PEOU1	Learning how to use the e-learning recommender system to access educational services is easy for me.	Davis (1989) and Davis et al. (1989)
	PEOU2	I find it easy to use the e-learning recommender system to find what I want.	
	PEOU3	My interaction with the e-learning recommender system to access educational services is clear and understandable.	
	PEOU4	The e-learning recommender system is flexible to interact with.	
	PEOU5	Overall, I find using the e-learning recommender system to access educational services easy to use.	
Service quality	SQ1	Information delivered from the e-learning recommender system is accurate.	Chutimaskul et al. (2005)
	SQ2	Information delivered from the e-learning recommender system is up-to-date.	
	SQ3	The e-learning recommender system always works properly without service disruption or downtime.	
	SQ4	The e-learning recommender system enables me to complete all necessary tasks electronically.	
User experience	UE1	I have become very skilled at using the e-learning recommender system.	Koufaris (2002), Taylor and Todd (1995b) and Venkatesh et al. (2003)
	UE2	I know where to find what I want on the e-learning recommender system.	
	UE3	I know more about using the e-learning recommender system than most users.	
	UE4	Using the e-learning recommender system helps me to locate information easily.	
	UE5	It is easy for me to move between different sections on the e-learning recommender system.	
	UA6	I am less aware of other things around me when interacting with the e-learning recommender system.	
	UA7	When successful in a task on the e-learning recommender system, I feel confident in using it for other tasks.	
User acceptance	UA1	The e-learning recommender system is easy to navigate.	Morris and Dillon (1997)
	UA2	I intend to use the e-learning recommender system more for my study.	
	UA3	I find information quicker on the e-learning recommender system.	
	UA4	Using e-learning recommender system would probably save my money.	
	UA5	Using e-learning recommender system would probably help me in monitoring time.	
Continuance usage intention	CBI1	I intend to continue using the e-learning recommender system in the future.	Al-Debei et al. (2013)
	CBI2	I will continue using the e-learning recommender system in the future.	
	CBI3	I will regularly use the e-learning recommender system in the future.	

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(2006) held the view that the Likert scale is one of the most useful devices available as it builds in a degree of sensitivity and differentiation of responses. Moreover, Likert scales are the most frequently used scales in information systems research (Sekaran, 2003).

2.3.1. Assessing the Validity and Reliability of the Constructs

Instrument validity is considered a critical stage to confirm that the instrument is accurate and measuring what it is intended to measure (Straub et al., 1989). According to Sekaran and Bougie (2010), different techniques can be used to ensure instrument validity, such as content, convergent and discriminant validity. Straub, Boudreau and Gefen (2004, p. 68) defined content validity as 'the degree to which items in an instrument reflect the content universe to which the instrument will be generalised. This validity is generally established through literature reviews and experts' judges or plans'. The content validity of our survey instrument was established in two ways. First, the constructs along with the measures used in this study have already been validated in previous studies, as they were all adopted from the existing literature. Second, the results of the pre-test with subject-matter experts assured the content validity of the survey instrument. The questionnaire was sent to two academics and two PhD students in the field of management information systems. The process started by asking two PhD students from Saudi Arabia who are studying in Australia to fill in the questionnaire. Students were asked to provide their feedback on whether the items were worded in an accurate, clear and understandable manner. The comments and notes they provided were taken into consideration and some of the items re-worded and refined. Thereafter, the questionnaire was sent to two subject-matter experts working as faculty members to complete and advise on whether the items would measure the construct and check item ambiguity, simplicity and redundancy. Finally, the questionnaire items were modified to incorporate the experts' feedback and comments.

Convergent validity is the degree to which multiple measures of a construct are correlated. Discriminant validity is the opposite of convergent validity, and assesses the degree to which two conceptually similar concepts are different (Hair et al., 2006). Convergent validity is used to ensure that all the items measuring a construct are grouped in one single construct. In this study, validity and uni-dimensionality of the scales were assessed with exploratory factor analysis (EFA) and examination of the correlation coefficients. In addition, convergent and discriminant validity of the measurement scales was assessed using confirmatory factor analysis (CFA). Specifically, composite reliability (CR) and average variance extracted (AVE) tests were conducted to measure convergent validity. Fornell and Larcker (1981) suggested that the value of CR for each construct must exceed 0.70, while the value of the AVE must exceed 0.50 for convergent validity to be assured. As for discriminant validity, it is established when the square root of the AVE from the construct is greater than the correlation shared between the construct and other constructs in the model (Chin, 1998).

Reliability refers to 'the extent to which a variable or set of variables is consistent in what it is intended to measure' (Straub et al., 2004, p. 68). For reliability of the scale, Cronbach's alpha (Cronbach, 1970), which is a common method used to measure the reliability and internal consistency of scales, was used. Hair et al. (2006) suggested that the reliability of the scale is generally accepted if the value of Cronbach's alpha for each construct is equal to or greater than 0.70. Nunnally (1978) argued that to level of reliability (alpha value) is a determination made by the researcher in terms of energy, time and the potential impacts if a lower level of reliability is applied. Notwithstanding, that an alpha of 0.95 is the gold standard, a lower alpha reflects the nature of measurement arose when dealing with multiple variables which are combined within an instrument (Nunnally, 1978).

2.3.2. Sampling

This study employed the survey questionnaire as the main method for collecting data. Web-based and self-administered questionnaires were developed based on previous literature. As this research is studying the continuous use of e-learning recommender systems, it is vital that the targeted universities have this technology in place. A list of such universities and contact data were obtained from the

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Ministry of Higher Education. The researcher then identified a university that was convenient. The selection was based on the fact that the selected university had been using the e-learning recommender system for a few years. In addition, the selected university has different branches across Saudi Arabia, which was thought likely to increase the response rate and the generalisability of the obtained results.

To obtain a list of students' emails, computer centre staff at this university were contacted face-to-face or online via emails and/or by phone calls. Their contact details were identified by personal connections and through the university website. The link to the web-based questionnaire was distributed via email to a total of 1,000 students, and participation was completely voluntary. It was available online and accessible to students for the period from the 5 February 2016 to the 15 May 2016.

In addition, there was a limited use of hard copies for the convenience of some students. A total of 350 questionnaires were randomly distributed by the researcher herself and by three professional survey collectors who were voluntarily recruited to distribute and collect the survey data from different locations.

A total of 406 surveys were returned from both the web-based and the self-administered questionnaires. Out of the 406 surveys collected, 54 were considered unusable, either because students indicated that they had never used the e-learning recommender system or because the collected self-administered surveys had many missing response items. The remaining 353 surveys were used in the analysis.

3. DATA ANALYSIS

Data analysis using Structural Equation Modelling (SEM) with Partial Least Square (PLS) was conducted using SmartPLS 2.0 M3 to test the structural model and hypotheses.

4. RESULTS

To evaluate the significance of the path coefficients of the formulated hypotheses, 353 cases, 5000 samples, and the no sign changes option were used in a bootstrapping procedure (Hair et al., 2012). Results presented in Table 4 indicates all study hypotheses were accepted according

Table 4. Hypotheses testing result

Hypotheses	Path Coefficient	T Statistics	P Values	Results
PEOU -> UA	0.344	6.947	0.000	Accepted
PU -> UA	0.535	9.295	0.000	Accepted
SeQ -> PEOU	0.420	6.362	0.000	Accepted
UA -> CUI	0.654	10.823	0.000	Accepted
UX -> PU	0.456	6.338	0.000	Accepted

to obtained t-values and p-values. For instance, user experience positively and directly influences perceived usefulness ($\beta = 0.456$, $p \leq 0.001$) and service quality positively and directly affects perceived ease of use ($\beta = 0.420$, $p \leq 0.001$). Furthermore, perceived ease of use and perceived usefulness positively and directly influence user acceptance ($\beta = 0.344$, $p \leq 0.001$; $\beta = 0.535$, $p \leq 0.001$, respectively). Finally, user acceptance positively and directly influences continuance usage intention ($\beta = 0.654$, $p \leq 0.001$).

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4.1. Correlation Coefficient of Latent Variables

The shared variance among the constructs was compared with the AVE from each construct to establish the discriminant validity among the constructs. The results provided in Table 5 show support for the discriminant validity among the latent variables in our model.

Table 5. Latent variable correlations

	CUI	PEOU	PU	SeQ	UA	UX
CUI	**1.000**					
PEOU	0.455	**1.000**				
PU	0.436	0.408	**1.000**			
SQ	0.473	0.420	0.372	**1.000**		
UA	0.654	0.563	0.676	0.497	**1.000**	
UX	0.289	0.193	0.456	0.223	0.268	**1.000**

Hence, the measurement instrument's content validity, reliability, convergent validity, and discriminant validity were all satisfactorily met in this study.

4.2. Inner Model

The R^2 and Q^2 values in this research were also measured. Table 6 and Figure 2 show that the R2 value for each endogenous latent construct in this study was above 25%, demonstrating an acceptable

Table 6. Results of R^2 and Q^2

Constructs	R2	Q^2	f^2
CUI	0.428	0.188	N/A
PEOU	0.176	0.070	0.222
PU	0.208	0.119	0.537
SQ	N/A	N/A	0.214
UA	0.555	0.285	0.749
UX	N/A	N/A	0.262

prediction level in empirical research (Gaur and Gaur, 2006; Griffith, 1996). Moreover, the coefficient of determination R^2, which is the central criterion for the structural model's assessment (Klarner et al., 2013), has a high value of 0.555 and 0.428 for the targeted constructs in this study.

In addition, Q^2 predictive relevancy measures were used to support these finding through (Stone, 1974) by performing the blindfolding procedure (Chin, 1998) with omission distance D = 9. All Q^2 values were well above zero for Continuance Usage Intention (0.188), perceived ease of use (0.07), perceived usefulness (0.119), and user acceptance (0.285).; indicating the predictive relevance of the PLS path model. Finally, the effect size (f^2 value) of perceived usefulness on user acceptance was large (53.7%); whereas, the effect size of perceived ease of use on user acceptance was moderate (22.2%). T effect sizes for service quality on perceived ease of use was moderate (21.4%), as was

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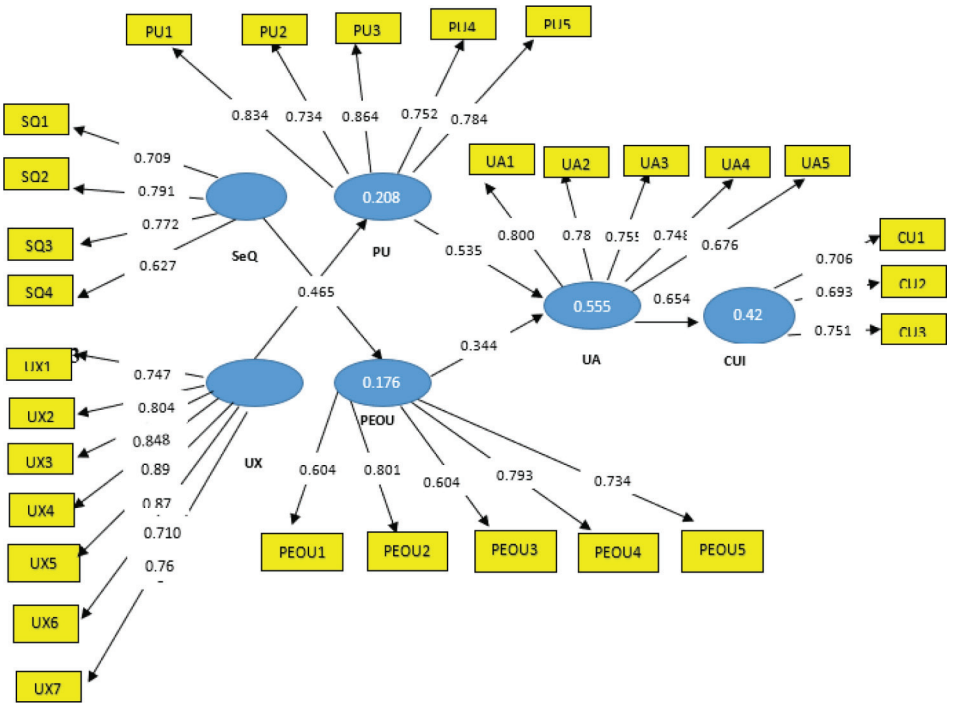
Figure 2. SmartPLS-SEM results



the effect size for user experience on perceived usefulness (26.2%). Finally, the effect size for user acceptance on continuance usage intention was large (74.9%).

4.3. Outer Model

Extraction communalities estimate the variance in each variable accounted for by the factors in the model (see Table 7). User experience rated the highest on the scale (0.624), followed by perceived usefulness (0.573), perceived ease of use (0.566), acceptance (0.510), service quality (0.453), and continuance usage intention (0.351). Use of the e-learning recommender system is strongly influenced by user experience (0.624), implying that the students' ability to locate information easily was a significant factor contributing to their user experience of the e-learning recommender system. Similarly, perceived usefulness and perceived ease of use strongly influence the use of e-learning analytics recommender systems (0.573, 0.566, respectively). The students' perceptions that the e-learning recommender system helped to improve productivity and was generally easy to use also significantly contributed to the students' use of the recommender systems.

The path coefficients results (Table 1) indicate perceived usefulness strongly influences user acceptance (0.535) and continuance usage intention is very much dependent on user acceptance (0.654). In addition, user experience has a relatively strong influence on perceived usefulness (0.456), as does service quality on perceived ease of use (0.420). However, the path analysis results also show a weak link between perceived ease of use and user acceptance of the e-learning recommender system compared to the influence of perceived usefulness. This suggests user acceptance and continued usage of the e-learning recommender system is more closely tied to perceived usefulness than perceived ease of use.

Clear and understandable interaction, the ability to complete all tasks electronically, and the help students receive to monitor time have the least impact on acceptance and continued usage of e-learning

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Table 7. Outer model results

	Weight	Loading	Communality	Redundancy
Continuance Usage Intention (CUI) Outward				
CUI1	0.399	0.706	0.331	0.181
CUI2	0.392	0.693	0.352	0.175
CUI3	0.425	0.751	0.351	0.209
Perceived Ease of Use (PEOU) Outward				
PEUO1	0.219	0.604	0.347	0.036
PEUO2	0.290	0.801	0.494	0.098
PEUO3	0.219	0.604	0.213	0.035
PEUO4	0.287	0.793	0.410	0.093
PEUO5	0.266	0.734	0.566	0.089
Service Quality (SeQ) Outward				
SeQ1	0.304	0.709	0.433	0.000
SeQ2	0.339	0.791	0.453	0.000
SeQ3	0.331	0.772	0.425	0.000
SeQ4	0.269	0.627	0.308	0.000
User Acceptance (UA) Outward				
UA1	0.262	0.800	0.419	0.268
UA2	0.258	0.787	0.619	0.342
UA3	0.247	0.755	0.403	0.281
UA4	0.245	0.748	0.439	0.266
UA5	0.221	0.676	0.514	0.266
User Experience (UX) Outward				
UX1	0.158	0.747	0.554	0.000
UX2	0.170	0.804	0.596	0.000
UX3	0.179	0.848	0.616	0.000
UX4	0.188	0.890	0.624	0.000
UX5	0.184	0.871	0.612	0.000
UX6	0.150	0.710	0.582	0.000
UX7	0.162	0.768	0.609	0.000
Perceived Usefulness (PU) Outward				
PU1	0.250	0.834	0.560	0.160
PU2	0.220	0.734	0.525	0.089
PU3	0.259	0.864	0.556	0.135
PU4	0.225	0.752	0.542	0.101
PU5	0.235	0.784	0.573	0.109

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recommender system. In contrast, regular use has the greatest influence on user experience of the e-learning recommender system (0.751), and easy to use has the greatest influence on perceived ease of use of the system for locating information (0.801). Furthermore, easy to navigate has the greatest influence user acceptance of the e-learning recommender system (0.800), and information delivered has the greatest impact on perceived service quality of the e-learning recommender system (0.791); which indicates the importance of the timeliness factor to the students. Finally, locate information easily was found to have the greatest influence on user experience (0.890), whilst using the e-learning recommender system has the greatest impact on perceived usefulness of the system to improve learning (0.864).

5. DISCUSSION

E-learner analytics recommender systems such as collaborative filtering systems aim to predict a student's interest in services/items including course information, grades, and references available via e-learning applications. Saudi universities do not demonstrate however the adoption of effective e-learning practices compared to Western universities such as those located in the United Kingdom (Elfaki et al., 2014). The factors contributing to the problems with e-learning adoption in Saudi Arabia may be related to culture, expectation around the use of technology in universities, regulations, and the availability of technical support. Moreover, service quality in Saudi universities is not determined by international standards and criteria and the e-learning analytics recommender systems available in Western universities through their e-learning systems have been adopted only to a limited extent in Saudi universities (Elfaki et al., 2014). The user's experience of a technology system is strongly influences their technology adoption and usage success. However, few studies have investigated the implication of this for continued e-learning tool usage (Deng et al., 2010). To address this issue, this research adopted a model that integrates TAM with two additional constructs: user experience and service quality to explore the factors influencing the acceptance and continuance usage intention of e-learning analytics recommender systems in Saudi universities. This research model can serve as a foundation for future research on students' adoption and post-adoption of e-learning analytics recommender systems.

This study found that the TAM constructs combined with user experience and service quality constructs significantly impacted students' adoption and post-adoption of e-learning analytics recommender systems. All direct relationships between the core constructs of the original TAM exhibited strong positive effects, with perceived ease of use and perceived usefulness found to positively and directly influence user acceptance ($\beta = 0.344$, $p \leq 0.001$; $\beta = 0.535$, $p \leq 0.001$, respectively). Together, they accounted for 55.5% of the variance in user acceptance of e-learning analytics recommender systems ($R2 = 0.555$). Hence, H1 and H2 are supported. Our results align with the previous TAM research (e.g. Davis et al., 1989; Venkatesh and Davis, 2000) and suggest that educational institutions should ensure e-learning analytics recommender systems are easy to use and usable. Universities could achieve this by increasing student awareness of the usefulness of using e-learning services including e-learning analytics recommender systems, providing e-learning and ICT training workshops, and refining IT/IS systems departments to meet different students' needs. In addition, user acceptance was found to positively and directly influence continuance usage intention ($\beta = 0.654$, $p \leq 0.001$). Therefore, H3 is supported.

Consistent with previous research, this study hypothesised a positive relationship between perceived service quality and perceived ease of use. It found service quality positively and directly affects perceived ease of use, validating H4. This finding aligns with previous research that validates the consistent relationships between service quality and perceived ease of use (Ahn et al., 2007; Cheong and Park, 2005; Rana et al., 2015). Based on this result, e-learning analytics recommender systems with higher service quality, that is, with more reliable, relevant, and current information will be perceived by students as an easy to use interface. This finding implies that designers of the

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e-learning analytics recommender systems need to pay more attention to the service quality issues including accuracy, relevance, reliability and timeliness of the content provided by such systems.

Finally, our findings confirmed that user experience positively and directly influences perceived usefulness ($\beta = 0.456$, $p \leq 0.001$), which is consistent with extant literature (e.g. Al-alak and Alnawas, 2011). Several studies have reported a significant relationship between user experience and e-learning system usefulness (e.g. Lee et al., 2013; Martin, 2012; Purnomo and Lee, 2013). Users who are skilled in using computers, Internet and e-learning systems are more likely to have more favourable perceptions towards the usefulness of an e-learning system than poorly skilled users (Lee et al., 2013; Purnomo and Lee, 2013). Given that e-learning recommender system technology is newly adopted in Saudi universities, this finding suggests that universities need to provide students with adequate training on using the systems. Online tutorials, awareness programs and efficient technical support may also assist students to develop their skills in using these systems.

6. CONCLUSION

The adoption of e-learning technologies for education service delivery in countries around the world aim to provide an inclusive, flexible and convenient learning pathway for students and a cost-effectiveness use of the learning spaces for universities. Within the trending e-learning phenomenon is the emergence of e-learning analytics recommender systems to support students to access and evaluate learning materials to meet their learning needs. Adoption of such systems has been slow in universities in Saudi Arabia however. Given that students' perceived usefulness, service quality, and perceived ease of use of the analytics recommender system influences their acceptance of, and continuance usage intention for the system, higher education institutions in Saudi Arabia must be more proactive in ensuring e-learning analytics recommender systems are accessible to students and ease to use.

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Potential of Deployment of Virtual and Augmented Reality in Emergency Management Training via an Exploratory Interview Study

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ABSTRACT

This article presents the outcome of an exploratory survey aimed to detecting the strengths and weaknesses and the degree of acceptance of the use of virtual and augmented reality in training of confined or suspected pollution environments workers. Forty-five Italian professionals (public and private) that work in health and safety in workplace, in different roles, have been involved in the survey (e.g. trainers, augmented and virtual reality specialists, researchers, health personnel). The analysis of the survey showed that the use of augmented and virtual reality allows several training sessions in safety, teach workers to perceive the risk and manage the negative emotions that hinder the success of the work. These reflections helped us to hypothesize a training proposal with the use of augmented and virtual reality.

KEYWORDS

Augmented Reality, Negative Emotions, Risk, Training Proposal, Virtual Reality

INTRODUCTION

Italian and international laws on professional training in emergency management (DPR 177/2011, DLgs. 81/2008; OSHA, 2004) generally define the minimum requirements, the necessary contents and the methods of training for operators/rescuers who work in "high risk" environments (e.g. confined spaces and areas suspected of pollution). In these environments, accidents often are deadly. According to the law, the professional training required to work in these environments must treat, from a theoretical point of view, specific aspects of the considerated work (e.g. in the event of an intervention to be carried out in a cistern, the information provided by the trainer to the operators should relate to the specific emergency management modalities of that context, instead of general information). While from the practical point of view, training must include frequent practical training not influenced by organizational, logistical, bureaucratic and economic problems (Menduto, 2013). Therefore, it is necessary to abandon the idea of a standardized and only theoretical training.

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In the past, training courses provided to professionals working, in these fields, were not adequate (Menduto, 2013); these have been redesigned, better defined and implemented to become more reactive and functional to the type of risk present in a specific context and in every action to be taken (State-Regions Agreement, 2016). If it is possible to provide specific content in relation to each potential problem to be addressed (selecting teaching / learning contents), how can we teach practical skills? Taking up the previous example, how can a specific rescue training be performed inside a tank if it is not immediately available to perform a targeted training? The analysis of the literature (Bacchetta et al., 2015; Menduto, 2015; Nicolucci, 2013; Sbocchi, 2018) highlights how the development of specific skills in emergency management is attributable to training courses that use active teaching methods (Barrow et al., 1980; Lotti, 2018; Stewart, 2014). These methods effectively link theoretical and practical knowledge. The simulation methodologies are part of these (Bonaiuti, 2017; Hetzner et al., 2011) as well as the use of highly sophisticated technologies (e.g virtual and augmented reality, AR/VR). In some work environments (health, medical, business), excluding high-risk contexts, AR/VR are already an essential component of training. From this observation, the hypotheses that led the exploratory survey presented in the contribution emerged: "Can virtual instrument improve and speed up the learning process of operators who have to work in high-risk contexts and lead them to a greater perception of risk? What are the possible criticalities and potentialities in the introduction of such technologies? What is the degree of acceptance of these technologies in who must use them?

The answer to the predious questions should allow to draw information to define how a training session with AR/VR should be organized.

The survey was carried out through the administration of an online questionnaire addressed both to professionals in the sector (that they should provide training courses), and to who should receive training. The results of the survey indicate that to achieve a widespread use of AR/VR in emergencies management training courses is still long. There are some Italian experiences that are moving in this direction (e.g SIMNOVA; Tecnologie d'Impresa; Cal-Teck) but there is still much distrust in who must provide and receive training. The reasons are due to various factors (e.g. the lack of knowledge of the trainers in the use of AR/VR in the teaching; lack of knowledge of the potential that these supports have in training; the belief that the use of these technological tools not develop permanent skills; unavailability of professionals to use these tools to train themselves). Despite these problems, the survey highlighted some potentiality connected to the use of AR/VR useful for organizing professional training.

BACKGROUND

Virtual and Augmented Reality

The current professional training courses, including those dedicated to "confined spaces" (even if marginally), are starting to use active training methodologies. According to Gherardi "the practical experience of those are learning is important. Learners are involved in real problem situations that allow them to develop knowledge and skills through reflection and understanding" (Gherardi, 2013). To support this training, in some cases, we can use the new technologies, for example the VR/AR.

VR/AR are not the same thing, and it is necessary to understand their distinctive elements because, from these elements, specific skills and different ways of training are developed.

VR "is the simulation of a real situation where the subject can interact through electronic technologies, unconventional and sophisticated interfaces (glasses and helmets on which the scene is represented and sounds are played) that give to users, the impression of being immersed in that environment. VR can provide the use of gloves (data-glove) equipped with sensors to simulate tactile stimulation and to translate the movements into instructions for the software" (Freina, Ott, 2015). There are two different types of VR: the immersive one (Jennett et al., 2008) and the non-immersive one (Robertson et al., 1993). In the first case, the user is completely isolated from the external environment

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and he is transported in the parallel reality reproduced thanks to a complex set of accessories that integrate the professional viewers (e.g. Oculus Rift) (Basu et al., 2014; Freina, Ott, 2015). This type of immersion is also called "spatial" because there is the perception of being physically present in a non-physical world (Freina & Ott, 2015). Immersitivity is considered fundamental for VR (Robertson et al., 1993). Among the automatic environments that support the immersive approach there is the CAVE environment, which is however too expensive and not very usable in training (Freina, Ott, 2015). In the second case (non-immersive), the environment is digitally created and has a lower emotional impact on the subject also for the quality of the viewers used (Freina, Ott, 2015) (e.g. Samsung Gear VR).

VR is very used in training and education because it is able to stimulate interactivity (Roussou, 2004), the motivation (Garris et al., 2002; Ott et al., 2009) and promote visual, auditive and kinesthetic learning (Leite et al., 2010; Freina, Ott, 2015).

AR "is a technology that allows computer-generated virtual imagery information to be overlaid onto a live direct or indirect real-world environment in real time" (Azuma, 1997; Zhou et al., 2008; Bronack, 2011, Lee, 2012, p. 13). In general, it could be argued that AR is the representation of an altered reality in which, to the normal reality perceived by our senses, artificial and virtual information are superimposed (Klopfer e Squire, 2008). "In AR the environment is real and not artificial as in virtual reality, but extended with information and imagery from the system" (Lee, 2012, p. 13). "In other words, AR bridges the gap between the real and the virtual in a seamless way" (Chang et al., 2010; Lee, 2012, p. 14).

AR provides an immersive experience mediated by technology in which the real and virtual worlds are mixed (Klopfer & Sheldon, 2010; Whu et al., 2013) and users interactions/involvement increased (Dunleavy et al., 2009; Whu et al., 2013). AR can be created and implemented by various technologies, such as desktop computers, portable devices, head-mounted displays (Broll et al., 2008; Johnson et al., 2010; Liu, 2009). Then, the concept of AR is not limited to any kind of technology and it uses the potential of the real world by providing additional and contextual information that increases the experience of reality (Squire & Klopfer, 2007; Whu et al., 2013).

Klopfer (2008) sustains that there are three categories of AR listed below.

Lightly augmented reality refers to a situation in which users use many information and physical materials from the real world and have access to few virtual information (Klopfer, 2008; Whu et al., 2013). Heavily augmented reality refers to a situation where the elements of the virtual world prevail and it is based on the use of different wearable devices (such as head-mounted displays) that work in a similar way to those used with virtual reality (Klopfer, 2008). Mixed reality is "created by location-awareness mobile devices is one typical example" (Klopfer & Yoon, 2005; Whu et al., 2013, p. 42).

Training Contexts With the Use of Virtual and Augmented Reality

From the analysis of the literature (Freina & Ott, 2015) emerges how the new virtual technologies, in the various forms, are becoming important in professional training; this has generated great curiosity and interest in insiders because the potential of these tools is undoubted and allow us new training mode. In addition to practical and economic advantages, many experts (Robertson et al., 1993) emphasize the great advantages of immersivity both in training and in learning (Freina & Ott, 2015). At the same time there are still many doubts about the use of virtual technologies due to the lack of knowledge of the professionals, the objective difficulty to test the tools, and the need to have the support of specialized personnel. The analysis of the literature (Freina & Ott, 2015) highlights a wide use of VR/AR in three specific areas:

- School (Ali et al., 2014; Eleftheria et al., 2013; Freina & Ott, 2015; Huang et al., 2014; Lee, 2012);
- University (Fedeli, 2013), in scientific subjects teaching (physics, astronomy, chemistry) (Freina & Ott, 2015; Izatt et al., 2014; Lee, 2012; Sidharth et al., 2014) or to help teachers to manage the class (Silva et al., 2014);

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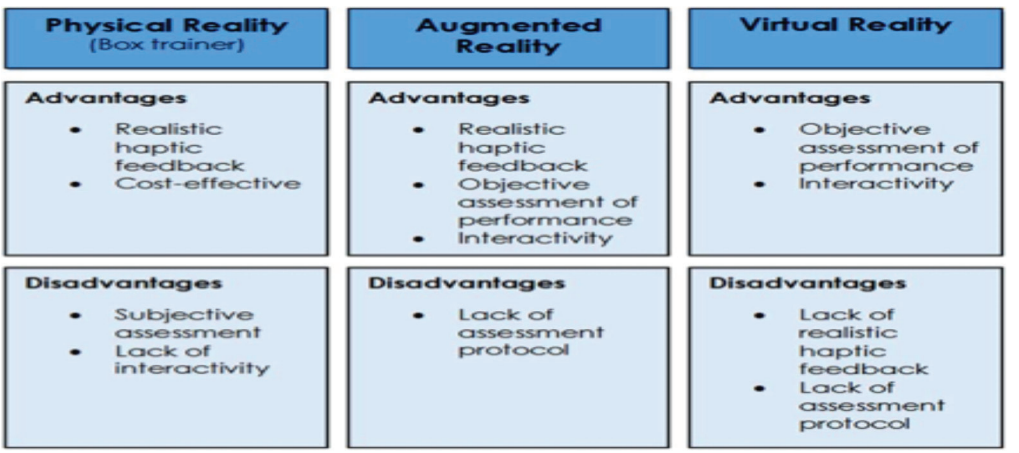
- Adult professional training in specific sectors that require immediate assistance or provide experiments before the concrete application (aviation, medicine, military environments, industry) (Bastiaens et al., 2014; Freina & Ott, 2015; Lee, 2012; Rahimian et al., 2014; Webster et al., 2014).

In professional training, that is our specific interest, the use of VR/AR is widespread in the health sector: in nursing training (Green, 2013; Griol et al., 2014) and medical training (Kleven et al., 2014; Ma et al., 2014). In medical field, for example, the Botden's studies of 2009 (Botden et al., 2009) highlighted the enormous advantages that AR allows to obtain in case of laparoscopy operations: better performance both on the task and on the learning of the operating technique in general, thanks to the release of "haptic" feedback in real time (Abate et al., 2010; Freina & Ott, 2015; Whu et al., 2013) to surgeons. At the same time Botden's studies highlighted the enormous potential of AR that is located halfway between a type of operation conducted in VR and one completely real (Figure 1).

Figure 1. Comparison of the different simulation techniques (Botden et al., 2009, p. 1697)



AR allows to guide doctors "step by step" during the procedure, decreasing their level of anxiety and acting as a sort of "user manual" of the entire operation (Botden et al., 2009).

Anastassova and Burkhardt studies (2009) showed how AR can be used within a community of specialized technicians bringing many advantages: the possibility of "learning by doing"; the development of knowledge in an active, explorative and autonomous way (starting from the stimulation that derives from the work environment); the facilitation of the learning process (because the information to perform the task, are proposed by the AR devices at the appropriate time, with a consequent reduction of dispersion of attention and more concentration on the task); the reduction of the possibility of error (in fact, the link between theoretical information and their pratical application is immediately visualized facilitating the memorization and the recovery of information in memory). Also, Ong et al. (2008) researches identified the advantages of AR as a tool helpful to specialized operators during their daily work routines.

In general, it is possible to think AR and VR as instruments that, within the learning processes, has the function of "scaffolding", because: they offer stimulation and tasks to be performed; focuse the attention of the subject on the task to be performed; simplifie and make the task more accessible; restrict the actions that can be performed, by maintaining the ones that are relevant and useful for the resolution of the task; show and exemplifie possible solutions to the task.

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The VR/AR Application in the Emergencies Management

Currently, in many fields and areas of emergency management (such as industries, confined spaces, emergency services and first aid) the new technologies are introduced into workers professional training (high-risk situations). In these contexts, where the possibility of practical experience is reduced due to the lack of access or because it is highly dangerous, VR/AR offer to users the opportunity to move safely, to experiment the best solutions without real dangers, and teaching to manage strong emotions that often hinder the successful outcome of the work. In 2009 at the National Conference "VR and Simulation to Predict and Manage Emergencies and Disasters" at the University of Udine (Italy), new projects presented on medical emergencies, fire management, crisis scenario training, aeronautical safety and support to crisis situations management that have hypothesized the use of virtual by heterogeneous and specialized workers (Fire Fighters, civil protection operators, components of emergency medical services, security managers, team members emergency of companies and even citizens). From this Conference emerged that the use of virtual applications, can teach to behave correctly in the various emergency cases. Taking advantage of the opportunities of the virtual, "serious games" (Breuer, Bente, 2010; De Freitas, 2008) have been created. These are video games whose teach users how to solve a problem or break down an obstacle (e.g. in the training of personnel assigned to various tasks). The primary purpose of serious games is (in our specific case) to educate/train the workers to the correct emergency managemente procedures (Brener et al., 2010; Graafland 2014; Ricciardi et al., 2014). For example, it is possible to imagine scenarios where paramedics must help a patient in different problem situations, or where an emergency situation (fire or an accident inside an industrial plant) is recreated and it must be managed. In this second case, for example, we can distinguish: strategical training simulations for staff members delegate to make decisions (as managers), realized through virtual control panels that recreate the real situations where is necessary to make decisions; simulations aimed to pratical training of personnel who have to intervene in case of emergency (both personal and personal rescue teams) (Ricciardi et al., 2014). In this second case, VR and /or Mixed Reality are used (Klopfer & Yoon, 2005; Whu et al., 2013): the operators are immersed in the scenario through the use of viewers and they are called to perform the "tasks" required. In this modality, the training can concern the single operator or be cooperative and concern a work rescue team. One of the great potentials of virtual simulation is to be able to recreate complex environments were the emergency evolves over time, just as happens in real life, including the consequent repercussions on people and things (Lateef, 2010). The operators can be immersed in different levels where they can learn how to better manage the different phases of the emergency. It is possible to develop new scenarios in relation to other types of emergency. Nowadays, different platforms give the possibility to simulate all the tasks and specific procedures by the role to be formed, through resources, functions, scenarios and tools reproduced and managed computers. These platforms are able to improve the skills of the operators to better manage emergency situations.

Some start-ups present in Italy use VR and AR to train health workers and rescue workers to face maxi emergencies, by simulating situations that are difficult to train in reality (e.g earthquakes, floods). Obtain the availability of the premises, organize the groups of workers to be trained, obtain the appropriate permissions, these are just some of the critical issues in planning a practical training simulation. Everything must be organized and planned without penalizing the activity of the workplace that must continue to function regularly. It is necessary to have new methods which, through the use of new technologies, guarantee an easier organization of training, lower management costs and more frequent and specific training. Logically this is not a simple step, because to train the workers, after having obtained the necessary tools, it is necessary to teach the trainers to work with the new technologies.

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Italian Experiences That Use the Virtual in Training

The SIMNOVA Center in Novara and Augmented Reality

The Interdepartmental Center for Innovative Teaching and Simulation in Medicine and Health Professions (SIMNOVA https://simnova.uniupo.it/) at the University of Piemonte Orientale is a reality set up to carry out training, research and services in various areas with particular attention to the use of simulation as a tool to innovate health and resecue training programs. The center is working with an AR software that, through a hardware, specifically a viewer produced by Microsoft (Hololens), allows real training sessions on problem situations created by the computer. The viewer adds virtual elements (objects, people, evolving situations) in the real environment in which the simulation is carried out, giving the possibility to structure an impactful and "immersive" training session for workers in training.

For example, a first-aid simulation scenario can be loaded on the display: an emergency scenario is recreated within the room simulating the effects of an accident (e.g. a person is on the ground unconscious). Through the movement of the hands and the movement of the eyes, which are perceived by the sensors of the viewer, it is possible to choose the operations to be performed; the various options for possible actions are available through interaction with a digital poster placed within the training scenario. The correct choices allow to continue in the simulation, the wrong ones are underlined by a guide voice and don't allow the continuation of the session. The software is also able to perceive the tone of voice that is used to perform certain operations, (for example, to draw the attention of the injured person or to make an emergency call) in order to evaluate its effectiveness.

Finally, the software, through the analysis of the speed of the movements of arms during the exercise estimates the force that subject is engaging in the simulation, defining its effectiveness or ineffectiveness. The tool could be used for the creation of specific training sessions in confined spaces, where it would be able to bring significant advantages in the emergency management. The ability to perform simulations several times, in absolute safety, without organizational and time limits is a significant advantage; being able to learn by directly performing the required actions undoubtedly helps the memorization, following the theory of Dewey of "learning by doing" (Dewey, 1916). Even the emotional/sensory stimulation could be of great importance in order to exploit the workers' emotional involvement and evaluate their suitability for the execution of certain types of interventions. At the same time the creation of stressful situations could help workers in training to learn how to manage these situations that are difficult to train through other training systems.

Tecnologie d'Impresa Srl in Como and Virtual Reality

Tecnologie d'impresa (http://www.tecnoimp.it/) offers a range of services to companies such as safety, environmental, quality and food hygene management systems. In all these fields it uses sophisticated and innovative technologies. The company's new software (DVR360) is a VR application capable of transferring the information contained in a risk assessment document in the digital world. Thanks to a complex software, the simulation allows you to move around the premises of the company, the application recognizes the places and allows you to view and investigate risks and dangers present in it. Users are immersed in a custom designed, highly realistic virtual environment. In particular, through the use of special viewers, the user is projected inside an industrial plant, where, moving between the various rooms of the building, the software recreates the critical conditions inside the premises. The purpose of the session is to identify the sources of risk and, where possible, eliminate them or prevent their harmful effects. The gloves allow you to interact with objects and touch them directly increasing the realism of the training session.

A limit that emerges is the need to have an expert computer programmer, able to always recreate new scenarios (if not already present in the basic software).

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Cal-Tek in Reggio Calabria and Serious Games

Cal Tek (http://www.cal-tek.eu) is a spin-off of the University of Calabria that conducts research and develops innovative products through the use of technologies such as simulation, VR (immersive and interactive), AR and serious games. Cal-Tek operates in various sectors and creates software for the professional training of operators from different professional fields.

Spin-offs like this shows that the interest in virtual technologies applied to the professional training of operators and rescuers is growing. The ever more advanced software, the enormous computing capacity of the latest generation processors, the evolution of VR displays and other accessories (gloves, lenses, headphones), allow nowadays to recreate very realistic environments and operating conditions. In this environments immersion and the sensorial stimulation allow an engaging training experience to workers.

RESEARCH DESIGN

Starting from the analysis of the literature (Anastassova & Burkhardt, 2009; Botden et al., 2009; Freina & Ott, 2015; Lee, 2012; Rahimian et al., 2014; Robertson et al., 1993) was created a qualitative-quantitative survey to verify if, currently, it is possible to hypothesise an emergency management training in confined spaces with use of VR/AR. The aim is to promote a more concrete and specific learning in training workers compared to that offered by traditional training methods. In particular, the thinking of experts in the field was investigated to understand: the general knowledge on the topic under investigation (VR/AR); the perception of the usefulness of virtual technologies in the training, in the emergency management training (in confined spaces) and finally in the perception of risk.

The survey's purposes were three:

1. To verify the "general" knowledge of AR/VR of professionals (research question 1);
2. To verify their knowledge of using AR/VR in training practices (research question 1 and 2);
3. To explore the degree of acceptance of professionals of safety in the workplaces (private and public sector) of the use of AR/VR in training (also personal) (research question 3).

The survey was conducted in 2018, at the Department of Health Sciences (DISSAL) of the University of Genova. The volunteer questionnaire was sent to people potentially interested/involved in emergency management training (population). The effective participants were experts in AR/VR; university researchers (engineering, health and safety technicians, emergency medicine); trainers in the field of health and safety. The researchers have created through the Lime Survey application, a quantitative/qualitative questionnaire administered in online mode. The questionnaire was structure and tested on students and teachers of the "Health and Safety Technicians Course" at the University of Genova before being definitively administered. This made it possible to make adjustements in the formulation of some question. The questionnaire was divided into five parts: personal data, knowledge on AR/VR; knowledge of AR/VR in training; knowledge of AR/VR in emergency management training; identification of advantages and criticalities. A quantitative/qualitative questionnaire was used in order to obtain the personal points of view of the participants. Each part of the questionnaire was designed in relation to the purposes described above. Table 1 presents a description of the parts of the questionnaire containing closed question with the possibility of adding contents and examples.

Data Analysis

Have been completed 79 questionnaires but only 45 (completed in each part) were cosidered. The quantitative results of the questionnaire have been elaborated by the Lime Survey software. The qualitative analysis of the open responses has been carried out by encoding text with the extrapolation

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Table 1. Questionnaire structure

Part One - Anagraphical Data		
	Question	**Collected Data**
Second part – general Knowledge of virtual and augmented reality	1. Do you know what are virtual and augmented reality? 2. Have you ever used virtual and augmented reality? 3. Have you ever seen to use virtual and augmented reality?	Useful data in response to the first purpose: to gather information on the general knowledge level of VR/AR
Third part – Knowledge of using virtual and augmented reality in training	1. Do you consider positive or negative the application of virtual and augmented reality in training? 2. Have you ever seen to use virtual and augmented reality in training? 3. Have you ever used virtual and augmented reality to train yourself?	Useful data in response to the second purpose: to detect the knowledge of using VR/AR in training
Part Four – Virtual and augmented reality in emergency management training	1. In your opinion, can virtual and augmented reality raise the perception of risk in the emergency management? 2. In your opinion, how should an emergency management training course for confined spaces be structured?	Useful data in response to the fourth purpose: to explore the degree of acceptance of a possible use of VR/AR in training (also personal)
Part Five – Advantages and criticality of the use of virtual and augmented reality in emergency management professional training in confined spaces.	1. What are the potentials of using virtual and augmented reality in emergency management training? 2. What are the critical aspects of using virtual and augmented reality in emergency management training?	Useful data to draw conclusions on the initial hypothesis and to highlight possible future job prospects.

of the conceptual categories of the recurring terms, the identification of the possible links between the contents, the realization of schemes and interpretative hypotheses.

Part One - Anagraphical Data

The participants were mostly males (31), age is between 25-35 years (18) and between 36-45 years (16) and ˃ 45 years (11). Their professional profile was health and safety technicians (34); with a similar distribution engineers, researchers and students (respectively 2); one party was (5) consultants, university professors, freelancers. In this section, the majority of the participants declared that their work concerns health and safety in workplace (20) followed by health and safety technicians (12), trainers and consultants (8). Also participated University researchers (1), components of the emergency services (2). A part of the participants replied "other" (2) (e.g. "methodologies for training, veterinary, food safety, trainer). The majority of the participants (23) work in health and safety sector from one to five years.

A critical analysis of the anagraphical data showed that the majority of participants are young age and are predominantly male. This information could be useful, as well as the type of profession carried out, to understand the different ways of approaching training in general and the degree of acceptance of the use of innovative strategies in training courses (such as AR/VR). For example, a trainer might be more supportive of using innovative teaching strategies than a safety consultant because more interested in development of professional training. In the same way, an operator belonging to a younger age group could be less intimidated by the experimentation of innovative training methods that involve the use of sophisticated technologies (such as AR/VR).

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Second Part - General Knowledge of AR/VR

Almost all of the participants answered affirmatively (37) to question one. Do you know what are AR/VR? (Figure 2).

However, most of the participans (32) have never personally used AR/VR, not even for recreation, games or entertainment (Figure 3). Only a small part (13) said they had already used AR/VR in these areas.

Figure 2. Do you know what are VR/AR?

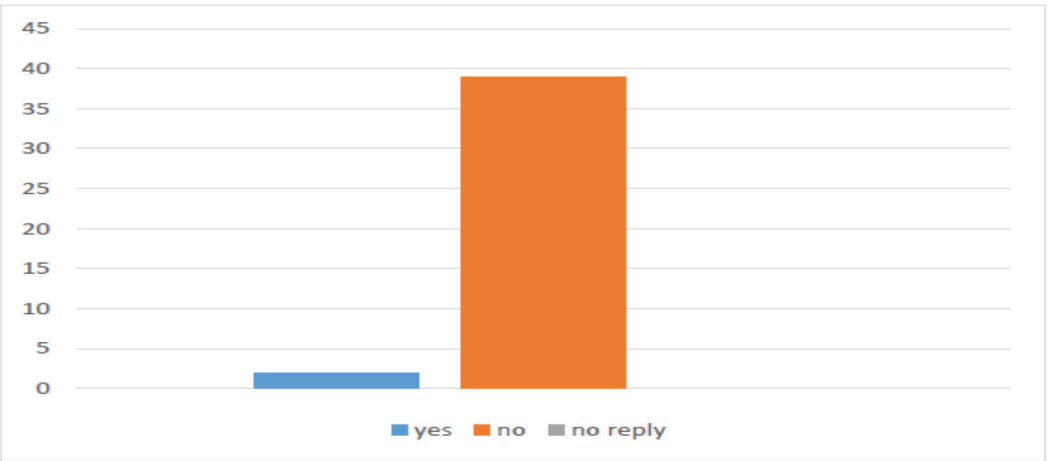
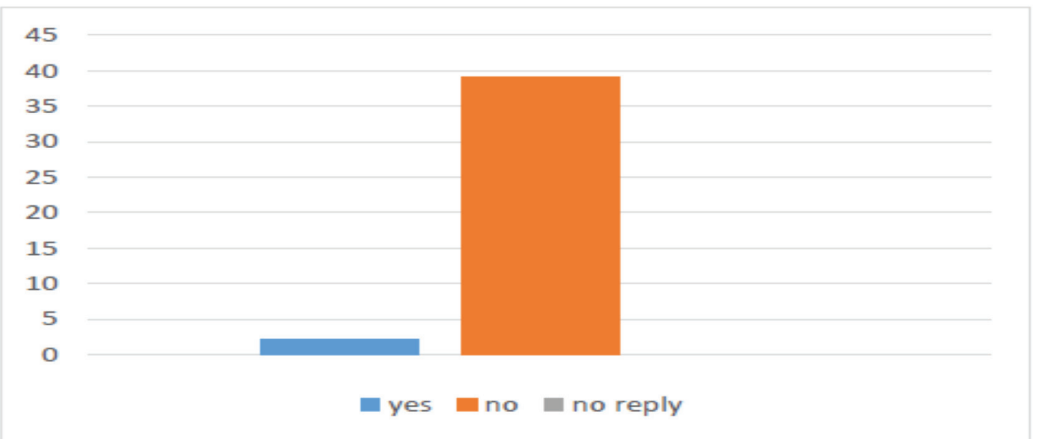


Figure 3. Have you ever used VR/AR?



The qualitative analysis of the text related to the previous question highlighted the categories and contents shown in the following table (Table 2) in order of priority.

The data analysis shows that the participans who used AR/VR in the past have done it mainly for ludic purpouse or entertainment. This trend confirms the result of the quantitative analysis data and underlines how currently these tools are present in entertainment but less in others professional areas.

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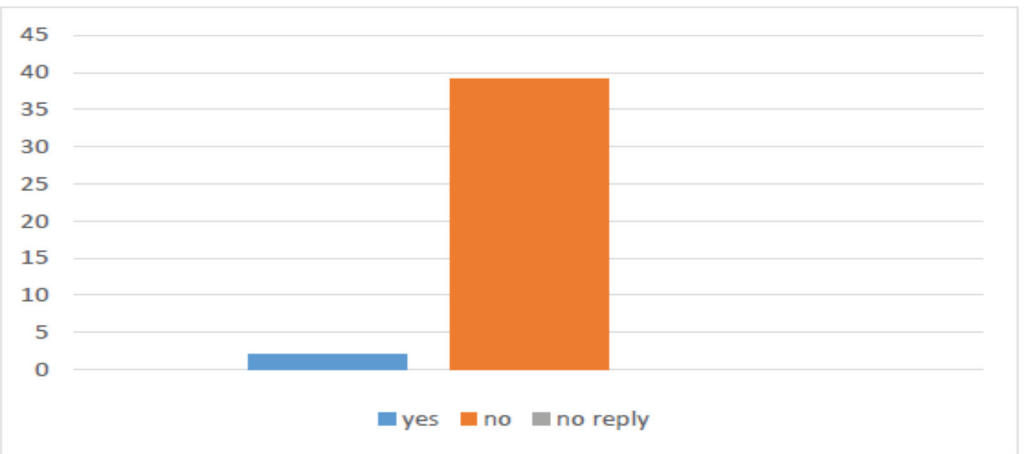
Table 2. Categories and contents highlighted by the qualitative analysis of the question (Figure 3)

Categories	Contents
Ludic goal, leisure, entertainment	Driving simulation on computer Video games Educational games for children
Demonstrative purpose, test	Used to test materials Used during field testing Used for the first aid test Volunteer in a test Used for advertising purposes
Research purpose	Creation of a virtual world Participation to a virtual reality research tests
Training purpose	Employee training Emergency management training Business training

The questionnaire shows, that a small part of participants tried VR to perform tests and demonstrations of various kinds (e.g. first aid test, material test, exhibitions, advertising demonstrations). The analysis also showed a low use of AR/VR for research and training purposes, such as in professional training or in emergency management training.

The majority of the participants (32) said they had never seen to use AR/VR (Figure 4).

Figure 4. Have you ever seen someone use VR/AR?



The qualitative analysis of the response provided, highlighted the categories and contents shown in the following table (Table 3).

Very interesting for this research, are the answers that highlight the use of virtual tools in different heterogeneous fields: simulation of surgical interventions, advertising of products in fairs, environment designing in architecture, experimentation in research. Experience in school, university, research and especially in the employees professional training confirm the literature data (Ali et al., 2014; Bastiaens et al., 2014; Eleftheria et al., 2013; Griol et al., 2014; Huang et al., 2014; Kleven et al. 2014; Lee,

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Table 3. Categories and contents highlighted by the qualitative analysis of the question (Figure 4)

Categories	Contents
Ludic purpose	Console Driving car simulators. Video games with virtual applications
Advertising, Marketing	Sale of products Advertising Fairs, exhibitions
Training	Secondary school students training (e.g. chemistry simulations) University Education Training software in various work areas Professional training
Simulation/Design	Environments' design and simulation in architecture, Virtual simulations during trade fairs. Simulations of surgical operations
Research purpose	Used in the realization of a research project

2012; Ma et al., 2014; Rahimian et al., 2014; Sidharth et al., 2014, Webster et al., 2014). This certifies a progressive and pervasive introduction of virtual technologies in many professional areas and open the debate on the potential and critical aspects of these new training tools. However, it emerges that many health and safety professionals have not yet known the world of virtual technologies, not even the basic concepts (e.g. the difference between AR/VR), while most of the participans know the tools but do not have never had the chance to test them. Few participants used virtual technologies for specific professional interests and for some of them virtual technologies became a tool of their work. Surely the lack of knowledge of materials and virtual technologies in general, leads people to think that virtual technologies are very expensive and highly sophisticated tools and therefore not very usable in the field of safety and emergency management. From the analysis of the literature (Robertson et al., 1993) and the experiences investigated (Cal-Tek) emerge that the diffused belief is wrong because the market offers different and advantageous solutions, often unknown to insiders (e.g. possibility to collaborate with companies that offer leases of materials including assistance, maintenance and computer programming).

Third Part of the Questionnaire - Knowledge of Using AR/VR in Training Practices

About half of the participants (25) believe that the use of virtual technologies can be useful in training (Graphic 4); many participants (19) have said that they are not able to answer.

The qualitative analysis of the answers highlighted four main categories: "innovative training", "practical advantages", "more complete training", "greater safety" (Table 4).

The participants highlighted some innovative characteristics of professional training with the use of virtual technologies: immersivity, sensorial stimulation, emotional involvement, the possibility of connect theoretical and practical notions. In addition, many participants highlighted the possibility of learning by following the theory of "lerning by doing" (Dewey, 1916). Many answers have highlighted some practical advantages that VR/AR can bring to professional training, such as reducing training time and costs, amortize costs, carry out multiple sessions training without organizational problems, train many users in less time. Of particular interest is the opinion of a participant that said: "VR/AR ensure the possibility to realize specific training in work environments in according to various activities." This underlines how these tools can be programmed and set up from time to time for each type of environment and operation, creating a less standardized and more specific training. Finally, the participants highlighted the possibility of VR/AR to improve many aspects of training, making it

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Figure 5. Do you think that the use of AR/VR in training is useful?

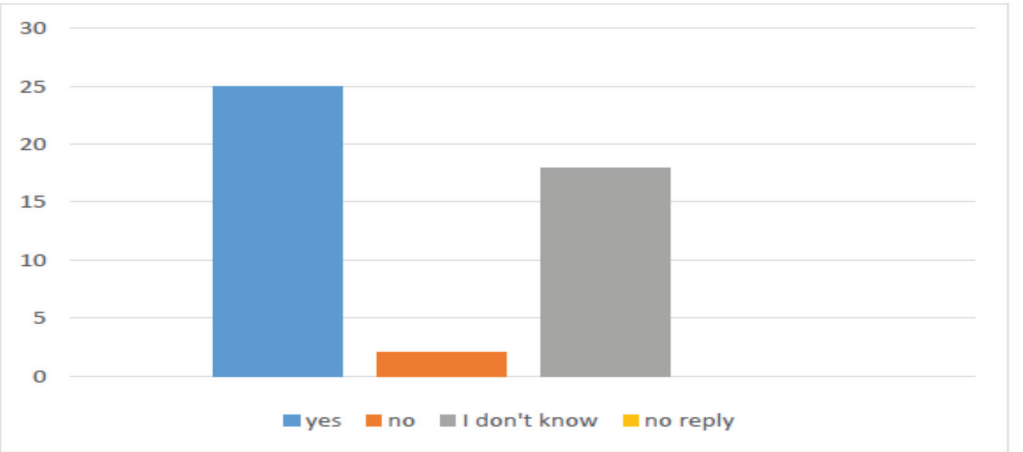

Table 4. Categories and contents highlighted by the qualitative analysis of the question (Figure 5)

Categories	Contents
Innovative training	Immersivity Fusion between theory and practice Sensorial stimulation. Emotional involvement Learning by doing More identification Help in the acquisition of useful skills in the emergency management
Practical advantages	Reduction of training time Train more users in less time and costs Creation of specific training designed on the work environment and on the different activities Amortize training costs
More complete training	Greater emotional involvement To verify the behavior of subject in a real situation Contextualization of training in more practical scenarios Helps to create / recreate real situations that are difficult to train with other training methods Help in the acquisition of useful skills in emergency management
Greater safety	To reproduce various real and dangerous situations in a safe and controlled environment. More complete training without risks for the subjects to be trained.

more complete and contextualized. Thanks to specifical scenarios created according to the needs of the case, the virtual technologies ensuring total safety of the worker in training that can train himself many times (gaining familiarity, confidence and safety) before moving on to practical training in reality.

About the question: "Have you ever used or saw to use VR/AR in training?" (Figure 6) the majority of participants answered "no" (39).

The qualitative analysis of the affirmative answers highlighted the categories and contents shown in Table 5.

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Figure 6. Have you ever seen someone use virtual and augmented reality in training?

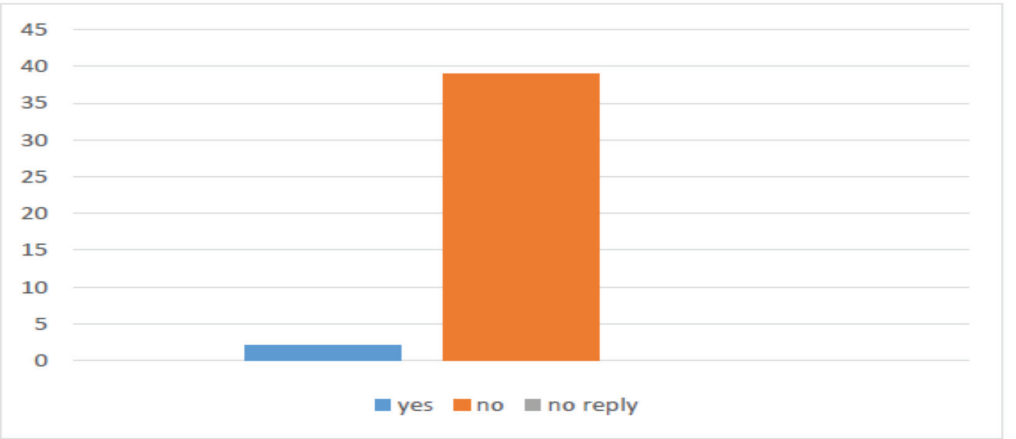

Table 5. Categories and contents highlighted by the qualitative analysis to the question (Figure 6)

Categories	Contents
School	Virtual reality used in secondary schools in science subjects.
Professional training	Training for emergency instructors. Training game to identify the risks included in the risk assessment document
Demonstration	During events and fairs on safety at work

Some participants saw to use VR in secondary school, as an integration to the theory in some scientific subjects: "*The RV is used in chemistry to simulate the effects of a chemical reaction or in geography to simulate the eruption of a volcano*". Only one participant stated that he attended a training course with the use of virtual technologies for emergency management. A second participant reported: "I saw to use virtual application to train the emergency staff of a company through the identification of the risks present in a risk assessment document." Finally, some participants indicated that they have seen some examples of "virtual" training during fairs and events in the stands dedicated to occupational safety. The data collected, even if limited, are interesting for our investigation. These demonstrate and confirm that emergency management training courses do not use virtual technologies enough and therefore they could bee redesigned.

The majority of participants answered "no" (39) at the question "have you ever used VR/AR to train yourself? (Figure 7).

Among the participants that answered "yes" (6) has been requested to specify how has been tested/used VR/AR in the training. The qualitative analysis of the text highlighted the categories and contents shown in Table 6.

Fourth Part of the Questionnaire: Virtual and Augmented Reality in Emergency Management Training

We asked if the use of virtual technologies could be useful to increase the risk perception of the workers in the emergency management training in confined spaces. The majority of the participants answered affirmatively (25), while a considerable part of the participants (18) answered "I

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Figure 7. Have you ever used VR/AR to train yourself?

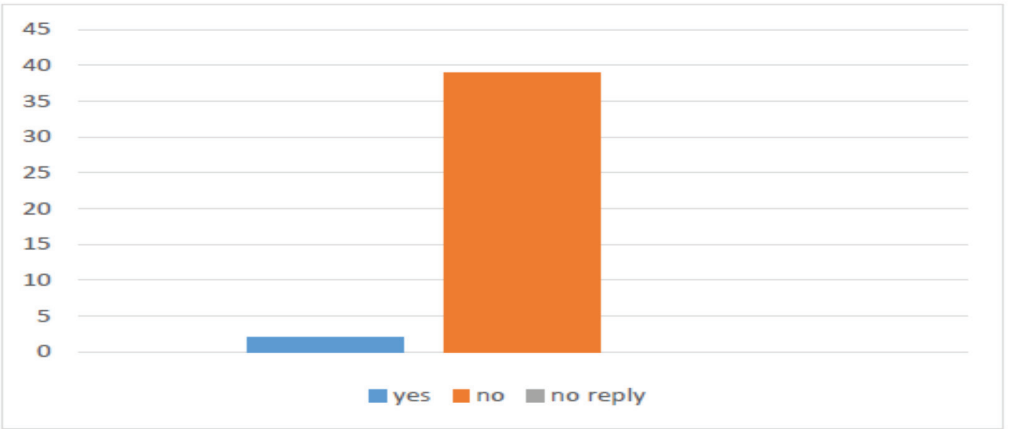

Table 6. Categories and contents highlighted by the qualitative analysis to the question (Figure 7)

Categories	Contents
Training course	Instructor training course for emergency management by using augmented reality. In an emergency course. Risk training

don't know", only two subjects answered negatively. They stated that the new virtual instruments cannot adequately replace traditional training because these tools are not able to faithfully recreate the real emergency conditions.

Among the partecipants who answered affirmatively, we asked "why?". The qualitative analysis of the text highlighted the categories and contents shown in Table 7.

Figure 8. Is the use of VR/AR useful for increasing the risk perception in the emergency management in confined spaces?

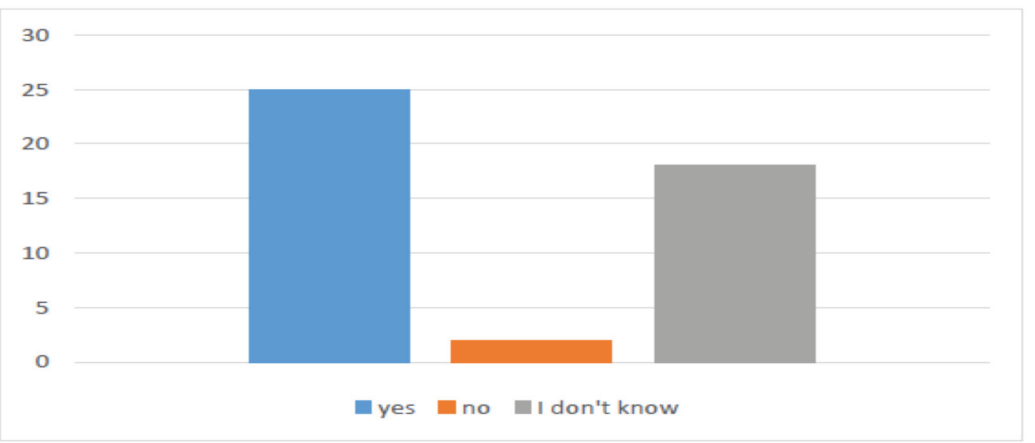

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Table 7. Categories and contents highlighted by the qualitative analysis of the question (Figure 8)

Categories	Contents
Emotional impact	Increasing the emotional impact and increases the perception of risk More emotional impact than standard training Immersion of participants in simulated reality that create a different emotional impact than traditional training
Reactions and behaviors analisys	Possibility to perceive the correct behavior to be held in danger situations Possibility to change incorrect and/or inconsiderate behaviors
Effectiveness of virtual training	Possibility to perform multiple exercise/training sessions in complete safety by perceiving the risks of the various activities Greater immersion Possibility to do more specifical training in a short time. Greater involvement
Representation of the dangers to be faced	Preventive analysis of dangers More perception of danger Ability to test spaces and conditions difficult to train in the ordinary training, improving the perception of specific risks

From the data analysis, it emerged that the improvement of the risk perception in the emergency management in the confined spaces is related to the emotional impact that the virtual technologies are able to assure to the training. Furthermore, the participants underline how more emotional impact derives to a partial (AR) or complete immersion (VR) of the workers in the simulation. In addition, the risk perception could increase thanks to the possibility of performing sessions in a repeated and frequent way in safety, allowing greater identification and greaters involvement of workers who would receive more precise and selective training. The participants appreciated the possibility of: virtual technologies of recreating and representing the environments and dangers to be faced being able to carry out preventive analyzes of the dangers and train the workers in critical situations in total safety, increase their perception of the specific risks in various training situations (Bacchetta, 2015; Nicolucci, 2013). Finally, the participants have indicated how should be structured a training course for emergency management in confined spaces with the use of VR/AR.

The qualitative analysis of the text provided highlighted the categories and contents shown in Table 8.

The participants recommended some examples of how emergency management training courses in confined spaces with the use of VR/AR should be structured. All participants agree on the potential and usefulness of virtual technology in training, but differences have emerged regarding how to insert and use virtual technologies in the training courses (Table 8).

The analysis of qualitative data showed that training courses structured with VR/AR should be organized and managed by highly qualified personnel (experts in confined spaces and emergency management), in order to build a course focused on contents and objectives strictly connected with the activities and risks present in the workplace. Furthermore, the need to work on the emotional sphere of the workers in formation emerged, making the training as real as possible. From this part of the questionnaire other useful information emerged. For example: many participants soustain that virtual technologies are solutions still far from current professional training; many participants believe that these technologies are very expensive. Instead the economic aspect is not a problem, because as the experiences mentioned (e.g. Cal Tek) show and the literature (Robertson et al., 1993) there are many companies that offer training methods through the use of VR/AR with the possibility to rent the equipment (including technical assistance, computer support and maintenance).

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Table 8. Categories and contents highlighted by the qualitative analysis on "how a training course should be organized"

Categories	Contents
Virtual used before and after the theory	Starting from a practical experimentation with the help of the virtual (preliminary test), continue with a theoretical support with the workers, then return to the virtual to verify possible changes (verification).
Virtual used in the theory	To use VR/AR during the classroom lessons in order to know a confined space, previously mapped, through the virtual viewer, before carrying out practical exercises.
Virtual between theory and practice 1	The virtual part between theory and practice would allow to train the procedures several times in safety, with the possibility of a phase of discussion and critical analysis of the dynamics; finally perform the real practice in a more prepared way.
Virtual between theory and practice 2	Division of the first theoretical part in two phases, one whithout and one with the use of the virtual. Then start a practical part where workers can use the VR/AR viewers, that could totally replace traditional training.
Trainers with pratic experience	The contents and modalities of training courses with the use of virtual technologies should be structured and organized by confined spaces and emergency management experts, who should choose the topics of training by focusing the major critical issues specific to these environments.
How to exploit the potential of virtual applications	To teach workers that there is always a difference between real and virtual. To work on the emotional sphere by making the training session as real as possible
Virtual used in practice	To create: practical and specific examples to the operators and the company to be trained, simulations of real danger situations, simulation confined space. To represent all the possible scenarios and solutions of the emergency management in order to find the best action solutions for each case

Issues, Controversies, Problems

The last two questions of the questionnaire highlighted the advantages and criticalities of using VR/AR in professional training of emergency management in confined spaces. The results allow to draw interesting conclusions about this research and help to define how a training course for emergency management should be structured with the use of virtual technologies. In accordance with participants' answers (Ta.9) a training course should include: a first phase of practical experimentation with the help of VR/AR (preliminary test); a second phase of analysis, debate and theoretical support between the learners and the expert trainers, and a third phase, again associated with virtual technologies to verify if there were any changes in behavior, and in safe work procedures (verification).

The major advantages which emerged are the emotional and immersive impact of the workers in training; the possibility to carry out a greater number of training sessions; the costs reduction and the possibility to carry out safety training in less time. In addition, other positive aspects emerged: the possibility of understanding if emergency workers are psychologically fit for the task to be performed; the increase in risk perception in workesr and the possibility of analyzing response times at emergency situation.

From the data analysis, some critical issues of virtual technologies applied to the professional training of emergency management, emerged: the impossibility of perfectly recreating an emergency situation; the lack of knowledge of the trainers of using VR/AR; high cost of equipment and possible adverse effects (nausea) caused by the use of particular types of viewers.

DIRECTIONS FOR FUTURE REASEARCH

Currently, most of the emergency management training courses in confined spaces use active teaching methods, mainly through the use of physical simulators which, unlike virtual technologies, have the great limitation of not having many training solutions. Recently, mobile simulators have been designed

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that can be moved in places who need training. The criticality of these simulators is limited range of training options available. Virtual technologies instead, ensure more training scenarios and grater realisim that increases the emotional involvement. This can allow to identify the worker most suitable to the execution of rescue interventions in the confined spaces. Moreover, the possibility to execute a particularly emotional training session several times, help the workers in training to better perceive the risks and to manage stress. Despite a positive tendency to use the VR/AR, some problems emerged: the need of a new method of interaction between the learner and the training tools; the necessity for traininer to follow specific training on virtual required to organize an effective and specific training.

In this perspective, the Simnova Center in collaboration with the University of Modena and Reggio Emilia and the University of Parma is carrying out a research project for INAIL (National Institute for Insurance against accidents at work) in order to study new usefull procedures to health emergency management in small and medium-sized enterprises. Moreover, the project wants to define new training methods of workers involved in first aid, also taking advantage of new virtual technologies (e.g. Microsoft Hololens). A hypothetical training course should be a sort of "flipped lesson" that includes: a virtual session (simulated environment with instruments and conditions equal to the real) where workers hypothesize possible solutions to the proposed problems in the virtual environement (brainstorming); a successive discussion session where the trainers can help the workers by teaching the correct safety work procedures and behaviors; a last virtual session (verify) where the workers repeat the training session in order to analyze if there were positive modifications in the management of problem situation.

CONCLUSION

The analysis shows that health and safety experts recognize the potential of virtual technologies in management professional training in confined spaces. However, many of them have not yet used these tools in the training. The most recognized feature of virtual and augmented reality is the immersion which ensures to workers a different and more real experience compared to traditional training practices. The introduction of these new tools in training is perceived as not immediate solution, in fact many professionals are distrust of the possible use of these technologies. They support that training needs to be improved but in a more "traditional" way. The possible excessive cost of such instruments and the creation of the various software necessary to reproduce specific intervention environments, worries the professionals. Even the current Italian legislation does not help a possible introduction of innovative systems in training. In fact, it defines in general the contents and modalities of training for confined spaces. Moreover, it is difficult to find companies ready to invest in alternative training methods because these may not be considered suitable by the legislation in the future. Despite the critical issues that have emerged, the potentials and advantages of virtual and augmented reality are undeniable. As other sectors of work (e.g. medical, surgical) also the emergency management training in confined spaces will be unavoidably influenced by virtual technologies.

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Gears in Motion:
Changing Perspectives of Interactions Among Online Presences

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ABSTRACT

This article expands Garrison, Anderson, and Archer's Community of Inquiry framework by adding a mechanism to understand the interactions among presences and domains in an online course. Based on a qualitative content analysis of student reflections, elements that create an optimal learning experience. The article discusses three findings and offers visual representations of each: how emotions are pervasive among the presences, a chronological representation of components in two phases, and a logic model showing if-then interactions among the components in a linear form. As a result of these findings, the gear model is proposed, which accounts for current research findings such as emotional and learner presences. The 'gears in motion' model offers a new, holistic perspective that illustrates the five elements necessary to create an optimal learning experience.

KEYWORDS

Cognitive Presence, Community of Inquiry, Emotional Presence, Gear Model, Learner Presence, Logic Model, Metaphor, Online Higher Education, Qualitative Analysis, Social Presence, Teaching Online, Teaching Presence, Visual Display, Visual Representation

INTRODUCTION

Higher education institutions are developing more online courses and components to meet the needs of today's generation of learners as well as non-traditional students who comprise approximately forty percent of the college population (American Council on Education). The National Center for Academic Transformation (White House, 2013) reports an average of forty percent cost reduction and improvement in learning outcomes with the thoughtful implementation of technology usage in a wide range of academic disciplines. Considering this level of interest and growth, efforts to understand the design and instructional challenges as well as opportunities to enhance learning in online environments are needed. According to the National Center for Education Statistics, 5.5 million students took at least one online course in 2012 (U.S. Department of Education, 2014). However, issues of quality and student retention have not been resolved even though Babson Survey Research Group (Allen & Seaman, 2013) reports 32% of total higher education enrollment in the United States is through online education. Allen and Seaman (2011) report a significant 10 percent growth rate for online enrollments, compared to the less than one percent growth of the overall higher education student population.

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To offer high quality learning opportunities in online educational settings, the dimensions and interactions involved need to be understood. The spaces and communities in which learning takes place need to be explored. To create and sustain such collaborative communities, the dynamics among the teaching, cognitive, and social presences must be understood (Akyol & Garrison, 2008). Research within the Community of Inquiry framework has shown significant results of social presence perceptions linked to online student satisfaction (Gunawardena, Lowe, & Anderson, 1997; Richardson & Swan, 2003), to perceived learning (Richardson & Swan, 2003), and to course design factors and teaching presence. Research on teaching presence shows the critical importance to the development of a sense of community (Shea, Li, Swan, & Pickett, 2005) and to successful online learning (Garrison & Cleveland-Innes, 2005; Swan & Shih, 2005; Vaughan & Garrison, 2006). In this paper, current research involving the Community of Inquiry (CoI) will be presented, with a focus on visual representations suggested by the researchers.

Background

This section serves to guide the reader through these notions: data visualization, data visualization in qualitative research, and how the Community of Inquiry research is displayed visually. This path helps the reader see the lack of an agreed upon visual display that accounts for the research findings based on this theoretical framework.

Kirk (2007) defines data visualization, a mixture of craft and science, as "the representation and presentation of data that exploits our visual perception abilities in order to amplify cognition". Representation refers to the choices being made as to which physical form best portrays the attributes of the raw data. The ultimate goal, cognition amplification, refers to the efficiency by which data can be processed into insights and knowledge by the reader or receiver of the visual. "The objective of data visualization should be to make a reader feel like they have become better informed about a subject".

Within the realm of qualitative research, Verdinelli and Scagnoli (2013) describe various types of qualitative data displays used in research: boxed displays, decision tree modeling, flow chart, ladder, matrix, metaphorical visual display, modified Venn diagram, network, and taxonomy. Emery (2014) adds word clouds, graphic timelines, and showcasing images and survey data as a way to supplement existing data representations to the list of ways to display qualitative data. Verdinelli and Scagnoli (2013) purport the need to expand the area of visual displays in qualitative research as they are underutilized.

Although mainly used for evaluating programs, a logic model can also be considered as a visual display for qualitative research. A logic model is a "systematic and visual way to present and share your understanding of the relationships among the resources you have… the activities you plan, and the changes or results you hope to achieve" (Kellogg Foundation, 2004, p. 1). According to this guide, connections are made visible between input and output: on one hand, resources and activities (processes, tools, technology, etc.), on the other hand, intended results (change in behavior, knowledge, skill, etc.) and possible outcomes. The purpose of this visual representation is to "assess the "if-then" (causal) relationships between the elements of the program," (Grant Development Support Unit n.d.). It answers this question: if we provide this input, and complete these activities, will it lead to the intended output? This is what the logic model helps us visualize.

Within the context of online education, to date, the only instance of logic models used to account for conceptual understanding, has been work done by Oh and peers focusing on online collaborative group work for adult learners (Oh, 2011; Oh, Liu, & Reeves, 2014; Oh & Reeves, 2013; as cited in Oh & Reeves, 2015). This paper hopes to add to the body of knowledge by providing a basic logic model for online learning experiences.

The online education visual representation usually cited in scholarly journals is what was presented by Garrison, Anderson, and Archer (2000) when they depicted the Community of Inquiry model in the form of a Venn diagram, shown in Figure 1. In this model, social, cognitive, and teaching presences are the components of an optimal learning experience.

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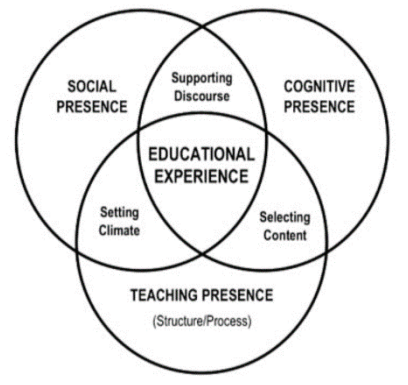
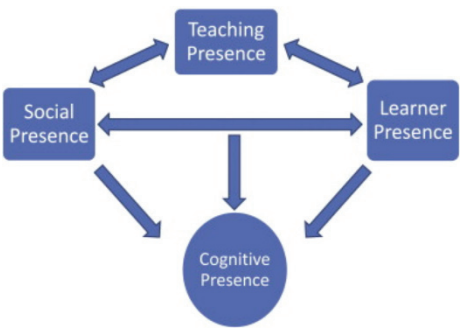
Figure 1. The original CoI framework: Garrison, Anderson & Archer (2000). ©2000 Garrison. Used with permission.



Much research has been done on the Community of Inquiry (CoI) and the presences influencing an optimal learning experience within online education. Research that has included visual displays or suggestions to revising the original Venn diagram are included in this section. First we will examine the research that has led to suggesting an additional element, such as a learner presence or emotional presence. Then, other research that suggests revisions for depicting how the presences interact will be reviewed.

Shea and Bidjerano (2010) suggest adding a fourth presence, learner presence, shown in Figure 2. They conclude that the learner's self-efficacy, self-regulation, and effort are part of learning presence.

Figure 2. Addition of learner presence: Shea & Bidjerano (2010) ©2010. Shea. Used with permission.



They also suggest by analyzing the roles of learners and taking into account learner presence, the explanatory power of the CoI framework will increase. Research presented in this paper confirms the need for this presence. The visual display of the revised CoI model shows three presences (social, teaching, and learner) having two-way interactions leading (pointing) to cognitive presence.

In the original CoI framework (2000), expressions of emotions are recognized as part of social presence and are noticeably absent in the other two presences. Research shows emotions experienced by students in an online setting go beyond social presence. Emotional presence is defined as "the outward expression of emotion, affect, and feeling by individuals and among individuals in a community of inquiry, as they relate to and interact with the learning technology, course content, students, and the instructor" (Cleveland-Innes & Campbell, 2012, p. 283). They conclude this presence exists within the other three presences. However, the authors did not publish

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a visual display of emotional presence. Via email, M. Cleveland-Innes stated that: "There is not yet an accepted visual that places emotional presence appropriately within the original Community of Inquiry model" (personal communication, April 8, 2019).

Rienties and Rivers (2014) interpreted and adapted the body of research on emotional presence and displayed it in the form adding the fourth circle into the Venn diagram. Other researchers (Onorato, 2014) interpreted findings and displayed emotional presence as a larger circle, encompassing the original CoI triad. Regardless of the fact that the emotional presence significantly impacts the other presences, researchers do not include visual representations of their suggestions and their readers are making inferences as to how this presence is manifested. Research presented in this paper confirms the need for this presence as well; there is a need to develop an accurate display of the data on emotions.

In addition to suggestions to add a presence, some research suggested visual representations that differed from the original CoI framework in how the presences interact. In an attempt to "uncover the critical relationships between the framework's components," Shea, Hayes, Uzuner-Smith, Gozza-Cohen, Vickers, and Bidjerano (2014, p.15) present a revised Venn diagram of the presences. This model shown as Figure 3, accounts for learner presence and shows how teaching, cognitive, and

Figure 3. Tentative reconceptualization of the CoI framework: Social presence within presences: Shea, Hayes, Uzuner-Smith, Gozza-Cohen, Vickers, and Bidjerano (2014). ©2014. Shea. Used with permission.

learner presences are social. They believe social presence would be located with actions, attitudes, and words of teachers and students. In this way, online learning within the COI framework would be more accurately depicted.

Le Roux and Nagel (2018) studied flipped classrooms and presented an image comparing their findings to the CoI within the image itself. The researchers include dashed line that separates the individual learning space (which includes teaching, learner, and emotional presences) from the collaborative learning space (which includes much of the original triad of presences). These researchers acknowledge the "motivational power of self-regulated, self-efficient learning activities and time management" within the learner and emotional presences; however, they believe it is not collaborative, nor interactive.

Armellini and De Stefani (2016) present a social presence-centered model, shown in Figure 4. They concluded that "social presence did not operate well as a stand-alone construct," rather, it plays a central role in creating "diverse online learning and teaching spaces" (p.1212). Social presence is embedded in the other presences, and influences them. Although the researchers do not mention learner presence, they mention "self-study" which feeds into other areas of their model.

METHOD

This paper emerged from unanswered questions from the doctoral study (HossainMardi, 2016). Continuing the research of qualitative analysis of student reflections (Mardi, 2019), this paper addresses the impact the study has had on the visual representation of the Community of Inquiry

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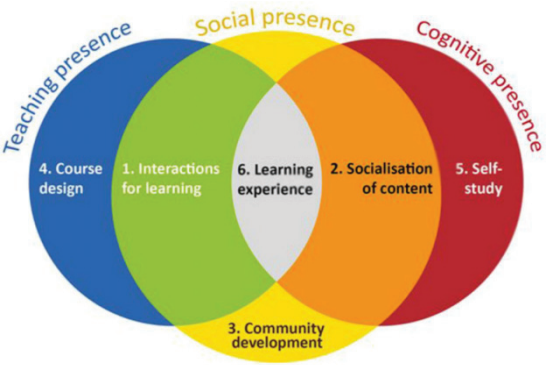
Figure 4. A new version of the CoI framework: Armellini and De Stefani (2016). @2016. Armellini. Used with permission.



(CoI) framework. The context of the original, overarching study at hand will be explained. Online undergraduate students in an educational technology course the researcher taught participated in this study. Students were explicitly prompted to reflect on their learning experiences and respond to areas directly related to the three presences through a 35-item survey. These perceptions were analyzed quantitatively. The analysis revealed the only student in the study who was not satisfied with the online course, perceived all presences to be high, except that s/he was not interested in the course topic.

A qualitative analysis of implicitly prompted written reflections offered insight into their learning experiences. In writing, students were asked to reflect on learning experiences; three of which became the data sets for my doctoral study: describe your best and worst class experience you have had (before course began), what you learned about yourself through the team collaboration process, and how this activity contributed to your learning (throughout the semester), and why you deserve an "A" (end of the semester). Through a qualitative content analysis approach, open and axial coding was carried out; creating codes that were data-driven and theory-driven. A re-evaluation and critical examination of the triadic model was needed to account for the findings of my research, research on learner and emotional presence, and future research based on the CoI framework. As a visual learner and researcher, I felt compelled to develop a visual representation of the research findings. A visual display that is be data-driven and theory-driven is needed to support this framework. The results in the following section came about through further analyzing the findings of my original research and adapting the claims to account for what other researchers found.

RESULTS

Finding One: Emotional presence functions as an independent dimension and exists at the interface of all other presences.

As student reflections were analyzed to find interactions among the CoI presences, one element that continuously emerged from the data was the expression of feelings and emotions. Figure 5 is a visual display of the emotions in student reflections, categorized by the interacting presences seen in the reflection. In "the professor was passionate about the subject," this emotion is not just about the teacher, it is about the teacher in the context of teaching the subject matter. The emotion exists at the interface of teaching and cognitive presences. In "I love building close relationships with people because it makes discussions more intimate and passionate," the relationship between connecting with peers and improving discussions is seen. The emotions expressed are between social and cognitive presence, at this interface. Emotions between the learner and social presences are seen

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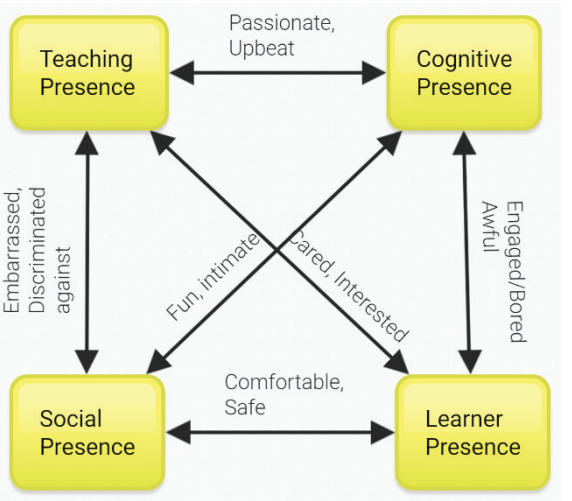
Figure 5. Emotions from student reflections within the interface of presences

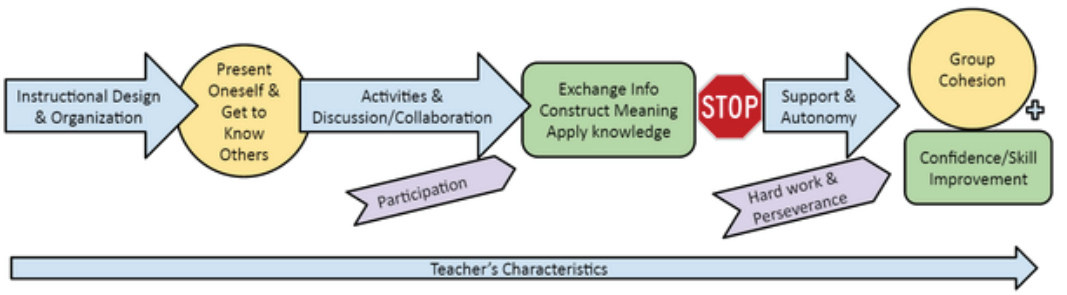


when students reflect on comfort and safety needed. The complete list of student reflections used to create this figure is in Appendix A. There were many emotions expressed in student reflections collected in the original study (HossainMardi, 2016). Rienties and Rivers (2014) present a list of emotions expressed by students.

Finding Two: A chronological representation of the components sums up the interactions among presences are show they are manifested in two levels or phases.

Figure 6 is a flowchart diagram that shows how the components interacted throughout the course of the semester. The large arrows represent elements of teaching presence; the circles represent

Figure 6. Flowchart diagram of interactions among online presences during semester



social presence components; the rectangles represent cognitive presence elements; and the smaller, tilted arrows represent student effort or student presence. All the components are data and theory driven, but the order in which they are associated was the researchers. This visual representation is the second finding of this study.

The first phase consists of elements one through five, with the "Learner & Teacher Emotions & Attitude" present. The second phase begins at the stop sign (which might have been better displayed

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as a yield sign) and consists of elements six through nine. Both phases need the element of emotional presence, described as element ten.

Element 1: Starting from the left, the instructor implements 'instructional design and organization' in the form of 'planning and evaluation' and 'content development.' Most of this happens before the course begins in an online format. Everything from how to grade the students to the layout of each activity is structured and put in place mostly toward the beginning of the course and is implemented throughout the semester.

Element 2: The first circle is related to basic introductions. Generally during the first week (or two weeks at the most) of all online courses, educators include activities for students to get to know each other and connect to some extent. Students and teachers 'present oneself' by showing 'expressions of emotion,' and opening up to others by 'self-disclosure.' Members of the learning community 'get to know others' by 'getting to know and connecting' to one another.

Element 3: The third element in Figure 6 is the 'activities and discussion/collaboration' arrow. In this stage, the instructor implements the 'direct instruction' and 'facilitating discussion' categories of Teaching Presence. 'Content delivery' and 'facilitating discussion' are the main roles the instructor takes on. Although 'giving feedback' and 'being helpful' are important in this stage of the course, the students seem to expect more of the teacher later in the semester. Early on in the semester students try to complete tasks on their own and research their questions before they email me asking for clarification or help (Student email, 2014).

Element 4: With the highest quality course design, and most passionate and responsive instructor, one can only provide opportunities for the online. Unless the student actually participates in the online activities, the best laid out curriculum will not be carried out. The data shows some element in student reflections that is directly related to and dependent on the student. 'Student participation' in the class activities and discussions that the instructor has developed and is facilitating, is a necessary component of this model. In this stage, 'class activity participation' is included as student effort, which is shown in the diagram as a tilted arrow.

Element 5: The first four elements lead to the first rectangle in Figure 6, representing cognitive presence. Students go through the phases of the practical inquiry model (Garrison, Anderson, & Archer; 2001). Students 'exchange information' in the form of 'respectful exchanges,' 'discussion participation,' and 'share ideas.' Then they 'construct meaning' by 'developing and reinforcing ideas.' The final phase is where students apply their knowledge "by means of direct or vicarious action" using thought experiments and consensus building within the community of inquiry (Garrison et al., 2001, p. 11). I interpreted this phase as the ability to 'apply knowledge.' This is seen in 'sharing creations,' 'sharing knowledge,' and 'real world application.'

The stop sign signifies the end of the first phase of this diagram. Some students reached this point and with successful and timely completion of all the course tasks, they obtained a complete score for the online course. Beyond the stop sign, higher levels of learning can be achieved.

Element 6: Many students, however, went the extra mile. The slanted arrow to the right of the stop sign signifies student effort. Through 'student's hard work' and 'perseverance,' they pushed themselves to do more or better quality work that was not specifically expected of them. Students persevered and overcame 'subject matter issues,' 'personal issues,' and 'technical issues.'

Element 7: The arrow to the right of the stop sign is the third element of teaching presence seen in student reflections, support and autonomy. Online educators need to 'give feedback' promptly, 'be helpful,' and 'encourage autonomy' so students will have the support to move forward, with the encouragement to become autonomous. This reflection helped show how encouraging autonomy on the teacher's part helps the students become more invested in their tasks, "I was able to collaborate with my team without supervision, which helped us to really step forward

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and take ownership in the work we produced during the discussion." The concept of scaffolding tasks to the point where students are motivated and competent toward the end of the semester to tackle course activities may seem obvious to most educators, but in online teaching much handholding is prescribed and needed. The online educator needs to find the balance between offering support and encouraging autonomy.

Element 8: The circle on the far right is part of the final result of the community of inquiry's journey, 'group cohesion' which is an element of social presence. Group cohesion includes 'recognize contributions,' 'group commitment' and 'sense of belonging.' The existence of group cohesion was not evident in the reflection of every individual, but there were reflections that some discussion teams had formed a close bond.

Element 9: The rectangle to the far right is the second part of the final result, 'improvement and progress,' which represents cognitive presence. Students 'improve confidence' and 'improve skills' related to the subject matter. The sense of group cohesion and improvement are related in a way that some students like to show their newly acquired skills to peers in an environment where contributions are recognized.

Element 10: The theme of 'emotional presence' is stretched from the beginning to the end, as the learners' and teacher's behavior and attitude towards one another, the class, and content has a great impact on the students' learning experiences throughout the course of the semester.

While the chronological display provided a context in which the presences interact, it also brought into question the causal relationships among the presences throughout the duration of a course. It seems teaching, cognitive, social, and learner presences exist within two levels, and the first phase or level must be reached before moving on to the higher level.

Finding Three: This logic model accounts for some if-then interactions among elements of an optimal learning experience.

Figure 7 shows the logic model based on qualitative and quantitative student reflections (Hossain Mardi, 2016; Mardi, 2019). The if-then relationships between presences are seen in this model, as well as the relative chronological order of presences within the course.

Starting from the left, the input required from the teacher and learner is shown. The activities that take place during the semester related to each of the four presences are shown. In the final column of the top table, the output or outcome is shown to be getting to know your peers and connecting at the social presence, and applying knowledge (sharing creations and knowledge, and making real world applications). These outcomes of the first level can be furthered by adding support (teaching presence) and perseverance (learner presence). In which case, it can lead to group commitment and sense of belonging, and an improvement in confidence and skills. This logic model accounts for the quantitative finding (Mardi, 2019) of the relationship between learner interest needed in the topic or subject and the sense of satisfaction gained from the course. While an online student perceived the teaching, social, and cognitive presences to be at a high level, he or she did not have a sense of satisfaction from the course; the reason was the lack of interest and curiosity in the subject.

There are two major shortcomings to this logic model. The first is that trying to include emotional presence at the interface of these presences would make the model crowded and confusing. The second issue is the linear form of the model. As shown by writing "ongoing" many times in the second level of the model, the first level input/activities/output continues to take place. This is difficult to visualize through the logic model presented here.

To address these shortcomings and provide an overall view of the CoI framework, a metaphor was used to produce the model presented in the following section. Lapan, Quartaroli, and Riemer (2011) describe using a metaphor to improve a logic model to accurately depict specific activities. In this paper, I propose using a gear model to depict the Community of Inquiry framework. Moser (2000)

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Figure 7. Logic model showing two phases of CoI elements; ultimately leading to sense of satisfaction, group commitment and sense of belonging, and improvement of confidence and skills

Presence	Input / Prerequisite	Activities	Output / Outcome
Teaching	Instructional Design & Organization	Direct Instruction Discussion Facilitation	
Learner	[Curiosity & Interest]	Participation	
Social		Present Oneself	Connecting
Cognitive		Exchange Info Construct Meaning	Apply Knowledge

Presence	Input / Prerequisite	Activities	Output / Outcome
Teaching	Instruction & Facilitation (ongoing)	Offer Support	
Learner	Participation (ongoing)	Perseverance: Overcoming Issues	[Sense of satisfaction]
Social	Connecting (ongoing)	Connecting (ongoing)	Group Commitment Sense of Belonging
Cognitive	Apply knowledge (ongoing)	Apply knowledge (ongoing)	Improve confidence Improve Skills

explains how metaphors influence information processing as they "not only enable the reflection and communication of complex topics and the anticipation of new situations, the use of different metaphor models also affects further perception, interpretation of experiences and possibly also subsequent actions" (p. 4). The model suggested in this paper offers a different perspective on how the presences outlined interact in an online educational setting.

CONCLUSION

Within the original CoI framework, most emotions are housed under social presence, and part of learner effort is under teaching presence. The three main presences overlap and at the intersection lies the optimal learning experience.

This paper suggests a different, less static view. The components elaborated on in the chronological representation in Figure 8 show an ongoing cycle and are in constant movement. To simplify the concepts, (as an example) getting to know course members is shown at the beginning the course because its existence is significant during that time. But members of a community of inquiry are continuously getting to know each other. Many student reflections show how this connecting of course members have led to better understanding of concepts, asking for help, and feeling enthusiastic about the course. This element of social presence is seen to impact teaching, emotional, cognitive, and learner presences. Other reflections have shown the effect of elements in similar ways.

The revised model suggested in this paper, is the gear model, illustrating how presences interact. Using the metaphor and visualization of functioning gears, the current research findings in the CoI realm are accounted for using this model. The components interact, and although interdependent, the system of creating an optimal learning experience is dependent on all the elements working

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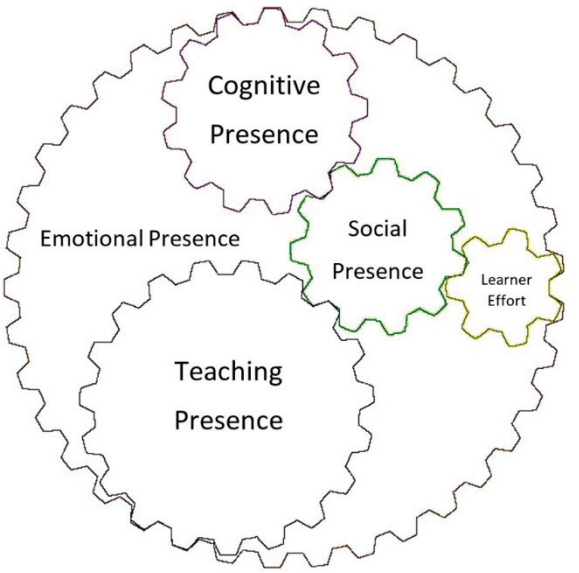
Figure 8. A screenshot of the gears in motion: the dynamic model representing CoI research, suggested in the paper



together, as illustrated using gears. I initially sketched a gear model with five gears to illustrate the metaphor. Unfortunately, it was not interactive or dynamic; it did not move. I was able to find a pre-existing model created by Röver (2016) to illustrate my metaphor and explain how the presences interact. This five gears gif image can be seen in full motion at http://www.andreas-roever.de/img/loony.gif (permission to republish the image was given by the creator in January 2016). This visual representation of the moving gears signifies the essence of inquiry taking place in a community: the teaching and learning should continue to be in motion. The gears, or presences, are in place to provide an optimal learning experience for the members of this community. Although described and analyzed in isolation to better create this dynamic, the presences should be visualized as a precise unit in continuous motion.

With the five-gear representation of components of an optimal learning experience in mind, below is a student's description of one of their online learning experiences that shows the elements in a short segment of an observation transcript. This student described the synchronous brainstorming phase of the discussion activity in the online class. The fact that emotions and perseverance on the learner's part exists alongside the social and cognitive presences is undeniable. Teaching presence is manifested in the design of the activity itself: having students collaborate to construct and confirm meaning in the online environment. The student explained how the team discussion was going:

I actually drew a blank [chuckling and adjusting her seat]. It wasn't that it was hard or anything, I don't know. After, you know, helping my mom and everything, I was just drawing a blank. But after I gathered myself (slightly higher volume), it was cool [nodding her head]. And it was really cool to see like I wasn't the only one thinking the way I was thinking. [waving right hand] I've noticed that, you know, the other girls put things down that I was thinking, and so that made me think a little bit harder and deeper.

This student had to push through issues of having her mom in the hospital and gather herself to focus on the synchronous task with her peers virtually present. She highlighted the importance of confirming as well as constructing meaning through group brainstorming with her team. In real time,

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having to respond in Google Drive after reading her team's brainstorming ideas, this student had to think "harder and deeper" to develop novel ideas. This short example illustrates how the elements interact and work together to achieve an optimal learning experience.

This gear model represents the dynamic interactions between the presences. Although each learning context differs, this model serves as the overgeneralized version in terms of the size of the gears: teaching presence being the largest gear, and emotional presence being pervasive.

Garrison, Cleveland-Innes, and Fung (2010) and Shea et al. (2009) confirm that the teaching presence has a central role in creating, integrating, and sustain the elements in the online environment. Student reflections also mirrored this notion. Emotional presence is displayed as the gear encompassing the others gears in the model, like a platform or base. In the metaphor, emotional presence is also the grease that gets the gears moving. The power of emotional presence is that is pervasive within the construct. Rienties and Rivers (2014) reviewed more than 100 studies and identified approximately 100 different emotions that may impact learners' attitudes, behavior, or cognition in a positive, negative, or neutral way. They assert "emotions can occur at any stage of the learning process, at any of the four presence areas, and might lead to completely different, even opposite, emotions for different learners" (p. 6). Emotional presence can be considered the grease to move the experience forward, and the spoke (from the idiom 'to put a spoke in someone's wheel') to obstruct the movement of the gears.

Learning Presence is introduced as a "proactive stance adopted by students who marshal thoughts, emotions, motivations, behaviors and strategies in the service of successful online learning" (Shea et. al, 2012, p. 90). Consistent with this research, self-regulatory behaviors such as time management, help seeking, self-evaluation, and self-direction were seen in the online undergraduate course in this study. Throughout e-observations over the course of the semester and through student reflections and emails, almost all of the components listed under Learning Presence were manifested in the online educational technology course in this study. However, perseverance and grit are not emphasized in this conceptual addition to the CoI framework as much as it is seen in the study. Learners have the ability to get these gears moving and make up for whatever the other presences lack, through learner effort and perseverance. If the static screenshot of the gears is viewed, one might think the placement is arbitrary. But the labeling or the smaller size of the other gears is not meant to minimize their significance, rather, the takeaway is to reinforce that fact that they all need to be functioning to continue to be in motion and create an optimal learning experience.

Tufte, "the Leonardo da Vinci of data" (New York Times; cited in Interaction Design Foundation, 2018), emphasizes the importance of displaying data: "There are right ways and wrong ways to show data; there are displays that reveal the truth and displays that do not" (1997, p. 45). The decision-making magnitude of the data displays in this paper is not at the life-and-death level Tufte describes. It is unlike stopping the cholera epidemic in 1854 or launching the space shuttle Challenger in 1986; but it has an effect on the community of researchers and practitioners looking to the Community of Inquiry for an understanding of how learning experiences are shaped.

Referencing Kirk's definition of visual representation, the goal of this process and visual display is "the amplification of cognition". I believe the CoI research community can improve the display of the framework with findings of thousands of research initiatives based on it. Static overlapping circles do not do the framework justice; I call on researchers to present visual representations of the CoI that amplify cognition and help online educators and designers "see" how learning experiences take place. As Stenbom (2012) encourages researchers to "criticize, refine and extend" the CoI model (p. 45), I too encourage researchers to do so with the gear model in addition to the original framework. To echo other researchers, "given the prominence of the framework in online education practice and research, continued focus to enhance its explanatory power is of paramount importance" (Shea et al., 2014, p. 15). The gear model assists online educators and course developers understand how the pieces of learning interact and fit together in an online setting. These dimensions or presences are better represented in this dynamic model that addresses the significance of learner effort and the impact of emotions within the online educational environment.

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ENDNOTE

Emotional presence is referred to in this paper, but it is not explicitly mentioned in the codebook (Appendix 2). Throughout the process of coding student reflections, emotions were coded into 'Teacher Characteristics,' 'Expressions of Emotions,' 'Self-Disclosure,' and 'Personal Issues.' To be able to visually display emotions, this paper offered the visual display in Figure 4, showing emotions at the interface of all presences. The student reflections used in that figure are in Appendix 1.

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APPENDIX 1

Parts of student reflections that included expression of emotion, categorized by the interacting presences seen in the reflection. (TP: Teaching Presence, CP: Cognitive Presence, LP: Learner Effort/ Presence, SP: Social Presence).

TP-CP:
the professor was passionate about the subject;
always had an up upbeat attitude when teaching

CP-LP:
I get bored when… I was completely engaged in the class;
It was so bad I felt awful after the discussion.

LP-SP:
everyone felt comfortable enough to share their ideas;
I feel that everyone needs to feel safe with each other to comment on tough or controversial subjects.

SP-TP:
I'm still not sure why he did that. It was really embarrassing. Plus I got a B, so it couldn't have been that bad.
feeling discriminated against because I participated in drama and was not an athlete

TP - LP:
it is always very frustrating when i can tell … they arent interested in the students success;
My teacher cared about the students as individuals.

CP-SP:
I really like fun classes; I love building close relationships with people because it makes discussions more intimate and passionate.

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APPENDIX 2

Optimal learning experience elements: categories, subcategories, and themes

Category and Subcategory		Theme/Code
TEACHER PRESENCE (TP)	Instructional Design & Organization	Planning & evaluation
		Content development
	Direct instruction	Content delivery
	Offer Support	Give feedback
		Being helpful
		Encourage autonomy
	Facilitating Discussion	Facilitating Discussion
	Teacher Characteristics	Teacher Characteristics
SOCIAL PRESENCE (SP)	Present Oneself	Expressions of Emotion
		Self-disclosure
	Connecting	Getting to know
		Connecting
	Group Cohesion	Group commitment
		Sense of belonging
COGNITIVE PRESENCE (CP)	Exchange Information	Respectful exchanges
		Discussion Participation
		Share Ideas
	Construct Meaning	Develop and reinforce ideas
	Apply Knowledge	Share creations
		Share knowledge
		Real world application
	Improvement & Progress	Improve confidence
		Improve skills
LEARNER EFFORT (LE)	Student Participation	Class Activity Participation
		Student's hard work
	Student Perseverance	Overcoming Subject Matter Issues
		Overcoming Personal Issues
		Overcoming Technical issues

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Design, Development, and Usability of a Virtual Environment on Moral, Social, and Emotional Leaning

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ABSTRACT

Virtual environments have the potential to be an important teaching tool for emotionally sensitive issues capable of producing a sense of presence, perspective-taking and introspection in users in a risk-free, rapid feedback experience. In designing such experiences, it is essential that users are regularly engaged in a collaborative design process. However, engaging in design, development, and evaluation can in itself provide a learning experience. Here, the authors present an approach to engaging children in the design, development and evaluation of a virtual learning environment, specifically a serious game, focused on inculcating empathy, ethical reasoning, and reflection for coping with bullying. It was demonstrated that children's involvement not only contributed to an improved virtual environment, but significantly engaging in the design process provided children with a novel and effective learning opportunity.

KEYWORDS

Collaborative Design Process, Social and Emotional Learning, Values Education, Virtual Learning Environment

INTRODUCTION

Child suicides in Japan, due to school bullying, are the highest they have been in more than three decades (BBC News, 2018). Kersten (2012) calls bullying victimization a "collapse of moral code and a symptom of the passing of everyday values" such as empathy, kindness, compassion and tolerance. Although Virtual Learning Environments (VLEs) are seen as an effective vehicle to transfer moral value orientations and positive emotions (Paracha & Yoshie, 2013; Hodhod et al., 2011; Zagal, 2009), they have never been considered pedagogically imperative by the Japanese school system. This is despite a growing wider focus on developing active and dynamic learning environments which incorporate digital technology and encourage a participative relationship between students and practitioners (Borges et al., 2014). In Japan, moral, social and emotional learning approaches are suppressed in the

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curriculum rather than given the precedence they deserve. Schools are focused more on improving academic skills of children (Paracha & Yoshie, 2013) than offering them with opportunities to explore personal, social and emotional issues, and related coping strategies in a virtual environment without involving any real-world risks (Chaffe, 2016; Abt, 1970).

Social and emotional skills are critical to be a successful student, citizen, and worker (Greenberg et al., 2003). This type of learning involves acquiring knowledge and skills to understand and manage emotions, set and achieve positive goals, feel empathy for others, establish positive relationships, and make responsible decisions (Casel, 2013). For virtual learning, Buck (2013) states that integration of game theory into non-game environments can create positive emotional responses such as joy, relief, curiosity, and creativity. This in turn may facilitate deeper understanding and management of emotion. Similarly, Granic et al. (2014) believe that serious games can provide immersive and compelling social, cognitive, and emotional experiences that can be transferable to real-world contexts, whilst operating as sites to apply problem-solving skills and enhance creativity. Granic et al. (2014) and Greitemeyer (2013) found that intergroup collaboration in multiplayer serious games reduces prejudice and increases empathy towards the outgroups. In this respect, learning may be achieved through the development of relatedness, a key element of self-determinism (Seaborn, 2015). Cuhadar & Kampf (2014) suggest perspective-taking in serious games is a prerequisite for developing empathy— one of the most important aspects of anti-bullying education.

Values education aims to stimulate ethical reasoning, reflection (Zagal 2011), awareness, responsibility, and compassion, thereby nurturing respectful and empathetic attitude towards others (Chowdhury, 2016) and supporting learners to overcome prejudice, discrimination, and immoral behaviors (Bruno et al., 2015; Weil, 2016, 2009, 2004, 2003; Brown, 2014; Chitkalamba, 2011). Serious Games developed in Virtual Learning Environments with embodied characters offer particular benefits for values education, such as coping with bullying. The feeling of presence, ethical reasoning and reflection coupled with the potential for learners to empathize with virtual agents in complex emotional situations (Hall, 2006a) allows the child to assume realistic roles, face problems, formulate strategies, make critical decisions and to get fast risk-free feedback on the consequences of their actions.

Shimpai Muyou ("Don't be afraid!" in English) was proposed in order to promote empathy and moral reasoning as an effective means to prevent school violence and delinquency issues in Japan (Paracha & Yoshie 2008). The aim was to design and develop Shimpai Muyou for Japanese pupils to help them learn about bullying victimization and related coping strategies, and to evaluate the usability, user experience, and efficacy of the system. The child's role in Shimpai Muyou was as an advisor or invisible friend to the victim in the bullying scenario, interacting with the victim at key points in the narrative. Value Sensitive Design (VSD) a theoretically grounded approach to designing technology that promotes human values e.g., peace, equality, empathy and tolerance (Hourcade et al., 2012; Friedman, Kahn, & Borning 2006) provided the ethos for development.

Inspired by the emerging paradigm of "engaging in research with rather than on children" (Hill, Laybourn, and Borland, 1996), child-centered approaches (Druin 2002) and the need for learner involvement in VLE development (Paracha & Yoshie, 2011), the Shimpai Muyou project was the first in Japan to use Participatory Design with children in the school setting to design educational technology involving over 200 children in the process (Table 1). Participatory Design provides engaging approaches and methods that enable users to participate and collaborate in (and throughout) the design process. Following the pragmatic stance, as seen in several studies (Hall et al., 2004, 2006, 2015; Read et al., 2013; Khaled & Vasalou, 2014; Read, 2015) the goal with Shimpai Muyou was to support children's input as informants.

Although the need to address the current lack of ICT integration into pedagogy is an identified problem in Japan (Aoki 2010) engaging children in design is still not the norm in the Japanese technology design culture, with resistance to adopting user-centered approaches. Furthermore, despite a growing consensus in the value of gamification of learning (Nicholson, 2012; Francisco, 2012) and the advantages of incorporating game components into teaching and learning strategies (Gutiérrez &

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Table 1. Overview of Shimpai Muyou participatory design and evaluation activities

Purpose	Experience and Participants	Participatory and Evaluation Methods
Informing early stage design	Conception Participatory Design Workshop (30 children)	Fictional Inquiry Comic-boarding Classroom Discussion Forums (CDFs)
Initial Prototype produced		
Improving narrative and story	Narrative Participatory Design Workshop (30 children)	Interactive Theatre-based Participatory Design Digital Storyboarding Interaction with SM CDFs
Prototypes providing short scenarios to explore storylines and interactions		
Improving the scenarios and interactions with SM during development	Formative Evaluation Sessions involving end-user interaction with limited versions of the prototype (80+ children in 4 formative evaluation sessions)	Interaction with SM Formatively evaluate the look and feel Improve design by creation of artifacts e.g. comic strips to improve characters / story CDFs
Final Prototype produced		
Evaluation phase	Summative user evaluation (20 children)	Questionnaires Logging aggregator Observations Think Aloud CDFs

Lopez, 2016), there has been little research into the benefits of co-designing gamification environments, including serious games, with the children who will ultimately use the system.

However, as we will highlight in this paper, not only does children's participation contribute to the application design, but further the experience can offer a valuable opportunity for learning. Whilst there are studies considering how engaging in Participatory Design and child engagement in the design process can support design and technical learning (Bødker, Kensing, & Simonsen 2004; Simonsen & Hertzum, 2010, 2012; Thumlert, de Castell, and Jenson, 2018) there is a lack of research that considers how domain learning, such as coping with bullying, can be integrated into design, as well as evaluation activities.

Table 1 provides an overview, with the following sections briefly presenting our approach to involving child-learners in Shimpai Muyou's development. The discussion highlights how design and interaction can empower children with ethical reasoning and reflection in order to enable them to challenge bullying. For full details of our approach and activities, for informing early stage design see Paracha, Khan, and Yoshie (2008); and Paracha and Yoshie (2008); for improving narrative and story see Paracha & Yoshie (2011); for iterative design and development see Paracha and Yoshie (2012) and Li et al. (2013); and for summative evaluation please refer to Paracha and Yoshie (2013) and Paracha, Jehanzeb, and Yoshie (2013). Here, we focus our discussion on how this participatory, child-centred approach not only generates input to design, but further that it empowers children with ethical reasoning, drawing upon important findings from each stage in the development.

Informing Early Stage Design: Conception Participatory Design Workshop

The first 1-day Conception Participatory Design workshop aimed to provide inspiration and concepts for narratives and design early in the design process. Design inputs to the workshop included initial

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paper-based graphics showing character and environment along with partial storylines. The Conception Workshop was held in Oita, at a Japanese school. 30 children aged 7-12 years old were recruited through the Parent-Teacher Association (panel of parents and educators at Japanese schools who help to ensure the safety of children) who gave their ethical approval for the children's engagement.

After a brief introduction, the child participants were divided into 6 groups of five children and engaged in three Participatory Design methods:

- Fictional Inquiry (Dindler & Iversen, 2007) which allowed designers to shape the context of collaborative design activities by creating partially fictional situations, artifacts, and narratives. This fiction was provided by children being asked to be "Detectives" investigating bullying on Mars. They drew scenes depicting different bullying situations and presented them using slides. The nature of the inquiry was exploratory, and enquired into the children's personal experience of bullying e.g., fictional bullies & victims and bully/victim gestures and language. Using Fictional Inquiry aimed to develop on an understanding of the children's views on bullying, types, situations, characters and language involved with bullying;
- Comic-boarding (Moraveji et al., 2007) which used specially created comic-based activities related to the bullying context to gather narrative and content ideas. This approach was selected as being particularly appropriate for Japanese children with considerable interest in comic books and anime (Ito, 2008). Children were asked to collaboratively complete a partially completed comic strip. The children's comic-boards depicted bullying scenarios, language and gesture contents that could be used for the design of the narrative of Shimpai Muyou;
- Classroom Discussion Forums (CDFs) (Hall et al., 2006) were used instead of focus groups, with pupils more familiar and comfortable with this approach that uses the typical classroom structures of "Table Time" (small group discussion) followed by "Circle Time" or "on the carpet" (whole class discussion) with hands-up questions and answers to obtain verbal feedback from children. CDFs aimed to provide ideas and stories for narratives and experience supporting children in discussing their opinions on bullying, coping strategies and the role of empathy and values.

Key Innovations, Findings and Contributions

Fictional inquiry, comic-boarding and CDFs yielded novel, quality outputs including types of bullying situations at school, emotions, empathy, language and gestures of bully or victims, with 43 design ideas produced from the workshop. Children were highly engaged, vocal and enjoyed collaboratively undertaking activities with useful outputs throughout the conception workshop.

Children provided feedback on the aesthetic and were positive about animation-based problem solving and interacting with Japanese animation characters similar to Nobita Kun, Chibi Maruko and Doraemon, although western animation characters were not popular among Japanese children. The children also preferred text-bubbles rather than natural language support or recorded voiceovers, focusing on simple interaction more similar to that with a comic than a game. This preference resulted in designing the interface (Figure 1) based on free text entry and simple point and click.

Engaging children in collaborative design activities such as comic-boarding, creating artefacts and narratives and engaging in classroom discussions provided significant input to the initial VLE design. Outputs contributed to the development of initial design ideas for the VLE, identifying outline, genre, requirements, and factors that would increase acceptance of VLE by Japanese children, as further detailed in Paracha, Khan, and Yoshie (2008), and Paracha and Yoshie (2008).

Using partially fictional situations and narratives and developing comic strips allowed children to discuss and explore stories and everyday experiences of school emotions, empathy, bullying scenes and coping with bullying. However, in addition, the participatory design methods applied provided tools to teach and learn about values, perspective-taking, compassion, ethical reasoning, empathy, reflection and inclusive principles in the classroom and school community.

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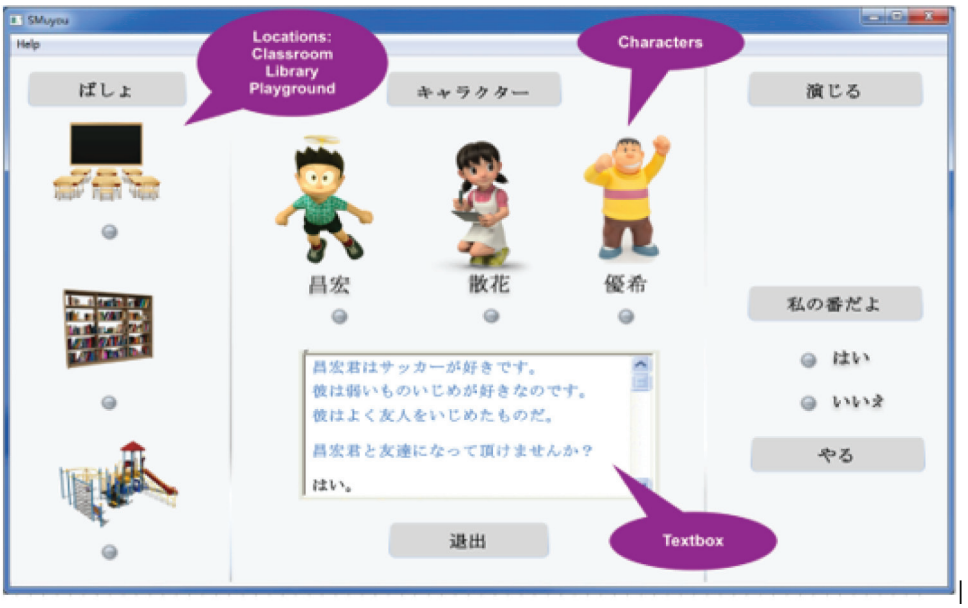
Figure 1. Interface



Children created scenarios and comic strips that reflected what happened in their daily school experience. This reflection allowed them to discuss incidents and issues that they were experiencing with the reflection achieved through the design exercises helping them to understand themselves better. The children were able to discuss and from that discussion create design artifacts that provided solutions to their personal experiences of feeling oppressed or victimized. In the CDFs, the children's discussion highlighted that the Participatory Design experience had made them feel empowered, that they felt they had a voice in the world. By rehearsing that voice in creating comics and scenarios in the classroom, they acquired a useful tool for exercising their voices outside of the classroom.

Improving Narrative and Story: Narrative Participatory Design Workshop

Shimpai Muyou's interaction provides children with bullying scenarios and it is critical that these are appropriate and engaging, providing compelling content. Shimpai Muyou was iteratively designed and developed, with an initial prototype providing short verbal and physical bullying scenarios with limited interaction functionalities developed to be used to support participatory narrative and content design. To achieve this a Narrative Participatory Design workshop was held, both to gain feedback in relation to the experience, narrative, plot and character motivations in the prototype, and to develop and extend dialogue and content for the narrative.

The 1-day workshop was held in Yufuin with 30 children aged 7-12-years-old. The Parent Teacher Association was contacted to obtain ethical approval for recruiting children. After a brief introduction, children worked collaboratively in 6 groups of five participating in:

- Interactive Theatre-based Participatory Design based on Freire's educational theory that oppression can be overcome by progressive education and practices (Friere, 1997) and Boal's (1993) Theatre of the Oppressed, a form of interactive theatre that aims to bring to light systemic exploitation and oppression within common situations. In Theatre of the Oppressed, the audience participates in the drama taking responsibility for actors on the stage, advising them and contributing to the narrative. The approach supports role and perspective taking for challenging social and emotional situations, such as bullying. For the design of Shimpai Muyou

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this technique was extended into a Participatory Design activity to explore story arcs, character motivations and plot points. Children were supported by a drama facilitator with each group taking the perspective of one of the characters in the VLE (e.g. the bully, victim, defender, bystander), collaborating together to decide the character's actions. The character was provided by an actor, with the groups advising the actor when asked to by the drama facilitator during the narrative;

- Digital Storyboarding (Paracha & Yoshie, 2011), see figure 2, was used via a storyboard software with the children co-producing short narratives combining images, text bubbles, voiceover and video on children's bullying experiences;
- Shimpai Muyou experience: children interacted with the prototype and were asked for their views on characters, storyline, as well as acceptability of the look and feel of interface;
- Classroom Discussion Forums: throughout the day, CDFs were held to discuss the activities, outputs and experience.

The Narrative Participatory Design Workshop was video recorded. Template analysis was used to provide priori themes which then evolved during the coding. For example, the importance of verbal, relational and physical abuse in relation to the bullying topic being researched was so well-established that the researchers safely expected them to arise in the data as priori themes, given their prominence in the literature. The main benefit of using a priori themes was that they helped to accelerate the initial coding phase of analysis.

Key Innovations, Findings and Contributions

The workshop, with its focus on the characters in Shimpai Muyou in both the Theatre of the Oppressed and the Digital Storyboarding provided rich information on children's views, perspectives and expectations of key-roles in bullying situations, character profiles, coping strategies, storyline design and progression. The output was highly creative with children contributing 156 unique design ideas during the workshop. Key contributions to the narrative included that almost all of the children's storyboards indicated a happy ending e.g., hatred turning into friendship, peace and conflict resolution. Based on this the Shimpai Muyou design team incorporated that happy ending segment in all of the virtual bullying experiences.

Children identified that bullying at Japanese schools was often one against many and mostly relational e.g., ignoring, verbal abuse, boycott, etc. This is a major difference to bullying experiences in countries such as the UK and the US, where one on one (or small group) physical bullying is often seen, particularly amongst boys. In response the design team included more relational and verbal bullying scenarios than physical ones and incorporated the many to one bullying prevalent in Japanese schools.

Shimpai Muyou focuses on empathic engagement between the child and the victim, with Theatre of the Oppressed and Digital Storyboarding generating appropriate dialogue for the bullying scenarios and for engagement with the victim. Digital Storyboards (Figure 2) directly captured language content,

Figure 2. Digital storyboards created by children depicting bullying scenarios at school

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gestures and coping strategies that children used to dealing with bullying, character impressions, emotions and empathy.

Exposure to the Prototype focused primarily on the aesthetics and interaction, with data collected on character appearances, storyline, empathy and gender preferences. During the CDF children offered different views on characters, storyline, empathy and gender, as well as identifying characteristics that would increase acceptability of the look and feel of the interface. CDFs offered opportunities for children to verbalize their views on bullying, bullying scenarios, speech acts, coping strategies, bully/victim's impression, role of empathy and values, favorite characters and their overall impression of the VLE.

The Participatory Design activities supported the children in ethical reflection throughout the workshop, with plentiful discussion exploring views of reducing and ending bullying at school. Using Participatory Design based on Boal's Theatre of the Oppressed was highly effective with Japanese children. Children experimented with different choices in bullying scenarios in a safe environment, and were able to see immediate (although safe) consequences as performed by the actors. These activities enthused the children with the strategies identified offering potential to increase self-confidence and self-esteem outside the classroom. During CDFs children stated that they felt empowered by voicing their ideas and having them heard.

Using interactive theatre techniques and digital storyboarding, coupled with experiencing a prototype virtual environment, children were able to create scenarios and dialogues that reflected their world. But further, such reflection helped them understand themselves better. Children were able to discuss and act out solutions to problems when they felt oppressed or victimized. Interactive drama, digital storyboarding, and classroom discussions provided an approach that enabled children to voice their views and empowered them with ethical reasoning, reflection and empathy in order to reduce bullying victimization.

Involving Children in Iterative Development: Participatory Design Through Formative Evaluation

Shimpai Muyou was iteratively developed over several years with an ongoing participatory design process incorporating formative evaluation accompanying prototype development. Using Participatory Design approaches the children engaged as informants, focused on specific issues, with results feeding back into improving the experience. During each formative evaluation, after a brief introduction to the Shimpai Muyou project, participants were involved in individual or small group interactions with the current prototype and then design activities, such as annotating screens and dialogue, discussing and improving characters, plot and storylines were conducted. The evaluations generated written and drawn artefacts along with recommendations and ideas gathered during Classroom Discussion Forums.

The prototypes of Shimpai Muyou provided part of all of the scenarios with the basic structure of the experience being that the child meets the victim and then watches a scenario in which the victim is bullied with In-Episode-Interaction providing navigation. After the bullying episode, the child then engages in Out-of-Scenario Interaction, a dialogue with the character in order to help them with their situation. After the scenario has ended, the End-Interaction functionality is activated, and the child can then review the scenario and their interactions.

Prototypes and workshops during the iterative development included:

- Verbal and physical bullying scenarios without any interaction functionalities were used to assess aesthetics, dialogue and narrative;
- Interactive experiences for partial and full scenarios, for example as detailed in (Paracha & Yoshie 2011). A workshop was held to determine whether children liked the characters as depicted; whether they were able to empathize with the victim character; and whether the bullying scenarios were intuitive;

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- Perspectives and views of the aesthetics of the characters and surroundings, determining if the children preferred 2D or 3D characters, realistic or cartoon style graphics and 2D or 3D environments. This enabled validation of potential scenarios for the VLE;
- Dialogue and interaction, with the victim and user interaction approaches focusing on the Out-of-Scenario Interaction in which the player acted as an advisor to a character. In-Episode-Interaction was limited for this prototype;
- In-Episode-Interaction, with the prototype providing navigation and orientation functionality enabling the user to explore and navigate in a scenario by following the character;
- End-interaction prototype providing functionalities enabling the child to watch snapshots of the key moments during interaction to support them in reflecting on their decisions and advice to the victim.

Key Innovations, Findings and Contributions

Children's input throughout the iterative development of Shimpai Muyou made a significant contribution to the design of the scenarios and interaction with the system. Discussing design issues and developing a credible, interesting scenario including considering bullying types, roles, gestures and language content brought improvements to the interface, storyline, character profiles and coping strategies. For example, in adding content for the bullying episode in the scenario children suggested many different forms of non-verbal threatening gestures for the bully that were incorporated into character scripts e.g., giving a stare, fighting, hitting, pinching, spitting, tripping, pushing, feeling angry, frightened and powerless.

However, not only did the participatory design and formative evaluation provide valuable design input, they also provided a mechanism to stimulate perspective-taking, ethical reasoning, reflection and empathy in children on bullying victimization. For example, children's discussion of non-verbal threatening gestures resulted in the children addressing their own lived experiences of bullying, responses and strategies to cope with threatening non-verbal behavior. Through active participation in the co-production of serious-game and game-environment components, there was evidence of student-centered autonomous learning, enhanced reflection, and positive student experience.

The children were highly positive about being included in the development of Shimpai Muyou feeling it gave them a voice. Becoming active participants in the iterative development process become intrinsically motivating, with the process of evaluation and offering feedback a learning activity that was in itself a positive reward. Malone and Lepper (1987) proposed that intrinsically motivated learning is more likely to be successful than extrinsically motivated learning, providing a taxonomy of intrinsic motivators which includes control, cooperation, and recognition. Ryan and Deci (2000) support this stating that if an individual finds activity engaging and carries it out without conditioning, then learning is more fruitful. Children engaging with the formative evaluation and participatory design of Shimpai Muyou had control, cooperation and recognition, with their voice and experiences incorporated. The formative evaluation offered children an atypical experience where their views, beliefs and ideas were seen as being critical. Children had control in shaping development, and cooperated both together and with researchers in order to achieve this.

The objective of the ongoing formative evaluation activities was to validate the prototype development at regular intervals in terms of usability. The final phase of user involvement in Shimpai Muyou's development was a summative usability evaluation.

Summative Evaluation With Children

Usability is defined by ISO 9241-11 (1998) as "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction". From a software perspective Lindgaard (1994) described usability as the ease of learning and using computer systems from the experienced and inexperienced user's point of view, something children as digital natives

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intuitively take for granted. Usability requires design principles aimed at children that adapt to, and consider their needs (Masooda and Thigambaramb 2015). This adaption means that usability in the context of Shimpai Muyou focused on the degree to which children were able to learn about bullying and to control, understand and enjoy the environment. The summative user evaluation for Shimpai Muyou took a mixed methods approach and focused on:

- Learning effectiveness with the evaluation seeking to explore if interacting with Shimpai Muyou did support learners in understanding, responding to and coping with bullying;
- Control and Interaction with the evaluation aiming to identify if children could easily navigate and interact with Shimpai Muyou;
- Engagement with Shimpai Muyou investigating if the user experience was interesting and enjoyable.

Emotional and sensitive issues are complex and difficult to discuss with children. Using a mixed methods approach provides diverse ways to understand user's viewpoints and experiences. 20 children aged 10 to 12 years participated in the evaluation. Participants were selected through purposive sampling based on the naturalistic observation of their classroom conduct (i.e. bully, victim, bully-victim, and bystander) and in consultation with their teachers. Ethical approval was obtained from the Parent Teacher Association with assurance that the data would be strictly used for research purposes only.

The summative evaluation began with a brief introduction to Shimpai Muyou and explanation that the children would be taking part in an evaluation. Children interacted with the prototype with researchers observing the children and engaging them in talking and thinking aloud about their interaction. After the interaction children completed a short questionnaire and participated in the classroom discussion forum.

Quantitative data was collected through questionnaires which focused on Shimpai Muyou's usability. This included whether participants felt they had had an effective experience and that they had learned about coping with bullying; whether participants were able to navigate, use and interact with Shimpai Muyou; participants response to the characters and preferred character; and whether the scenario and experience was useful, interesting and realistic. All of the child's interactions with the agents and the environment were logged, with a logging aggregator providing collected and aggregated log file data from different sessions and sources in a single combined data sheet. Logs captured all meaningful player actions such as visiting a virtual school location, meeting a bully, asking help from friends, opening a coping resource room etc. and were interpreted using log file analysis (Cocea & Weibelzahl, 2009).

Qualitative methods included think-aloud user testing (Desurvire, Caplan, & Toth, 2004) with the children talking through their interaction decisions whilst engaging with Shimpai Muyou. Observational methods (Moreno-Ger et al., 2012) included recording the upper torso and face of the child during interaction in order to capture children's emotional reactions. Recordings of the peer-interactions were also captured, with facial expression analysis used as one of the measures to indicate satisfaction. Classroom Discussion Forums (CDFs) (Hall et al., 2006) were used to explore ease of use, satisfaction with the Shimpai Muyou experience, likeability of characters/environment, difficulties with the application, emotional reactions and empathy vis-à-vis synthetic characters and virtual bullying scenarios. The CDFs were recorded and subsequently analyzed, using template analysis of expressed emotions and video-taped facial expressions, and occurrences of right or wrong choices through log files.

Key Innovations, Findings and Contributions

The results from summative evaluation, as presented in Paracha and Yoshie (2013), Paracha, Jehanzeb, and Yoshie, (2013), and summarized in Table 2, identified that children had enjoyed interacting with

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Shimpai Muyou and had increased their knowledge and understanding of bullying. Providing an ecologically valid evidence-based intervention targeting bullying in the classroom generated results that revealed pupils have a good level of understanding on bullying victimization after interacting with the characters in different virtual bullying scenarios. Shimpai Muyou stimulated discussion both in the classroom and across the whole school, with an improvement in school culture and sensitization to bullying informally reported by teachers and children in the month after the Shimpai Muyou evaluation. The children clearly understood the basic design of the VLE, the scenario and the role of the main characters. Child learners favored point and click and the use of texting for interaction. Whilst children were positive about the aesthetic, they wanted a more game-like experience, preferring to have more control over the interaction pace, which they considered to be too slow.

The scenario comprehension and believability of characters was considered to be high with children reporting that the bullying scenarios depicted real-life in Japanese schools. Children responded positively to the characters, appreciated the aesthetic and were seen transposing their own feelings onto the characters in the process of understanding bullying victimization. Empathic engagements with the characters were apparent. For instance, the victim character Haruto was favored the most, while the bully Masahiro was disliked by many, particularly by girls, with the victim-character evoking empathy, whereas the bully-character triggered anger.

Shimpai Muyou aimed to create spaces for dialogue, collaboration and reflection in order to induce deeper thoughts and a change in attitudes. The ethical dilemmas of the bullying scenarios elicited values-driven decisions from children e.g., defending victims, taking sides with victims, informing and seeking help from adults, comforting victims and trying to stop bullies. Think aloud, observations and CDFs helped to establish Shimpai Muyou's potential for tackling emotionally sensitive issues, both through recording and analyzing emotional reactions, but particularly through children talking about their own experiences and perceptions whilst discussing their interaction. Interacting with Shimpai Muyou was found to empower children with moral self-reflection and empathy to challenge bullying (Table 2). Emotional responses including guilt, shame and moral dilemmas were triggered when the players realized that they had violated a moral standard. Increased awareness of bullying was observed, specifically intuitive interaction with characters that significantly decreased children's level of moral disengagement on bullying victimization.

DISCUSSION

The UN's Resolution on Protecting Children from Bullying (9 November 2018) highlights the occurrence of bullying in all parts of the world and the fact that children who are victimized by such practices may be at heightened risk of compromising their health, emotional well-being and academic work and for a wide range of emotional and/or physical problems, as well as potential long-term effects on the individual's ability to realize his or her own potential. Providing approaches to coping with bullying and supporting Personal, Social and Emotional learning in schools and classrooms is essential. VLEs and Serious Games clearly offer an approach that is effective, however, there is still a lack of uptake and limited use of VLEs in the school classroom.

The advantages of gamification of learning, including serious games, have been widely cited and discussed from both empirical and pedagogical perspectives. When appropriately designed, such environments can encourage specific user behavior (learning, progression, accomplishment) with high levels of confidence (O'Donovan et al., 2013) and can facilitate personalized, intrinsically motivated learning that is participatory in nature. The act of game play itself can become a positive award (Seaborn, 2015). Furthermore, the potential of Serious Games to enable personal, user centric learning is significant. Constructionist theorists purport that learning through personally meaningful projects is more effective than passive learning (Pink, 2010).

Our experience of involving children in the iterative design and development of Shimpai Muyou highlights that design-of-gamification can act as a learning enabler. Shimpai Muyou was designed

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Table 2. Shimpai Muyou summative evaluation

Category	Indicative Comments	Specific Observation
Increased children knowledge about bullying and related coping strategies	**R8B:** "before when there was a fight, I would meddle, but now I will speak calmly". **S7G: "**Bullying is wrong and everyone must speak up about it to stop it". **S3B:** "But, now no matter how tempting it is, I'll not stoop to their level and always seek for help from an adult."	- Use of ethical dilemmas and Socratic persuasions brought about positive changes in children's violent behavior. - Teachers confirmed that they noticed an increased awareness of the bullying issue in the participating child-learners as compared to those who did not participate in the interactive session with Shimpai Muyou.
Empowering anti-bullying Morality Effectiveness on Conflict Resolution	**K5G:** "it made sense because people will see several things such as not to throw trash on others, learn how to have good manners and not to call bad names".	- weakened the association between moral disengagement and bullying. - No noticeable improvement in their conflict resolution skills, with a longer intervention required to assess this
Technical Infrastructure/ Ease of Use	**M3G:** "It is very interesting how this VLE works". **M5B:** "It is very easy to use, requiring that you simply point to indicate your wishes on the screen and then press this button." **S3B:** "it was very easy for me to ignore bully in the computer than here at school". **T4B:** "…I like 3D characters and objects." **C8G:** "I'd like to face bully in a 3D school." **Y9B:** "what should I do?"	- No hesitation in using technical equipment - Queries concerning "Send" button - Excitement, enthusiasm, & desire to participate - Boys less apprehensive - Balance in learner's freedom and learning
Appeal and Perceived Usefulness	**E1G:** "interesting, fun, better than comic books." **I7B, J2G, M3G, D1B & R2B:** "quite different from DS & PSP, but amazing." **S7G:** "It is cool; everything we do is useful".	- Children clearly empathized with the bullying victim - acknowledged bullying awareness - dilemmas required hard decision making - Confusion concerning the textual references
Immersion and Social Empathic Engagement with Characters	**M6B** & **K5G:** "we'll allow Haruto to play with us." **A4G:** "It was really nice solving my friends' problems." **C6G:** "I felt as I'm in the real world, because this happens all the time at our school." **I7B:** "Yes, it was a fun experience with a lot of friends".	- The virtual characters elicited appropriate emotional responses from learners ranging from "sad for Haruto" to "angry with Masahiro". - Positive emotional engagements led to immersion
Urge to Replay	**E1G:** "I had a lot of fun using Shimpai Muyou and would like to play again." **C6G:** "interesting will try" **Y9B, T4B** & **A4G:** "I'd prefer playing PSP or DS.	- Desire to further use the application "for multiple stories" - more about the characters' future relationships - Children found characters believable as they "listened to them"

and evaluated in a classroom setting. Researching with rather than on children identified the learning benefits possible from participating in the design of a VLE for bullying. The workshops brought forward many important and interesting design issues with Japanese children. Shimpai Muyou introduced a design culture which organizes the creativity of children in search for new solutions and includes the configuration of the problem to be solved. Knowing that engaging in the design

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of a virtual environment can in itself provide the learning experience could encourage schools and stakeholders to considering investing in such innovative technology, and opens research avenues in relation to the development of pedagogical models for learning-through-design of technology.

According to Thompson (2014) qualitative research experiences should provide an important aspect of behavior change research. During the design, development and evaluation of the VLE, the participation of children in collaborations was seen to have an impact on their learning and behavior. Using Participatory Design approaches, particularly interactive theatre and digital storyboarding informed meaningful emotional and ethically notable scenario design, while at the same time provided children with opportunities to reflect and change their negative behavior. The Participatory design offered current information from children perspectives on realistic bullying scenarios, storyline, speech acts, creating new scenes, coping strategies, bully or victim impressions, role of empathy, friendship and values. But more, the workshop's activities of collaboratively directing actors in an interactive drama; creating digital comic strips; interacting with a prototype of Shimpai Muyou; and discussing views and experiences of bullying served as a sensitization training opportunity to teach pupils about the role of compassion, perspective-taking and empathy in counteracting bullying. Sensitization training through Participatory Design offered an approach to creating a safe environment for all children at school, with findings from workshops highlighting how participatory design and conflict resolution enrich and complement each other. Conflict resolution researchers have not yet given sufficient attention to participatory design as a learning approach, however, as this paper identifies, designing moral and values-based experiences directly supports children's reflection and learning related to sensitive emotional issues.

With Shimpai Muyou our goal was to create a VLE on values education that support children's personal, social and emotional learning in relation to bullying. In engaging children in the development of a VLE for personal, social and emotional learning, such as bullying, as this paper has highlighted, we also supported value education teaching and learning. Japanese children felt empowered to know that they had a voice in the world. By rehearsing that voice in digital space, they acquired confidence to stand up to bullying. Believing that they could make a difference in their lives, should empower children to make a greater difference in their lives and communities. Participatory Design with children served as a powerful way of reflection, ethical reasoning, empathy and perspective-taking. The proposed methodology and pedagogical model are potentially capable to address similar other challenges such as hate crimes, vandalism, drug and alcohol abuse, sexual bullying, gang membership and gang violence, truancy, and excessive absenteeism.

Shimpai Muyou was one of the first technology-enhanced learning interventions on school bullying in Japan. As such the project sought to increase the quality of ICT applications in the Japanese education system. The Shimpai Muyou project developed a novel approach to address ethical and emotional aspects in the learning process. The focus on bullying represents a problem of relevance to the country's school system, with Participatory Design activities as well as interaction in a Virtual Environment providing an approach to engaging with bullying providing individual personalized learning strategies as well as providing a focus point to support and underpin whole-school approaches to tackle bullying.

CONCLUSION

Learner involvement is a widely accepted principle in development of VLE, yet there are few attempts to relate learner participation in design and development to learning of the domain the virtual environment provides. There is a lack of discussion of the impact of participating in a VLE's design and development on participants. This study is amongst the few that considers how learner involvement in design, development and evaluation can provide learning opportunities.

Shimpai Muyou served as a practice space for Japanese children to develop moral, social and emotional competencies in order to challenge school bullying. However, this practice space was not

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only provided by the completed virtual environment, but also in the activities experienced through participating in design. Shimpai Muyou's development identifies that Virtual Environments can offer learning not only in experiencing the intervention as learner, but also through designing the intervention as participant.

By engaging with children in design, development and evaluation activities, not only were they introduced to scientific and design thinking in relation to new technologies, but further they were actively engaged in learning about coping with bullying. Carefully planning the engagement of learners to provide integrated learning should become standard for virtual environment development with developers needing to consider the potential of integrating innovative subject-related learning experiences within participatory design, and thus adding direct value to the experience for learners. Learner-centered design needs to become more than a set of techniques for design, instead it must be viewed as an innovative learning opportunity with real benefits for learners.

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Avatar-Based Learning and Teaching as a Concept of New Perspectives in Online Education in Post-Soviet Union Countries: Theory, Environment, Approaches, Tools

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ABSTRACT

In the article the avatar-based learning and teaching (A-BL&T) as a concept of control and managing knowledge in modern socio-economic conditions is proposed to use for assessment a university's economic efficiency. It is shown that all elements, methods and techniques (tools) do not operate in isolation, but rather are interrelated, complementing each other. All of them are used in the process of management and, in a combination, are powerful tools for increasing efficiency of management. Based on the example of avatar-based learning and teaching in Russian universities as modern educational environments, a conceptual model, methodology, and methods have been obtained for the automation of planning and calculation of the academic load in the university.

KEYWORDS

Avatar-Based Learning and Teaching, Concept of New Perspectives in Online Education, Conceptual Model, Knowledge, Methods and Methodology, Modern Socio-Economic World System, University Environments

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INTRODUCTION

Avatar-Based Learning and Teaching (A-BL&T) as a concept of control and managing knowledge in modern socio-economic conditions (Mkrttchian and Aleshina, 2017) is a way of assessing a university's economic efficiency. A central component of the economic efficiency of the university is the cost of educational services. In general, the total price of the university services is an expression of all expenses for their creation, that is, the amount of the depreciation fund (equipment, buildings, structures), a revolving fund (current costs: wages with charges, charges for public utility services and others) and fund of development.

The development and implementation of innovative technologies in the educational process objectively require significant upfront costs: costs of preparing academic content, training teachers and staff, the costs associated with the organization of communication and the purchase of additional computer equipment, and other capital investments. Institutions are increasingly faced with difficult decisions related to their technology investments. When costs associated with developing, delivering, and providing support services for learning are closely examined, the challenges become stark (Blouin, et al., 2009). However, the cost of new educational services should not increase substantially. If we accept that the aim of administrative decisions is university's economic development, then the following relationship may serve as one of the performance indicators:

$$P_f = F / C$$

where:

- P_f is the performance indicator;
- F is the difference between the funds gained as a result of the management decisions and the costs of implementation of these decisions;
- C is the costs of implementing management decisions.

Along with the common activities of operation and development in Russian universities, there are important features of the organization of educational processes in the university with the distance education and distributed learning.

Analysis of the organization of educational process in higher educational institutions with the distributed structure points to the following features:

- Student groups for the study of each discipline formed from students living in different regions of the Russian Federation;
- Teachers need to be skilled in conducting classes with the use of distance learning technologies, provided by working programs of disciplines;
- Increased demands on the structuring, storage, monitoring and updating of training materials;
- Planned load of teachers is calculated according to the complexity of educational activities carried out within the planned schedule online (analogue the classroom activities in traditional training) and training activities carried out in offline mode (analogue the individual work of students in traditional education);
- Actual load of teachers per semester is calculated based on the planned load in accordance with the operational monitoring of the movement of the trainees contingent;
- The price of educational services is calculated in accordance with the level of the salary of the region, where the students are taught;
- Accounting and distribution of the funds should be conducted on the basis of the budgets of each department of the university distributed structure.

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In addition, the implementation of educational programs, using distance learning greatly increases the load of teachers in preparing and updating training materials. Their development is quite complex both in terms of use of the information and communication technologies, and in aspects of the pedagogy. The teacher has to be a master of the tools used to prepare e-courses and to conduct classes. In addition, the teacher should be a scriptwriter, able to build a training activities plan based on individual features of the target audience of listeners. Since the process of transition to distance learning technologies and their development is evolutionary, it is greatly extended in time. Involvement of new mechanisms in the learning process is gradual. Therefore, the development and updating of e-learning courses is continuous and a record of such labor grows into a separate task.

The traditional division of the academic load to the lectures, practical classes and individual work of students in the university with the distance education is not enough. First, it is necessary to determine the list of training activities carried out by teachers in the framework of open and distance learning, and to determine the complexity rates for each of them. All these activities can be divided into two groups - the online and offline activities. The first group includes training activities to support the contact distance technologies (chat, voice conferences, webinars, etc.) that have pre-approved schedule. The second group includes training activities, such as forums, e-mail correspondence, working with virtual laboratory complexes, monitoring the implementation of the course projects, consulting in blogs, social networks, etc.

Generally, the separation of students in the training groups is geographical in a nature, as time zone varies greatly in different regions. In this situation, the obvious solution is to move from study groups to educational threads with a large number of students. Combining educational groups in the threads, the maximum number of students in each discipline and consideration time zones requires the direct involvement of the university administration in the decision-making.

In the design of an avatar-based learning and teaching (A-BL&T) software system the concept of control and managing knowledge in the Cloud is essential. Structure of folders and files uploaded by user is actually the semantic network with hierarchical relationships “folder (ancestor) - file (descendant)”. Thus, here arises a problem of semantic hierarchical networks storage method for a large number of users in a relational database (and in such data structures that would be suitable for quick hierarchy extraction using relational algebraic operations). Hierarchical structures are often found in applications for e-learning. It can include structures of user relationships, user group hierarchies, and the course structure and so on. These structures should be persisted and reconstructed repeatedly during application lifecycle.

The authors in the paper give a brief overview of the possible storage methods. This study proposes a solution to the problem of storing a plurality of hierarchical semantic networks in a relational database. Particular attention is paid to optimizing existing storage method, carried out in order to reduce data duplication. In this study, semantic networks operations and hierarchical data storage in a relational database algorithm are combined.

BACKGROUND

The most researched, highly effective storage methods for hierarchy in relational systems are tree management method (Chen and Guestrin, 2016; Chandrasekar et al., 2013). The basic methods for persisting trees in relational systems are adjacency list, materialized path, nested sets and closure. The short description of each method is given below.

Adjacency List and Hierarchical Structure of Data

The “ancestor-descendant” relation is stored together with data as the simple link to the immediate ancestor.

The hierarchical structure of data and its storage with use of this method is presented (Vasenin, Mkrttchian, 2016). The main problem when using such a way of storage – is the difficulty of

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quick extraction of complete hierarchy. The difficulty is because of accessing each lower level requiring an operation that imposes restriction on the greatest possible depth of structure (tree) (Ren and Gibson, 2013).

Materialized Path and Hierarchical Structure of Data

For each node in structure of hierarchical data it is stored also enumeration of all his ancestors.

The hierarchical structure of data and its storage with use of this method is presented (Vasenin & Mkrttchian, 2016). As enumeration of ancestors is stored in one element of a structure of hierarchical data, the main lack of this method is additional overhead costs of work with this element: checks on infinite loops, string concatenation etc.

Nested Sets and Hierarchical Structure of Data

For each node in structure of hierarchical data two additional fields are added: left (the left border of a set, some number which is less than all numbers, which use descendants of the current node) and right (the right border of a set, number which is less than all numbers, which use descendants of the current node). Thus, the relation "ancestor - descendant" is defined by entry of the descendant left value into an ancestor's interval (left; right).

The hierarchical structure of data and its storage with use of this method is presented (Vasenin, Mkrttchian, 2016; Cai and Zhu, 2015). Use of nested sets allows get rid of restriction on the maximum possible depth of a tree, and joint uses of this method with the Adjacency List method will allow to take all structure of hierarchical data by means of one operation of relational algebra. However, costs of inserting and moving of nodes demand a large number of additional operations that is especially significant on hierarchical structures with a high nesting level.

Closure Structure and Data

Two relations are used – one enumerates nodes of a semantic network and contains data, and another enumerates all links between them (including implicit links).

The hierarchical structure of data and its storage with use of this method is presented (Vasenin & Mkrttchian, 2016). For each node, the metadata of a semantic network are stored (information what "parent" of "descendants" he is and at what nesting level). Extracting hierarchy structures from a relational system with closure table method (Vasenin, 2016) does not require recursive operations that eliminates the problem of inability to perform recursive operations using the database management system used in the software product. The "depth" predicate may be used to select just one level of hierarchical structure or in order to optimize some queries.

This storage method uses different relations for storing nodes of a semantic network separate from metadata (the connections between nodes in the network), that allows the use of the same nodes in the semantic networks of different users.

MAIN FOCUS OF THE CHAPTER

Issues, Controversies, Problems, Solutions and Recommendations

Avatar-Based Learning and Teaching (A-BL&T) as a concept of control and managing knowledge is has issues of scalability as hierarchy increases. In addition, the same nodes can be used in hierarchy structures of different users (ext. courses shared between different users) and not all storage methods allow this while retaining the possibility of scaling.

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Proposed Decision of Hierarchical Semantic Network in a Relational Database Storage Method

For the solution of a problem of storage of a hierarchical semantic network, it is offered to add one more predicate to the closure for linking of a hierarchical semantic network with the specific user of program system that will allow storing hierarchies of all users of system and to make operations over a set of hierarchies at once. Thus, the relation will look as follows: (user ID, parent ID, child ID, depth). This method of storage allows making of all basic operations over a semantic network without noticeable delays for the user of system.

Consider basic operations:

Extracting all hierarchy for concrete user: SELECT * FROM node INNER JOIN closure ON closure.child_id = node.id WHERE closure.user_id = $currUserId

Adding new node to user folder's structure: INSERT INTO closure (user_id, parent_id, child_id, depth) VALUES ($userId, $nodeId, $nodeId, 0); INSERT INTO closure (user_id, parent_id, child_id, depth) SELECT $userId, p.parent_id, c.child_id, (p.depth+c.depth+1) FROM closure p, closure c WHERE p.user_id=$userId AND c.user_id=$userId AND p.child_id=$parentId AND c.parent_id = $nodeId

First query inserts self-closure, the second inserts required closure to all ancestors of new node:

Removing sub tree: DELETE FROM closure WHERE user_id = $userId AND child_id = $nodeId

Move sub tree operation represented by sequential "disconnecting" sub tree from old ancestors and "connecting" to new ancestors.

One weakness of the described method of storage of a hierarchical semantic network in relational system is the increase in excess data when editing hierarchy to other users of program system. At "naive" implementation of the present functionality by copying part of hierarchy from one user to another, the volume of excess data can increase.

To reduce this shortcoming is to de-normalize the closure by adding an additional predicate – a user ID that owns hierarchy node, introducing links between hierarchies of semantic networks of different users. Thus, the relation will look as follows: (user_id, parent_id, child_id, depth, owner_id).

Respectively, when using possibility of opening of access to part of hierarchy to other users of system, users will edit part of hierarchy that is owned by the first user.

In the left part of Figure 1 the hierarchy of the first user who opened access to sub tree node "D" of second user (his semantic network is shown in the right part of figure) is shown. Thus, in a tree of the second user when opening to it access only one additional node which actually is the link to node in other semantic network that provides creation of communications between hierarchical networks of different users and reduction of volume of the duplicated data is added.

A proposed solution is to extract hierarchical structure from database with no more than two SELECT operations:

- Select primary keys of all users, who opened access to hierarchy for given user: SELECT DISTINCT owner_id FROM closure WHERE user_id = $currUserId;
- Select all hierarchy, available to given user: SELECT * FROM node INNER JOIN closure ON closure.child_id = node.id WHERE closure.user_id = $currUserId OR closure.user_id IN ($foreignTreeOwnerIds).

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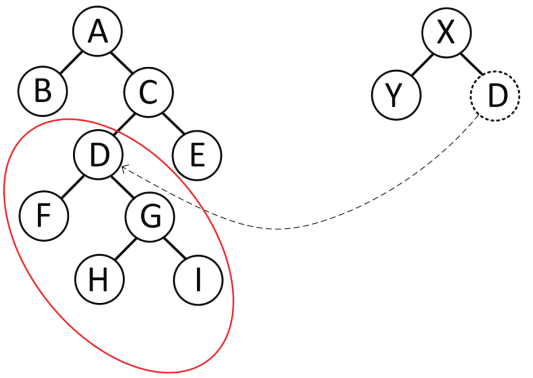
Figure 1. Linking two sematic networks



A Conceptual Model for the Automation of the Planning and Calculation of the Academic Load in the University With the Distributed Structure

Avatar-Based Learning and Teaching (A-BL&T) as a concept of control and managing knowledge considers the process of provision of educational services in a university with a distributed structure. First of all, regardless of the use of the learning technologies, the main regulating document is the training curriculum. This curriculum sets the number of hours for a particular discipline semester. The working program of the discipline determines the format and type of interaction between teachers and students.

Let us consider the n kinds of the interactions between the teacher and student as a part of education process with the distance learning ($i = 1,..,n$). That can be webinars, classes via videoconferences, online and offline student consulting, etc.

The university provides educational services in the several areas of preparation, and each of them has its own curriculum, which number is equal to the p'. The educational process for the each curriculum is carried out a few semesters. The maximum number of semesters in each curriculum is equal to t'. Then the maximum number of semesters and therefore the maximum number of the terminal parts from the set of terminal parts (j) for the disciplines according to the curriculums is equal to $p = p' \cdot t'$ ($j = 1,..,p$). Each curriculum has its own set of disciplines that can be studied a few semesters. At the same time, we assume different the disciplines that have the same name but the different content for the different curriculums.

Let us introduce the following notation. Y – the set of terminal parts for the disciplines from the curriculums in this academic year, p – the number of terminal parts; X – the set of different disciplines, k – their number; T – a set of semesters in the curriculums. We assume the cardinality of T is determined by the longest curriculum $\left|T\right| = 12$.

In terms of this notation curriculum can be modeled as a bipartite graph $K_1(X \cup T, E_1)$, where some vertices (corresponds to the disciplines, that are not a part of the curriculum, as well as semesters семестрам, exceeding the maximum term in the current curriculum) are isolated. We can represent such a model as an adjacency matrix Θ with dimension $k \times 12$:

$$\theta_{ij} = \begin{cases} 0, & if\ i\text{-th discipline isn't implemented in } j\text{-th semester} \\ 1, & if\ \text{i-th discipline is implemented in } j\text{-th semester} \end{cases}$$

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Let us extend this description to the whole set of the curriculums of the university. We construct a binary relation $R_1 \subset X \times Y$, establishing the mapping between the terminal parts and all disciplines of the university in the form of a bipartite graph $K_2(X \cup Y, E_2)$.

We make the weighing of the graph $K_2(X \cup Y, E_2)$ and construct its following submissions:

- Adjacency matrix $\left\|M\right\|_{p\times k}$, that determines the amount of the classroom load of i-th discipline in j-th terminal part from the set of terminal parts;
- Matrix $\left\|D\right\|_{p\times k}$, that determines the amount of the out-of-classroom load of i-th discipline in j-th terminal part from the set of terminal parts;
- Matrix $G = \left\|g\right\|_{p\times k}$, determines the presence of classroom and/or out-of-classroom load of i-th discipline in j-th terminal part from the set of terminal parts:

$$g_{ji} = \left[\frac{m_{ji} + d_{ji}}{m_{ji} + d_{ji} + 1}\right]$$

If the discipline is not present in the current curriculum at all or at the current semester, then $m_{ji} = 0$ and $d_{ji} = 0$.

A variety of high school educational programs and their respective curriculums generates a set of opposite but similar in content subjects. For example, the discipline "Mathematical analysis" may be present in an explicit form in a first curriculum, as the first of four semesters of the discipline "Mathematics" in a second curriculum, and by one of the semesters of the course "Higher Mathematics" in a third curriculum. The content of these disciplines may be similar. This diversity makes it difficult to make the load distribution and provides a strong argument for the unification of the names of the disciplines in the curriculums.

Let us take into account disciplines with the similar content. To the end we define Z – the set of subject areas, that unites the disciplines different by names but similar by content, and that can be grouped into the same thread, and l – their number.

We construct a binary relation $R_2 \subset X \times Z$, establishing the mapping between the disciplines of the university and the subject areas in the form of a bipartite graph $K_3(X \cup Z, E_3)$.

Let us represent such a model as an adjacency matrix $\left\|C\right\|$ with detention $k \times l$:

$$c_{im} = \begin{cases} 0, & if\ i\text{-th discipline isn't apart of } m\text{-th subject area} \\ 1, & if\ i\text{-th discipline is apart of } m\text{-th subject area} \end{cases}$$

For the modeling and optimization of the load distribution of the university faculty, we have to take into account training groups of students. U – The set of training groups of students, and g' – their number. And we know the number of students in each training group.

We construct a binary relation $R_3 \subset Y \times U$, establishing the mapping between the terminal parts and the training groups in the form of a bipartite graph $K_4(Y \cup U, E_4)$.

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We make the weighing of the graph $K_4\left(Y \cup U, E_4\right)$ and build an adjacency matrix $\left\|W\right\|_{p\times g'}$, which determines the planned number of the students in each training group, who studies by j-th terminal part from the set of terminal parts:

$$w_{im} = \begin{cases} 0, & m\text{-th group doesn't study in } j\text{-th semester segment} \\ < num\_of\_students >, & m\text{-th group studies in } j\text{-th semester segment} \end{cases}$$

The planned number of students can be more than the actual amount at the moment of the academic load planning. The increase of the current number of students by a certain percentage for the calculation of the planned contingent allows us to take into account the effect of the student's movement, such as a transfer from other universities or the restoration from the academic leave. The percentage increase may depend on the semester and is based on statistical data of the previous years or on the basis of expert estimations.

Then we can determine the number of students enrolled in a terminal part j:

$$q_j = \sum_{a=1}^{g'} w_{ja}$$

A few threads of students can study on each educational program (union of small groups from several regions). According to the financial reasons, the university is always more advantageous to decrease the number of threads of the same subject area and, consequently, the number of teachers per discipline. In other words, the number of threads for each subject area should converge to 1. However, to maintain the quality of education is not always possible.

Knowing the values of q_j, we can determine a vector $B_M = \left\|b\right\|_l$, where b_i – the minimum number of threads that is necessary for the educational process in *i*-the subject area:

$$b_i = \left\lceil \frac{\sum_{r=1}^{k}\left(c_{ri}\sum_{j=1}^{p}\left(g_{jr}\cdot q_j\right)\right)}{h_{\Rightarrow@\&}} \right\rceil$$

where $h_{\Rightarrow@\&}$ - specification of the number of students in the thread, which can be calculated with the expert estimates based on the number of hours for the contact kind of activities. $h_{\Rightarrow@\&}$ can be the same for the all subject areas or can be set according to features of the educational program (technical, economic, legal, etc.).

Combining groups to the threads should take a place in such a way that the total load of the teaching stuff was minimal, but provided a good quality of education.

Let us make a transition from the calculation of the academic load for the discipline for each training group to the calculation of load for the thread of training groups. We build a matrix that determines classroom load $\left\|M\right\|_{p\times k}$ and matrix $\left\|C\right\|_{k\times l}$ that maps subject areas and disciplines that allow us to obtain a vector of hours for the contact activities $\left\|L\right\|_l$, where the each element corresponds to the maximum value of the classroom load for the disciplines from the same subject area:

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$$l_i = \max_{a\in[1,k],j\in[1,p]} c_{ai} \cdot m_{ja}$$

Out-of-classroom load can be calculated separately for each training group in the thread, or calculated using the values of the total contingent of the thread and the given coefficients.

Then we can define the total teaching staff load of the University for a Semester as:

$$F\left(H_1, H_2, H_3\right) = \mathrm{B}_M{}^T \left(L + H_1\right) + Q^T \left(H_2 \cdot D + H_3\right) \cdot C \cdot \mathrm{B}_D \quad (1)$$

where:

- B_D – the vector, that defines the dependence of the out-of-classroom load from the number of threads for the subject areas (we will consider the vector is unit vector);
- H_1 – the vector, that defines the number of hours to increase classroom load in case of distance education for each subject area;
- H_2 – the diagonal matrix of coefficients, that takes into account the complexity of the control of the individual work of the students;
- H_3 – The matrix $p \times k$, which defines additional hours for the additional control (course project, calculation and graphic work, etc.) for each terminal part.

Methods for the Automation of the Planning and Calculation of the Academic Load in the University With the Distributed Structure

As already noted, the organization of educational process in the university with the distributed structure has the fundamental features and requires a special model of educational process, as well as the model of calculation and optimize academic load and teacher's salary. We should consider all the factors of the education process with open and distance learning and revise approaches to building a plan of educational activities and their participants. Distribution of students by training groups becomes nominal, so the obvious solution for the organization of interaction between students and a teacher is moving from the training groups to the training threads.

To calculate the load we propose to use a system of coefficients that characterize the complexity of each type of the activity that uses the distance learning technologies. Since we should carry out the planning beforehand, we propose to consider the approximate planned contingent of students based on data from previous years and use a correction factor that takes into account possible fluctuations in population due to contributions, transfers and renewals of students.

The coefficient system performs the following important functions for the academic load planning:

1. Selection of the optimal ratio of the volumes of the academic load and its cost;
2. Changing the calculation algorithm with consideration of the changing environmental factors. That is, the possibility of eliminating, uniting or separating into the components of certain activities.

Formula (1) admits the different values in the non-zero positions of the vector H_1 and matrices H_2, H_3. Suppose that the university establishes the uniform values for all subject areas and disciplines in the terminal parts respectively (h_1, h_2, h_3).

Formula (1) allows us to determine a necessary number of the teaching staff at the stage of the planning the training threads and the academic load distribution. We can consider the minimum number of teachers at the departments with the restriction:

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$$F\left(H_1, H_2, H_3\right) \geq h_{min} \tag{2}$$

where h_{min} – the minimum number of the academic hours for the semester in the university.

To support teachers whose disciplines contain a small amount of classroom load and a small contingent we can define requirements:

$$\left(L + H_1 + \left(Q^T \left(H_2 \cdot D + H_3\right) \cdot C\right)^T \geq H_{min}\right) = \left\|1\right\|_l \tag{3}$$

where $H_{min} = h_{minl}$ – the minimum number of the hours for the discipline thread.

We also set the thresholds for H_1, $H_2 \cdot D$ and H_3. $\bar{h}_1$ – the minimum value to increase the classroom load for the thread, $\bar{h}_2$ – the minimum amount of time to check the individual work of the student and $\bar{h}_3$ – the minimum number of hours to do additional control:

$$H_1 \geq \left\|\bar{h}_1\right\| = \left\|1\right\| \tag{4}$$

$$H_2 \cdot D \geq \left\|\bar{h}_2\right\| = \left\|1\right\| \tag{5}$$

$$H_3 \geq \left\|\bar{h}_3\right\| = \left\|1\right\| \tag{6}$$

Thus, the study of the functional (1) for the min with the system of restrictions (2)-(6) enables us to find out the appropriate values $\left(h_1, h_2, h_3\right)$, meet the certain conditions set by the management of the university.

The Methodology for the Automation of the Payroll for the Teachers in the University With the Distributed Structure

Avatar-Based Learning and Teaching (A-BL&T) as a concept of control and managing knowledge in modern socio-economic system considers the teacher's salary calculation. As already described, within the $M = \left\|m\right\|_{p \times k}$ and $D = \left\|d\right\|_{p \times k}$ the teacher uses n kinds of activities with the students, and to each of them correspond the dedicated hours for each subject area. We can describe that by the matrices $V_1 = \left\|v\right\|_{l \times n_1}$ and $V_2 = \left\|v\right\|_{l \times n_2}$, where $n_2 = n - n_1$. The values v_{di} where $d = 1,..,n_1$ – are the activities according to the appropriate contact (classroom) load, and v_{di} where $d = n_1 + 1,\ldots,n$ – are the hours for the out-of-classroom (the control of the individual work of the student, the course project, etc.) interaction for one student.

We can calculate the total hours of the out-of-classroom interaction with the student for each subject area as $V_2 \cdot \left\|1\right\|_{n_2}$.

The university sets the cost of an hour for each kind of activity. That values are described by the vectors-columns $S_1 = \left\|s\right\|_{n_1}$ and $S_2 = \left\|s\right\|_{n_2}$:

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$$S_1 = \begin{pmatrix} s_1 \\ s_2 \\ s_3 \\ \vdots \\ s_{n_1} \end{pmatrix} S_2 = \begin{pmatrix} s_1 \\ s_2 \\ \vdots \\ s_{n_2} \end{pmatrix} \tag{7}$$

To solve the problem of finding the optimal scheme of payment in case of using distance education technologies we will consider the problem (1)-(6) is solved i.e. h_1, h_2 and h_3 are known. The checking of the course projects, the calculation and graphic work, etc. by using the open and distance learning is the same in contrast to the classical way, so in most cases we can evaluate h_3 by the expert and $h_3 = \overline{h}_3$.

Consider the values of V_1 and V_2, we can write the number of hours for the threads in the subject areas for the semester:

$$F\left(V_1, V_2\right) = \mathrm{B}_M{}^T \cdot V_1 \cdot \left\|1\right\|_{n_1} + Q^T \cdot G \cdot C \cdot V_2 \cdot \left\|1\right\|_{n_2} \tag{8}$$

Then, the university should pay the teachers for the classes with using the distance education technologies according to the threads by the subject areas the next values:

$$F\left(V_1, V_2, S_1, S_2\right) = \mathrm{B}_M{}^T \cdot V_1 \cdot S_1 + Q^T \cdot G \cdot C \cdot V_2 \cdot S_2 \tag{9}$$

Let us proceed from the general case (9) to a more individual, but the most commonly used at the universities. Controlling the individual work is the crucial part of the out-of-classroom work. That is $d_{ja} \cdot h_2$ for the one student. The second important thing is the checking of various kinds of writing h_3. They together should be provided by the respected values $v_{(n-1)i}$ and v_{ni} (the restriction (12)). Then $n_1 = n - 2$, and $n_2 = 2$:

$$\overline{V_2} = \begin{pmatrix} v_{211} & v_{212} \\ v_{221} & v_{222} \\ \vdots & \vdots \\ v_{2l1} & v_{2l2} \end{pmatrix}, \overline{S_2} = \begin{pmatrix} s_{212} \\ s_{222} \end{pmatrix} \tag{10}$$

Accordingly, (9) can be written as:

$$F\left(V_1, \overline{V_2}, S_1, \overline{S_2}\right) = \mathrm{B}_M{}^T \cdot V_1 \cdot S_1 + Q^T \cdot G \cdot C \cdot \overline{V_2} \cdot \overline{S_2} \tag{11}$$

With restrictions:

$$\left(Q^T \left(H_2 \cdot D + H_3\right) \cdot C\right)^T \le E_l \cdot C^T \cdot G^T \cdot Q \cdot V_2 \cdot \left\|1\right\|_{n_2} = \left\|1\right\|_l \tag{12}$$

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$$L \le V_1 \cdot \left\| 1 \right\|_{n_1} = \left\| 1 \right\|_l \tag{13}$$

$$F\left(V_1, V_2, S_1, S_2\right) \le M_{max} \tag{14}$$

where M_{max} – the maximum wage fund.

The study of the functional (11) taking into account the constraints (12)-(14) is achieved in practice by the pre-calculating the parameters of the academic load (1)-(6).

In addition, the task can be complicated by the teachers qualification, described by the column vector $A = a_r$:

$$\mathrm{A} = \begin{pmatrix} a_1 \\ a_2 \\ \vdots \\ a_r \end{pmatrix} \tag{15}$$

for each of the r teachers, who is taken into account while paying the contact (classroom) load and not considered for the out-of-classroom load hours, as for that kind of load the assistance and tutors are more appropriate to reduce the cost.

We define the matrix $P = p_{r \times l}$ to map the teacher with the subject areas threads. If the teacher does not have classes for the threads of the i-th subject area in this semester, then $p_{ei} = 0$, else p_{ei} equals to the number of the thread of the given subject area, that are related to the teacher:

$$p_{ei} = \begin{cases} 0, & \text{teacher doesn}'\text{t has classes for the } i\text{-th subject area} \\ \left\langle num\, of\, threads \right\rangle, & \text{teacher has classes for the } i\text{-th subject area} \end{cases} \tag{16}$$

Then (11) will be presented in the form of:

$$F\left(V_1, \overline{V_2}, S_1, \overline{S_2}\right) = \mathrm{A}^T \cdot P \cdot V_1 \cdot S_1 + Q^T \cdot G \cdot C \cdot \overline{V_2} \cdot \overline{S_2} \tag{17}$$

The study (17) to the minimum value with the constraints (12)-(14) allows us to offer the management of the university a variety of the solutions for the problem of finding the coefficients for the wag system. Moreover, the more values of $V_1 = \left\| v \right\|_{l \times n_1}$, $V_2 = \left\| v \right\|_{l \times n_2}$ and $S_1 = \left\| s \right\|_{n_1}$, $S_2 = \left\| s \right\|_{n_2}$ will be given, the easier to determine the optimal values from the given array.

The selection criteria in this problem primarily are the following:

1. Compliance with the total wag fund;
2. Average salary of the teacher in accordance with their qualification;
3. Comparison of the cost of the small and large threads, of the popular and new educational programs.

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FUTURE RESEARCH DIRECTIONS

The Avatar-Based Learning and Teaching (A-BL&T) as a concept of control and managing knowledge in modern socio-economic conditions requires further development to be able to face challengers related with a growing number of users of E-Learning Systems and increasing demands on system performance.

CONCLUSION

The possibility of hierarchical structures persistence with described method opens up great opportunities to e-Learning applications scaling. In this chapter, we proposed and justified a decision of hierarchical semantic network in a relational database storage method. Proposed method allows to build connections between the networks of same type. The presented method is brought to the practical implementation of a software system in the Cloud:

- The main competitive educational advantages are made by the innovations related to the implementation of the new directions and specialties, the changes in the quality of educational services, educational process, the new approaches in the learning process, etc.;
- The factors providing innovations in education should include open education and distance learning technologies. Such techniques based on the principles of the digital economy provide an extended range of learning opportunities. Implementation of distance technologies is effective in terms of macro- and micro-environment changes, in the case of the new industries or technologies that lead, in turn, to the new professions;
- New or changed requirements of future specialists are; the appearance of new segments in the industry - a common incentive for innovation, providing a competitive advantage. Therefore, the development of evidence-based, with the principles of self-organization, educational governance structure, scientific, practical and innovative processes, which effectively functions as an open information and educational space, will ensure the generation of new knowledge and technologies, high competitiveness of students in the labor market;
- Analysis of the processes of planning and accounting of the academic load in the university with the distributed structure showed their complexity and the significant difference from the traditional. We offered the conceptual model for extracting and structuring information about the organization of the educational process in the suck kind of the university. This model is formalized in a set of graph models, allowing mapping the most important objects of the educational process that use the open and distance learning: curriculums, semesters, disciplines, subject areas of training, training groups. This approach allows us to quickly plan and determine the actual academic load as well as to solve the problem of minimizing the financial expenses of the university in the future, while maintaining appropriate quality education;
- The methodology developed for the planning and optimization of the academic load in the university with using the open and distance learning provides the control system factors affecting the overall load distribution structure. The developed model of its calculation (1) - (6), as well as the method of calculation of teacher salary based on the optimum load distribution parameters (12) - (14) allow us to calculate the academic load and its cost both in the current period, and conduct analytical calculations pre-painting costs for the next period. In addition, this method allows us to identify possible wasteful distribution of threads in terms of cost or identify disciplines with an increased cost that can avoid a similar situation in the planning of future periods.

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The Effect of Using Blended Learning Method on Students' Achievement in English and Their Motivation Towards Learning It:

Blended Learning, Achievement, and Motivation

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ABSTRACT

The purpose of this study is to investigate the effect of using a blended learning method on ninth grade students' achievements in English and their motivation towards learning it. The sample consisted of 100 female students selected purposefully and distributed into two groups: experimental and control. The experimental group studied English through a computerized program in the traditional method, while the control group was taught by the traditional method only. The results revealed statistically significant differences between the two groups in favor of the experimental group both in the achievement and the motivation towards learning English. The researchers recommended using computerized teaching in addition to the traditional method due to the positive results shown by the current study. In addition, they recommended conducting studies that measure the effect of blended learning on some aspects related to English language such as: vocabulary, spelling, pronunciation, or any other aspects.

KEYWORDS

Academic Achievement, Blended Learning, E-Learning, Motivation Towards Learning English

INTRODUCTION

Integrating technology in most aspects of modern life has become a crucial issue that requires substantial and radical changes in every field especially in the field of education. Therefore, it is necessary to keep up with technological developments to cope with the problems that may arise as corollaries, such as large amounts of information, increase in the number of learners, shortage of teachers and long distances. Such developments have led to the need for many methods for teaching and learning, especially with the advent of the modern revolution in information technology, which has made the world a small village with a greater need for sharing experiences with others and providing

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learners with multivendor rich environments in research and self-development. As a result, a lot of styles, methods and new ways of teaching and learning, including the appearance of e-learning and blended learning, have emerged (Tayebinki and Puteh, 2012).

There is no doubt that the e-learning approach has remarkable advantages as many scholars have concluded (e.g. Arsham, 1995; Codone, 2001; Pollard and Hillage, 2001; Wagner and Kozma, 2005; Naidu, 2006; Alshetwi, 2014; Arkorful and Abaidoo, 2014). As one of the best learning methods at hand, it helps in finding solutions for knowledge explosion and the increasing demand for education (Alshetwi, 2014). Nonetheless, other scholars have found that the e-learning approach involves some disadvantages and shortcomings. O'Donoghue et al. (2004) and Nedeva et al. (2010) have asserted that e-learning students lack the sense of community and feel somehow isolated because of the scarcity of interpersonal communication skills with their peers and teachers through awareness of how they can make this possible. More disadvantages have been pointed out by Lewis (2000), Dowling et al. (2003) and Hameed et al. (2008).

Findings concerning the negative aspect of the e-learning approach did pave the way for the emergence of the blended teaching method. Yılmaz and Orhan (2010) said that the ideal method to solve the inadequacy of interaction problem confronted in technology-based learning is to blend traditional learning and online learning to benefit from the advantages of both. Graham (2006:1) defined blended learning as "a combination of instruction from two historically separate models of teaching and learning: traditional face-to-face learning systems and computer-mediated learning".

Blended learning is of a great benefit since it gives students access to global networks and shifts the role of the teacher more into a facilitator and mentor in an environment that enables learning groups to use multimedia, e-mails, virtual libraries, and all internet data collaborative software. Besides, it allows learners to listen, feel, see, think about and interact with the learning materials. It helps them to practice what they learn and not to depend only on theoretical knowledge (Fakhir, 2015). Learners can gain more confidence, responsibility and creativity since the class becomes more student-centered rather than teacher-centered (Al Fiky, 2011). They can learn at their own speed, which creates the chance for more individualized education (Bailey and Martin, 2013) and they can learn from different real-life resources which can provide them with more authentic information (Chen and Jones, 2007).

As for the learning motivation, Gardner (1985, p. 10) defined it in a second or foreign language learning environment as "the extent to which the individual works or strives to learn the language because of a desire to do so and the satisfaction experienced in the language learning activity". It is a key factor in the teaching-learning process. When students are appropriately motivated, a better understanding of the material is gained and a higher achievement is attained (Fisher and Baird, 2005). Indeed, there is an interrelationship between motivation and achievement since motivation can influence how we learn and what we learn. (Schunk, 1995). Research reveals that motivated learners can perform challenging activities, as well as enjoy and adopt a deep approach to learning (Schunk et al., 2008).

Poon (2013) noted that blended learning motivates students and makes them satisfied, as teachers can create an online environment that enhances self-confidence, autonomy and reflection. Besides, they can vary their learning materials that suit students' different levels and needs (Huang et al., 2006). Moreover, they can reduce students' feelings of isolation, provide them with continuous feedback and encourage interaction between them and their students and among students themselves. Such condition can enhance motivation, which in turn may positively affect achievement. This is in line with Clayton et al. (2010) who asserted that learners prefer a more engaging learning environment in which they can have direct interaction with teachers and other learners.

This study's purpose is to investigate the effectiveness of blended learning (as a new experience in Jordan) on students' achievement in English and their motivation towards learning it.

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PROBLEM AND SIGNIFICANCE OF THE STUDY

The problem of this study stems from the need to vary the teaching methods used in the field of English language learning, to develop the educational process used and to provide better learning and satisfactory outputs. As a result, it is worthwhile to find various modern teaching methods that help students to learn in an appropriate way in order to "produce graduates with the skills and competencies required to participate in the modern world in the 21st century" (Jordanian Ministry of Education, 2003). Besides, the problem stems from the need to evaluate the EFL educational institutions' plans and programs in blended learning and computerization of the English curriculum in order to identify its pros, support it and avoid the cons by knowing their causes. This will help to recruit efforts and resources in a way to achieve the real goals of educational programs.

Thus, the study tries to examine the following hypotheses:

Hypothesis One: There are statistically significant differences at the level of significance ($\alpha = 0.05$) in ninth grade students' achievement in English as a foreign language attributed to the method of teaching (blended learning method, traditional method) in favor of the blended learning method.

Hypothesis Two: There are statistically significant differences at the level of significance ($\alpha = 0.05$) in ninth grade students' motivation toward learning English attributed to the method of teaching (blended learning method, traditional method) in favor of the blended learning method.

The significance of this study stems from the fact that it provides clear insights into the field of using technology in the educational process to encourage policy makers to adopt blended learning as an effective way that may enhance the quality of English learning and teaching process in EFL contexts taking Jordan as an example. Besides, this study may encourage policy makers to conduct effective training programs for teachers to enable them to use the suitable techniques of blended leaning in order to develop students' English competencies. In addition, this study may provide deeper insights into students' motivation towards using technology for learning English. Furthermore, the findings can be used as a reference for other scholars to conduct more research. Finally, this study is hoped to reveal the real impact of blended learning on students' achievement in English so that the findings may enrich the area of blended learning in general.

However, the generalization of the results of this study is limited to the computerized educational program of Aim High curriculum published by Oxford University Press. Also, it is limited to Jordanian ninth grade female students studying English in the second semester of the academic year 2016 / 2017.

LITERATURE REVIEW

Much research has been conducted on the blended learning approach and reached conclusions that underline its efficiency. Fakhir (2015) investigated the effect of using blended learning on Jordanian sixth grade students' achievement in English and their attitudes towards it. The sample consists of 50 students divided into two groups: 25 who received blended learning teaching, while the other half were taught using the traditional method. The sample was selected from two schools in Amman. The results showed statistically significant differences in students' achievements and attitudes in favor of the experimental group who was taught by using blended learning.

Ceylan and Kesici (2017) investigated the effects of blended learning on the middle school students' academic achievement level and product evaluation scores. The sample consisted of 53 students of both experimental and control group in the 6th grade classrooms during the 2014/2015 in Turkey. The blended learning method was supported by using technology and a software course. Their results showed that blended learning environment had effectuated a major difference in students' academic achievement on behalf of experimental group.

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Similar field studies were later published, most recent of which is Oweis (2018), who conducted a pilot case study to find out the effect of blended learning on the achievement of German Jordanian University students in English and their motivation to learn it. Thirty-four students were selected purposefully and divided into an experimental and a control group, for the pilot study before implementing it on a large-scale sample. The results showed that the experimental group, taught by the blended method using computer-based teaching, performed better than the control group, who was subjected to the traditional method, and that the experimental group's motivation to learn English was better.

However, Cracraft (2015) studied the effect of blended learning on students' success rate as compared to the traditional way of teaching. This study aimed at finding out if students' achievement improved when using blended learning in their daily classroom practices. The results of the t-test showed that there was no significant change in students' achievement whether they were taught by the traditional model or the blended one.

Besides, Tosun (2015) studied the effect of blended learning on EFL students' vocabulary knowledge. Forty intermediate level students who studied intensive English at METU prep-school in Turkey participated in the study. Twenty of them formed the experimental group who studied the target vocabulary items through blended learning strategies while the other 20 (control group) learned the same vocabulary items through the traditional way of teaching. The results showed that blended learning, compared to the traditional method, did not improve the students' achievement in vocabulary.

Moreover, Wong et al. (2018) found that there was no obvious difference in students' academic achievement when the blended approach had been used, but they stressed its positive effects on both learner autonomy and students' motivation compared to the traditional approach. Their research implied that blended learning is suitable for secondary school English classes if accompanied by sufficient monetary, equipment and technical supports.

One can notice that, in general, some of the studies in the literature encouraged the use of blended learning over the traditional one. However, other studies revealed that blended learning did not improve students' achievement when compared with the traditional method. Thus, what distinguishes the present study is that blended learning is a new experience in the Jordanian environment (as an example of EFL context) that deserves to be thoroughly investigated. The goal is to find out the effectiveness of using it in the classroom to reveal if it can be implemented to improve students' level in English, provide them with the required competencies to participate in the world of technology and enhance their motivation towards learning English since not all related studies agreed upon the efficiency of blended learning in enhancing students' performance.

DESIGN AND METHODOLOGY

Research Design

This study followed the quasi experimental method to measure the impact of blended learning method on ninth grade students' achievement in English and their motivation towards learning it. This study includes one independent variable, and two dependent variables.

Independent Variables

The independent variable in this study is the method of teaching with two levels:

- Method of teaching using blended learning
- Traditional way of teaching

Dependent Variables:

- Achievement in English
- Motivation towards learning English

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The following symbols denote the procedures to be followed for a set of two groups:

(Experimental) R G1 O1 X1 O2
(Control) R G2 O3 X2 O4

The symbols (G1 and G2) represent the two groups. The letter (R) refers to the random distribution of the groups. The symbols (O1 and O3) state that pre- achievement (Students' total achievement at the end of the first semester) and pre-motivation were conducted. Next, the students were exposed to the two treatments as denoted by (X1: using blended learning in teaching and X2: using traditional method in teaching). Post- Achievement (Students' total achievement at the end of the second semester) and post- motivation were held as denoted by the symbols (O2 and O4).

STUDY POPULATION

The population of this study comprised all female ninth grade primary students (n = 2263) enrolled in the Irbid educational directorate in Irbid Governorate in the first semester for the 2016/2017 academic year. There are 37 primary schools in the Irbid educational directorate. In order to implement this study in a naturalistic school setting, existing intact classes were used (O'deh and Malkawi, 1992).

Students are from different towns within the Irbid Education Directorate. The population of this study is representative of almost all the existing social classes in Jordan in terms of gender, age, nationality and native language. They are homogenous in terms of their nationality, mother tongue (Arabic), exposure to English as a foreign language, educational system and cultural background. Pupils in the selected schools – as well as all Irbid Government schools - were from approximately equivalent socioeconomic status as defined by the Ministry of Education of Jordan.

STUDY SAMPLE

The study sample consisted of all female ninth grade students at two schools. They were selected in the random way. The sample of the study consisted of 100 female students of English divided into two treatments in a random way. The first treatment was taught through the blended learning method and the second treatment was taught through the traditional method.

To verify the equivalence between the two groups in terms of achievement, means and standard deviations of female students' total scores in English language obtained at the end of the first semester 2016/2017 were calculated according to group variable (experimental and control). To illustrate the statistical differences between the two groups, a t-test was implemented. The results showed that there were no statistically significant differences between them since t-value was 0.905 with a significance of 0.374.

Besides, to verify the equivalence between the two groups in terms of motivation, means and standard deviations of female students' motivation towards learning English, before using blended learning as a teaching method, were calculated for both groups (experimental, control). To illustrate the statistical differences between the two groups, a t-test was used. The results showed that there were no statistically significant differences since t-value was 0.88 with a significance of 0.931.

STUDY INSTRUMENT

Motivation Scale

This scale is used to measure the learning motivation of ninth grade primary students; it consists of 16 items. These items were rated using a 5-point Likert scale with the following anchors: 1 = Strongly Agree; 2 = Agree; 3 = Neutral; 4 = Disagree; and 5 = Strongly Disagree. This instrument is adopted

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and adapted from Aldalalah et al. (2015). The instrument is designed in the Arabic language and translated into English (see Appendix). The total score of the Motivation scale is 80.

Instrument Validity consists of two different aspects, that is face and content validity. According to Gay and Airasian (2000), face validity relates to the degree to which a test appears to measure what it claims to measure, and Content validity refers to the degree to which a test measures an intended content area. Face validity was judged by an education list panel of experts. The feedback and comments received from them were employed to establish the necessary clarifications, changes, and modifications before and after piloting the study.

The pilot study consisted of 31 participants. The researchers used Test-Retest to check the reliability of the instrument. The reliability coefficient of this instrument was computed by the implementation of Cronbach Alpha whereby it was 0.82 for the whole scale. The internal consistency in this instrument was 0.91.

A General Overview of the Curriculum Software Adopted for Blended Learning Program Used at One of the Two Schools

The control group was taught traditionally using Aim High curriculum. On the other hand, the experimental one was taught by using the digital version of the same curriculum in addition to the traditional way of teaching (blended learning program). The digital version of Aim High is a six-level curriculum published by Oxford University press. It is oriented to non-native students of English around the world. The school had adopted level 3 for grade 9. The book develops English language in use and works on many levels: vocabulary, reading, writing and speaking. It has a dictionary corner with a specialized version of a digital dictionary, which focuses on the diction used in the book. Texts found in the book cover a wide variety of subjects in different fields and from all over the world and include the essential study skills. The iTools digital material adds vivid atmosphere to class teaching, especially with schools depending on smart boards. iTools include the students' book and the workbook material, with the ability to write, highlight, listen and fill with key answers. Level 3 comes with a CD to extend vocabulary knowledge with idioms, expressions, phrasal verbs, grammar practice and everyday English. These practices are provided by learning through fun games. Level 3 has an online practice that saves time for student preparation and presentation. It also provides additional homework activities that enable teachers to mark and track automatically. Revision and self -assessment sections help students to pass exams in addition to an extensive testing material.

PROCEDURES OF THE STUDY

The study was applied according to the following procedures:

- Obtaining the approval of the school principal and the teachers who will apply the study. The researchers talked with them about the study, its objectives, and its importance in order to provide the necessary facilities to conduct the study especially that the period of the application of the study needed a whole semester;
- Training teachers: Prior to the beginning of this study, the teachers assigned to the experimental group participated in three days of training sessions that focused on education issues regarding English teaching. The teachers were informed that they would be part of an experiment in which new instructional methods will be tested. They worked with the new methods and learned how to use them with their students. In the present study, the focus was on the "English". The teachers were trained explicitly about using blended learning in the teaching of English. They were exposed to how to use the computerized materials and train students to use them in their learning. The procedures of selecting groups and assigning group members were explained to the teachers.

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The researchers met the teachers for feedback and assessment regarding the application of the teaching method;

- Dividing the study sample randomly into two groups: the experimental group and the control group;
- Calculating students' total scores in English at the end of the first semester to verify the equivalence between the experimental and control groups;
- Teaching the experimental group using the blended learning material at the beginning of the second semester 2016 / 2017. Blended learning was performed in multiple ways since it is flexible. Yet, it focused on the individuality of students' needs as well as teachers' sufficiency. The blended learning group was taught using three approaches: Station Rotation, Whole Group Rotation and Flipped Classroom, as recommended by the training sessions given to teachers after approving the curriculum. In Station Rotation, teachers divided the classroom into small groups; each group was given a specific task, in which they were all attached to the main topic of the module which could meet students' needs. Through this method, students utilized technology in performing the tasks. On the other hand, Whole Group Rotation method allowed students to perform one task at a time as a whole group. The third technique used in teaching was the Flipped Classroom. In it, students were shown special designed materials, iTools, such as videos, power point presentation or texts that sometimes were accompanied by pictures. They were asked to give certain responses or perform tasks depending on the material given to them, such as using selected vocabularies, grammar or writing; the responses were delivered via the internet;
- Teaching the control group the regular educational material (textbook) using the traditional method. The traditional way of teaching depended mainly on the teachers' efforts to deliver the information needed to the students. Teachers used whiteboards, cassettes for listening comprehension and worksheets for grammar. The only resources used were the teacher's book, student's book and the workbook. Any extra activities teachers used also depended on the exercises given at the end of each unit or book. Group work was performed to encourage students to participate more confidently in the process of learning;
- After the completion of the teaching process for the experimental and control groups, students' total scores in English at the end of the second semester were calculated and the motivation scale was applied to find out the effect of blended learning in comparison with the traditional method;
- Analyzing the results and drawing conclusions in light of the hypotheses of the study.

RESULTS OF THE STUDY

The statistical analysis was done by using SPSS software.

Results Achieved in English

The first hypothesis was the following: H1. There are statistically significant differences at the level of significance (α=0.05) in ninth grade students' achievement in English language attributed to the teaching method (blended learning method, traditional method) in favor of the blended method.

To examine this hypothesis, means, standard deviations and t-test for female students' total scores in the English language were calculated according to group variable (experimental and control). The control group learned English through the traditional teaching method while the experimental one learned English via blended learning. The results are shown in Table 1.

Table 1 shows that there is a statistically significant difference at ($\alpha = 0.05$) between the means of the female ninth- grade students' final total scores in English attributed to group variable in favor of the experimental group. The mean of the experimental group was (158.24), compared to the mean (121.20) for students in the control group. This indicates the positive effect of using blended learning on the achievement of female ninth grade students compared to the achievement of those who learned English through the traditional method. This result is further illustrated in Figure 1.

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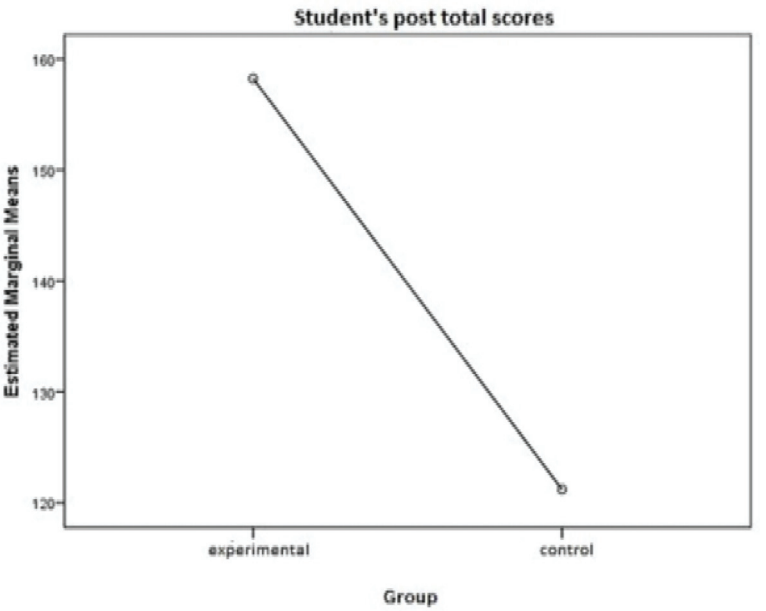
Table 1. Means, standard deviations and t-test for female students' total scores in English obtained at the end of the first semester 2016/2017 according to group variable (experimental and control)

Students' Post Total Scores						
Group	**Number**	**Means**	**Standard Deviation**	**T Value**	**Degrees of Freedom**	**Significance**
Control	50	121.20	30.960	5.86	98	0.00*
Experimental	50	158.24	34.103			

* Statistically significant at (α = 0.05)

Figure 1. Experimental and control groups' total achievement at the end of the second semester 2016/2017



Results of the Students' Motivation Towards Learning English

The second hypothesis was the following: There are statistically significant differences at the level of significance (α =0.05) in ninth grade students' motivation toward learning English attributed to the teaching method (blended learning method, traditional method) in favor of the blended method.

To examine this hypothesis, means and standard deviations of the 9th grade students' motivation towards the English language were extracted according to the variable of the teaching method (blended learning vs. traditional way of teaching). To illustrate the statistical differences between the means, the t-test was used. Table 2 illustrates the results.

Table 2 shows statistically significant differences (α = 0.05) in means of the 9th grade students' motivation towards English language learning according to the variable of the method (blended learning or traditional education) with a value of 2.265 and a statistical significance of 0.032. Differences are in favor of blended learning.

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Table 2. Means, standard deviations and t-test for 9th grade students' motivation toward the English language according to group variable

Method	Number	Means	Standard Deviation	T Value	Degrees of Freedom	Significance
Blended	50	4.48	. 40	2.265	26	.032
Traditional	50	3.97	. 74			

DISCUSSION OF RESULTS

Discussion of Results Achieved in English

In fact, students' achievement was measured in two ways: modern assessment strategies and traditional way. The modern assessment included group-work assessment, in which students were asked to form groups of different educational levels; weak, intermediate and strong, to perform a particular task such as explaining a text or answering questions or even extracting a grammatical rule. Additionally, experimental methods were used, such as direct interaction in situations. For example, students were asked to work in supermarkets and deal with customers to improve their language proficiency, went to historical places in Jordan such as Jerash and Petra to communicate with tourists after preparing historical background information about the visited area. They even conducted debates on different subjects such as electing a candidate to represent the class. The traditional way included paper and pen-based exams with various types of questions: multiple choice, true or false, short or essay questions, and oral exams. In this study, the experimental group who was taught via the blended learning method had higher total scores than the control one.

The previous result can be attributed to the implementation of a new method of teaching that led to an increase in students' understanding and absorption of the content of the material given. Students could use Power Point presentation or specialized websites to visualize the materials they wanted to learn. Consequently, a connection could be created between the theoretical and the practical components, and this, successively, made the learning process easier and more accepted. This result is in line with findings by Fakhir (2015) who advocated using Power Point slides and data show as instructional materials in the blended learning approach so that students can practice what they learn.

Blended learning is an integrated method of teaching that employs the educational techniques without forgetting the role of the teacher, and this facilitates the way students acquire knowledge by themselves, enabling them to understand better the complexities of language since they can learn what they want when they want. They could master much better the rules of grammar and vocabulary of English. Past studies (e.g. Al Fiky, 2011) also agreed with the previous point and showed that blended learning enables learners to learn freely since the educational process becomes more student-centered. In addition, this method, with its interesting content, contributed to the improvement of the educational environment, which led to increased motivation of students towards learning, and thus enabled students to interact, deal with and assimilate the information and concepts contained in the educational content.

Moreover, the nature of the interaction between the learner and the computer may affect students' achievement since they may receive consistent feedback and encouragement if their answers are right. Besides, the computer asks them to repeat and try again if their answers are wrong. Such repetition may consolidate the correct answer in the student's memory and enable them to gain an understanding of what they need when they need it. This idea is in line with what Al Fiky (2011) concluded about the valuable feedback offered in the blended learning approach. Furthermore, students can interact with other students from all over the world to discuss English topics that suit their background knowledge, their learning styles and their interests, thereby enhancing their communicative skills. Many studies in the related literature, such as Yılmaz

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and Orhan (2010) and Fakhir (2015) confirmed this finding. Indeed, students can benefit from both the advantages of the traditional classroom and those of the computer programs in blended learning which will be reflected positively on their achievement. In the related literature, many studies are in line with this study and have proved the efficiency of blended learning in enhancing students' achievement (e.g. Yılmaz and Orhan, 2010; Fakhir, 2015; Ceylan and Kesici, 2017; Oweis, 2018). On the other hand, other studies had an opposing point of view (for example, Cracraft, 2015; Tosun, 2015; Wong et al., 2018). This may be attributed to the differences in the characteristics of the sample, in the facilities and the different techniques used and the ways followed in applying the blended method in the different classes.

Discussion of the Results of the Students' Motivation Towards Learning English

The results of the statistical analysis showed that there was a statistically significant difference at the level of ($\alpha = 0.05$) in the ninth-grade students' motivation toward learning English in favor the students of the experimental group who received the blended learning method of teaching. The previous finding may be due to the computer's high potential in providing information. Besides, the designs of the computer-based materials are attractive and motivating for students. The availability of color, music, photos, drawings and sound, exceed the fixed drawings in the book and make learning more enjoyable. Blended learning mixed fun with learning provide opportunities for students to meet their needs, by taking into consideration their individual differences. The same conclusion was also indicated by Oweis (2018) who talked about the nature of the computerized material and how it may affect students' motivation positively.

The previous result relates the increase in students' motivation towards learning English to the style in which it was displayed and which raises students' attention and enthusiasm. This is in addition to the reinforcement provided through the computer, which has had a good and efficient effect on the student's self, and which differed from the reinforcement provided by the teacher, which was offered through only pronouncing known and familiar words to the student, as teachers provide direct feedback after the exercise. All what was mentioned above may have increased students' motivation towards learning through the computer. Besides, the previous output may be accredited to the uncommon innovative element in providing computerized English language lessons, for the new methods are usually thought to be interesting and boost motivation.

In fact, most computer programs aim at increasing the internal motivation of the students, due to the presence of many factors in the task they perform. Considering this type of teaching method as satisfying and enjoyable for students, it worth noticing that external motivation is weaker and less lasting than the internal one. Students who are enhanced internally perform their duties and learn classroom materials in an appropriate way (Ormrod, 1998). This is fostered by the fact that the computerized material contains, as mentioned above, the attractive elements of colors, images, sounds, movements, and many other things that increase students' motivation towards learning English language. This result is supported by Oshea and Self (1983), who showed that animated attractive visual images provided by the computer enhance the internal motivation of students. As is clear, internal motivation provides students with the strongest power to develop themselves and learn in an adequate way.

Although the related studies didn't all agree upon the efficiency of blended learning in enhancing students' achievement, some of them asserted its efficiency in enhancing students' motivation but not achievement. For example, Wong et al. (2018) pointed out that blended learning did not promote students' achievement but had positive effects on students' motivation towards learning English. This may be attributed to the interesting and enjoyable way of showing the educational content of the blended learning materials which enhances and attracts students' attention.

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CONCLUSION

Changes are inevitable nowadays since we live in the world of technology. Thus, policy makers try to exert efficient efforts to improve the quality of learning at educational institutions. In fact, blended learning is a new method that enables students to benefit from both the teacher and the computer since it is a combination of traditional learning and e-learning. This study has clearly shown that blended learning positively affects students' achievement in English and increases their motivation towards learning it. Blended learning engages students in the learning process since teachers play the role of facilitators, in contrast to the traditional method where teachers are the cornerstone and students are most of the time passive recipients. Moreover, it provides students with different types of activities that suit their different styles. In fact, it is important because it enhances students' self-confidence and makes them responsible for their own learning since they are able to search in many electronic sources or ask their teachers when they need help. Besides, it enhances students' internal motivation (because of the interesting, enjoyable and attractive nature of the computerized material), which is one of the major secrets that leads to great outcomes in the educational process. It comes from the inner self, and from the needs and desires of students themselves. So, policy makers need to provide students with what feed into their motivation. Therefore, it is beneficial to adopt blended learning in EFL classrooms.

RECOMMENDATIONS

In light of the previous findings, the researchers recommend the following:

1. Supplying schools with more facilities and techniques that may contribute in enhancing the blended learning experience;
2. Reorganizing the educational content of the curricula in order to be in harmony with the requirements of the blended learning;
3. Conducting similar studies that measure the effect of blended learning on some aspects related to English learning such as vocabulary, spelling, and pronunciation;
4. Conducting more studies on other class samples and other variables such as students' or teachers' attitudes towards blended learning;
5. Conducting intensive training for English language teachers on implementing the blended learning method to enhance their information technology skills.

Pedagogical Implications

1. Teachers need to use a variety of strategies, methods and techniques while implementing the blended learning approach to increase students' enthusiasm and avoid making them feel bored such as visual and auditory aids: films, pictures, songs. Group work as a whole class and smaller communities within the class can also be used, in addition to face-to-face interaction and internet-based interaction;
2. The blended learning should not be used only for teaching English but must be implemented in other classes such as Science, Math and Social Sciences;
3. Educational aids found on the network websites (e.g. You Tube, Wikipedia and Electronic Dictionaries) and used in this study must be used to help students understand the educational content and encourage their self-learning abilities.

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APPENDIX

Motivation scale

No.	Item	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1.	Learning English is not difficult					
2.	I learn English because I like it					
3.	Speaking English encourages other people to respect me					
4.	knowing English enhances my feeling of success					
5.	Learning English develops my general knowledge					
6.	Learning English enhances my self-confidence					
7.	Speaking English enables me to communicate with people from other cultures					
8.	I find English as an interesting subject					
9.	I would like to study English courses at the university in the future					
10.	Knowing English helps me to get better jobs in the future					
11.	Knowing English makes me an educated person					
12.	I don't mind to study English in my free time					
13.	Knowing English helps me to continue my studying abroad in the future					
14.	Learning English helps me to cope with the current changes in the world					
15.	Knowing English enhances my self –satisfaction					
16.	Learning English gives me a Positive sense of challenge					

Dr. Dima Ali Hijazi, corresponding author, has been working at Yarmouk University in the Language Center since 2010. She has got her MA in 2006 and her PhD in 2010 from Yarmouk University. Both degrees are in English language curriculum and instruction. Since 2010, she has been working as an assistant professor. She has published 9 research papers in international journals. Her fields of interest are: English language pedagogies, teaching English as a second/foreign language, English teacher education and training programs and English pragmatics.

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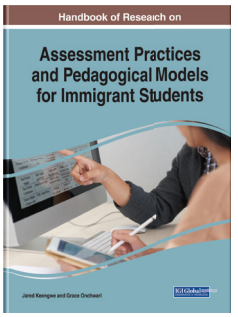

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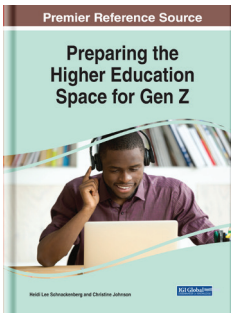

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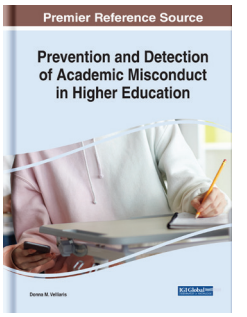

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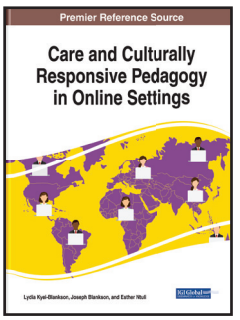

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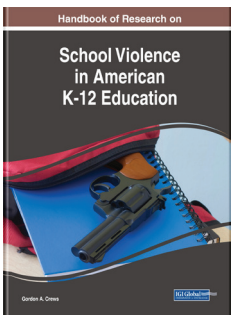

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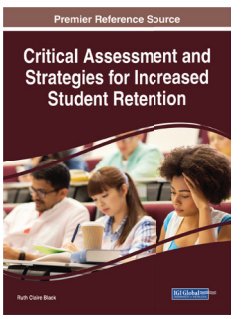

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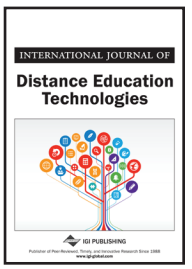

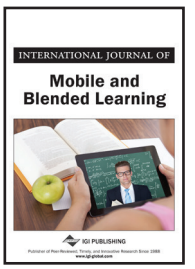

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IGI Global's Transformative Open Access (OA) Model:

How to Turn Your University Library's Database Acquisitions Into a Source of OA Funding

In response to the OA movement and well in advance of Plan S, IGI Global, early last year, unveiled their OA Fee Waiver (Offset Model) Initiative.

Under this initiative, librarians who invest in IGI Global's InfoSci-Books (5,300+ reference books) and/or InfoSci-Journals (185+ scholarly journals) databases will be able to subsidize their patron's OA article processing charges (APC) when their work is submitted and accepted (after the peer review process) into an IGI Global journal.*

How Does it Work?

1. When a library subscribes or perpetually purchases IGI Global's InfoSci-Databases including InfoSci-Books (5,300+ e-books), InfoSci-Journals (185+ e-journals), and/or their discipline/subject-focused subsets, IGI Global will match the library's investment with a fund of equal value to go toward subsidizing the OA article processing charges (APCs) for their patrons.

   Researchers: Be sure to recommend the InfoSci-Books and InfoSci-Journals to take advantage of this initiative.
2. When a student, faculty, or staff member submits a paper and it is accepted (following the peer review) into one of IGI Global's 185+ scholarly journals, the author will have the option to have their paper published under a traditional publishing model or as OA.
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4. This fund will be offered on an annual basis and will renew as the subscription is renewed for each year thereafter. IGI Global will manage the fund and award the APC waivers unless the librarian has a preference as to how the funds should be managed.

Hear From the Experts on This Initiative:

"I'm very happy to have been able to make one of my recent research contributions, 'Visualizing the Social Media Conversations of a National Information Technology Professional Association' featured in the *International Journal of Human Capital and Information Technology Professionals*, freely available along with having access to the valuable resources found within IGI Global's InfoSci-Journals database."

– **Prof. Stuart Palmer**,
Deakin University, Australia

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