eL&mL 2011

The Third International Conference on Mobile, Hybrid, and On-line Learning

February 23-28, 2011 - Gosier

Guadeloupe, France

eL&mL 2011 Editors

Göran Karlsson, KTH, Sweden

Dumitru Dan Burdescu, University of Craiova, Romania

Bernd Krämer, FernUniversität in Hagen, Germany

eL&mL 2011

Foreword

The Third International Conference on Mobile, Hybrid, and On-line Learning [eL&mL 2011], held between February 23-28, 2011 in Gosier, Guadeloupe, France, continued bringing together federated views on mobileLearning, hybridLearning, and on-lineLearning. eL&mL 2011 was dedicated to educators, eLearning experts, and students to exchange their ideas, experiences and lessons learnt in different facets of modern learning.

eLearning refers to on-line learning delivered over the World Wide Web via the public Internet or the private, corporate intranet. The conference was intended to provide an overview of technologies, approaches, and trends that are happening right now. The constraints of e-learning are diminishing and options are increasing as the Web becomes increasingly easy to use and the technology becomes better and less expensive.

As the ease of execution increases, more and more institutions are discovering the benefits of delivering training via the Web. Interest in e-learning is at an all-time high, and the workshop served as a stimulus to accelerate collaboration and dialog among the e-learning providers, trainers, IT researchers and the lifelong, self-directed learners. Such business trends as an increased global economy, the pressures for rapid development, and the necessity of teamwork are shaping the present state and the future of eLearning.

Employees are increasingly aware that they must continue to update and advance their skills if they want to understand the state-of-the-art technologies and remain valuable to their organizations. This means that learners will be more and more self-directed, and they will want access to what they need when they need it. The Internet based educational materials and the e-learning providers have to meet this demand.

The conference focused on the latest trends in e-learning and also on the latest IT technology alternatives that are poised to become mainstream strategies in the near future and will influence the e-learning environment. Ubiquitous systems proliferate quickly due to the latest achievements in the industry of telecommunications, electronics, wireless, and economical globalization.

Wireless and mobility allow any user to timely use resources using various access technologies under (assumed) secured and guaranteed privacy. The family of mobile devices expand dramatically, allowing a user to have a portable office everywhere, every time. Mobile learning became a fact, due to the technical accessibility and Internet communications. Many online classes, learning systems, university curricula, remote education, and virtual training classes are now part of the corporate education and use.

Progress is made in user modeling and adaptive learning models. The generalization of successful practices on mobile learning is favored by many national and international projects and policy synchronization boards. Adaptation implies also the use of the classical methods, still in use and useful in some contexts and for some categories of users. Hybrid learning is an increasing trend in education today. The traditional classroom learning has been historically proven beneficial. Hybrid learning is rather a series of different learning strategies going from teacher-centric to student-centric. This

improves the critical thinking, creativity, self-management, self-study, and advance problem solving thinking of the student.

We take here the opportunity to warmly thank all the members of the eL&mL 2011 Technical Program Committee, as well as the numerous reviewers. The creation of such a broad and high quality conference program would not have been possible without their involvement. We also kindly thank all the authors who dedicated much of their time and efforts to contribute to eL&mL 2011. We truly believe that, thanks to all these efforts, the final conference program consisted of top quality contributions.

Also, this event could not have been a reality without the support of many individuals, organizations, and sponsors. We are grateful to the members of the eL&mL 2011 organizing committee for their help in handling the logistics and for their work to make this professional meeting a success.

We hope that eL&mL 2011 was a successful international forum for the exchange of ideas and results between academia and industry and for the promotion of progress in the areas of mobile, hybrid and on-line learning.

We are convinced that the participants found the event useful and communications very open. We also hope the attendees enjoyed the beautiful surroundings of Gosier, Guadeloupe, France.

eL&mL 2011 Chairs

Herwig Mannaert, University of Antwerp, Belgium
Masaya Okada, Shizuoka University, Japan
Elliot Soloway, University of Michigan Ann Arbor, USA
Göran Karlsson, KTH, Sweden
Dumitru Dan Burdescu, University of Craiova, Romania
Adam M. Gadomski, ECONA, Italy
Bernd Krämer, FernUniversität in Hagen, Germany

eL&mL 2011

Committee

eL&mL Advisory Committee

Herwig Mannaert, University of Antwerp, Belgium
Masaya Okada, Shizuoka University, Japan
Elliot Soloway, University of Michigan Ann Arbor, USA
Göran Karlsson, KTH, Sweden
Dumitru Dan Burdescu, University of Craiova, Romania
Adam M. Gadomski, ECONA, Italy
Bernd Krämer, FernUniversität in Hagen, Germany

eL&mL 2011 Technical Program Committee

Luis Alberto Álvarez-González, Universidad Austral de Chile - Valdivia, Chile
Trish Andrew, The University of Queensland-Brisbane, Australia
Theodoros N. Arvanitis, The University of Birmingham, UK
Ilham Benyahia, Université du Québec en Outaouais, Canada
Werner Beuschel, University of California, Irvine (visiting), USA
Christos Bouras, University of Patras, Greece
Maria Helena Braz, DECIVIL/ICIST - IST, Technical University of Lisbon, Portugal
Carsten Brockmann, University of Potsdam, Germany
Julien Broisin, IRIT, France
Dumitru Dan Burdescu, University of Craiova, Romania
Vanco Chabukovski, Ss. Cyril and Methodius University - Skopje, Republic of Macedonia
Maiga Chang, Athabasca University - Edmonton, Canada
Ruay-Shiung Chang, National Dong Hwa University - Hualien, Taiwan
K.O. Chow, City University of Hong Kong, China
Bee Bee Chua, University of Technology, Sydney, Australia
Petre Dini, Concordia University, Canada / IARIA, USA
Roza Dumbraveanu, State Pedagogical University "Ioan Creanga" - Chisinau, Moldova
Jesualdo Tomás Fernández Breis, Universidad de Murcia, Spain
Bekim Fetaji, South East European University - Tetovo, Republic of Macedonia
Joseph Finkelstein, Johns Hopkins University, USA
Adam M. Gadomski, ENEA, Italy
Ivan Gancev, University of Limerick, Ireland
Fred Garnett, London Knowledge Lab & Digital Literacies (ESRC TLRP-TEL Programme), UK
Leonardo Garrido, Tecnológico de Monterrey, Mexico
David Guralnick, Kaleidoscope Learning - New York, USA
Felix Hamza-Lup, Armstrong Atlantic State University - Savannah, USA
Margareta Hellström, KTH, Sweden
Mike Joy, University of Warwick, UK
Keiichi Kaneko, Tokyo University of Agriculture and Technology, Japan
Göran Karlsson, KTH, Sweden
Surya Bahadur Kathayat, Norwegian University of Science and technology (NTNU)- Trondheim, Norway

Copyright Information

For your reference, this is the text governing the copyright release for material published by IARIA.

The copyright release is a transfer of publication rights, which allows IARIA and its partners to drive the dissemination of the published material. This allows IARIA to give articles increased visibility via distribution, inclusion in libraries, and arrangements for submission to indexes.

I, the undersigned, declare that the article is original, and that I represent the authors of this article in the copyright release matters. If this work has been done as work-for-hire, I have obtained all necessary clearances to execute a copyright release. I hereby irrevocably transfer exclusive copyright for this material to IARIA. I give IARIA permission or reproduce the work in any media format such as, but not limited to, print, digital, or electronic. I give IARIA permission to distribute the materials without restriction to any institutions or individuals. I give IARIA permission to submit the work for inclusion in article repositories as IARIA sees fit.

I, the undersigned, declare that to the best of my knowledge, the article is does not contain libelous or otherwise unlawful contents or invading the right of privacy or infringing on a proprietary right.

Following the copyright release, any circulated version of the article must bear the copyright notice and any header and footer information that IARIA applies to the published article.

IARIA grants royalty-free permission to the authors to disseminate the work, under the above provisions, for any academic, commercial, or industrial use. IARIA grants royalty-free permission to any individuals or institutions to make the article available electronically, online, or in print.

IARIA acknowledges that rights to any algorithm, process, procedure, apparatus, or articles of manufacture remain with the authors and their employers.

I, the undersigned, understand that IARIA will not be liable, in contract, tort (including, without limitation, negligence), pre-contract or other representations (other than fraudulent misrepresentations) or otherwise in connection with the publication of my work.

Exception to the above is made for work-for-hire performed while employed by the government. In that case, copyright to the material remains with the said government. The rightful owners (authors and government entity) grant unlimited and unrestricted permission to IARIA, IARIA's contractors, and IARIA's partners to further distribute the work.

Table of Contents

The Perception of Students Regarding E-Learning Implementation in Egyptian Universities

The Case of Arab Academy for Science and Technology

Sarah El Gamal,
College of Health, Community and Education
Northumbria University
Newcastle Upon Tyne, England, UK
sarah.el-gamal@unn.ac.uk

Rasha Abd EL Aziz,
College of Management and Technology
Arab Academy for Science and Technology
Alexandria, Egypt
rasha_a@aast.edu

Abstract—**Adopting e-learning in Egypt with population, over 80 million, needs clear understanding of the students' characteristics, perception, and cultural aspects. The large number of students per class in higher education in Egypt has highlighted the role of and the need for e-learning. This paper will focus on the Egyptian students as the customer in the e-learning process. It will try to identify the students' education preference, perception regarding e-learning mode effectiveness, and their e-readiness to its adoption by answering 'What is the preference of the Egyptian students' regarding HE mode in Egypt?' and 'What is the students perception regarding the effectiveness of e-learning as a higher education mode of learning in Egypt?' A structured questionnaire was designed to target higher education students in main two cities in Egypt. Data collected was statistically analyzed using Statistical Packages for the Social Sciences. Findings enabled the researchers to make conclusions and recommendations regarding e-learning implementation in Egypt.**

Keywords: e-learning; perception; e-readiness; cultural aspects.

I. INTRODUCTION

The penetration of technology and computers in different sectors including education has changed the ways services are delivered to customers, making automating applications obvious in learning systems [1]. There are an increasing number of university networks of this kind all over the world, and the use of computers in the learning process, access to the Internet by students as a vehicle for self-directed learning, educational broadcasting and video-conferencing are all being stepped by [2].

With the changing environment, educational institutions are forced to reconsider the methods in which they deliver their educational services. They now need to serve more students, yet, they have to shrink their budgets [3]. This creates a calling need for e-learning, which creates new opportunities for both educational institutions and students. E-learning has been defined by Wagner et al. as the learning experience enabled by electronic technologies [4].

Despite the clear need for studies that address the students' perception, preferences and e-readiness in developing countries, literature seems to focus on technical aspects. Accordingly, the main focus of this paper is the Egyptian students' preference regarding the different higher education modes, and their perception regarding the effectiveness of e-learning as a higher education mode in Egypt.

II. PROBLEM DOMAIN

Learning is a major sector in the Egyptian industry. As a service provider, learning institutions have realized the importance of investing in technology to control cost, attract students, and fulfill customers' needs for convenience and technical innovation [16]. Literature has been rich with studies regarding e-learning potentials. It also provides a clear view on how e-learning is adopted in developed countries. However, technologies can not be adopted regardless of the adopters' nature, perception, and preferences.

A study [12] about Egypt has highlighted that the quality of higher education in Egypt is decreasing due to the rapidly growing enrolment that started in the 1970s and 1980s, which, as a result, lead to large classes and the decrease of resources available [12].

Although e-learning seems to be the dream that would solve the education hassle in Egypt, in order to make e-learning more popular in Egypt, and to successfully adopt this technology, it is required to understand the users', perception, and preferences. Therefore the study at hand aims to survey the students' perception towards e-learning and whether they believe that it is an effective mode or not. It seeks to understand the nature of the Egyptian students, their frequency of use, and whether they believe that e-learning can help improve education in Egypt

III. RESEARCH QUESTIONS

In order to understand the perception of students regarding e-learning implementation in Egypt, we need to answer the following questions:

- What is the preference of the Egyptian students' regarding HE mode in Egypt?
- What is the students perception regarding the effectiveness of e-learning as a higher education mode of learning in Egypt?

 ISBN: 978-1-61208-120-5

IV. E-LEARNING PERCEIVED USEFULNESS

E-learning has been significant in Information and Communications Technology (ICT). It delivers knowledge to developing countries and it integrates many ICT capabilities in a noble cause. E-learning could dramatically increase access to education. It improves quality of education by accessing global academic resources and by offering training to academics. It also helps learners take an active role, work with their colleagues/instructors from a variety of locations [17].

E-learning is believed to take a competitive advantage over the conventional methods due to the speed and efficiency of the Internet, especially in making announcements. Moreover, e-learning could be the dream for people with work or family commitments; due to the high flexibility in time and place it offers [8]. E-Learning creates an interactive environment for teachers and students, as well as the opportunity for discussion and clarification of class content [9]. It also enables educational institutions to target learners who are unable to participate in traditional-learning environments [10].

The Internet provides a rich source of information with different perspectives in research, high speed and countless resources to improve student work. Students can undertake group work through the collaborative groupware [11]. E-learning also enables participants to choose the course scope, appropriate time, access up-to-date content and even customize it.

A. *E-Learning in Egypt*

The higher education quality in Egypt has been declining due to the rapidly growing enrolment rate that started in the 1970s and 1980s, which lead to a large number of students per class [4] [12] [13].

Beckstorm et al. [12] stated in their investigation about readiness for e-learning in Egypt that there is a positive response to Egypt readiness. Regarding the Internet initiative, the Ministry of Communications and Information Technology has been maintaining a free internet access nationwide since 2002, where more than 15,000 ports serving 2 million internet users, with users paying only for local phone tariffs.

E-learning in Egypt could provide solutions to problems such as overcrowded classrooms and transportation problems. The adoption of e-learning in Egypt can provide an economic and more suitable solution to the higher education problem by filling in the gap between the number of university places available in Egypt and the growing demand for higher education.

The Egyptian Ministry of higher education has made its first attempt in collaboration with higher education institutions in Italy, Canada and the United States to launch Egypt's first electronic non-profit university.

E-learning in Egypt has many challenges, some of which are the immature infrastructure, unawareness, resistance to change, and computer/Internet illiteracy [3][5]. Yet, it is essential [8][9] that the Egyptian government considers e-learning, especially in the higher education, where most of problems originate; in order to meet the needs of increasing numbers of students and cover the requirements of the job market in a period of communication and knowledge revolution [9].

To sum up, we would say that although e-learning in Egypt is expected to face many challenges, yet the perceived usefulness outweighs the disadvantages. But in order to adopt a new technology in Egypt, users can not be ignored [14]; as they are the real customers without which the system will fail. Since the overall customer satisfaction is not a new issue; it can be a central factor to evaluate and control strategic marketing [3].

V. RESEARCH METHODOLOGY

In order to answer the above stated questions, a questionnaire was designed to survey students' usage patterns, e-readiness, their perceptions and priorities with regard to E-learning usefulness, effectiveness and implementation issues. The survey was administered in the two main cities in Egypt. 100 questionnaires were distributed over higher education student respondents from Alexandria and Cairo. 77 valid questionnaires were returned.

The questionnaire was designed in English and translated into Arabic. Questionnaire forms were distributed in both languages, according to respondents' preferences. The questionnaire contained 24 variables distributed among 12 different questions. A summary of the questionnaire form is presented in Tables 1.

A. *Statistical Treatment*

Simple frequencies derived for the questionnaire variables are reported below. For further analysis of the findings, Statistical Packages for the Social Sciences (SPSS) was used to analyse the data. Chi-squares tests were applied to the questions, as they tabulate the variable into categories and computes a chi-square statistic. This test compares the observed and expected frequencies in each category to test that all categories contain the same proportion of values or test that each category contains a user-specified proportion of values.

Where the answers were ordinal as in questions 4 and 5, the mode was calculated to assume an average, making the standard chi-square test also applicable, to assess whether the distributions of results differ significantly from findings given by different segments of the population in the questionnaire which might have arisen by chance. For questions 4 and 5, two supplement hypotheses were developed. Mode, Crosstabs and Chi square tests were used to assess student's preference mode against the mode effectiveness for the following hypotheses.

B. *Frequencies*

- 97.1% of the study sample uses the Internet on a daily basis, while only 2.9% use it monthly.
- 80% of students are aware of the e-learning concept, while 20% of them did not even hear about it.

 ISBN: 978-1-61208-120-5

- 61.8% of students prefer traditional on-campus learning mode, while only 35.3% choose e-learning and 2.9% preferred other modes of learning.
- 51.4% of students agree that e-learning is an effective mode, while a close percentage of 48.6 opposed the idea.
- The majority of students (94.3%) believe that e-learning will face difficulties during its implementation, while only 5.7% believe the opposite.
- Exactly half of the students (50%) believe that e-learning would help in overcoming the problems of higher education, while the other half do not.
- 62.9% of respondents agree that the introduction of e-learning will enhance the quality of higher education, while 37.1% agree on the opposite.
- 54.3% of the sample believes that there is no chance to gain skills via e-learning graduates as compared to traditional learning, while 45.7% agree that e-learning graduates may gain more skills.

C. Data Analysis

In order to analyse the data collected the following null hypotheses were tested and interpreted as shown below:

١) *H01: Higher education students in Egypt are aware of e-learning educational mode.*

Since e-learning programs have been evolving and adopted all over the world, we would expect that higher education students in Egypt would be aware of this learning module. To see whether there was greater than expected e-learning awareness in the survey population, we used the chi square test. Results were obtained as follows:

'Have you ever heard of e-learning before?' (Q2): Chi-square= 12.600a (df = 1, sig. =0.000).

With these values, we can reject the null hypothesis. The interpretation is that the majority of Egyptian students seem to have heard of e-learning. Although e-learning has just come out of its infancy, it is sound enough to make this clear significance in the awareness question.

٢) *H02: There is no significant variation in students' preferences regarding the higher education learning mode.*

Since e-learning programs advantages have been clear and obvious, and because it has not yet dominated the Egyptian market, we would expect that higher education students in Egypt will not have a clear inclination towards any of the learning modes. To see whether their preferences are different from our expectations, chi square test was used and the results obtained as follows:

'Which would you prefer e-learning, or traditional on-campus learning?' (Q3): Chi square = 17.706 (df = 2, sig. = 0.000). With these values, we can also reject the null hypothesis. The interpretation is that the majority of Egyptian students seem to prefer the traditional on-campus learning mode despite of all the advantages of e-learning. This may ring the bell to show that the Egyptian culture seems to resist change and fear uncertainty.

٣) *H03: There is no significant difference between the perceptions of student's regarding the educational mode and its effectiveness.*

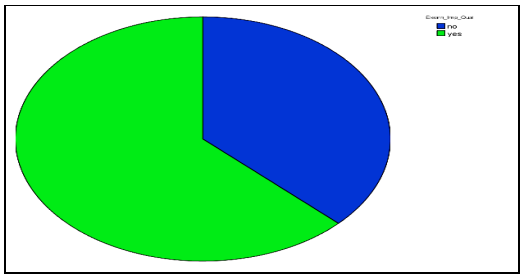


Figure ١. EL would improve the higher education in Egypt

In order to test hypothesis three, we formulated two sub-hypotheses:

١. *H03.1 Students prefer on-campus education because they are more familiar with it*

The majority of the Egyptian higher education students in the sample under investigation preferred traditional on-campus education. This may be due to resistance to change, cultural aspects, fear of uncertainty and the low expectations of e-learning programs. To assess the previously mentioned hypothesis, Modes, Crosstabs and chi square tests were applied and results obtained were as follows:

'E-learning is not an effective mode because:' (Q5) Chi square = 19.402a (df = 9, sig. = 0.022). These results allow us to reject the null hypothesis. The interpretation is that most respondents prefer on-campus educational mode. They believe that e-learning is not an effective educational way. This may be due to their fears from a number of factors as minimum interaction and students and lack of synchronous feedback to questions and assignments.

٢. *H03.2: Students preferred e-learning because it solves HE problems.*

For those respondents who preferred e-learning, it is assumed that their choice is built upon the problems that already exist in traditional higher education programs as large class sizes and limited number of universities available with respect to population. Therefore, e-learning is taken as a way out of such problems. To test these assumptions modes, Crosstabs and chi square tests were applied and results obtained were as follows:

'E-learning is an effective mode of education because': (Q4) Chi square = 34.444a (df = 20, sig. = 0.023). Consequently, we can again reject the null hypothesis. The interpretation is that higher education students who prefer e-learning as an educational mode believe in its effectiveness. Factors such as addressing differences in learning styles and studying according to learner's convenience are the main causes of such results. Therefore, we can reject hypothesis H03. Beliefs about the

 ISBN: 978-1-61208-120-5

ineffectiveness of e-learning as educational approaches are the main reasons for student's preference of on-campus education mode. On the other hand, students who prefer e-learning trust its effectiveness.

٤) *H04: E-learning will not face difficulties during its implementation.*

As e-learning technologies have been available and widely used across different nations, we would expect that e-learning should not face any difficulty during its implementation in the higher education in Egypt. To see whether Egyptian students believe that e-learning may face difficulties during its implementation, chi square test was used and the results obtained as follows:

'Do you think e-learning will face difficulties during its implementation?' (Q5): Chi square = 27.457a, (df = 1, sig. = 0.000). With these values, we can again reject the null hypothesis. The interpretation is that most of the Egyptian students highly believe that e-learning will face many difficulties during its implementation in Egypt. This may be because of the cultural aspects that always seem to be neglected by decision makers, and technology adopters.

٥) *H05: E-learning will improve HE problems in Egypt.*

Logically and theoretically speaking, e-learning should be regarded as the dream that would solve higher education problem, but in order to test whether in reality, students believe that it will improve the higher education situation in Egypt or not, chi square tests were used and the results obtained as follows:

'Do you think e-learning will help in overcoming the problems of higher education?' (Q6): Chi square = 0.029a, (df = 1, sig. =0.866).

'Do you think e-learning can help in improving the quality of higher education in Egypt?' (Q7): Chi square = 2.314a, (df = 1, sig. = 0.128). With these values, we fail to reject the null hypothesis. The interpretation is that students seem to lack confidence in the way e-learning would be implemented and are rather disappointed with the current system. They seem to doubt that higher education problems in Egypt could be solved by adopting a new technology.

٦) *H06: Egyptian higher education Students in Egypt are infrequent Internet users.*

As Egypt is a developing country, with a high rate of illiteracy, we would expect students to be infrequent Internet users. In order to test this hypothesis, chi square test provided the following results:

'How often do you use the Internet?' (Q1): Chi square = 0.029a, (df = 1, sig. = 0.000). With these values, we can reject the null hypothesis. The interpretation is that higher education Egyptian students are very frequent Internet users. This is very interesting because it clarifies that young adults are technology users and most of them use the Internet on a daily basis. This puts a big question mark on why they negatively perceive e-learning implementation in Egypt.

٧) *H07: There is no significant variation between e-learning graduates and on-campus graduates with regards to recruitment chances.*

Because e-learning advantages is known to the public, and its content should not be of less value than the traditional on-campus learning mode, we expect that there should not be any significant variation between e-learning graduates and on-campus graduates with regards to recruitment chances. In order to test this hypothesis chi square test was again used and the results obtained as follows:

'Do you think e-learning will improve higher education problems in Egypt?' (Q10): Chi square = 17.371a, (df = 1, sig. = 0.000).

With these values, we can reject the null hypothesis. The interpretation is that students believe that recruiters are biased and will not give equal chances to e-graduates. One more time cultural aspects speak out to prove that technology adopted in the West may not have the same effect.

TABLE I. QUESTIONNAIRE SUMMARY

#	Question	Possible answers
1	How often do you use the Internet?	Daily/Weekly/ Monthly
2	Did you hear about e-learning before?	Yes / No
3	If you have th opportunity to choose the type of higher education would you prefer e-learning?	Traditional/On-campus education E-learning
4	Do you think e-learning is an effective way of learning in higher education?(If your answer is NO go to question 6).	Yes / No
5	E-learning is an effective mode of education because: (Go to question 6) – Offers an interactive mode of education – Courses are presented in separate modules – Learning is reinforced through clear learning objectives for each module – Courses are easy to navigate – Helps in developing learner's skills – Encourages access to more related electronic course material – Students may have the opportunity to mix what they learn with practical work	1: Strongly agree 2: Agree 3: I do not know 4: Disagree 5:Strongly disagree
6	E-learning is not an effective mode of education because: – Students need to feel connected to their school – Lack of interaction between classmates and instructors – Lack of real time feedback to questions and assignments – Classroom environments helps students to learn more – Needs perfect computer and Internet skills – More expensive that traditional education – Bandwidth and Internet speed could represent some obstacles	1: Strongly agree 2: Agree 3: I do not know 4: Disagree 5: Strongly disagree
7	Do you think e-learning will face difficulties during its implementation in Egypt?	Yes / No
8	Do you think e-learning will help in overcoming the problems of higher education in Egypt?	Yes / No
9	Do you think e-learning can help in improving the quality of higher education in Egypt?	Yes / No
10	Do you think that e-learning graduates will gain more skills than traditional education graduates?	Yes / No
11	Do you think e-learning graduates will be acknowledged and accredited as equally as traditional learning students from professional bodies and employers?	Yes / No
12	Do you think that e-learning graduates will have equal chances of recruitment as on-campus students?	Yes / No

 ISBN: 978-1-61208-120-5

VI. DISCUSSIONS AND CONCLUSION

E-learning seems to be the upcoming trend. It has been spreading worldwide. However, Egypt has not really begun to take advantage of the e-learning medium. Although the adoption of e-learning in Egypt can provide an economic and more suitable solution to the higher education problem by filling in the gap between the number of university places currently available in Egypt and the growing demand for higher education, the Egyptian Ministry of Higher Education has not yet dominated the Egyptian Market. Egypt has just launched its first non-profit private, electronic university in order to put some light and support to the e-learning modules, but still students seem to doubt the effectiveness of such a mode besides the difficulties during the implementation phases. They prefer the traditional on-campus learning mode as a way to avoid uncertainty.

A variety of reasons have lead to students' doubt about the new educational platform such as the lack of normal college environment, asynchronous interaction and feedback between learners and instructors, and technological infrastructure problems such as Internet speed and bandwidth besides the familiarity of the structure routine of traditional on-campus education. This highlights the role of the Egyptian Higher education authorities and the Ministry of Communication and Information Technology in increasing public awareness about e-learning concepts, benefits, validity of the e-learning degree granted and the technological infrastructure available in Egypt.

As Lorenzi and Riley have reported in their article [16], the main success factors to system success are behavioural more than technical. An interesting feature of the Egyptian situation is the clear concern regarding learning via electronic forms, and yet are very frequent Internet users. They seem to trust the technology, and even use it frequently and yet do not trust the system and its power in solving improving the higher education in Egypt. Egyptian students seem to have heard about e-learning, but actually are not aware of the associated benefits which again emphasize the role of Egyptian authorities in dealing with resistance to change dilemma and addressing customer needs.

In the wider study of which this survey is part of, further investigation of the social and stakeholder context will be undertaken. Better understanding of the context of e-learning readiness and perception should enable decision makers in Egypt to address their customers' needs more fully. As customers are becoming more powerful than they previously were, and are more able to switch to other providers that if their expectations are not met [17], universities seeking e-learning adoption should try to make their potential students aware of the technique, process, and output.

Finally, we would say that although e-learning has a lot of potentials and advantages, it can not be actually promising in Egypt until e-learning readiness and perception have been taken into consideration.

REFERENCES

[١] Abd El Aziz, R. (2009), ATM Location and Usage in Egypt: Social and Technical Perspectives, PhD Thesis, University of the West of England, Brisol, UK

[٢] Varis, T. (2006), 'e-learning and higher education', [Online]. [Accessed: 1December 2010]. Available at: http://www.elearningeuropa.info/files/media/media11006.pdf

[٣] Wagner, N., Hassanein, K., and Head, M. (2008). Who is responsible for E-Learning Success in Higher Education? A Stakeholders' Analysis. Educational Technology & Society, 11 (3), 26-36. [Online]. (Accessed: 2 December 2010). Available at: http://www.ifets.info/journals/11_3/3.pdf.

[٤] Weinert, K. D. (2005), 'A Brief History of ATMs'. Accessed online 10 December 2010 at [http://www.stopoutmfees.com/newpage3.htm]

[٥] Richard, A., (1992), Higher Education in Egypt.[Online].[Accessed: 1 April 2010]. Available at: http://www-wds.worldbank.org/servlet/WDSContentServer/WDSP/IB/2000/07/19/000009265_3961002123123/Rendered/PDF/multi_page.pdf

[٦] Abdel-Wahab, A. Gad (2008), 'Modeling student's intention to adopt e-learning: A case from Egypt', Turkish Online Journal of Distance Education TOJD, January 2008, Vol.9, No.1, pp.157-168. [Online]. [Accessed: 25 November 2010]. Available at: http://www.ejisdc.org/ojs2/index.php/ejisdc/article/view/355.

[٧] Yieke, Felicia A. (2005), 'Towards Alternatives in Higher Education: The Benefits and Challenges of E-Learning in Africa'. CODESRIA Bulletin, No. 3 & 4, pp.73-75, [Online]. [Accessed: 24 May 2010]. Available at: http://www.codesria.org/Links/Publications/bulletin3_05/yieke.pdf

[٨] Palloff, R. and Pratt, K. (1999), Building Learning Communities in Cyberspace: Effective Strategies for the Online Classroom. San Francisco; Jossey-Bass Publishers.

[٩] Rossiter, D. (1997), The Digital Edge?: Teaching and Learning in the Knowledge Age. Queensland: QUT Publications and Printery.

[١٠] Maddux C. (ed.) and Johnson D. (2001), The Web in Higher Education: Assessing the Impact and Fulfilling the Potential. New York: The Haworth Press.

[١١] Online Collaborative Learning in HE (2003), [Online],. 11 Accessed: 25 November, 2010. Available at: http://clp.cqu.edu.au/introduction.htm

[١٢] Beckstrom, M, Croasdale, H, Riad S M, and Kamel M M, (2004) 'Assessment of Egypt's elearning readiness'. [Online].. Accessed: 7 December 2010. Available at: http://mohamedelzayat.net/egypt%20readiness%20for%20elearning.pdf

[١٣] Khaled, A. (2008) 'EGYPT: Uncertain future for e-university', University world News, [Online]. [Accessed: 3 November 2010]. Available at: http://www.universityworldnews.com/article.php?story=20080703152831554

[١٤] Abd El Aziz, R., Beeson, I., and El Ragal, A. (2007), 'An Empirical study to measure ATM usage in Egypt' IBIMA Proceedings, Dublin, Ireland, ISBN: 0-9753393-7-0

[١٥] Goode, M. and Moutinho, L. (1995), 'The effects of free banking on overall satisfaction: use of automated teller machines', International Journal of Bank Marketing, vol. 13, no. 4, pp. 33-40, MCB UP Ltd.

[١٦] Lorenzi, N. and Riley, R. (2000), 'Managing Change', J Am Med Inform Assoc. 2000; 7(2): 116–124.

[١٧] Ijazdar, R. and Hu, Y. (2004), 'How Banks Manage CRM: A B2B Perspective', Masters thesis, Lulea University of Technology, Nordic region.

 ISBN: 978-1-61208-120-5

Evaluating the Effectiveness of a Multiprofessional Online Mentor Update Tool

Stephen White, Karen Ousey
The University of Huddersfield
Huddersfield, UK
stephen.white@hud.ac.uk , karen.ousey@hud.ac.uk

***Abstract*—This paper presents evaluation data following the implementation of a multiprofessional online mentor update tool designed to meet the learning needs of mentors in clinical healthcare practice. The huge resources needed to sustain traditional delivery of the updates, plus the inability of mentors to attend these events, were amongst the main drivers for the development of this tool. Results of the evaluation have identified that the flexibility of the online tool promotes engagement for both mentors and their line managers, and in doing so provides academic staff to alternatively utilize the time saved delivering it. The multiprofessional originality and uniqueness of the package has also promoted users to consider the mentor role from an inter-disciplinary perspective. With the Nursing and Midwifery Council praising the package as an example of innovative good practice, it is intended to promote its use in other regions that provide healthcare education.**

Keywords - Educational technology; Online learning; Mentor update; Multidisciplinary; Interdisciplinary

I. BACKGROUND

In healthcare education, the fundamental purpose of the mentor's role is to support students and facilitate their learning and experiences within the clinical area; in order to achieve this, the mentor has to be adequately prepared for their role, understanding the mentor role and the educational needs of their mentees. This paper presents the results of an evaluation of an interactive multi professional web-based update package for mentors of nursing, midwifery and healthcare professionals. The package, originally conceived at the University of Huddersfield [1], has now been designed for use by fourteen professional groups; nurses; midwives; operating department practitioners (ODPs); occupational therapists; physiotherapists; dieticians; podiatrists; audiologists; clinical physiologists; diagnostic radiographers; radiotherapists; social workers; speech and language therapists and paramedics across the nine Higher Education Institutions (HEIs) in the Yorkshire and Humber Strategic Health Authority [2].

This paper offers an overview of the need for an alternative mentor update package, identifying and exploring the impetus for its development; progressing to discuss data collection and analysis of an evaluation undertaken on the effectiveness of the package. Themes that have arisen from the analysis, developing knowledge, duration, usability and accessibility are discussed. Finally, a summary of the results and future developmental plans are presented.

II. THE NEED FOR AN ALTERNATIVE MENTOR UPDATE PACKAGE

The purpose of the update is to inform mentors of curricula amendments, any changes within the Higher Education Institutions (HEI) that may influence students' learning, as well as offering a forum for mentors to discuss issues and to ask questions. Traditionally within the United Kingdom (UK), the programme of updates for these professional groups, in particular nursing, midwifery and ODP, has been undertaken by each HEI, in a uni-professional fashion, within or around the clinical areas. These updates have been known to last from two hours, to all-day and are generally led by a member of academic staff; when considering the vast numbers requiring updating each year, combined with their widespread geographical locations, it can be seen how this places a significant burden on the HEI's resources and requires a large number of registered health practitioners to leave the clinical areas for a substantial amount of time. However, despite these events regularly being made available, the numbers of attendees can be small, even as few as one or two. To determine why this is, a process of informal discussions with mentors, combined with evaluation through the audit process was undertaken [1]. This ascertained that a significant number of mentors are not attending due to increasing workloads, plus limited staffing

 ISBN: 978-1-61208-120-5

resources; they are prioritising the adequate staffing of clinical areas over attendance at mentor updates, supporting the earlier findings [3].

The role of the mentor has been investigated [4] and it was identified that most mentors were aware of the significance of their role in facilitating the development of students' clinical skills and experience and acting as a source of support. However there are barriers that can sometimes hinder the effective mentor role; mentors in Myall et al.'s study [4] highlighted staff shortages and increasing demand on placement capacity as contributing to an increased workload which often led to a lack of time to carry out the role, with many completing assessment documentation in their own time. Such constraints were also identified as preventing mentors from attending regular updates, resulting in some feeling they had unmet continuing professional development needs. There was a genuine belief that the mentor role was pivotal to students' clinical learning experiences and as such it was vital that the mentor was able to access ongoing support and preparation in carrying out this role ensuring that students could be supported to become confident and competent practitioners [2]. The development process and structure of the online package itself is described in detail in previous publications [1, 2].

III. DATA COLLECTION

A questionnaire was made available to all mentors accessing the tool and was completed on a voluntary basis. No personal details were required, but respondents were asked to identify which professional group they belonged to, to ascertain whether or not all professional groups were accessing the information. The questionnaire contained both quantitative and qualitative questions (Table I). A Likert scale [5] was used to extract data: strongly agree – agree – neutral – disagree – strongly disagree with space available to add in comments.

IV. DATA ANALYSIS

To date six hundred and fifty-two mentors have undertaken the online update over a ten-month period; Table II shows the demographic of the disciplines. Although the majority of mentors accessing the update were nurses, this was to be expected, not only because they are greater in number across the region, but because this professional group (and midwifery) are required to update yearly. ODPs are the next most-regular group to update, every two years, whilst other professional groups accessing the package currently have no mandatory requirement to update themselves while undertaking the mentor role.

TABLE I. EVALUATION QUESTIONS

This update activity has helped me in knowing where to access information relating to the mentorship of students?
I have an improved understanding of how the mentor role can function in a multi-professional way?
I have been given all the relevant information to assist me in my role?
My ability to mentor has been enhanced through carrying out this activity?
There are accountability and responsibility issues associated with mentoring – this update has improved my understanding of them?
Through this activity my understanding of how to improve the learners' experience has been enhanced?
This activity has developed me professionally?
The update package was easy to navigate?
Carrying out the update was an enjoyable experience?
Overall, the package has met my needs?
The content in the initial generic section was relevant to my role as a mentor?
The content in the Sets was relevant to my role as a mentor?
The content in the profession-specific area(s) was relevant to my role as a mentor?
Overall, the update activity was relevant to my role as a mentor?
How long, not including breaks, did the update take you to complete?
Were you given time during your working day to complete this update?
With 1 being the lowest and 10 being the highest, how would you rate this online package when compared to other updates you have experienced?
Following this experience, would you, by choice, undertake other activities online?
What did you like most about the update?
What did you like least about the update?

V. DEVELOPING KNOWLEDGE

The update provided all of the relevant information relating to the mentorship role, as reported by 83% of mentors, with 86% indicating that it helped

TABLE II. NUMBER OF MENTORS IN EACH DISCIPLINE THAT HAVE COMPLETED THE UPDATE PACKAGE (N= 652)

Audiology	3	Operating Department Practitioner	14
Clinical Physiology	4	Paramedic	0
Diagnostic Radiography	2	Physiotherapy	4
Dietetics	0	Podiatry	0
Midwifery	30	Radiotherapy	0
Nursing	593	Social Work	1
Occupational Therapy	1	Speech and Language Therapy	0

 ISBN: 978-1-61208-120-5

provide them with the knowledge of where to access information. In relation to specific sections, positive responses were received from 87% of the users on the generic content (17% Strongly Agree, 70% Agree), 85% on the content in the Sets (16% Strongly Agree, 69% Agree), and 89% on the profession-specific content (20% Strongly Agree, 69% Agree). 91% were in agreement that undertaking the online update had been relevant to their mentor role (19% Strongly Agree, 72% Agree) (Figure 1).

One mentor commented, '*Good update - interaction good as makes you consider all areas. Good to reflect on past experiences whilst having update and relevant learning criteria*', however, two mentors commented that they would have preferred a face-to-face update and would prefer the information to be paper based; it is worthwhile noting that there were consistent negative responses from two mentors for every question, clearly indicating a dislike for anything computer-based. However the majority reported that they preferred the online version as '*it made me think*' and '*more interactive than sitting listening to a tutor*'; a sentiment echoed by another mentor '*i had to engage a lot more than i do in the attended updates where i don't always concentrate*'.

VI. DURATION

The online update had been developed to overcome the problem of clinical staff struggling to find time to attend scheduled update activities, and instead allow them to update as and when they found appropriate, additionally allowing the academic staff more time to visit the clinical areas and provide support to both students and clinical staff.

When asked 'How long, not including breaks, did the update take you to complete?' the mentors' responses indicated that 48% took less than 2 hours to complete it, and 76% completed it in under 3 hours (Table III). In contrast, 8% of mentors responded that the update had taken longer than 4 hours; it is not an unreasonable assumption that this was due to them accessing multiple areas of content, because students from more than one discipline were placed within their clinical area. This would have traditionally required them to attend multiple update events.

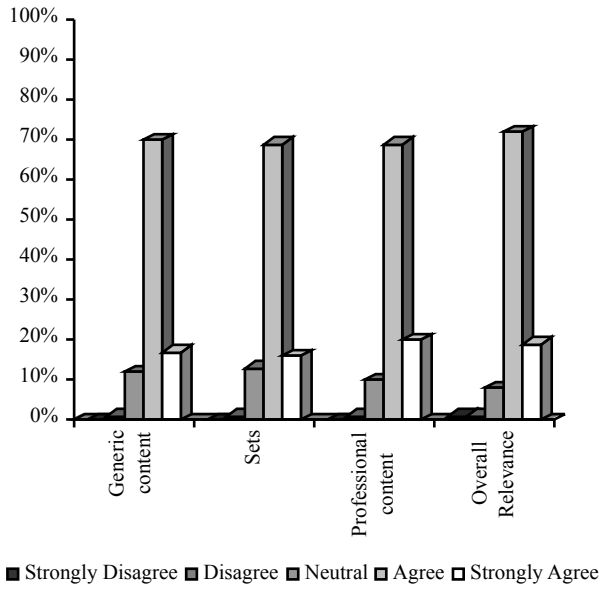


Figure 1. Relevance of the content

When asked '*Were you given time during your working day to complete this update?*' it was interesting to note that 64% of mentors had been given the time, which appears to contradict the supposition that mentors had not been able to attend the face-to-face update sessions due to work pressures. It is not unreasonable to surmise, based on some qualitative comments, that in response to a new system being introduced, line managers had made time available; one mentor stated that this was the '*first time ever that I have been given time…*' Another mentor identified that *'I have just started a new job so had the time during working hours as part of induction programme'. However,* not all mentors were afforded time to undertake the package, but due to the nature of the delivery were able to complete it in personal time, one mentor said, *'Because of the shortage of staff on our unit time was not available to allow me to complete this in works time'.* Indeed one mentor; '*found quiet time within night shift to complete'* which would not have been possible to achieve had they been expected to undertake the traditional face-to-face

TABLE III. TIME TAKEN TO COMPLETE THE UPDATE

Less than 1 hour	5%
1 to 2 hours	43%
2 to 3 hours	28%
3 to 4 hours	15%
4+ hours	8%

 ISBN: 978-1-61208-120-5

session. Respondents did state that they would have found it beneficial to be informed of the approximate time it takes to complete the update, prior to starting it, so that they could plan their time accordingly. They also commented that they would have liked to see a 'timeline' on each page so they knew how much they had completed. These issues are being addressed, with the evaluation data on duration, discussed above, being used to provide guidance on the average length of time it may take to complete the package. A progress indicator is also being introduced; however this is proving more difficult than anticipated due to the 'looping' options available to the mentors as they progress through the package.

VII. USABILITY

The online package was reported as easy to navigate by 73% of the mentors (18% Strongly Agree; 55% Agree), with a further 17% providing a Neutral response. Despite this being a positive outcome for a new tool with an untested design, and although one mentor commented that '*I am not the best IT person but find it so easy to use*', the data suggests there is still room for improvement (Figure 2).

Ease of use featured regularly in the qualitative comments, with mentors indicating that the tool was '*easy to navigate', 'easy to understand and follow', 'straightforward to use', and 'user friendly'*. Arguably one parameter from which usability could be determined is how enjoyable the mentors found the experience. 36% of the mentors indicated positively with regard to enjoyment of the activity (6% Strongly Agree; 30% Agree), with

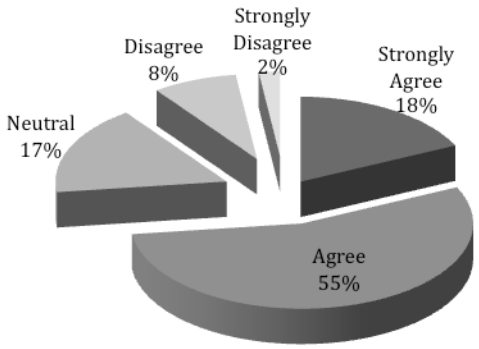


Figure 2. The update package was easy to navigate

42% staying Neutral in their response; this means that 22% did not enjoy the experience (16% Disagree; 6% Strongly Disagree). It is not possible from this data alone to determine if these mentors' lack of enjoyment is a direct result of this particular package, or the delivery method, nor whether the actual experience of updating is enjoyable, in itself. However, when asked if they would, by choice, undertake other activities online following this experience, 81% of the mentors said '*Yes'*. Also, when invited to rate this package in comparison to other updates they have experienced (1 being the lowest and 10 being the highest), 70% valued it 6 or above, with 16% providing a neutral response (Figure 3).

The outcome of these two questions suggests that overall the package was well received and the lack of enjoyment experienced by some may not be specifically related to the tool.

VIII. ACCESSIBILTY

The inability of mentors to attend traditional updates had been cited as one of the main drivers for the initiative and therefore accessibility of the package was an important factor in determining how successful the tool had been for mentors.

Flexibility and convenience were repeatedly mentioned when mentors were asked what they liked most about the update, particularly being able to undertake it in a place of their choice, rather than having to attend a session in a specific

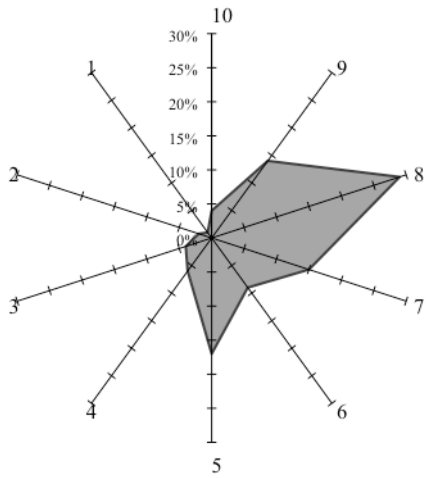


Figure 3. With 1 being the lowest and 10 being the highest, how would you rate this online package when compared to other updates you have experienced

location, *'it was convenient for me to do at home because I have childcare issues to think about'; 'I could do it at work and not attend a study day'; 'if I have to attend a day course it is 140 miles round trip'; 'I could sit in my lounge and drink tea!'*

Being able to undertake the update at a time of their own choosing, was also perceived to be beneficial by mentors, '*I could complete it in my own time when convenient for me*'; '*able to do online read at your leisure*'; '*it could be done when it was convenient to me and my workplace*'; '*it was on line so didn't need to go to a lecture and could do it when i wanted*'; '*the ability to complete update without attending a teaching session, made it easier to fit in work commitments*'.

In addition, the ability to work at their own rate, as and when practical for each mentor, was identified as advantageous, '*was able to complete at a convenient time and pace*'; '*able to complete it at my own speed*'; '*I was able to work at my own pace*', as was the functionality that permits mentors to carry out the update intermittently, returning as and when time permits, '*because the ward has been so busy i have been able to do this in my own time and be able to go back to it from time to time*'; '*could log out and complete the course in sections rather than having to complete it in one go*'; '*liked the ability to log in and out and not complete the update in one sitting*'.

IX. SUMMARY

'*Yes, it exceeded what I thought I needed but in reflection may be it was just what the doctor ordered'*.

As indicated by this quote from one of the mentors, the online mentor package has evaluated positively during the evaluation period. Users of the package have found it easy to navigate, whilst also identifying that it has met the learning and information needs required to undertake their mentor role effectively.

The inability of staff to attend updating activities [1,3] appears to have been remedied in many ways through the online version, with significant numbers undertaking the update in a short period of time. This would appear to not only be due to its flexible access allowing staff to fit it into their schedules [6,7], but also as a result of a visible shift in the line managers' willingness to give time during the working day. It may be that the stimulus of a new approach was the cause of this, but whatever the reason, it contradicts suggestions that staff lack motivation and incentive to attend [8], if provided with the opportunity.

Somewhat surprisingly, staff also stated that they generally enjoyed the experience, and whilst it is unknown whether this also applied to the traditional approach, there is clear evidence that this tool was appreciated, in the main, above previous update experiences. This supports findings that online approaches to learning can provide stimulus and interest for students [9], promoting meaningful learning [10].

The multi-professional originality and uniqueness of the package has also promoted the professional groups to learn about the mentor role from an inter-disciplinary perspective, and importantly it has provided them with a 'one stop shop' to enhance their knowledge base in mentoring students from more than one discipline and one HEI at one session.

It is anticipated that freeing academic staff from the 'burden' of delivering the updates will now enable them to concentrate this time more effectively in providing further support for the mentors within the actual placement environments; thus meeting their identified needs [3,11].

A limitation of this evaluation is that the majority of the participants are from one discipline, nursing, which may make it difficult to generalize the results. However, this can also be construed as a positive, because for this professional group, annual updating will have been 'the norm' throughout their career; as such they are the group most suited to evaluate this new tool against their previous, traditional, experiences.

X. CONCLUSION AND FUTURE WORK

The development and implementation of the package has proved successful in meeting the mandatory training needs of mentors in practice. Additionally it has identified the importance of clinical practitioners learning together and has promoted interdisciplinary learning. The Nursing and Midwifery Council have praised the package as being an example of innovative good practice, and as such it is intended to promote use of it in other regions that provide healthcare education. It

 ISBN: 978-1-61208-120-5

is also anticipated that the structure underpinning the tool may be utilized for other subject areas.

Future work includes continual evaluation of the package to ensure the information maintains its relevance and currency; it is anticipated that this will be achieved through delegation of administrative rights to each discipline or institution, allowing self-management of the content.

Further development of the chat tool is also being considered, to introduce video functionality, in order to enhance the interactions between the mentors. However, initial investigations into this suggest there may be problems accessing video via some institution's networks, due to current security settings.

REFERENCES

[1] Ousey, K.J. and White, S.A. "Developing a multi-professional e-learning mentor update package", Proceedings of the International Conference on Mobile, Hybrid, and On-line Learning, elml, 2009, pp. 103-107.

[2] Ousey, K. and White, S. "A case study exploring a multi-disciplinary collaborative initiative to use e-learning to meet the professional learning needs of health care practitioners," in Interprofessional E-Learning and Collaborative Work: Practices and Technologies, A. Bromage, L. Clouder, J. Thistlethwaite and F. Gordon, Eds. IGI-Global: Pennsylvania, 2010, pp. 286-300.

[3] Pulsford, D., Boit, K. and Owen, S. "Are mentors ready to make a difference? A survey of mentors' attitudes towards nurse education", Nurse Education Today, 22(6), pp. 439-446, 2002.

[4] Myall, M., Levett-Jones, T. and Lathlean, J. "Mentorship in contemporary practice: the experiences of nursing students and practice mentors", Journal of Clinical Nursing, 17(14), pp. 1834-1842, 2008.

[5] Trochim, W.M. "Likert scaling". Available from: http://www.socialresearchmethods.net/kb/scallik.htm. Accessed: 01 December 2010

[6] O'Malley, J. and McGraw, H. "Students perceptions of distance learning, online learning and the traditional classroom", Online Journal of Distance Learning Administration, 2(4), 1999.

[7] Sit, J.W.H., Chung, J.W.Y., Chow, M.C.M. and Wong, T.K.S. "Experiences of online learning: students' perspective", Nurse Education Today, 25, pp. 140–147, 2005.

[8] Joshua-Amadi, M. "Recruitment and retention: a study in motivation", Nursing Management, 9, pp. 7–21, 2002.

[9] Rosenlund, C.H. and Damark-Bembenek, B. "Assessing the effectiveness of an online program", Nurse Educator, 24(1), pp. 5–6, 1999.

[10] Jonassen, D.H. "Transforming learning with technology: Beyond modernism and postmodernism or whoever controls the technology creates the reality", Educational Technology, 40(2), pp. 21–25, 2000.

[11] Hutchings, A., Williamson, G.R. and Humphreys, A. "Supporting learners in clinical practice: capacity issues", Journal of Clinical Nursing, 14, pp. 945–955, 2005.

 ISBN: 978-1-61208-120-5

An E-learning Course on E-Commerce

Designed, developed and delivered as a distance learning course for EU remote communities

Thanasis Hadzilacos
Open University Cyprus
Lefkosia, Cyprus
and Computer Technology Institute, Patras, Greece
Email: thh@ouc.ac.cy

Angelika I. Kokkinaki
University of Nicosia,
Nicosia, Cyprus
Email: kokkinaki.a@unic.ac.cy

Panayiotis Kyriakou
Open University Cyprus
Lefkosia, Cyprus
Email: panayiotis.kyriakou@ouc.ac.cy

Grigoris Liassis
Open University Cyprus
Lefkosia, Cyprus
Email: liasis.g@gmail.com

Konstantinos Paraskevas
Email: paraskevasd@gmail.com

***Abstract* — This paper presents aspects of the design, development and implementation of an e-learning course on e-commerce. This course was delivered as distance learning to adults living in remote areas of EU. The course was developed as part of the REVIT project, which proved sustainable methods for offering courses by employing available ICT infrastructure in local schools, after hours, a synchronous e-learning platform for the weekly lectures and a variety of asynchronous tools for communication and support of the learners.**

Keywords - e-learning; distance learning; e-commerce; REVIT project.

I. INTRODUCTION

Designing, developing and implementing e-learning courses is a complex endeavor involving pedagogical, technological and economic aspects. In REVIT, a project that run from 2008 until 2010 in Finland, Poland, Bulgaria, Greece and Cyprus and was financed by the LifeLong Learning Program (LLP) of the EU Commission, such issues were tackled for e-learning courses designed specifically for the needs of small remote communities. Considerations included the unavailability of local qualified teachers, the very small number of people who are interested in and capable to follow a particular course in such communities, the availability of Internet infrastructure and tools, and the need for the methodology developed to be scalable.

This paper presents aspects of the design, development and implementation of an e-learning course on e-commerce, which was developed within REVIT. It was initially developed for citizens living in remote areas in Greece and Cyprus. As part of the localization process of the REVIT project, partners may localize the contents of the course to their own special requirements. Beyond its contributions within the REVIT project, however, this paper should also be of help to others who might wish to use the methodology and the e-course design.

In line with these, this paper aims at 1) outlining the methodology for identifying users educational needs related to e-commerce, 2) presenting a specific framework of the design of REVIT e-course on e-commerce, 3) allowing partners and others who will be localizing REVIT courses to understand the design parameters and thus perform their tasks more efficiently, and 4) facilitating the evaluation of the design and development of the REVIT e-course on e-commerce.

For this course, the development team consisted of an expert on e-learning pedagogy and technologies, an e-business domain expert and two engineers with specializations on multimedia and e-learning technologies. The development team was responsible for the design of the course and the corresponding learning material. Three of the team members had previous experience in the field of e-learning. One of them has also launched an actual e-commerce web site and has applied in practice some of the concepts discussed in the course! The domain expert was exposed to conventional academic environment and the whole process was a learning experience that was inspirational to enrich her coursework material as well as seminars given to the business community. The development team was complimented by the tutor who had background in e-business. It is worth noting that the tutor

 ISBN: 978-1-61208-120-5

was serving in the military, while delivering the course; this experience was both challenging and rewarding. The course has been offered once and the feedback received has been incorporated in a second version of the design and implementation.

The remaining of this paper is structured as follows. Section 2 provides a brief literature review on relevant pedagogical approaches as well as the methodology used for identifying the educational needs of the target audience. Section 3 provides a description of the design of a REVIT e-course along with examples. Section 4 provides the preliminary evaluation of the course based on its first implementation. Section 5 concludes this paper.

II. PEDAGOGICAL PERSPECTIVE AND NEEDS ANALYSIS

REVIT e-courses were designed according to active learning, learner-centered principles. A REVIT e-course is conceived as a set of learning activities; its curriculum is not a sequence of names (a table of contents, describing what the teacher lectures about) but a set of verbs (describing what the learner does). The sequencing of these learning activities ranges from the simplest, the sequential, to the most complex, a labeled directed graph. (e.g. «If you found Activity A too difficult, do Activity B; else go to Activity D»). A REVIT e-course includes the learning objects involved (such as video-lectures, exercises, simulations, and text), the learning objectives (and other Metadata: who prepared it, when, for what type of learners, prerequisites, IPRs, technical infrastructure needed), and the learning environment (e.g. Moodle, OpenSim, Elluminate, Café@Palaichori, + tutor; including the structure of, say, Moodle).

The design of a REVIT e-course requires the learner profile, the tutor profile, the learning objectives and their prerequisites including learning environment structure and technical infrastructure. A (high-level) description of the learning activities (including learner time/effort required) is given, as well as the sequencing of the learning activities (including time restrictions or recommended timing: e.g. “one lesson per week”). A (high level) description of the learning objects, including sizing (e.g. a 2’ video), sources, and recourses necessary for implementation; a prototypical ‘exam’ (which need not be a standard written exam, but something that a learner must be able to do if successful) is included in order to determine the level of depth of the course.

In line with the overall pedagogical paradigm and in order to identify the profile of the learners, the project team visited and met the prospective learners to get to know them personally and their socioeconomic context. In informal discussions during these visits, the topic of how Information and Communication Technologies and E-commerce, in particular, can be used to promote local products and services emerged a number of times. To illustrate these with two indicative cases, we included those of Elena and Dimos.

Elena lives in Palaichori, a village in Troodos mountain in Cyprus. She works together with her husband in a family business, that is, a small retailer of electronics devices. Through her acquaintances, she became aware of agro-touristic initiatives promoted through the Cyprus Organization of Tourism and received funding to renovate their old family mansion into a bed and breakfast facility offering traditional Cypriot hospitality. Funding was also available for developing a webpage, which provides basic information about accommodation offered and the vicinity area; email is used for preliminary communication and provisional booking; transactions are not supported. With no formal studies in Business Administration, Hotel and Hospitality Management or other relevant field, Elena is in charge of most operations in the facility, which operates primarily during weekends in the winter time, while it enjoys high season during summer. She perceives e-commerce as a promise but with caution: something to help her run the facility more conveniently and effectively but also something that will take her in unfamiliar and possibly dangerous waters.

Dimos is in his late forties and lives in Ios, a small, remote, Greek island, “where three (hectic tourist) months feed the other (boring to death) nine”. From an early age, he demonstrated his creativity and his artistic inclinations. Under his family influence, however, he did not pursue studies related to his inclinations; rather, he enrolled in a Business School where he has attended several classes without graduating. Currently, he works as an employee in a Third Party Logistics Operator, by day. After hours, he works at a self improvised atelier at home making jewelry and other artifacts that are sold via jewelry shops and tourist souvenir shops in the island. His designs are popular among locals and tourists, alike. However, Dimos feels that his lack of specialized studies in design is an inhibiting factor not only for the development of this hobby into a full-blown business but also for his creativity. The e-commerce topics sounded promising as he could use it to create his own retail channel easily and relatively inexpensively.

With these (and other similar) cases, it was decided to design a course on e-commerce and include learning activities related to the complete business process for products and services. The course was to be based on tutorial discussions, learning activities, podcasts for acquiring additional exposure in the field and homework assignments as explained in the following section.

 ISBN: 978-1-61208-120-5

III. DESIGN AND DEVELOPMENT OF THE E-COMMERCE COURSE

The learning methodology for this course includes an initial two-hour face-to-face meeting in the school of the village in the presence of the local coordinator of the REVIT project to outline the structure of the course and the use of specific tools. An overall description of the E-commerce course can be found in Appendix A. Information on the design and the development process is available at http://revit.cti.gr.

A fundamental principle followed in this project is the separation, with clearly defined interfaces, of the design, the implementation and the delivery of the course. The design requires the combined expertise of e-learning pedagogy and technology, and of deep subject knowledge, far beyond that which will be delivered in the course. The implementation, i.e. filling the educational activities designed with specific content, does not require the presence of an e-learning pedagogy or technology expert any more. Finally, the distance delivery of such a course does not need a university-level instructor. It is this separation of levels that guarantees scalability and transferability: Although the cost of developing and delivering one such course would be prohibitive for the small audience that a couple of remote communities can provide, to repeatedly deliver it is quite feasible. Furthermore, localizing such a course in another language and culture did not call for a redesign, nor for repetition of the initial research, but mainly for the translation and localization of the educational material and activities.

The methodological approach allows the learners to perform a number of e-learning activities.

- Learners participated in synchronous distance learning sessions that entail tutorial discussions on e-commerce concepts. Sessions are coordinated by a remote instructor. At implementation level, it is supported by Elluminate Live™ v.10.
- An asynchronous e-learning system (Moodle v.1.9.4, an open source LMS) and various Web 2.0 tools were used, including wikis, blogs, pre-recorded podcasts with e-commerce case studies and RSS feeds.
- Participants worked on their own using specifically designed educational material and software (asynchronous distance learning).
- They communicated, cooperated and constructed new knowledge with their fellow students, using the modern tools and communication spaces provided, through well designed and structured educational activities.
- Finally, participants had the opportunity to access e-shops (developed by the design team using a Content Management System, Joomla™) parameterized and personalized to fit their business plan.

The primary aims of this course are to i) let the participants perceive the Web as new channel for doing business and ii) have them accept the idea of directly marketing their products and services using the Web, selling their products and services through the Web and facilitating some of their business processes with the help of Web-enabled tools, at large.

IV. ASSEMENT AND CONCLUSIVE REMARKS

Overall, the course was successful. Trainees learned how to use web to investigate for competitors and products, the different kinds of online advertising, how to conduct online surveys and organize online events, about copyrights and personal data safety in online transactions, and how to build their own e-commerce site. They understood procedures and means that they should be aware for while doing online business.

The methodology followed was flexible and easy for everyone to follow. Learners founded courses very interesting. The one-week time period between classes was enough for learners to do their assignments and study additional material. Podcasts, were received very positively because they contained mostly practical examples and no complicated terminology, addressing all the main aspects of e-business.

In sum, the learners acquired valuable knowledge in e-commerce procedures that could be applied in local businesses; realized the importance of copyrights and personal data security; realized that there exist legislation and directives that define commercial online activity; met and socialized with new people.

The overall assessment of the project, including evaluation of the courses offered is described in detail in the relevant deliverable of the project, available at http://revit.cti.gr/. It included questionnaires for the students, participation in a (multinational) focus group at a conference at the end of the project and a directed interview with all tutors (also available at the web site for registered users).

We reconsider ways to introduce the e-shop platform earlier in the course, so that learners complete the parameterization of their e-shops in an incremental manner along with the topics introduced during weekly synchronous sessions. It is expected that in this way, they would have time to reflect, review and evaluate their design.

ACKNOWLEDGMENT

This paper has been partially supported by the REVIT project (143664-LLP-1-2008-1-GR-KA3-KA3MP) funded by the Lifelong Learning Program of DG Education and Culture, EUC.

REFERENCES

[1] C. Beard, C. and J. P. Wilson, The Power of Experiential Learning, Kogan Page, London, 2002.

[2] M. Csikszentmihalyi, Flow, The Psychology of Optimal Experience, Harper Collins, New York, 1998.

[3] Ch. Dede, "Constructivist Learning Environments: Immersion in Distributed, Virtual Worlds," in: Constructivist Learning Environments: Case Studies in Instructional Design, B. Wilson, Ed. Educational Technology Publications, 1996, pp. 165-177.

[4] M. Fetscherin, and C. Lattemann, "User Acceptance in Virtual Worlds," in: Journal of Electronic Commerce Research, vol. 9, no. 3, 2008, pp. 231-242.

[5] S. L. Howell, P. B. Williams and N. K. Lindsay, "Thirty-two Trends Affecting Distance Education: An Informed Foundation for Strategic Planning," in: Online Journal of Distance Learning Administration, vol. 5, no. 3, 2003.

[6] P. Jarvis, Adult Learning in the Social Context, Croom Helm, London, 1987.

[7] D. C. Kayes, "Experiential learning and its critics: Preserving the role of experience in management learning and education", in: Learning and Education, Academy of Management, vol. 1, no. 2, 2002, pp. 137-149.

[8] D. A. Kolb, Experiential Learning: Experience as the Source of Learning and Development, New Jersey: Prentice-Hall, 1984.

[9] M. Ma, and R. Agarwal, "Through a Glass Darkly: Information Technology Design, Identity Verification, and Knowledge Contribution in Online Communities," in Information Systems Research, Informs, Maryland, 2002, pp. 42-67.

[10] A. P. McAfee, "Enterprise 2.0: The Dawn of Emergent Collaboration," in: Management of Technology and Innovation, vol. 47, no. 3, 2006, pp. 21-28.

[11] D. J. Pine, D.J. and J. H. Gilmore, "The Experience Economy: Work is Theatre and Every Business a Stage", Harvard Business School Press, Boston, 1999.

[12] D. Porter, "Innovations, Trends, and Creativity in Distance Learning," in: Proceedings of 4th International Congress on Education and Technology – Inter-American University of Puerto Rico, 2006, p. 2.

[13] E. von Glasersfeld, "A constructivist approach to teaching," in Constructivism in Education, L. P. Steffe and Gale Eds. Hillsdale, NJ: Erlbaum, 1995, pp. 3-15.

[14] J. Walker, "Through the looking glass," in: The Art of Computer-Human Interface Design, B. Laurel, Ed. Addison-Wesley, 1990, pp. 213-245.

[15] P. Watzlawick, J. N. Beavin, and D. D. Jackson, "Pragmatics of Human Communication: A Study of Interactional Patterns, Pathologies, and Paradoxes," Published by W. W. Norton and Co/NY, 1967.

[16] W. Winn, Learning in Virtual Environments: A Theoretical Framework and Considerations for Design, Educational Media International, Washington, USA, 36: 4, pp. 271 — 279, 1999.

V. APPENDIX A: OVERALL DESCRIPTION OF THE E-COMMERCE COURSE

Title: Introductory Course in E-Commerce

Type of Course: International Course (initially offered in Greece and Cyprus, translated in English and localized for Bulgaria)

Dates: 18/01/2010 – 10/05/2010 *(every Monday, in total 14 weekly one-hour synchronous meetings in the form of tutorial discussions)*

Short Description: The main aim is for trainees to experience through appropriate educational activities, the direct marketing of their products and services using the Web, selling their products and services through the Web and facilitating some of their business processes with the help of a Web-enabled tool. The objectives of this course in detail are as follows:

Knowledge

- Use web tools to identify competitors' offers and customers' needs.
- Define and describe the processes involved in electronic business. Identify and evaluate different web advertising methods (i.e. banners, paid ads, online coupons, promotional emails etc)**.**
- Identify the critical success factors in e-commerce (ways to support communications, trust enhancing methods, etc).
- Become aware of the challenges involved in e-commerce and become familiar with best practices to overcome them. Understand fundamentals of logistics related to the distribution of physical products. Become aware of legal and ethical obligations regarding direct marketing and e-commerce.
- Get familiar with the process of parameterization of a prototype and the reference to a framework that can be used to evaluate alternative e-business implementations.
- Become familiar with funding/sponsoring possibilities to support future e-business initiatives.

Skills

- Search the web for products and services relevant (i.e. similar or complimentary) to their own and evaluate them from a marketing perspective.
- Identify the principles of their electronic retailing (e-tailing) strategy for products or services.
- Promote and advertise a site.
- Describe their own business and e-business needs
- Customize (parameterize) a template application program to derive their e-business implementation.
- Evaluate alternative e-business prototypes for their company and decide based on a structured framework.

Attitude

- Adopt a positive, yet realistic, attitude towards e-business, acknowledging its potentials and limitations.
- Form a well-informed attitude relevant to their company's needs and priorities, their effectiveness, complexity, advantages, limitations and overall feasibility.

A. Teaching and Learning Methodology

Each week there were: a **synchronous** *(1-1.5 hours)* session through the use of Elluminate and **asynchronous**

learning activities *(2-3 hours)* developing e-Commerce skills. A typical synchronous session would include:

Welcome (5'-15'): the participants try to login the synchronous Elluminate application and check the functionality of their speakers and microphone. Tutor welcomes the participants, asks questions about the assignments and tries to prepare the field for the class to begin.

Introduction (15-30'): The tutor gives an introduction on the topic of the day, prepares the class slideshow and makes some questions in order to begin a discussion with trainees, encouraging their participation.

Practice (30'-40'): Tutor shares his Internet browser or his desktop, so everyone can have access to his material. Based on the theory and tutor guidance, participants try to execute live some exercises and examples. Normally this procedure brings up questions which are discussed during the class. In most cases, learners have personal examples to share in order for the material to be easier understood. The communication with trainees is effected through voice or chat.

Assignment (5'): At the end of the class, tutor gives directions to learners about their weekly assignments. The assignments are located in the Moodle part of the Revit portal and most of the times learners write their answers or comments in the forum, which is also located in Moodle.

Asynchronous Activities All course material can be found in Moodle so that learners have always access to it. The preferred means of communication for questions and clarifications is the Moodle forum; direct communication with the tutor through e-mail is also possible. Podcasts were prepared corresponding to each week of the course; learners could download and listen to them in several means (mobile phone, car, personal media player etc.).

Participants' Profile:

IOS : 2 participants *(1 male and 1 female)*
PALAICHORI : 6 participants *(1 male and 5 female)*

Some of the learners owned a local business and some of them were having unrelated jobs (such as teachers or courier employees). They all wanted to attend the course in order to create an e-commerce site or expand electronically their activities. They had experience on how the use of Elluminate, since they had completed the Introductory Revit course on Internet Services.

Activities

The activities designed for the learners were flexible enough to match their capabilities and broad enough to relate to a large part of the "theory". Examples include:

- Use of search engines to locate competitors and products Identification and description of online ads.
- Drafting the questions for a customer survey
- Creating an online questionnaire
- Listening to the discussions (podcasts) and posting comments in the forum
- Registering in an online market and search for products related to own or projected business.
- Use of the web to organize own vocation.
- Design, Creation and parameterization of an e-commerce site.

Learners were following class material and tutor's guidance during synchronous sessions. In asynchronous sessions didn't spend much effort so we were trying to solve any problem during the synchronous sessions. Some extra Elluminate meetings were made in order for learners to understand some course issues.

Platforms Used

Elluminate Live™ v.10, Moodle v.1.9.4, Web 2.0 tools (wikis, blogs, podcasts and RSS feeds) Joomla™.

The overall structure of the course follows. Sections are denoted by a three level notation, in the style of Section k.l.m. The first level (i.e. k) refers to the lesson during which it was delivered. The second (i.e. l) refers to the learning objective addressed and the third one (i.e. m) relates to the learning activity that supported the learning objective.

Section 1.1.1 "Exploring The Business Environment – Look Up Competition": Participate in an online session and use Google and Hakia search engines to search for competitors, substitute products or services.

Section 1.2.1 "Exploring The Business Environment – Search Engines": Discuss in the forum the cases when popularity-based search engines are the preferred choice. That is when the desired result is described well by a set of keywords.

Section 1.2.2 "Exploring The Business Environment – Assignment On Search Engines": Use a popularity based search engine (i.e. Google to search for something related to your business (i.e. products/services offered in your region similar to yours). Repeat the search with another search engine (i.e. Bing). Add your comments in the forum.

Section 1.2.3 "Exploring The Business Environment - Learn About Semantic Web Or Web 3.0": Have you ever encountered a case in which the selected keywords could not yield the desired results in a search engine? If yes, try to characterize such cases. If not, try the following case: During one of her visits in Bulgaria, one of the contributors tasted a white wine that a delicate flavor of roses in its bouquet. It was explained to her that this is due to the fact that vines absorb aromas from their surroundings and this particular vineyard was neighboring to cultivation of roses. Unfortunately, she cannot recall the name of the wine, although she recalls that the bottle had an elongated shape with downward spiral edges and greenish kind of etiquette.

 ISBN: 978-1-61208-120-5

Can you find this wine based on this description? Add comments in the forum.

Section 1.2.4 "Exploring The Business Environment – Assignment On Semantic Web": Visit www.hakia.com which is an ontological search engine based on Web 3.0 technologies. Use the phrase "Bulgarian wines with floral aroma" Can you locate it? The third link gets you to www.alibaba.com and although not helpful at this point the trainees should make a mental note about it and we'll get back to this marketplace later. Add your comments in the forum.

Section 1.2.5 "Exploring The Business Environment – Business Environment Analysis": Use various search engines to collect as much information on the products and services they offer and use web assessment tools to evaluate their online presence.

Section 1.2.6 "Exploring The Business Environment – Business Environment Analysis Discussion": Discuss the analysis you have conducted in the forum.

Section 2.1.1 "Getting To Know What your Customers Want And How to Reach Them": Participate in an online session and do the following tasks: Use the Feedmil search engine to search in social media for customers' perceptions and views. Discuss how it could be important to your business. Visit the website of a national newspaper or a news portal and identify the ads. Go on www.facebook.com and visit your Profile or the Profile of your tutor and identify the ads. Visit www.google.com and search for a keyword and identify the ads. Visit www.youtube.com and watch a video and identify the ads and the major differences from the previous cases. (Explore different methods of soliciting customer's views and preferences. Use a variety of web advertising and online promotions to reach your customers. Understand how to measure success of these promotional alternatives.)

Section 2.2.1 "Getting To Know What Your Customers Want and How To Reach Them - Marketing Fundamentals": Use podcasts to learn the theory on Marketing Fundamentals.

Section 2.2.2 "Getting To Know What Your Customers Want And How To Reach Them – Conduct a list of questions": Use a text editor and type some questions you would like to ask your customers (demographics, preferences, suggestions etc)

Section 2.2.3 "Getting To Know What Your Customers Want And How To Reach Them – Advantages And Limitations of Web Advertisements" Use the 7 diffs and sims game approach to discuss the web over traditional media.

Section 2.2.4 "Getting To Know What Your Customers Want and How To Reach Them - On-line Ads": Use podcasts to learn the theory on on-line ads.

Section 2.2.5 "Getting To Know What Your Customers Want And How To Reach Them – Search On-line Ads": Search ads and display ads.

Section 2.2.6 "Getting To Know What Your Customers Want And How To Reach Them – Evaluate On-line Ads Assignment": Which would you consider as your first choice?

Section 3.1.1 "Getting To Know What your Customers Want And How To Reach Them – Online Survey": Participate in an online session and do the following tasks: Use the list of questions you prepared at home and a web-based survey tool to create a preliminary online survey to solicit information your customers. Consult http://groups.yahoo.com and explore how you can use Email to send emails to your customers

Section 3.2.1 "Getting To Know What Your Customers Want And How To Reach Them - Online Survey": Use a web-based survey tool (as demonstrated in class) and enhance the online survey for your customers. Email the link of your survey to a few customers/friends/family members and ask them to answer the questions.

Section 3.2.2 "Getting To Know What Your Customers Want And How to Reach Them - Online Survey": Solicit their feedback on the questions. Change questions, Add or remove based on the feedback you receive.

Section 4.1.1 "Getting to Know What Your Customers Want And How To Reach Them - Products And Services Promotion": Participate in an online session and do the following tasks: Visit www.coolsavings.com. Describe how products and services are promoted. Discuss ways to solicit answers from your customers for your survey questions. Update your survey

Section 4.2.1 "Getting To Know What Your Customers Want And How To Reach Them - Products And Services Promotion": Use podcasts to learn about the theory on Web Advertising and become familiar with the terminology and the concepts.

Section 4.2.2 "Getting To Know What Your Customers Want And How To Reach Them - Products And Services Promotion": You are given a budget of 1000 Euros for promotion of your company for the next three months. What would you do with it. Defend your choice.

Section 4.2.3 "Getting To Know What Your Customers Want And How To Reach Them - Products And Services Promotion": Use podcasts to learn about the theory on promotions, online events and attractions.

Section 4.2.4 "Getting To Know What Your Customers Want And How To Reach Them - Products And Services Promotion": Get in groups of 2-3 and organize an online event for your region. Present your ideas in class. Vote for the best plan and start implementing it.

Section 5.1.1 "Electronic Commerce Part I: Tangible Products" Participate in an online session and visit e-commerce sites that sell tangible products. Discuss advantages and limitations of conventional vs. online setting.

Section 5.2.1 "Electronic Commerce Part I: Tangible Products": Study the material on e-commerce.

 ISBN: 978-1-61208-120-5

Section 5.2.2 "Electronic Commerce Part I: Tangible Products": Study the material on disintermediation, channel conflict, re-intermediation.

Section 5.2.3 Electronic Commerce Part I: Tangible Products": Get to www.alibaba.com register (it is for free) and put up sales lead for your local products (or ask for buying leads for products that you need for the functioning of your business.

Section 6.1.1 Electronic Commerce Part I: Tangible Products Shipping And Handling": Participate in an online session and Visit several different sites, place an order for several different products and see how shipping and handling issues are handled. Study their returns policy. Discuss payment methods. Refer to security aspects.

Section 6.2.1 "Electronic Commerce Part I: Tangible Products Shipping And Handling": Study the material on lessons learned and success factors for e-commerce sites.

Section 6.2.2 "Electronic Commerce Part I: Tangible Products Shipping And Handling": Discuss in the forum your concerns on shipping and handling.

Section 7.1.1 "Electronic Commerce Part II: Services" Participate in an online session and plan a trip. Visit an on-line travel agent. Reflect upon needs/desires that have not been satisfied by such sites. Use a destination management system such as www.visitbritain.com/ What other features could you get from a destination management system?

Section 7.2.1 "Electronic Commerce Part II: Services Travel Agent Services" Organize your trip using at least 3 of the suggested travel agent sites.

Section 7.2.2 "Electronic Commerce Part II: Services Travel Agent Services" Discuss in a forum advantages and limitations on travel online services. Which is your favorite?

Section 8.1.1 "Electronic Commerce Part II: Travel Agent Services": Participate in an online session and discuss about your experiences on travel online services. Use special-purpose Web 2.0 tools (www.wayn.com or www.tripadvisor.com) to see how travelers share tips, recommendations and advice. Discuss your findings. Based on the analysis of your fantasy trip, now identify points of interest, historical sites, local products (oil, wine, aromatics herbs etc) and/or establishments (vineries, olive mills, crafts, arts etc) special treatments or spas,, that can be complementary to your business and may be referred and used as marketing tools to promote your services (i.e. to extend the length of visits for guests). You may get information and inspiration from regions like Napa Valley in California or Provence in France. Discuss your ideas (30 minutes).

Section 8.2.2 "Electronic Commerce Part II: Travel Agent Services": Study reading material on travel and tourism services online and Zaragoza case study.

Section 9.1.1 "E-environment": Participate in an online session to learn on Data Protection and Privacy issues as well as issues related to the contract law, that is, information on i) The company identity including address; ii) The main features of goods or services; iii) Prices information including tax and, if appropriate, delivery costs, iv) The period for which the offer or price remains valid; v) Payment, delivery and fulfillment performance arrangements; vi) Right of the consumer to withdraw (i.e. cancelation terms); vii) The minimum duration of the contract and whether the contract for the supply of products or services is to be permanent or recurrent, if appropriate; viii) Whether an equivalent product or service might be substituted and confirmation as to whether the seller pays the return costs in this event. Compare the derived policies and negotiate solutions. Visit site www.out-law.com /page - 430 for more details. Visit the www.w3.org/WAI site and get to know accessibility issues, the Accessibility Law and guidelines to avoid common accessibility problems.

Section 10.1.1 "E-environment": Participate in an online session. Get to understand how the legislation on Intellectual property rights (IPR) (2001/29/EC) extends to Internet i.e. through infringement of content (see for example www.copyscape.com) or misappropriate replication of patented tools (i.e. Amazon's patented "one-click" purchasing option. Get to understand issues related to tax jurisdiction (Council Directive 2002/38/EC and Council Regulation 792/2002) on how Value Added Tax (VAT) was to be charged and collected for electronic commerce. List to the podcast to learn how the business plan of nau.com and how it differs from its competitions. Visit www.nau.com to see how the concepts have been implemented in practice.

Section 10.2.1 "E-environment – European Union": Listen to the podcast to understand what the European Union Act 2002/58/EC Directive on Privacy and Electronic Communications means in practice.

Section 11.1.1 "Implementation And Evaluation Of An E-commerce Site": Participate in an online session Visit www.useit.com. Learn about the Usability Heuristic Evaluation as outlined in Nielsen (2000). Select an e-commerce site and apply the Usability Heuristic Evaluation. Discuss the results.

Section 12.1.1 "Implementation And Evaluation Of An E-commerce Site": Participate in an online session. Use the implemented prototype and learn how to parameterize its attributes.

Section 12.2.1 "Implementation And Evaluation Of An E-commerce Site": Work on the prototype and complete your parameterization.

Section 13.1.1 "Implementation And Evaluation Of An E-commerce Site": Participate in an online session. Present your parameterized prototype. Each student may select someone else's e-commerce prototype and apply the usability evaluation heuristics to identify advantages and limitations. Discuss the results in the forum (1 hour).

Section 14.1.1 "Implementation And Evaluation Of An E-commerce Site": Participate in an online session. Questions and Answers. Explore funding opportunities for e-commerce development for each country.

 ISBN: 978-1-61208-120-5

The Automatic Evaluation Testing

Tasks with graphics character

Martin Němec, Radoslav Fasuga
Department of Computer Science
VŠB – Technical University
Ostrava, Czech Republic
martin.nemec@vsb.cz, radoslav.fasuga@vsb.cz

***Abstract*—With the further development of computer technology, the non variant test question with automatic evaluation has been gradually applied at schools and universities, which positively reduces the work volume of teachers and demonstrates a proper way to test students. The primary aim of this paper is to describe the methods and algorithms for determination of equivalency and similarity rate of tasks' graphic outputs in learning management system. Among the analyzed types, there are tasks the result of which is a graph of corner-edge type, logic circuit, geometric construction or graphic behavior of function of one real variable. We performed more than 2,000 student's final tests that confirm the applicability of our solutions.**

Keywords-logic diagram similarity; geometric constructions similarity; function behavior similarity; automatic testing; e-learning

I. INTRODUCTION

Nowadays, information technologies are used more frequently in the educational process. There are several reasons for the phenomenon. The rising number of the computers and the Internet access creates a very easy way of getting information from the Internet and consequent eventual comparison of these information with other students. Use of computers in all methods of education helps to improve understanding of the created teaching materials and also allow students to involve and use several senses into the training process.

A Knowledge Testing is part of the training process. Nowadays different learning management systems (LMS) enable us to create tests with online assessment [1]. These tests are mostly textual and once we need to include the graphic questions (charts, diagrams, electrical circuits, etc.) the tests can be used in a very limited form or unusable at all [2][3]. Another possibility is using the external programs but they usually have some compilation issues with LMS and do not have automatic scoring feature [4][5]. They can mostly be used as tools for practical experiments only, not for testing.

Our aim is to introduce the tool that includes modules for processing some of the graphic tasks. These modules extend the LMS to the possibility of testing the graphic tasks and allow analyzing them automatically.

II. STATE OF THE ART

Defining the main educational goals is very important part of the whole educational process. The aim of education is a characteristic change of the student which should be generally achieved during a certain period of time (once the student has passed the training) [6][7].

In the most of the cases, the Bloom's taxonomy of educational objectives is considered as a basis. The original Bloom's Taxonomy divides educational objectives into three domains (Cognitive, Affective and Psychomotor).

The new revised Bloom's taxonomy (Fig. 1) is aimed just for a cognitive domain as the complex domain. This domain is prefered by lectors. The revised Bloom's taxonomy divides the educational goals into six basic groups [8][9].

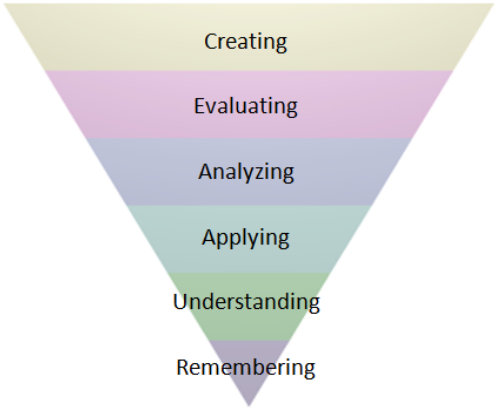


Figure 1. The new revised Bloom's Taxonomy

Bloom's Revised Taxonomy:

1. Remembering: can the student recall or remember information?
2. Understanding: can the student explain ideas or concepts?
3. Applying: can the student use information in a new way?
4. Analyzing: can the student distinguish between the different parts?
5. Evaluating: can the student justify a stand or decision?
6. Creating: can the student create new product or point of view?

 ISBN: 978-1-61208-120-5

It is necessary to test and automatically evaluate more sophisticated knowledge than remembering only because we need to know whether the student can understand, apply, analyze, evaluate and create individual problems (Fig. 1).

A. *Testing*

Examination process is one of the most important parts of the whole educational system. Examination is used for checking the students' acquired knowledge, but it is also the direct part of educational process. Furthermore, the testing is taking advantage at all six points of Bloom's taxonomy.

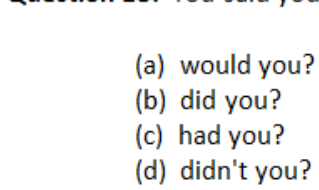


Figure 2. Sample of text variant question

Variant questions are the most common way of testing nowadays (Fig. 2). Mostly the way of testing is especially suitable for testing at the first area, such as memory testing of a small group of people. Memory testing in a big group of people by the method of variant questions is usually very hardly achievable, mostly impossible.

Another way of testing are simply made with questions that allow to the author to achieve the specific inquiry where students have to create their own answer such as number, vector, character string, etc.

The students have to make the solution by themselves not choosing it from the represented pictures as it happens in the case of the variant questions. Unfortunately, simply made questions are mainly suitable to present the result in the text form.

The special types of the pictures with graphical form are very infrequently or almost never used. The example of these kinds of questions may be assembled like a different schemes based on the principles of diagrams. Examples of such types of questions may be putting together the various schemes based on the principle of the charts. This includes the UML diagrams, ER diagrams, etc. An example of such a diagram is shown in Fig. 3.

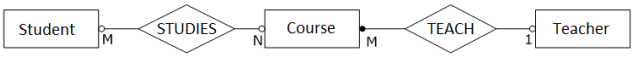


Figure 3. Example of E-R diagram

This type of graphic questions is quite like the variant answers. The student has to select the correct answer from several variants (Fig. 4). The variant tests are widely used today, but this type of testing is good for memory testing only, not for other Bloom's groups (Understanding, Applying, Analyzing, Evaluating and Creating) (Fig. 1). And these educational goals are more important than remembering.

When we want to test these educational goals, we need to make students creating their own graph, diagram, circuits, etc. And we want as well the results to be evaluated automatically.

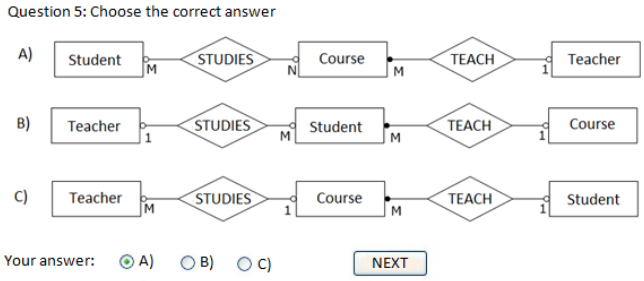


Figure 4. Example of a graphic question with variant answers

Our aim was to prove that these types of graphics tasks can be automatically evaluated with a properly created algorithm and with support of software environment.

As each of the tasks may have different features and algorithms, the individual test modules have been created, which can be practically applied and tested in education process.

III. TESTING MODULES

Currently, we have to verify the functionality of the developed and tested modules, which can be divided into four categories. The result of this work is to verify the use of the test modules in practical teaching process.

Students have to create their answer using the module with graphics interface in a Learning Management Systems (LMS), like Blackboard [10], WebCT [11], or Moodle [12].

A. *Tasks with graph result*

In practice we face the tasks of which the result solution is a graph (node-edge type). This means that the result is a graphical task consisting of a variable number of nodes and edges of different types.

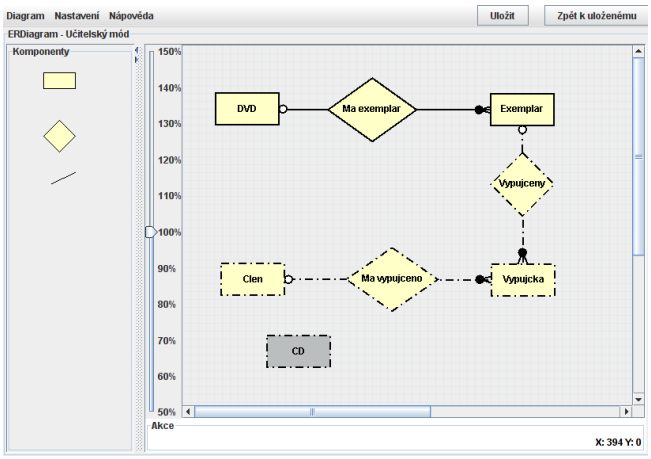


Figure 5. Screen shot of testing module for ER diagrams

The example of the task can be database's theory in ER-Diagram, UML diagram, the diagram in SW engineering, etc. The problem arises when we need to check these two solutions and figure out if the solutions are equal or similar to each other. The basic problem of comparing these tasks is their independency on position in a graphical placement of chart elements.

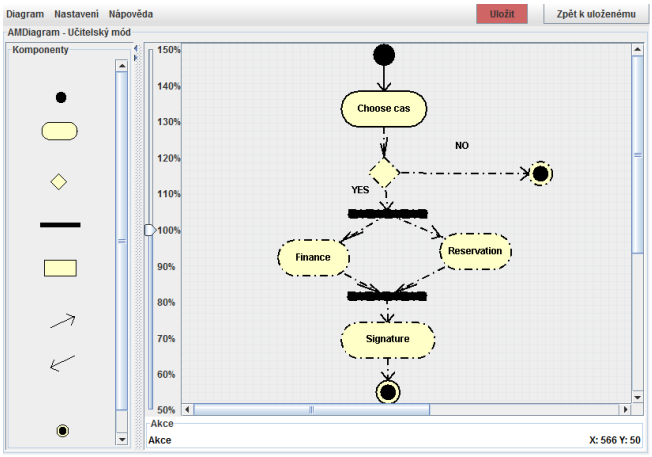


Figure 6. Screen shot of testing module for UML diagrams

Two different-looking graphics tasks can be logically identical. One of the goals of this work is to find out methods and their corresponding algorithms, which allow evaluating these type-task results and comparing the resulting degree of similarity between two tasks results.

The main principle of automatic evaluation is to separate a result, which is represented as a node-edge diagram into two sets. The first set includes nodes and the second set includes edges.

Some limits enabling identification of particular objects are essential to be able to evaluate the tests results automatically that´s why the author has to create a set of names that contains a variety of node names. Not only the set may include the correct nodes, but also the names that are not need for a correct result; these names can be used for creating more difficult questions.

As the first step, the algorithm evaluates set of nodes with their attributes between original graph A (created by a teacher) and evaluation graph B (created by a student). After the algorithm evaluates the nodes, it takes the set of edges. All edges have self attributes and two nodes. Once we have all the sets evaluated, we can calculate the final similarity.

We use the following equation for evaluating (1), where n(x) is the set of edge weight, e(x) is the nodes weight, O(X) is the number of elements and d(A,B) is the measures of graph similarity [10].

$$d(A,B) = 1 - \frac{\sum_{i=0}^{p}\sum_{j=0}^{r}\left|(n(u_i) - n(v_j))\right| + \sum_{i=0}^{q}\sum_{j=0}^{s}\left|(e(u_i) - e(v_j))\right|}{\max(O(A), O(B))} \quad (1)$$

The sample modules for testing graph results are shown in Fig. 5 and Fig. 6.

B. *Tasks for testing circuit simulation*

In some areas, such as logic circuits, electrical circuits, etc., a similar problem occurs as with the graph. Two circuit diagrams are given and our aim is to compare these schemes to find the accurate connection.

In this case it is not possible to use a similar principle as the comparison in the previous case, as two circuits having the same characteristics, but different connection may exist.

According to the selected type of scheme, there are various circuit elements: resistor, coil capacity, power, etc. are for electric circuits. The logic gates have different types (none, AND, OR, NAND, etc.).

However, accuracy of the connection depends on accuracy of the circuit input and output.

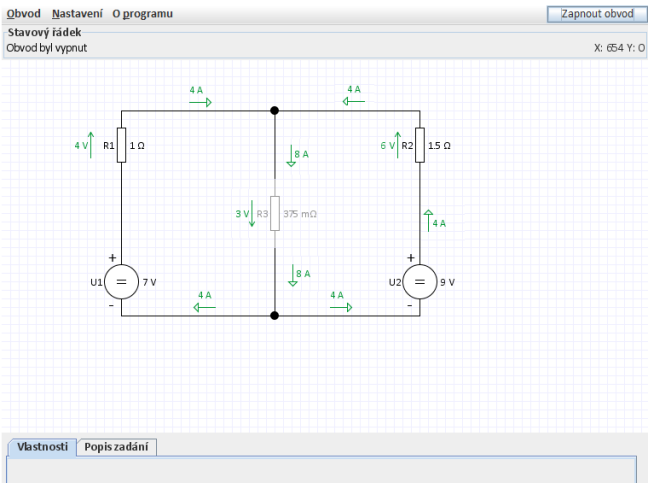


Figure 7. Screen shot of testing module for electric circuits

Nowadays, there are professional tools for simulating the circuits including the setting characteristics of separate variables on the relevant parts exist, unfortunately, the tools are not intended for learning purpose and require specific knowledge of the field. As a result they can't be used for familiarizing the students with the subject.

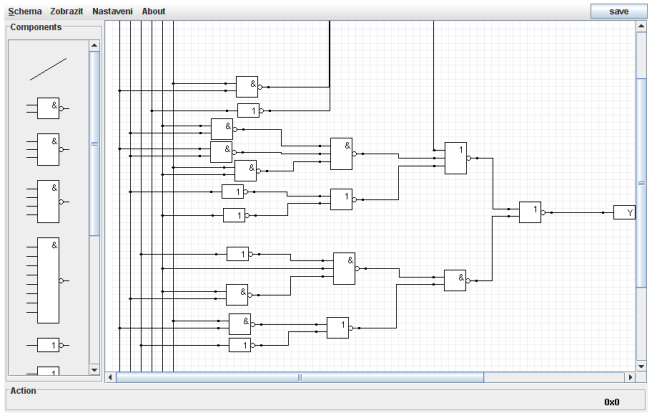


Figure 8. Screen shot of testing module for logical circuits

The main principle of evaluation is a conversion of the graph into the truth function for logical circuits [14] or function for analyzing electric circuits [15]. We evaluate and compare the student's final function and teacher's function.

We use the equation (2) for evaluation, where y_i is the value of the student's function (truth table) and z_i is the value of the teacher's function. The aim is to meet the target primarily on opportunity of automatic testing and valuation of the received information.

$$d(A,B) = 1 - \frac{\sum_{i=0}^{2^k-1} |(y_i - z_i)|}{k}, \text{ for } k=max(n,m) \quad (2)$$

Our module can not only test electric circuits and combinational logic circuits, but also sequential logic circuit [14]. The sample modules for testing circuit simulation are shown in Fig. 7 and Fig. 8.

C. Tasks for geometric construction

For teaching subjects such as mathematics, geometry, descriptive geometry, computer graphics, etc., it is necessary to compare the tasks based on the geometrical structures, for which several ways of solution exist. It means that our next researched area is the comparison of equivalence of geometric structures.

Design task represents a set of graphical objects (point, line, plane, etc.) and a number of construction methods (e.g. calculating the intersection of two lines). The whole design task can be divided into following sages – the given objects, the results of single design steps, and the result – the final objects.

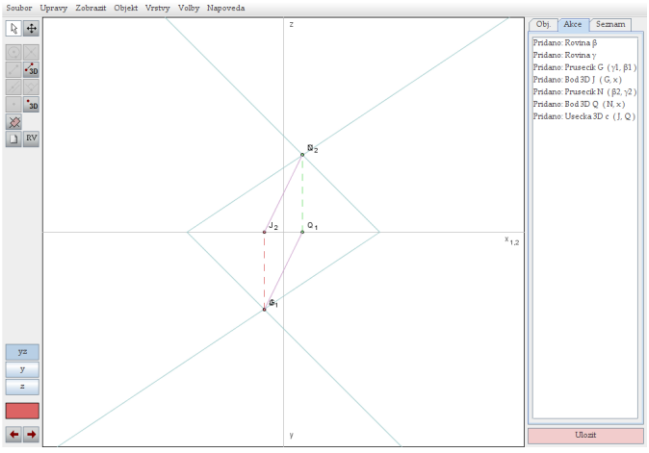


Figure 9. Screen shot of testing module for descriptive geometry

Examples of such types of tasks are geometrical constructions in descriptive geometry and computer graphics, for example the constructions in Monge projection, in axonometry, in oblique projection, etc.

We can evaluate similarity with equation (3), where $v_{A,i}$ is the set of student's construction steps and $v_{B,i}$ is the set of teacher's constructions steps. In our case we focused on the Monge projection only because general description of each type of projection would be very extensive and it is not necessary for the resulting functionality [16].

$$d(A,B) = 1 - \frac{\sum_{i=0}^{n} |(v_{A,i} - v_{B,i})|}{n} \quad (3)$$

The sample module for testing geometric procedures is shown in Fig. 9. We prepare next modules for other projections (axonometric projection, perspective projection and others).

D. Graphic behavior of function of one real variable

Investigation of graph of the function defined by the functional quote y = f (x) is one of the mathematics subjects. In this case the task is to calculate the function properties based on the function quote (landmarks, the intervals of monotonicity, etc.) and use these properties to outline the resulting graph of this function [17].

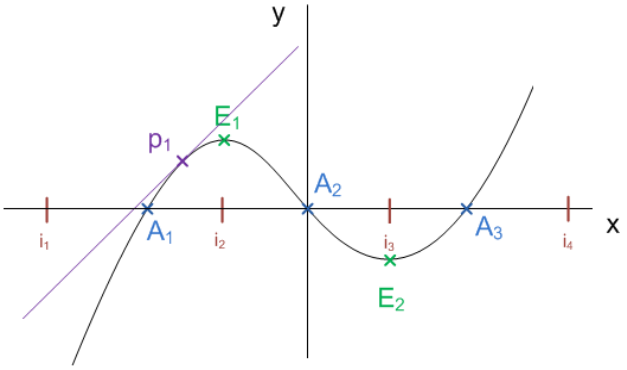


Figure 10. A Graph of example function

The Fig. 10 shows an example of the real function of the function f with some elements (points A1, E1, p1 tangent, the end points of major intervals i1, etc.) demonstrating the basic properties of the investigated function. In general, there are the following characteristics such as roots, extreme, inflection points, boundedness etc. The attributes are used to describe the three basic types of elements.

Basic elements for characterization:

- Point – roots, intersections, extremes, etc.
- Interval – interval of function increasing or decreasing, etc.
- Lines – asymptote, tangent line, etc.

The determining of the graph is based on the properties, calculated from the specified function y = f (x). Student will investigate the resulting graph and draw it manually, based on the properties.

 ISBN: 978-1-61208-120-5

Figure 11. Screen shot of testing module for graphics function

$$d(A,B) = 1 - \frac{\frac{\sum_{i=a}^{b} |(f(i) - (m_i \pm \delta))|}{|b-a|} + \frac{\sum_{i=0}^{n} |(p_i - (r_i \pm \sigma))|}{n}}{2} \quad (4)$$

The evaluation equation compares distance of the accurate graph with the student's graph approximate curve (4).

The final level of similarity is calculated as the deviation of the student sketched curves, comparing actual progress on the specified interval <a,b> with accuracy δ. If the graph contains a set of characteristics (roots, intersections, extremes, etc.), we have to compare this set too. The sample test module for testing the function is shown in Fig. 11.

IV. MODULE PROPERTIES

All generated test modules can be run in three basic modes:

- Author's Mode - The module runs to allow the author to create specifications and sample solutions of the tasks.
- Student's Mode - This mode enables students to create their own final solution.
- View Mode - In this mode the module is configured to display the final solution without the possibility of intervention into the solution. Student and tutor can view the student's created solutions. It can also display the correct solution to the student (e.g. during self-testing process).

The author has several kinds of evaluations:

- Absolute evaluation – server evaluates full resulting and evaluated task as absolutely correct or not.
- Percentage evaluation – author can define percent evaluation and server evaluates proportional result.

Primary benefits include the following:

- The proposed algorithms can be tested by the students not only for memorizing the learning material but practically at all levels according to Bloom's taxonomy (remember, understand, apply, analyze, evaluate and create).
- Everything can be processed using LM systems electronically and transparently, which also allows you to get a feedback (which part of education is the most difficult for students).
- Tutor has no need to evaluate the tests results manually anymore. The modules and process will evaluate the tests automatically and display the correct results to the students.
- Students accessing from the Internet can verify their knowledge anywhere and any time. Moreover, as it has already been mentioned, testing is a direct part of the process of teaching.

A. *The use of testing modules in LM systems*

Test modules is planned to be implemented in the LM systems and design of the modules is adapted for this installation [10][11][12].

It is necessary to define the format of data for their transferring between different applications and server, processing and storing. This format should be adaptive for possible changes, suitable to transfer data via Internet and also for processing within the test modules.

Use of LM systems has the essential advantages:

- Easy creating and defining of the tests.
- Clarity on the test details (when, who performed the test, score, duration, number of attempts, etc.).
- Easy storage and archiving of all activities using the database.
- Statistical evaluation of past tests that can help to reject the inappropriate tests (a small percentage of correct solutions).

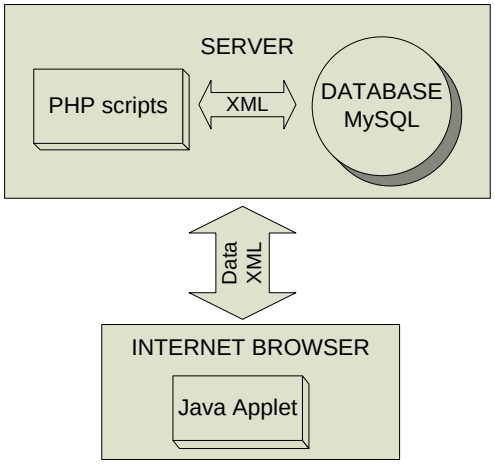


Figure 12. Modules communications

All communication and data processing scripts are created in PHP but they can always be modified for other languages, e.g., ASP. Setting of the modules properties using a few basic parameters is part of module building-in process into the LMS. With these parameters the basic features such as an identification key chart type, mode of diagrams, and way of storing and retrieving data are set. The build-in module with setting is shown in Fig. 12.

 ISBN: 978-1-61208-120-5

Current test counts are written in Table I. We have two types of tests. Final test must be completed by a student before in the end of a semester. Practical test may be completed by a student throughout the whole semester several times.

TABLE I. TABLE OF TEST COUNTS

Number of tests counts		
Type of tasks	***Practice test count***	***Final test count***
Module for testing ER diagrams	1000	1000
Module for testing UML diagrams	1000	1000
Logic circuit	200	50
Geometric construction	100	20
Graphic behavior	100	30

In the testing, we performed more than 2,000 real final tests in education that confirms the applicability of the various modules in teaching.

V. CONCLUSION AND FUTURE WORKS

Our goal is to show that the opportunity of automatic testing is not limited on using variant and simply made questions. It is possible to carry out the automatic check of graphic tasks if the objects are properly described.

The design and implementation of the graphic testing modules for chosen areas demonstrates its big contribution to training automation sphere. This type of education is very practical a useful for both tutors and students. With a help of these modules, we can extend our possibilities of automatic evaluation. Now we don´t need to use the variant questions only because we can require such type of questions as “Create the diagram”, “Correct the electric circuit”, “Connect logical circuit”, “Draw construction of Monge projection” and others.

In the future we are planning to work over other types of graphic problems to demonstrate opportunities of such a special type of tasks.

REFERENCES

[1] H. T. Huo, "Study on the Function of Test Paper and Questionnaire in Moodle Course", Proc. International conference on modeling and simulation, May 2009, pp. 271-274.

[2] Z. Xiaochun, Z. Bo, L. Juefeng, and G. Qiu, “A test automation solution on GUI functional test”, IEEE Conference on Software Maintenance, July 2008, pp. 1413-1418.

[3] A. Memon, “An event-flow model of GUI-based applications for testing”, IEEE conference on Software Testing, Verification and Reliability, Vol. 17, September 2007, pp. 137-157.

[4] H. Uzunboylu, "Using dynamic geometry software Cabri 3D for teaching analytic geometry", Innovation and kreativity in education, vol. 2, 2010, pp. 1385-1389.

[5] H. Pesman and A. Eryilmaz, "Development of a Three-Tier Test to Assess Misconceptions About Simple Electric Circuits", Journal of educational research, vol. 103, 2010, pp. 208-222.

[6] B. Bloom, "Taxonomy of Educational Objectives, The Classification of Educational Goals. Handbook I: Cognitive Domain.", New York: David McKay, 1956.

[7] A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom’s Taxonomy of Educational Objectives, edited by L. W. Anderson and D. R. Kraftwohl _Longman, New York, 2001.

[8] C. Johnson and U. Fuller, "Is Bloom’s Taxonomy Appropriate for Computer Science?", Proceedings of the 6th Baltic Sea Conference on Computing Education Research (AICPS ’06), vol. 276, 2006, pp. 120-123.

[9] T. Ho and T. Lee, "Teaching Thinking Skills In E-Learning - Application Of The BLOOM’S TAXONOMY", ITE Teachers' Conference, 2004.

[10] Blackboard Inc, Blackboard Course Management System [online], [cit. 2010-12-10]. Available: http://www.blackboard.com/.

[11] WebCT, Course Management System [online], [cit. 2010-12-10]. Available: http://www.webct.com/.

[12] Moodle, Course Management System [online], [cit. 2010-12-10]. Available: http://moodle.org/.

[13] J. Fournier, "Graph Theory and Applications", France, 2009, ISBN 978-1848210707.

[14] J. Cavanagh, "Sequential logic: analysis and synthesis", CRC/Taylor & Francis, 2007, ISBN 978-0849375644.

[15] K. Charles and S. Matthew, "Fundamentals of Electric Circuits", 4th Edition, McGraw-Hill, 2009, ISBN 978-0077263195.

[16] E. Watts, "Descriptive Geometry", Watts Press, 2008, ISBN 978-1443730006.

[17] L. Graves. "The Theory Of Functions Of Real Variables", Second Edition, Dover, 2009, ISBN 978-0486474342.

 ISBN: 978-1-61208-120-5

A Social Interaction Taxonomy: Classifying User Interaction Tasks in Web Applications

Monika Steinberg, Nicole Ullmann, Jürgen Brehm
Institute of Systems Engineering - System and Computer Architecture
Hannover, Germany
[steinberg, brehm]@sra.uni-hannover.de, nicole.ullmann@fiwii.de

Abstract – **For social web applications, motivated users are an essential part. They create the new (Open) Content that is presented to users. Without ongoing current content such web applications are unviable. Creating and editing content means user interaction upon resources and with each other. It is no surprise that web applications evermore tend to use game design principles to keep their users motivated. In this contribution, a Social Interaction Taxonomy (SIT) is presented that classifies users for any kind of interaction within any kind of web application. For this purpose, we designed a taxonomy which classifies typical activities within web applications to prepare them for global rewarding with points and special awards in the next step. The focus of this contribution lies on the classification of user interoperation tasks in social web applications and the derivation of our taxonomy. It creates the basis for a Global Interaction Rewarding Model (GIAR) via RESTful web services. Web applications, that want to reward their users' activity with points, badges or other prizes in a global and application-independent way, can embed our taxonomy for activity logging with rewarding and the generation of activity stats known from game design (user rankings, level progression, etc.). By applying simple game principles like rewarding points and creating appealing, emotive user experience a "*boring*" vocabulary trainer becomes a vocabulary learning game. Students or other users of such rewarded interaction stay motivated. They easily walk through learning phases because they do not perceive it as learning, but as playing. Next to gaming mechanics, the developed Social Interaction Taxonomy can be embedded into, e.g., web activity monitoring systems to gain classified information about the users' behavior.**

Keywords – Game Design Mechanics; Interaction Taxonomy; User Interaction; Social Media, Web Applications.

I. INTRODUCTION

Since the first days of the World Wide Web, the Web design process is changing. Whereas the first available web sites presented static content to a user, nowadays users are able to interactively create new content. Web design has evolved into web application design, where the internet browser acts as the operating system and web sites act as applications, the user interacts with. As web sites become more and more interactive, principles and methodologies known from ID (interaction design) must be considered during the design process of a web application. One basic principle is that there is not "*the*" solution to a known interface design problem, there are always more solutions, and hence designing interfaces is always an iterative process of building prototypes and testing them with users to validate or dismiss a solution. In the past few years, a new trend can be observed in popular web applications like Twitter [1] or Flickr [2]: using game design principles to motivate respectively encourage users to keep being active within their applications.

The great benefit of games is, that people enjoy playing them (even for hours or days), because it is fun. It is something, they like to do since "*play is something one chooses to do*" [3]. More and more, web applications make use of simple game mechanics, like collecting points or providing leaderboards to "*put the fun in functional*" [4] and by this, keep their users motivated since they perceive the application as a game and have fun using it.

From this, it follows that designers of modern, interactive and engaging web sites must combine tenets from the mentioned disciplines: web design, interaction design and game design. Incorporating even simple game mechanics like rewarding points, leaderboards or level systems causes significant overhead during the design process of web applications. One has to choose, which interactions to reward, develop algorithms and models for leaderboards or level systems and compute activity stats to be presented to the user. The effort for data management rises as one has to manage the content that users create interactively, which is still the main purpose of web applications, and the data needed for applied game mechanics.

In some cases the effort of applying game principles does not pay off, e.g., for short-term online surveys where the main purpose is to aggregate data. But especially for such applications the quantity of data is important and this can only be accomplished by motivated participants. The quality of data is crucial for applications like the qKAI [5] mashup framework, which utilizes Open Content [6] [7] for interactive knowledge transfer and semantic resource annotation. Assessing certain criteria of information quality can hardly be managed automatically because they are of subjective nature, so it is up to motivated users to make statements about such criteria [8]. Utilizing game mechanics without the need to integrate them into an application can be achieved by using an independent global interaction rewarding service that deals with the whole "*game*" administration. One only needs to choose which interactions to reward and integrate corresponding service calls into the

 ISBN: 978-1-61208-120-5

application to be developed. The service manages the interaction logging and rewarding, the evaluation of activity stats like leaderboards, level rankings and other kinds of information that have the ability to encourage people when presented to them. The rewarding service acts completely independent of a specific web application and by this can aggregate activities within different applications a user is active in. This can be used to derive some kind of a global WWW-activity ranking that reflects how active users are on the internet and may motivate them, to be more active in various web applications they have accounts in.

A. Our Contribution

This contribution is based on the master thesis of Nicole Ullmann [9] and her contribution to the qKAI mashup framework [5] [8]. In the following, we propose a Social Interaction Taxonomy (SIT) that classifies typical activities in (social) web applications by type and purpose. Based on this taxonomy we designed a generic rewarding system for user interoperation tasks in web applications that rewards interactions with points depending on the effort to execute them. Beside points users may win awards depending on the number of times, certain interactions have been executed. In addition, the rewarding system regularly determines the most active users within interaction-classes or interaction-skills to reward them with special awards. To overcome the mentioned need to integrate game mechanics into one's web application a RESTful web service [10] has been designed and implemented that enables any kind of application to reward users for being active by simply calling the rewarding service. The web service provides two types of service calls: calls for interaction logging respectively rewarding and calls for activity stats known from game design (leaderboards, level and skill-rankings, progression and gained awards). The focus here lies on game design mechanics and the derivation of the Social Interaction Taxonomy as basis for Global Interaction Rewarding (GIAR) discussed in further publications [9].

B. Structure of this contribution

In Section 2, we introduce some exemplary aspects regarding game design. In Section 3, we describe the derivation of our Social Interaction Taxonomy (SIT) and its interaction classification concept. This contribution ends up with conclusion and outlook in Section 4.

II. GAME DESIGN

Compared to the first existing computer games like Pong [11], nowadays developing (good) games is a complex process. It may take several years from the initial idea to the market-ready product and often involves staff playing different roles like producers, publishers and developers. Also the development process itself may be comprised of several stages like pre-production, production, milestones and post-production. It would go beyond the scope of this thesis to address the game development process in its entirety. So the main purpose of this section is, to give an insight into one sub task of game development: the game design. According to Wikipedia, game design is "*the process of designing the content and rules of a game in the pre-production stage and design of game play, environment and storyline during the production stage*" [12]. Thus, the first two stages of game development deal with game design whereas the milestone stage deals with the development of ascending game versions like alpha, beta and the final release version. The post-production stage deals with game maintenance after it has been released. Before we take a closer look at game design it must be mentioned that the mentioned game development process and its components is just a generic sketch of how to create games and can be found in (most) game developing companies. It varies from company to company and from game to game as it depends on the game type/structure/concept itself, the company's size and its experience with game development but the presented procedure is a good way to create games.

A. Basic Game Mechanics

Games use different mechanics to create an enjoyable game play. There is probably no complete list containing all possible mechanics, but the following five game mechanics, brought together by A. J. Kim [13], have showed up not only to be useful for games, but also for interaction designers creating social software and web services.

Points: Rewarding user interactions with points or the like is a pretty basic but yet a very effective mechanic that almost every computer game uses because they are easy to integrate and may serve as a basis for a lot of other mechanics. Points may be used to assemble leaderboards, which have a great motivational potential, as they tap into people's "*innate competitive drive*" [14]. Game designers need to be aware, that leader board mechanics encourage people to "*game the system*". This colloquially means that they learn how to achieve the highest rankings. Another application of points, are levels that map user's in-game progress or experience. For example, role-playing games use levels to unlock new powers or items. Beyond the game industry, points are often used to strengthen the customer loyalty by making them redeemable, e.g., like Payback [14] (Germany) does.

Collecting: Collecting is very popular, not just with computer games, people collect almost everything: shoes, baseball cards or stuffed animals. When it comes to computer games, people collect weapons, trophies or set items. Completing a set is a highly emotional moment, because it often takes a long time to find all set items and sometimes this never happens, which is frustrating to most players. Collecting mechanics generally have a great engaging factor, because people are happy about things they discover or gain. Especially, in applications or games with a social background, people love to brag about their collection.

Feedback: A. J. Kim's [14] definition of feedback as a game mechanic is quite the same as M. Prensky's [3]

 ISBN: 978-1-61208-120-5

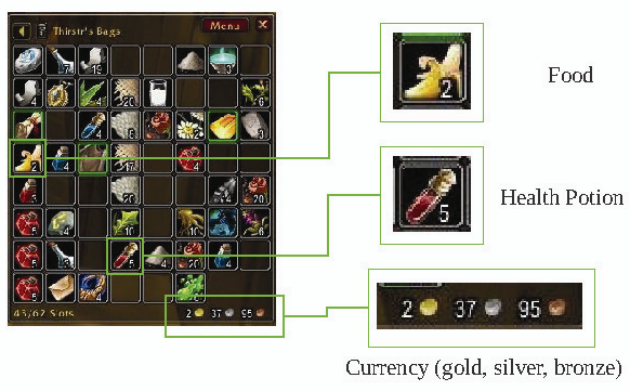


Figure 1. World of Warcraft inventory [21]

definition of feedback as a structural key element: feedback is the basis for player progression. If a game does not provide any feedback on interactions by a player, she does not know how these interactions take effect on her progression or the game play itself but beside this functional aspect of feedback, according to A. J. Kim, feedback makes games "*more fun & compelling*" [9].

Exchange: According to Amy Jo's definition, "*exchanges are structured social interactions*" [14], that can be explicit or implicit (in other words emergent). For example, most massively multiplayer online role-playing games provide options to trade items socially with other players and this trading interaction is explicit. A typical implicit interaction, mostly known from social browser games like Farmville [16], is called "*gifting*" which means that one can make others a present of items they have earned or found.

Customization: Almost every game offers the opportunity to customize it, be it the graphics resolution or the volume of sound effects. Beside this technical customization, players are able to change their in-game character's look, attributes and equipment. The customization may be performed automatically, e.g., by testing a graphics card's performance and an appropriate adjustment of the graphics resolution or by players themselves, e.g., by changing the color of a car in a car racing game.

B. Reward Types

Game designers greatly use their imagination, when it comes to the incorporation of engaging rewards as there are no limits to possible reward types. However, the following, incomplete list introduces typical rewards that can be found in some form or other in most modern computer games [17]. Skill Rewards are used to enable players to improve their in-game character's attributes and/or skills, e.g., increasing strength and vitality in Sacred 2 [18], or anything else that can be enhanced, e.g., technologies in Civilization [19]. Mostly, this is accomplished by rewarding skill points that players can freely distribute on different skills/attributes they possess.

Inherent Rewards are not directly given out by a game. It is the game's innards like graphics or sound that players enjoy, given that the game has a good design. Things like a thoughtful, exciting story or an imaginative, virtual world can be very rewarding and by this enhance the experience of a player.

Resource Rewards can be found in games, where resources play a role and this reward type can be easily included. Typical resource rewards are in-game currencies like gold or coins, resources that are "*essential for survival*" like food or health potions and other types of resources that are required by the game itself, e.g., armor and weapons. These resource rewards can be usually collected and stored in an inventory (see Figure 1).

Extension Rewards are given out if a game can end due to time-limitations or because characters die. The game rewards extra time or extra lives to extend the time a player can spend playing it. A widely known example of extension rewards are those green "*1-up mushrooms*" used in Super Mario Bros [20] to extend Mario's number of lives (see Figure 2).

Figure 2. Mario's 1-Up reward [20]

Accomplishment Rewards in general, are challenges, a player accomplishes in a game. Accomplishing typical tasks in games like leveling up, beating an enemy, answering questions or finishing quests can be rewarding if their degree of difficulty matches a player's progress, otherwise they are too hard or too easy to handle.

Motivational Rewards are simple things like points or trophies a player can earn respectively win, but they are not confined to virtual goods only. Also in-game characters encouraging one with words like "*well done*" or deeds may be very motivational to players.

III. SOCIAL INTERACTION TAXONOMY

In this section, we describe the derivation of the Social Interaction Taxonomy (SIT) and its interaction classification concept.

A. Interaction

Interaction must not only be seen as something that happens between a player and a computer, it has also a social aspect as a lot of games are played with other people. This of course holds true for almost all non-computer games, as the amount of games played solitarily, is small compared to

 ISBN: 978-1-61208-120-5

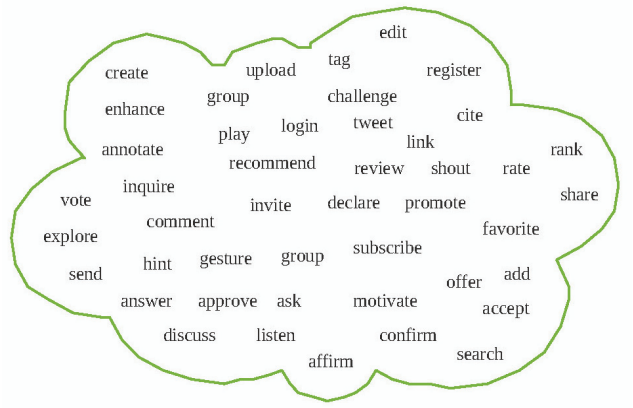


Figure 3. Social Interaction Cloud

games played with others. With the rising of the World Wide Web, designers of computer games more and more include social interactions into their games. There is a huge amount of multi mass online role playing (MMORG) games available and probably the most successful of them is World of Warcraft [21]. Critics stating, that playing computer games is an isolating activity, need to be aware of the fact that most computer games nowadays involve social interactions, although these social interactions are not face-to-face. However it must be brought into question, whether restricting social interactions solely on computer games, does not result in another form of social isolation, either.

B. Lessons Learned From Game Design

As seen in the Game Design area, user interaction can be classified. We extended this approach and developed a global Social Interaction Taxonomy for web applications – especially in the social media area. We overcome the in-game restricted rewarding models, choosing this overall generic and application-independent approach. The RESTful web service design allows embedding the Social Interaction Taxonomy in any web application.

C. Classifying Social Interaction Tasks

In order to create a global rewarding system, that rewards users for any kind of interaction, currently available activities in web applications need to be aggregated. Figure 3 illustrates this aggregation via a Social Interaction Cloud that makes no claims of being complete, because it is almost impossible to catch all interactions or rather their designation from every available web application. Nevertheless, the taxonomy that will be deduced in this section is generic enough to cover all possible (social) interactions and hence can serve as a basis for a global rewarding model. Certainly, (social) interactions can be classified in various ways, although we must state, that we did not find any available interaction taxonomy during research. The taxonomy we deduced, classifies interactions using two consecutive criteria that are based on two questions. The first question is: Who is involved in an interaction? As the overall aim is to design a rewarding model that rewards user interactions, every interaction involves a user. So the more precise question to ask is: With whom or what does a user interact? The last question reveals which possible counterparts an interaction in this taxonomy may have. It may either be a "*virtual*" object, like a video or a picture, which we will refer to as a resource, or it may be another user that in this sense constitutes a "*real*" object. Hence, the first criterion used to initially classify interactions is, whether it is a user resource or a user-user interaction. In the following, the first criterion will be stated more precisely by highlighting the properties of a resource respectively a user being part of an interaction.

Criterion 1

Criterion 1 classifies an interaction by its counterpart, which can be a resource, a user or both.

Resource: resources are things like videos, pictures or blog posts and in most cases they are directly accessible via an URI. Otherwise, they are indirectly accessible via the web application hosting the resource. Resources miss the characteristic of being "*active*". In an interaction, i.e. they are completely passive. Hence a user somehow interacts "*on*" and not "*with*" a resource.

User: although users can be seen as some type of resource, we make the distinction because users as opposed to resources have the characteristic of being "*active*" in an interaction. In the sense of the previous definition, a user interacts "*with*" a user and thus those interactions can be referred to as communication between users.

Both: in general, a taxonomy's purpose is not, to classify an object into exactly one category as they may belong to different ones, so for some interactions it is possible to classify them into both categories. For example, the grouping interaction may refer to group resources as it is possible within the social tagging system GroupMe! [22] or it may refer to group friends into self-defined friend-lists within Facebook [23]. The result of applying the first criterion on the given interaction cloud, is illustrated in Figure 4. It splits the cloud into two interaction-classes: the user-resource interaction-class with a resource as counterpart and the user-

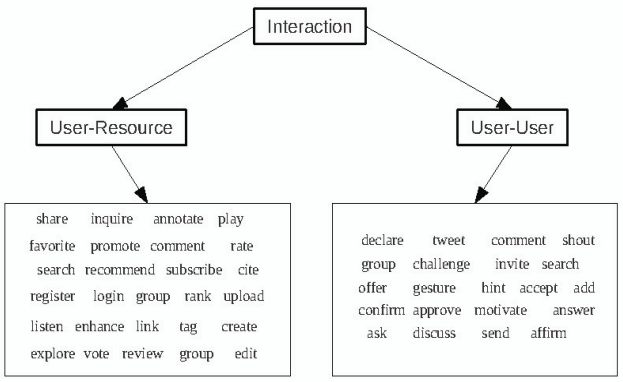


Figure 4. Interactions classified by its counterpart

 ISBN: 978-1-61208-120-5

user interaction-class, where a user acts as a counterpart. As mentioned before, the classification of interactions is based on two (consecutive) questions and the second question is: How does a user interact with its counterpart? Both interaction classes answer this question from different angles and therefore use different criterions to assign their interactions to interaction-types. Interaction types belonging to the user-resource interaction class make a statement about what a user does with a resource. The following criterion (Criterion 2.1) gives an overview on interaction-types that we have deduced for this class and Figure 5 illustrates those interaction-types.

Criterion 2.1

Criterion 2.1 classifies user-resource interactions by what a user does with a resource.

Create: creating new resources means to make them directly or indirectly available via URIs. If a user uploads a picture to an online photo sharing community, the picture has been available before but not on the internet. As opposed to this, creating a new blog post "*really*" creates a new resource. Indirectly available refers to scenarios, where a resource is protected and can only be accessed after an authorization.

Edit: these interactions virtually "*happen*" around existing resources and do not necessarily result in a modification of a resource's contents, e.g., tagging a picture does not change it, but all these interactions are related to the edited resource.

Rate: every direct or indirect, positive or negative feedback on resources is covered by this interaction-type. For example, a book review is a direct rating whereas subscribing a GroupMe! group is an indirect rating.

Explore: this interaction-type covers all those interactions that do not fall into the previous types because, to put it crudely, nothing "*happens*" with a resource, it is neither created, edited nor rated - it is just explored. For example, if a user plays an online game, she explores but does not change it. The allocation of user-user interactions roughly follows communication science as it regards those interactions as a communication between users. These communicative interactions are distinguished into two communication types. This distinction is based on how intense a communication is. In an intensive communication, sender and receiver constantly or at least once change their parts. The intention of a sender is always any kind of reaction by the receiver and this is not always given in a less intensive communication, where a reaction by the receiver is not always expected or even wished-for. The intensity of a communicative interaction is the last criterion that maps user-user interactions into the following types. Figure 5 illustrates this classification.

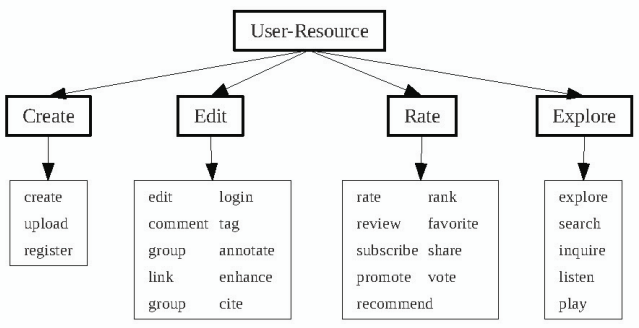


Figure 5. User-Resource interaction-types

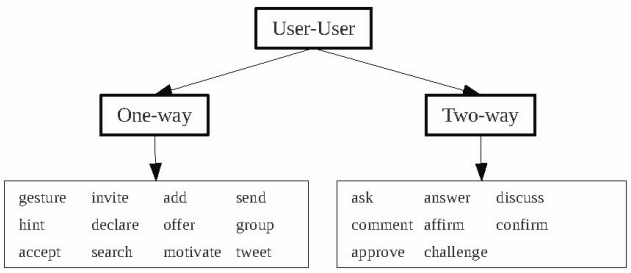


Figure 6. User-User interaction-types

Criterion 2.2

Criterion 2.2 allocates user-user interactions by their communicative intensity.

One-way: in a less intensive communication process, the sender is significantly more active, than the receiver and mostly does not get any response by the receiver. This is why, we refer to those interactions as being one-way, because there is either no reaction by the receiver required or the reaction is of no relevance for the sender that it is noteworthy.

Two-way: a two-way interaction, as its name implies, is an intensive communication as both, sender and receiver are active and constantly change their parts in a communication process. Even if sender and receiver only change parts once, for example in a scenario, where a user asks a question that is answered by another user, it is of high relevance for the sending user to get a response from at least one receiver. Putting together the mentioned criterions, finally results in a (social) interaction taxonomy as it is illustrated in Figure 7.

 ISBN: 978-1-61208-120-5

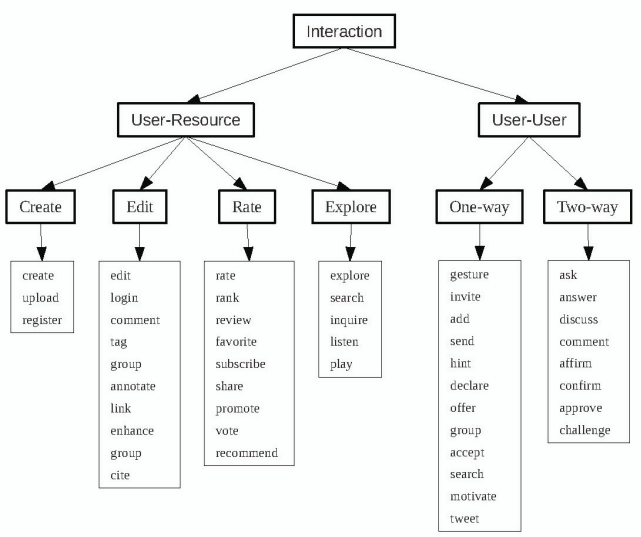


Figure 7. Social Interaction Taxonomy (SIT)

IV. CONCLUSION AND OUTLOOK

We presented a concept, to integrate an application-independent model for globally rewarding of user interaction tasks. The Social Interaction Taxonomy (SIT) can be integrated into web applications by RESTful web services. SIT serves as foundation for activity monitoring, interaction rewarding or analyzes. Increasing incentive and motivation to ongoing participation in social web applications are further use cases global interaction rewarding is very useful for. Basic game mechanics and reward types are presented and have been applied, in order to reward user interactions or to give feedback on their effect on users' progression. Our overall goal was, to create a global rewarding system acting independently from concrete (web) applications and especially from interactions, they offer. Therefore, we developed the Social Interaction Taxonomy. This taxonomy classifies interactions, at first by its counterpart which can be a resource or a user and then by the way a user interacts with a resource, respectively by the intensity a user socially interacts/communicates with another user. The taxonomy is ideal to classify and reward activity in learning contexts because it can turn any application into a game this way. SIT also allows tracking progress and users' activity upon web-based learning resources. An implemented application scenario relying on SIT will be exemplified at the conference.

REFERENCES

[1] Twitter, a microblogging service, http://www.twitter.com, last update: 2010, retrieved: 2010-12-15.

[2] Flickr, share your photos, watch the world, http://www.flickr.com, last update: 2010, retrieved: 2010-12-14.

[3] M. Prensky, "Digital game-based learning", McGraw-Hill, New York, 2001.

[4] A. J. Kim, "Putting the fun in functional - applying game mechanics to social media", http://www.slideshare.net/amyjokim/fun-in-functional-2009-presentation, last update: 2010, retrieved: 2010-12-04.

[5] M. Steinberg and J. Brehm, "Towards utilizing open data for interactive knowledge transfer", Proc. Digital World 2009, International Conference on Mobile, Hybrid, and On-line Learning, ISBN: 978-0-7695-3528-9, pp. 61-66, 2009.

[6] Open definition, http://www.opendefinition.org/, last update: 2010, retrieved: 2010-12-04.

[7] C. Bizer, T. Heath, and T. Berners-Lee, "Linked Data: principles and state of the art", Proc. 17th International World Wide Web Conference, WWW2008, ISBN: 978-1-60558-085-2, pp. 1265-1266, 2008.

[8] M. Steinberg and J. Brehm, "Towards enhanced user interaction to qualify web resources for higher-layered applications", Proc. Digital World 2010, International Conference on Mobile, Hybrid, and On-line Learning, ISBN: 978-0-7695-3955-3, pp.105-110, 2010.

[9] N. Ullmann, "Design and implementation of a global rewarding model based on user interaction tasks", master thesis, Leibniz Universität Hannover, System and Computer Architecture, 2010.

[10] R. Thomas Fielding, "Architectural styles and the design of network-based software architectures", PhD thesis, University of California, Irvine, 2000.

[11] Wikipedia, Pong, http://en.wikipedia.org/wiki/Pong, last update: 2010, retrieved: 2010-12-04.

[12] Wikipedia, Game design, http://en.wikipedia.org/wiki/Game_design, last update: 2010, retrieved: 2010-12-04.

[13] J. Porter, "Game mechanics for interaction design: An interview with Amy Jo Kim", 2009, http://bokardo.com/archives/game-mechanics-for-interaction-design-an-interview-with-amy-jo-kim/, last update: 2009, retrieved: 2010-12-04.

[14] A. J. Kim, "Putting the fun in functional - applying game mechanics to functional software", 2007, http://www.slideshare.net/amyjokim/putting-the-fun-in-functiona, last update: 2009, retrieved: 2010-12-04.

[15] Payback, http://www.payback.de/, last update: 2010, retrieved: 2010-12-04.

[16] Farmville, http://www.facebook.com/FarmVille, last update: 2010, retrieved: 2010-12-04.

[17] Casual Game Design, the reward series, part 1: The basics of reward, 2006, http://www.casualgamedesign.com/?p=42, last update: 2006, retrieved: 2010-12-04.

[18] Ascaron. Sacred 2 - fallen angel, http://www.sacred2.com, last update: 2009, retrieved: 2010-12-04.

[19] Civilization, http://www.civilization.com/, last update: 2010, retrieved: 2010-12-04.

[20] Super Mario Bros, Wii, http://www.mariobroswii.com/, last update: 2009, retrieved: 2010-12-04.

[21] Golem Special: World of Warcraft, http://www.golem.de/specials/wow/, last update: 2010, retrieved: 2010-12-04.

[22] F. Abel, M. Frank, N. Henze, D. Krause, and P. Siehndel, "Groupme! - combining ideas of wikis, social bookmarking, and blogging", ICWSM, editors E. Adar, M. Hurst, T. Finin, N. S. Glance, N. Nicolov, and B. L. Tseng, AAAI Press, pp. 230-231, 2008.

[23] Facebook: a social network service and website, http://www.facebook.com, last update: 2010, visited: 2010-08-22.

 ISBN: 978-1-61208-120-5

Factors Affecting the Adoption of e-Learning: A Meta-analysis of Existing Knowledge

Boštjan Šumak, Marjan Heričko, Maja Pušnik
University of Maribor
Faculty of Electrical Engineering and Computer Science
Smetanova ulica 17, 2000 Maribor
bostjan.sumak@uni-mb.si, marjan.hericko@uni-mb.si, maja.pusnik@uni-mb.si

***Abstract* — There are different factors that can influence a learner's decision on how and when they will use a particular, innovative e-learning technology. In the existing literature, there are many studies that deal with the identification of factors and their impact on a user's acceptance of e-learning technology. This paper demonstrates the results of a meta-analysis – a statistical synthesis method that provides the opportunity of viewing the research context by combining and analyzing the quantitative results of several independent empirical studies. The meta-analysis was conducted on the basis of empirical data gathered from 28 independent empirical studies in the field of e-learning acceptance. The meta-analysis provided strong evidence that perceived usefulness is the strongest predictor of a learner's adoption of an e-learning technology.**

Keywords- e-learning, technologies adoption, meta-analysis, TAM, UTAUT, Hedges g

I. INTRODUCTION

E-learning is a way of learning that is supported by information communication technologies (ICT) and services, and that makes it possible to deliver education and training to anyone, anytime and anywhere [1]. We can also say that e-learning is a term that stands for all types of technology-enhanced learning services and processes, including web-based learning, virtual classrooms, and digital collaboration [2]. E-learning technologies are not only being used by educational organizations. Recently, and in the business sector especially, companies have been recognizing the benefits of using e-learning technologies that can provide cost-effective on-line courses to their employees.

In order to succeed, e-learning technologies must have a positive impact on the learners. When the learner is presented with a new e-learning technology or service, there are different factors that influence their decision on how and when they will use a particular e-learning technology or service. In the existing literature, we can find many studies that deal with the identification of factors that influence a user's behavioral intentions and the actual use of an e-learning technology. These studies are usually based on acceptance theories and approaches that have been developed and continuously improved over the last two decades.

This paper is organized as follows: in the next section, the main acceptance theories are presented. The third section describes the research methodology of our study. In the subsequent section, the results of the data analysis are given. In the last section, we conclude the paper with a discussion of the results and the implications of the results of the present study.

II. ACCEPTANCE AND USE OF IT

According to Venkatesh et al. [3], there are different streams of research that deal with answering how and why individuals adopt new information technologies. One stream of research focuses on the individual acceptance of IT, where a user's behavioral intentions or actual use is used as a dependent variable. In the second stream, there are studies that focus on implementation success at the organizational level. In existing literature, we also found a large amount of studies that deal with the conformance level of the technology with the tasks that the end users must complete by using specific information technology. **Figure 1** shows a basic conceptual framework of acceptance models explaining individual intentions for using information technology and the actual use of information technology.

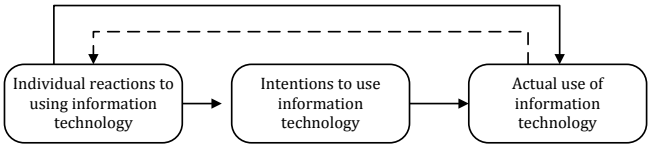


Figure 1 - Basic Concept underlying User Acceptance Models **[3]**

One of the most widely technology acceptance theories being used is the technology acceptance model – TAM [4]. Davis proposed TAM to explain the potential user's behavioral intentions of using a technological innovation. TAM is based on the theory of reasoned action – TRA [5], which is a psychological theory that can be used to explain behavior. The Motivational Model (MM) is another psychological theory that is often being employed in studies dealing with the factors that have an impact on the end user's motivation in the use of an information technology. Venkatesh et al. [3] reviewed existing literature and empirically compared eight theoretical models: TRA, TAM, MM, TPB, the combined TAM and TPB, Model of PC Utilization (MPCU), Innovation Diffusion Theory (IDT) and Social Cognitive Theory (SCT). In the same study, the authors introduced and validated a new theoretical model, called the Unified Theory of Acceptance and Use of Technology (UTAUT). Table I provides a list of independent

 ISBN: 978-1-61208-120-5

and dependent variables, specified by individual acceptance theoretical models.

TABLE I. INDEPENDENT VARIABLES AND DEPENDENT VARIABLES IN ACCEPTANCE MODELS

Theory	Independent variables	Dependent Variables
TRA	attitude toward behavior (ATB), subjective norm (SN)	behavioral intentions (BI), actual use (U)
TAM	perceived usefulness (PU), perceived ease of use (PEOU)	attitude toward use (ATU), behavioral intentions (BI), use (U)
MM	intrinsic motivation (IM), extrinsic motivation (EM)	behavioral intentions (BI)
TPB	attitude toward behavior (ATB), subjective norm (SN), perceived behavioral control (PBC)	behavioral intentions (BI), actual use (U)
MPCU	facilitating conditions (FC), social factors (SC), perceived consequences (PCON), long-term consequences (LTC)	behavioral intentions (BI), actual use (U)
IDT	relative advantage (RA), ease of use (EOU), image (IM), visibility (VIS), compatibility (COM), results demonstrability (RD), voluntariness of use (VOL)	behavioral intentions (BI)
SCT	computer self-efficacy (CSE), perceived outcomes (POUT), affect (AFF), anxiety (ANX)	use (U)
UTAUT	performance expectancy (PE), social influence (SI), effort expectancy (EE), facilitating conditions (FC)	behavioral intentions (BI), actual use (U)

Most researchers are interested in the structural relationships among constructs in the research model that help explain an individual's acceptance of a technology. The empirical data is usually statistically analyzed using structural equation modeling (SEM). The results of structural equation modeling are usually presented in a set of causal relationships, where each causal relationship is described using the following attributes: independent variable, dependent variable, path coefficient (β), and significance value (p). In the next section, the research methodology is presented together with the research question and data collection process.

III. RESEARCH METHODOLOGY

In existing literature, we can find different studies reporting different results about the size estimates of path coefficients in common factor relationships. We can find variations in the predicted effects and significance levels in studies with different types of users and e-learning technologies. This fact raises the following research question:

RQ1: *What is the mean effect size of a particular factor (PU, PEOU, etc.) on a user's acceptance (BI, ATU or U)?*

To answer the above-stated research question, we performed a meta-analysis. Meta-analysis allows various results to be combined, taking into account the relative sample and effect sizes [6]. In the meta-analysis, only significant causal relationships were included.

In the systematic literature review, we used the scientific database ScienceDirect for searching relevant studies. The papers included in this study were searched using a combination of:

- *Keywords, related to an acceptance theory* - Technology Acceptance Theory (TAM), Theory of planned Behavior (TPB), etc.
- *Keywords, related to e-learning technologies* - e-learning, elearning, on-line learning, web learning, etc.

We identified 28 journal papers (all the paper references are listed at the references). We developed coding rules to ensure that all studies were treated consistently. The coding dealt with the identification and coding of:

- *Context* – the context, in which the study was performed. Usually with a short description of the e-learning technology.
- *Sample size* – the number of respondents included in the sample frame.
- *Ground theory* – the theory upon which the research model was developed and tested.
- *Independent variable* – the name of the independent variable.
- *Dependent variable* – the name of the dependent variable.
- *Path coefficient* – the size of the path coefficient (β).
- *Significance level* – the p value.

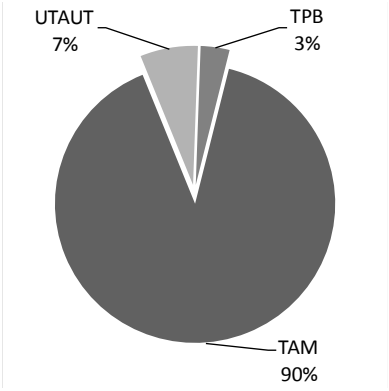


Figure 2 – Summary of theories, on which the reviewed studies were grounded

 ISBN: 978-1-61208-120-5

The chart on the Figure 2 reveals, that most of the studies that were reviewed and included in the meta-analysis, used TAM as a ground theory.

TABLE II. SAMPLE SIZE STATISTICS

	Estimate
Total sample size	8133
Average sample size	254
Min sample size	31
Max sample size	858
Number of students users	5167
Number of non-students users	2966

Table II summarizes the sample sizes across all studies that were included in the meta-analysis. The lowest sample frame size comprised 31 respondents and the highest sample frame included 858 students.

IV. DATA ANALYSIS AND RESULTS

A. Analysis method

Meta-analysis is a statistical technique that can be used to assimilate information from different independent studies. Effect size is the main statistical concept in meta-analysis, which refers to the magnitude of the effect observed in the study, which can be:

- *The size of the relationship between variables*. There are many different statistics that can be used to estimate the effect size, for example: the Pearson product-moment correlation coefficient, r; the effect-size index, d; odds ratios, etc.
- *The degree of difference between group means*. There are different metrics that can be used to describe the differences in the arithmetic means of different studies. These metrics are, for example: Cohen's *d*, Glass's Δ and Hedges's *g*, which was also used in this study.

The basic principle in meta-analysis is to calculate the effect sizes for individual studies, convert effect sizes to a common metric and then combine metrics to obtain an average effect size. This study included several independent studies, therefore the meta-analysis was conducted on a "random effects" basis. The assumption underlying this was that each study included in this study is taken from a population that is likely to have a different effect size to any other study included in the meta-analysis.

In the meta-analysis in this study, we focused on a set of causal relationships, listed in Table 3. Table 3 shows descriptive statistics about causal relationships (independent variable → dependent variable) with the following metrics:

- the number of causal links, evaluated in all studies (N links)
- the number of significant positive causal links found (SIG+)
- the number of non-significant positive causal links found (not SIG+)
- the number of significant negative causal links found (SIG-)
- the number of non-significant negative causal links found (not SIG-)
- the maximum significant positive path coefficient size (SIG+ MAX)
- the minimum significant positive path coefficient size (SIG+ MIN)
- the average significant positive path coefficient size (SIG+ AVE)
- the maximum significant negative path coefficient size (SIG- MAX)
- the minimum significant negative path coefficient size (SIG- MIN)

TABLE III. SUMMARY OF MAIN CAUSAL EFFECTS

Independent variable	**Dependent variable**	**N links**	**SIG+**	**not SIG+**	**SIG-**	**not SIG-**	**SIG+ MAX**	**SIG+ MIN**	**SIG+ AVE**	**SIG- MAX**	**SIG- MIN**
PEOU	PU	26	25	1	0	0	0.690	0.160	0.406		
PU	BI	17	17	0	0	0	0.850	0.134	0.399		
PU	ATU	12	12	0	0	0	0.750	0.183	0.505		
PEOU	ATU	11	10	1	0	0	0.707	0.178	0.327		
ATU	BI	11	10	1	0	0	0.999	0.164	0.369		
PEOU	BI	9	6	0	0	3	0.410	0.137	0.239		
PU	U	6	4	2	0	0	0.670	0.180	0.443		
ATU	U	4	3	1	0	0	0.400	0.224	0.331		
PEOU	U	4	3	1	0	0	0.300	0.110	0.233		
BI	U	3	3	0	0	0	0.545	0.190	0.365		
ANX	PEOU	2	0	0	2	0				-0.220	-0.530

According to the values in Table 3, the causal link PEOU → PU is the relationship that has been evaluated most often in existing e-learning acceptance studies. In almost all studies, a significant positive relationship between the perceived ease of use and the perceived usefulness of an e-learning technology has been demonstrated. The perceived ease of use also has a positive influence on the learner's attitude toward using an e-learning technology and the actual use of an e-learning technology. There were cases where the perceived ease of use had a negative influence on the

learner's behavioral intentions. However, the negative influence on the learner's behavioral intentions was insignificant.

The perceived usefulness has a positive influence on a learner's behavioral intentions, attitude toward using e-learning technology and actual use of e-learning technology. The learner's actual use of an e-learning technology is also influenced by their attitude toward using the technology and behavioral intentions. Anxiety is a factor that can negatively influence a user's perceptions about the ease of use of e-learning technology.

TABLE IV. SUMMARY OF CAUSAL EFFECT SIZES (RANDOM EFFECTS MODELS)

	PEOU → PU	PU → BI	PU → ATU	PEOU → ATU	ATU → BI	PEOU → BI	PU →U	BI → U
Number of samples	25	17	12	10	10	6	3	3
Total sample size	6509	3947	3808	3233	3163	927	983	699
Hedges's g	0.928	0.796	1.240	0.689	1.594	0.485	0.933	0.788
Standard error	0.115	0.089	0.179	0.092	0.303	0.088	0.353	0.082
Variance	0.013	0.008	0.032	0.008	0.092	0.008	0.125	0.007
Z	8.070	8.915	6.936	7.494	5.286	5.526	0.264	9.587
p (effect size)	0.000	0.000	0.000	0.000	0.000	0.000	0.008	0.000
95% Low	0.703	0.621	0.889	0.508	1.001	0.313	0.240	0.627
95% High	1.154	0.971	1.590	0.869	2.188	0.657	1.626	0.950

Table IV shows the estimates of Hedges's g statistics for individual causal relationships. In almost all causal relationships, the effect size is medium. The effect size is relatively small only in the case of a causal relationship between the perceived ease of use and behavioral intentions. Table V summarizes the effect sizes of individual causal relationships, according to the effect size categories proposed by Kampenes et al. [7].

TABLE V. EFFECT SIZE INTERPRETATION

	Hedges's g	**Interpretation**
PEOU → PU	0.928	Medium effect
PU → BI	0.796	Medium effect
PU → ATU	1.240	Large effect
PEOU → ATU	0.689	Medium effect
ATU → BI	1.594	Large effect
PEOU → BI	0.485	Medium effect
PU → U	0.933	Medium effect
BI → U	0.788	Medium effect

The results of the meta-analysis in the field of e-learning acceptance revealed the following facts about causal relationships:

- The effect size is largest in the case of PU → ATU, and in the case of ATU → BI. The perceived usefulness also has a relatively strong influence on the actual use of an e-learning technology.
- The perceived ease of use had a relatively strong effect on perceived usefulness.
- A medium-effect size was found in ATU→BI and BI→U.

V. CONCLUSIONS

The present meta-analysis of 28 e-learning acceptance studies involved 8,133 observations. The studies involved mostly used TAM as a ground theory for an investigation of factors that influence a learner's adoption of e-learning technology. The meta-analysis provided evidence that:

- Perceived usefulness is the strongest (direct or indirect) determinant for the learner's adoption of a specific e-learning technology.
- Perceived ease of use has a relatively small influence on a learner's intention of using a specific e-learning technology.
- The actual use of an e-learning technology is predicted by perceived usefulness and behavioral intentions.

The above-listed facts are important for different stakeholders. In particular, e-learning system developers and e-learning content providers have to improve the set of features and functionalities that will best benefit end users during their use of an e-learning technology. In our future research we will perform a qualitative-quantitative study that will help to identify which are the most useful e-learning functionalities.

In our future research, we also intend to include moderator variables (for example: user type and e-learning type). This will help us to understand if there are any other factors that have an influence on individual causal relationships.

VI. REFERENCES

[1] B. Šumak, M. Heričko, G. Polančič, and M. Pušnik, "Investigation of E-Learning System Acceptance using UTAUT," *International Journal of Engineering Education*, vol. 26, no. 6, pp. 1327-1342, 2010.

[2] F. Rodríguez, M. Berenguel, J. L. Guzmán, and S. Dormido, "A Virtual Course on Automation of Agricultural Systems," *International Journal of Engineering Education*, vol. 22, no. 6, pp.

1197-1209, Nov. 2006.

[3] V. Venkatesh, M. G. Morris, G. B. Davis, and F. D. Davis, "User Acceptance of Information Technology: Toward a Unified View," *MIS Quarterly*, vol. 27, no. 3, pp. 425-478, Sep. 2003.

[4] F. D. Davis, "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology," *MIS Quarterly*, vol. 13, no. 3, pp. 319-340, Sep. 1989.

[5] M. Fishbein and I. Ajzen, *Belief, attitude, intention, and behavior : an introduction to theory and research*. Reading Mass.: Addison-Wesley Pub. Co., 1975.

[6] W. King and J. He, "A meta-analysis of the technology acceptance model," *Information & Management*, vol. 43, no. 6, pp. 740-755, 2006.

[7] V. Kampenes, T. Dyba, J. Hannay, and D. Sjoberg, "A systematic review of effect size in software engineering experiments," *Information and Software Technology*, vol. 49, no. 11, pp. 1073-1086, 2007.

Studies, included in the literature review and meta-analysis:

[1] J. Bourgonjon, M. Valcke, R. Soetaert, and T. Schellens, "Students' perceptions about the use of video games in the classroom," *Computers & Education*, vol. 54, no. 4, pp. 1145-1156, 2010.

[2] I. T. Brown, "Individual and Technological Factors Affecting Perceived Ease of Use of Web-based Learning Technologies in a Developing Country," *The Electronic Journal of Information Systems in Developing Countries*, vol. 9, no. 5, pp. 1-15, 2002.

[3] C. Chiu and E. Wang, "Understanding Web-based learning continuance intention: The role of subjective task value," *Information & Management*, vol. 45, no. 3, pp. 194-201, 2008.

[4] P. Hu, T. H. K. Clark, and W. W. Ma, "Examining technology acceptance by school teachers: a longitudinal study," *Information & Management*, vol. 41, no. 2, pp. 227-241, 2003.

[5] M. Lee, "Explaining and predicting users' continuance intention toward e-learning: An extension of the expectation–confirmation model," *Computers & Education*, vol. 54, no. 2, pp. 506-516, 2010.

[6] J. Lee, H. Cho, G. Gay, B. Davidson, and A. Ingraffea, "Technology Acceptance and Social Networking in Distance Learning," *http://ifets.ieee.org/periodical/6-2/6.html*, vol. 6, no. 2, pp. 50-61, 2003.

[7] M. Lee, C. Cheung, and Z. Chen, "Acceptance of Internet-based learning medium: the role of extrinsic and intrinsic motivation," *Information & Management*, vol. 42, no. 8, pp. 1095-1104, 2005.

[8] B. Lee, J. Yoon, and I. Lee, "Learners' acceptance of e-learning in South Korea: Theories and results," *Computers & Education*, vol. 53, no. 4, pp. 1320-1329, 2009.

[9] S. Liu, H. Liao, and J. A. Pratt, "Impact of media richness and flow on e-learning technology acceptance," *Computers & Education*, vol. 52, no. 3, pp. 599-607, 2009.

[10] J. T. Marchewka, S. Liu, and K. Kostiwa, "An Application of the UTAUT Model for Understanding Student Perceptions Using Course Management Software," *Communications of the IIMA*, vol. 7, no. 2, pp. 93-104, 2007.

[11] T. Mcgill and J. Klobas, "A task–technology fit view of learning management system impact," *Computers & Education*, vol. 52, no. 2, pp. 496-508, 2009.

[12] E. Ngai, J. Poon, and Y. Chan, "Empirical examination of the adoption of WebCT using TAM," *Computers & Education*, vol. 48, no. 2, pp. 250-267, 2007.

[13] C. Ong, J. Lai, and Y. Wang, "Factors affecting engineers' acceptance of asynchronous e-learning systems in high-tech companies," *Information & Management*, vol. 41, no. 6, pp. 795-804, 2004.

[14] C. Ong and J. Lai, "Gender differences in perceptions and relationships among dominants of e-learning acceptance," *Computers in Human Behavior*, vol. 22, no. 5, pp. 816-829, 2006.

[15] A. Padillamelendez, A. Garridomoreno, and A. Delaguilaobra, "Factors affecting e-collaboration technology use among management students," *Computers & Education*, vol. 51, no. 2, pp. 609-623, 2008.

[16] J. Roca, C. Chiu, and F. Martinez, "Understanding e-learning continuance intention: An extension of the Technology Acceptance Model," *International Journal of Human-Computer Studies*, vol. 64, no. 8, pp. 683-696, 2006.

[17] J. Roca and M. Gagne, "Understanding e-learning continuance intention in the workplace: A self-determination theory perspective," *Computers in Human Behavior*, vol. 24, no. 4, pp. 1585-1604, 2008.

[18] R. Saade and B. Bahli, "The impact of cognitive absorption on perceived usefulness and perceived ease of use in on-line learning: an extension of the technology acceptance model," *Information & Management*, vol. 42, no. 2, pp. 317-327, 2005.

[19] R. A. Sánchez and A. D. Hueros, "Motivational factors that influence the acceptance of Moodle using TAM," *Computers in Human Behavior*, vol. 26, no. 6, pp. 1632-1640, 2010.

[20] M. J. Sanchez-Franco, "WebCT – The quasimoderating effect of perceived affective quality on an extending Technology Acceptance Model," *Computers & Education*, vol. 54, no. 1, pp. 37-46, 2010.

[21] Ø. Sørebø, H. Halvari, V. F. Gulli, and R. Kristiansen, "The role of self-determination theory in explaining teachers' motivation to continue to use e-learning technology," *Computers & Education*, vol. 53, no. 4, pp. 1177-1187, 2009.

[22] Y. Tao, C. Cheng, and S. Sun, "What influences college students to continue using business simulation games? The Taiwan experience," *Computers & Education*, vol. 53, no. 3, pp. 929-939, 2009.

[23] T. Teo, "Modelling technology acceptance in education: A study of pre-service teachers," *Computers & Education*, vol. 52, no. 2, pp. 302-312, 2009.

[24] T. Teo, C. B. Lee, C. S. Chai, and S. L. Wong, "Assessing the intention to use technology among pre-service teachers in Singapore and Malaysia: A multigroup invariance analysis of the Technology Acceptance Model (TAM)," *Computers & Education*, vol. 53, no. 3, pp. 1000-1009, 2009.

[25] S. Toral, F. Barrero, and M. Martineztorres, "Analysis of utility and use of a web-based tool for digital signal processing teaching by means of a technological acceptance model," *Computers & Education*, vol. 49, no. 4, pp. 957-975, 2007.

[26] E. Vanraaij and J. Schepers, "The acceptance and use of a virtual learning environment in China," *Computers & Education*, vol. 50, no. 3, pp. 838-852, 2008.

[27] G. D. Wagner and D. D. Flannery, "A quantitative study of factors affecting learner acceptance of a computer-based training support tool," *Journal of European Industrial Training*, vol. 28, no. 5, pp. 383-399, 2004.

[28] M. Yi, "Predicting the use of web-based information systems: self-efficacy, enjoyment, learning goal orientation, and the technology acceptance model," *International Journal of Human-Computer Studies*, vol. 59, no. 4, pp. 431-449, 2003.

 ISBN: 978-1-61208-120-5

Are We Ready to Move Towards a New Type of Teacher Training?

Case Study: The WETEN Project

Göran Karlsson
KTH Mechanics
SCI School, KTH
Stockholm, Sweden
e-mail: karlsson@mech.kth.se

Margareta Hellström
KTH Learning Lab
VIL School, KTH
Stockholm, Sweden
e-mail: mhel@kth.se

Carmen Holotescu
Timsoft Ltd.
Timisoara, Romania
e-mail: cami@timsoft.ro

Gabriela Grosseck
Faculty of Sociology and Psychology
University of West Timisoara
Timisoara, Romania
e-mail: ggrosseck@socio.uvt.ro

Roza Dumbraveanu
Information Technologies in Education
State Pedagogical University "Ion Creanga"
Chisinau, Moldova
e-mail: r.dumbraveanu@gmail.com

Abstract—**To assure a quality learning process in Higher Education, continuous training of teachers is a priority. This paper is a case study about the training of trainers organized in the WETEN project, presenting how the topics were chosen, how the educational technologies and facilitation contributed to the building of learning community.**

Keywords-Higher Education, HE, teachers training, web 2.0, social media, WETEN

I. INTRODUCTION

Bologna process changes have as consequences the increasing demands made on academic staff to contribute to life-long learning activities and to put the focus on restructuring of teaching and learning, on student centered learning. Thus, professional development of the academic staff has an important contribution to make in the realization of the Bologna objectives. A quality education requires teachers, who are better and continuously trained, who assume the responsibility of improving continuously their own knowledge and skills, who are motivated, enthusiastic, e-mature, who collaborate, sharing their experiences and learn from the others, from their students too, who innovate, improving support for learners through new educational technologies [1].

This education paradigm implies reform of the initial and in-service training of teachers and trainers to prepare them for their new responsibilities, in particular by highlighting the requirement and the opportunities for continuous professional development of academic staff from Higher Education (HE) Institutions.

Among European standards and guidelines for internal quality assurance within HE Institutions published by European Network for Quality Assurance (ENQA) [2] are mentioned that institutions should have ways of verifying that staff involved with the teaching of students are qualified and competent for these tasks (quality assurance of teaching staff) [3].

In this context, this paper is a case study about the training of trainers from HE organized within the framework of the WETEN (definition: see Section II) project [4]. With a focus on how the topics were chosen and how the educational technologies and facilitation contributed to the building of learning community, the paper presents:

- a short description of the WETEN project (aims, objectives, key activities).
- the current situation of teachers' experience in using new educational technologies from two partner countries (Moldova and Ukraine).
- two models of the integration of new technologies in teachers training (approaches from Sweden and Romania).
- the potential benefits of these type of training through highlighting some of the problematic issues – and barriers we encountered.
- a proposed agenda for future research and development of teachers' training scenarios for the HE sector.

II. THE WETEN PROJECT: SHORT PRESENTATION

Western-Eastern Teachers education network (WETEN) is a three years project funded within the EU TEMPUS

 ISBN: 978-1-61208-120-5

Programme. The project started in 2009 and is coordinated by Kaunas University of Technology, Lithuania.

The HE Institutions from Moldova and Ukraine are characterized by a limited use of digital services, limited ICT integration in their on-campus teaching, and a very low proportion of e-learning courses.

The provision of formal retraining for teachers from HE Institutions from Moldova and Ukraine for ICT implement-ation in the curricula is seldom and uncoordinated.

In the framework of the WETEN project, a network of university teachers from European HE Institutions is built to share expertise on effective learning and teaching in universities. This network for pedagogical innovation in HE aims to bring together experts from universities from Europe, to share good practice, materials and new teaching methods with teachers from five HE Institutions in two eastern countries, Moldova and Ukraine.

In order to redesign their own courses, teachers from the universities in Moldova and Ukraine who are partners in WETEN will take part in five courses [5]:

1. Student centred learning.
2. Curriculum design.
3. Quality of teaching.
4. ICT enhanced learning.
5. Technologies of e-learning.

These 5 courses are developed by domestic faculties trained by the EU partners (Lithuania, Portugal, Romanian, and Sweden). The training sessions in Sweden and Romania are presented below.

III. TRAINING OF TRAINERS

The experience of EU partners in methodology and methods of mapping and enhancing education, in promoting new teaching methods, in creating eLearning systems, as well as application of methods of effective management in this field would be extremely useful for partner universities. The project has achieved this goal via training domestic faculties to propagate EU values, advocate for Moldovan and Ukrainian universities.

The training for trainers' activities of faculties from the participating partner institutions (Ukraine and Moldova) at EU member institutions has given insights into pedagogic practice at HE and has identified good and innovative practice.

There has been in total five such training activities in the EU member countries: Belgium, Lithuania, Portugal, Romania and Sweden.

We will here exemplify with the training activities at KTH in Stockholm and at Timsoft Ltd. Romania.

These activities imply short-term training for trainers in mastering and use of eLearning environments and new educational technologies. The training sessions have been organised to update and enhance the needed competences of teachers: how to use the eLearning platforms for sharing content, for promoting action learning, for management of learning activities.

A. *Training in Sweden: Blended Approach Using LMS*

The training at KTH (Royal Institute of Technology) took place for one week in January 2010. From Moldova there were eight and from Ukraine three participants. They represented university presidents, university vice presidents and faculties.

The aim was to inform about generic staff training of new employed faculties, their specific training in web based learning, KTH use of LMS, blogs, videos, podcasts. Also to give input to the five training courses for partner universities' staff developed in the project.

The titles were:

- Good elearning design: What to think about? Learning by practicing. Self-reflexion. Blogging. The course is never finished.
- Elearning academic staff training. Basic communi-cation and teaching.
- From PLATO global education networking to mash up global university. Historical overview of net based education at KTH from 1979 to 2009.
- Web 3.0: Remote and virtual laboratories.
- IPR, copyrights and Creative Commons licenses.
- Plagiarism, cultural differences among international students, use of Urkund [6] web based system for text matching.
- Interactive HDTV via fiber networks in Sweden and globally.
- Bridging net based introductory course in physics.
- Resource Center for Net Based Education an KTH Virtual Campus Project.
- Support resources: Learning Lab, librarian on duty, math mentoring.
- Net based coaching in mathematics for grade 6-12 pupils by KTH students.
- Moving media, video recording of lectures, streaming server.
- Academic staff training in Sweden and at KTH historically from 1970 to 2010.
- Elearning K-12 staff training.
- Online assessment.
- Accreditation of elearning.
- Benchmarking of elearning.

The training was organized with an introduction by an expert of each subject followed by discussions. A specific problem during these discussions is that not everybody is fluent in English so translations into Romanian and Russian must be done; this hinders somewhat the smoothness of the discussions.

All the materials were published in a LMS, the teachers having to participate in online activities after the face-to-face training. These activities were facilitated and contributed in building a real learning community.

B. *Training in Romania: Blended Approach Using Microblogging*

The learning community was consolidated during the training organized in Romania, by Timsoft, a company specialized in eLearning and mobile applications.

 ISBN: 978-1-61208-120-5

The training was organized in a blended manner, using the microblogging platform Cirip.eu [7], implemented by Timsoft.

Besides the facilities of a microblogging platform, Cirip.eu provides the following:

- *Embedding multimedia objects in notes:* images, audio and (live) video clips, live-streaming, presentations, files, google docs and forms, cognitive visualizations as diagrams, learning designs as mindmaps etc.
- *Sending and receiving messages* via the web, mobile, SMS, IM (Yahoo and Jabber), e-mail, Firefox/Chrome extensions, API, Twitter, RSS, desktop and other 3rd party applications, etc.
- *Creating public or private user groups.* Collaboration groups can be created between the participants in an event, members of a class or university year, for a course enhancement or in order to run an entire online course. Groups have an announcements section (*Group News*), where moderators can post notes and materials such as SCORM/LOM objects, for group activities.
- *Domain specification for microblogs and groups.* This simplifies the search for microblogs or groups of a certain domain, for example educational microblogs or groups used for online courses or workshops.
- *Monitoring RSS feeds* for sites, blogs, social networks or search feeds.
- *Tagging* the content.
- *Creating and conducting polls and quizzes,* (which can be answered online or by SMS).
- *Visualizing statistics and representations of the users/groups interaction* networks.

Cirip.eu integrates a wide range of Web2.0 applications and social networks organized around educational resources, many of them in Top 100 Tools for Learning 2009 [8].

The training was focused on the following topics:

- Social learning in HE.
- Web2.0 in HE.
- Open Educational Resources (OER).
- Moodle LMS.

There were also examined different solutions for delivering online courses, for learning enhancement, for integrating social learning in formal learning provided by Timsoft, and by three Romanian universities:

- University Politehnica of Timisoara.
- University of West Timisoara.
- University Vasile Goldis Arad.

The materials of the training were prepared by teachers and trainers from Timsoft and the three mentioned universities; this way bringing a wide experience and perspective.

On Cirip.eu a private group dedicated to training was opened [9]. The aims of the group were:

- To gather the materials, interactions and collaborative multimedia exercises during the training;
- To livestream the presentations during the meeting that could be watched and commented by the partners and teachers who did not take part in the training;
- To offer an environment for practicing new educational technologies, such as microblogging and the social networks whose resources are embedded in cirip notes;
- To integrate future reflections and interactions with other teachers who did not take part in the f2f training.

The content of the group was enlarged with *feeds/search feeds* monitored by the group members using the platform corresponding facility; they are delicious.com feeds on project topics, but also with the _weten tag [10] corresponding to the collection built by the group members.

The interaction in the group and on the platform continued after a face-to-face meeting. In this way the learning community was enlarged with Cirip members such as students, trainers, teachers, practitioners, becoming a real community of practice.

Almost all of the group members built her/his own Personal Learning Environment on cirip, which can include:

- Connection/ communication with the followed users.
- The groups they participate in, according to the topics of interest.
- The site/blog/network/search feeds.
- The social networks providing educational objects, which can be included in messages.

In the group dedicated to learning designs, the trained teachers could discuss, validate and improve the scenarios of the new courses they have developed, formalizing them as mindmaps embedded in cirip notes.

All the interactions on Cirip constitute also an important dissemination activity of the WETEN project.

IV. CONCLUSIONS

During the last years, there exists a growing interest in social media, both in society and in education, with tools such as blogs and microblogs, folksonomies, RSS feeds, wikis, media-sharing applications, networking applications, and other social artifacts. When applied to higher education, these new Web2.0 technologies enhance students' learning experiences through customization, personalization, and rich opportunities for networking and collaboration [11].

In this context, the trainings presented above were designed such as to offer complementary topics, and also complementary technologies, consolidating a real learning community. Besides the knowledge on the proposed topics, the trainings have given the participants knowledge and experience:

- In online communication and collaboration.
- In collaboratively using of Web2.0 technologies and applications.
- In creating Personal Learning Environments.
- In participating in communities of practice.

Participating in the blended training programs have allowed teachers, themselves nontraditional students, to

 ISBN: 978-1-61208-120-5

learn experientially under the same conditions as their future students.

Trainings have provided an opportunity to learn about new learning technologies, but also models for best practices.

As we mentioned above, the approach proposed by the WETEN project tries to fill a gap between the theoretical and practical aspects of blended learning for trainers.

Developing an important number of courses for different target groups, using new technologies, the WETEN project could become a real pool for research, for experimentation of blended learning techniques.

However, we believe it is necessary to reconsider the role of educators. Thus, teachers need to

- Assume a new attitude (without going to extremes);
- Set themselves up as innovators in education, by promoting new pedagogical objects: courses under an audio/video form (podcasts, videocasts), books/manuals in the shape of a wiki, communicating with our students through blogs, etc.
- Try to bring arguments in favour of a taking a correct stand when faced with these realities.
- Plead in favour of renewing our psycho-pedagogical tools.
- Enjoy the pleasure offered by the act of knowledge.

ACKNOWLEDGMENT

The WETEN project is funded by the European Commission through its Directorate-General for Education and Culture programme TEMPUS.

REFERENCES

[1] C.Holotescu, Technical Requirements of Educational Software Report, Knowledge Economy Project, August 2007, http://ecomunicate.ro (latest access date Dec. 14, 2010).

[2] http://www.enqa.eu, latest access date Dec. 14, 2010.

[3] I. Huet, A.V. Baptista, D. Neri de Sousa, D. Casanova, J. Schreurs, and D. Rutkauskiene, "A cross-cultural study of pedagogical traditions in four EU universities", Proceedings of the IASK International Conference Teaching and Learning 2009, M. Muñoz and F. Ferreira, Eds., pp.192-200, International Association for the Scientific Knowledge. Porto, Portugal.

[4] http://www.weten.org, latest access date Dec. 14, 2010.

[5] D. Rutkauksiene, J. Schreurs, I. Huet, and D. Gudoniene, "Train the teachers in student-centred learning and teaching", Proc. 13th International Conference on Interactive Computer aided Learning, Set. 2010, Hasselt, Belgium.

[6] http://www.urkund.com/int/en/, latest access date Cec. 14, 2010.

[7] C. Holotescu and G. Grosseck, "Learning to microblog and microblogging to learn. A case study on learning scenarios in a microblogging context", The 6th International Scientific Conference eLearning and Software for Education, Bucharest, April 15-16, 2010.

[8] J. Hart, "Top 100 Tools for Learning 2009, http://c4lpt.co.uk/recommended, latest access date Dec.14, 2010.

[9] http://www.cirip.ro/grup/wetentm?lg=en, latest access date Dec. 14, 2010.

[10] http://www.delicious.com/tag/_weten, latest access date Dec. 14, 2010.

[11] G. Grosseck, "To use or not to use web 2.0 in higher education?", New Trends and Issues in Educational Sciences, World Conference on Educational Sciences, Nicosia, North Cyprus, 4-7 February, 2009.

 ISBN: 978-1-61208-120-5

Qualitative Analysis: Identification of the Factors Influencing e-Learning System Acceptance

Luka Pavlič, Maja Pušnik, Marjan Heričko, Boštjan Šumak
University of Maribor
Faculty of Electrical Engineering and Computer Science
Smetanova ulica 17, 2000 Maribor, Slovenia
luka.pavlic@uni-mb.si, maja.pusnik@uni-mb.si, marjan.hericko@uni-mb.si, bostjan.sumak@uni-mb.si

Abstract — **This paper demonstrates the results of our research activities, which investigated the positive and negative aspects of an e-learning system called Moodle. The research involved 235 students, providing us with unstructured answers about their opinions on what features are most important when using an e-learning system. The research focused on what students felt was missing and what they thought were the most important and beneficial features for an e-learning system used for on-line learning. Based on their answers, we conducted a qualitative analysis and identified the main factors that influenced the acceptance of e-learning systems. Based on the results of the qualitative analysis, we have proposed a theoretical acceptance model that could be used to measure the acceptance and use of an e-learning system.**

Keywords- e-learning system; Moodle; acceptance

I. INTRODUCTION

The basic goal of our qualitative research, conducted at the University of Maribor's Faculty of Electrical Engineering and Computer Science in Slovenia, was to identify the main factors that influence a user's decision, to use a certain e-service -- in our case, a specific e-learning service called Moodle. By analyzing the quality of the data, we wanted to provide an answer to the question: what are the factors that significantly influence the acceptance and use of an e-learning system and how do we measure them? The research was done step by step, as defined by the quality process execution of empirical research.

Perceived usefulness is the most important factor that predicts the acceptance and use of e-learning system. This causal relationship was confirmed by Yi and Hwang [1], Ong et al. [2], Liaw et al. [3], Zhang et al. [4], Ngai et al. [5], Lee [6], Vanraaij and Shepers [7]. However, Brown [8] showed that in the developing country, the perceived usefulness is not the main predictor of usage of an e-learning system. In his research, the perceived ease of use was found to be the most important factor. E-learning system acceptance studies found in the literature are usually based on existing acceptance theories and models, where researchers try to confirm causal relationships proposed by the theoretical model on which the study is grounded. The main objective of this study was to find additional factors, which are not included in existing acceptance theories that may have significant influence on user's perceptions when using an e-learning system.

This paper is presented in the following manner. The second section presents the facts about the research: the planning, data collection and data analysis, and how we created data codes from the results. The third section presents the implementation and results of the qualitative analysis method and the fourth section discusses the results. The fifth section describes the limitations we had to take into consideration. The sixth section concludes the main knowledge gained over the course of our research.

II. RESEARCH METHODOLOGY

This research was focused on the factors that influence the user's decision to use a specific e-service in the future. We chose a qualitative research approach to gain data. Based on this, we developed a theoretical model composed of the most important factors that influence the user's decision. We did this because we wanted to gain as much information as possible, and not restrict our research to only our ideas, as would have been the case if we conducted a structured question survey type of research. In our research, we defined a specific area of e-services that we would research in more detail, the e-learning system Moodle, a rather popular open source e-learning system that was also used at the Faculty of Electrical Engineering and Computer Science in Maribor.

A. Research Questions

The main objectives of this research were 1) to identify the factors that influence the acceptance of an e-learning system, and 2) to compare the identified factors with the factors of existing empirically tested acceptance models together with factors from existing quality models.

Since the research focused on a specific system, the targeted participants in the research were all users of the Moodle system. Therefore, the ideal population in our case is represented by all users of Moodle. Because Moodle is an open source system, it is very difficult to determine the number of users currently using the system. Each month the number of registered users increases by approximately 1,300. Based on a statistical report from September 2010 [9], there were 49,481 registered and approved Web Moodle installations in 211 different countries. At the time of this paper, the number of registered users reached nearly 37 million.

 ISBN: 978-1-61208-120-5

The method, chosen as appropriate for collecting qualitative data, was an online survey with open unstructured questions. An online survey was chosen so that the respondents were not limited by time while participating. The study participants were entirely free to decide on their level of participation. To compare the factors affecting the use of Moodle we asked the following research questions: 1) What features and/or characteristics are most important for the use of the online course management system, Moodle, and 2) What features and/or characteristics are missing when using the online course management system Moodle?

B. Data Collection

The answers to previously defined questions were provided by the users of different Moodle systems that had been installed in Slovenia. The invitation to participate in an online survey was sent to every student that had registered for Moodle at the Faculty of Electrical Engineering and Computer Science in Maribor at the time of the survey. We also sent a request for participation to a number of contact addresses at various higher education and other education institutions in Slovenia.

III. Data Analysis

In answer to the first question ("what is most important") we received 232 replies. For the second question ("what is missing") we received 227 responses. In the following sections we will present the method behind the qualitative data analysis and the results of the analysis.

A. Analysis method

The answers given by the respondent's online survey were provided in a qualitative form. The qualitative data was not numerical; therefore it was necessary to choose a method for qualitative analysis, whose basic purpose is to work with raw qualitative data and formulate it into new concepts or improve already existing concepts.

To define the concepts from qualitative raw data we performed coding, which is one of the most common techniques for qualitative analysis. While coding qualitative data, the raw data was arranged into conceptual categories and, in this way, new topics or concepts were created. The coding was carried out in order to reduce the amount of data and to effectively manage information units. The process of coding, which was managed based on the two research questions, consisted of two concurrent activities: data reduction and the analytical categorization of data. The general coding technique was then supplemented by a method of successive approximation, whose aim was the improvement of theories or concepts that were acquired in the coding method. The basis of the successive approximation method was represented by basic theoretical models and concepts, as defined in the coding method.

B. Results of Data Coding

For the purpose of qualitative data analysis, we used a test version of a tool called QDA Miner [10]. QDA Miner is a tool devoted to analyzing qualitative data that provides features for: 1) text management with support for various file formats such as Excel, Word, SPSS, etc., 2) text retrieval tools for searching for specific simple and complex text patterns in documents, 3) text coding tools for creation and edition of hierarchical codebooks, code merging, splitting, etc., and 4) qualitative analysis tools for obtaining a list of all codes along with different statistics such as their frequency, the number of cases in which they are found, etc.

Table 1 summarizes the list of codes that were identified in the process of coding during the qualitative analysis of answers to the first question ("what are the most important features"). The list of codes is arranged in descending order of frequency codes. For each code, we also determined the percentage of code opposed to the full list of codes. The most frequently identified code was the accessibility of the material as well as the availability of the learning material.

TABLE I. Identified Codes and Code Classification in Concepts

Code	***N***	***%***	***Concept***
Learning material availability	86	18.70	Usability
Electronic task submission	55	11.90	Usability
Evaluation supervision and records of grades, assessments	29	6.30	Usability
Transparency	23	5.00	Quality of UI
Calendar and Information notifications	22	4.80	Usability
Quizzes	21	4.60	Usability
Security and data privacy	19	4.10	Security
Simplicity	17	3.70	Ease of Use
Communication	16	3.50	Communication
Smooth operation	15	3.30	Stability
System reliability	15	3.30	Reliability
Fast transfer	14	3.00	Responsiveness
Forum	13	2.80	Usability
Logging in anytime and anywhere and SSO	12	2.60	Availability, SSO
Up-to-date information	11	2.40	Content quality
Material quality	11	2.40	Content quality
Simple and clear interface	10	2.20	Quality of UI
Explanation of exercises and solved examples	9	2.00	Content quality
Exact description of to-do tasks	7	1.50	Content quality
Unity, Moodle unification	5	1.10	Facilitating conditions
All information in one place	5	1.10	Usability
Modern design and technology	4	0.90	Quality of UI
Stability	4	0.90	Stability
Connectivity with other systems	3	0.70	Interoperability
Live communication	2	0.40	Communication
Archiving, version control	2	0.40	Maintenance capability
Efficiency	2	0.40	Efficiency
Search tool	2	0.40	Usability
Contentment with the system	2	0.40	Contentment
Personification	2	0.40	Personalization
Multimedia content, animations, video	2	0.40	Content quality
RSS news	2	0.40	Web 2.0
Minimization	1	0.20	Quality of UI
The window flexibility	1	0.20	Adaptability of UI
Task verification	1	0.20	Functionality
Appropriate indexing	1	0.20	Functionality
Guidance for further acquisition of knowledge	1	0.20	Content quality
Organization between objects and groups	1	0.20	Organization of UI

 ISBN: 978-1-61208-120-5

Code	*N*	*%*	*Concept*
Availability of content after schooling completion	1	0.20	Availability
Insight of registered in the subject	1	0.20	Functionality
Multiple browser support	1	0.20	Portability
Single sign on - SSO	1	0.20	Availability, SSO
Multilingualism	1	0.20	Quality of UI
Sophistication	1	0.20	Accuracy
Games and fun	1	0.20	Playfulness
Consistency	1	0.20	Consistency
Functionality	1	0.20	Functionality
Interactivity	1	0.20	Interaction
FAQ for each subject	1	0.20	Usability
Codes together	**459**	**100**	

Figure 1 shows built share codes, depending on their frequencies. In the chart, we can see that 40% of codes occurred more than five times, however, 34% appeared only once.

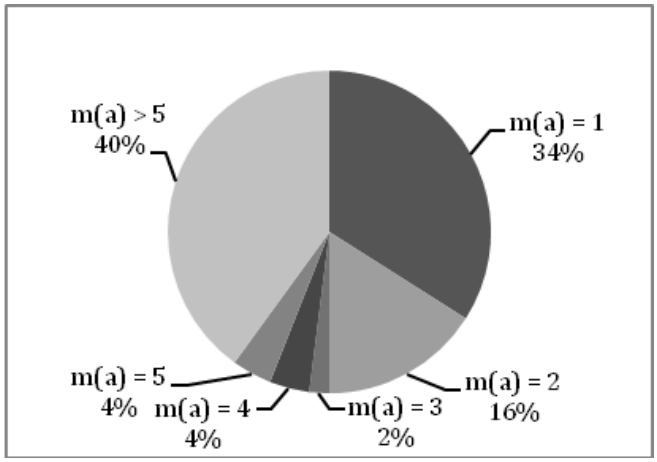


Figure 1. Share of equal codes depending on their frequency (1. question)

TABLE II. IDENTIFIED CODES AND CODE CLASSIFICATION IN CONCEPTS

Code	*N*	*%*	*Concept*
Satisfaction	46	16.5	Quality of service
Unity, Moodle unification	25	9.00	Facilitating conditions
Modern design and technology	18	6.50	Quality of UI
Calendar and Information	14	5.00	Usability
Other forms of communication - chat	14	5.00	Communication
Transparency	12	4.30	Quality of UI
Up-to-date information	9	3.20	Content quality
Evaluation supervision and records of grades, assessments	9	3.20	Usability
Simple and clear interface	7	2.50	Quality of UI
Multimedia content, animations, video	7	2.50	Content quality
Notifications	6	2.20	Usability
Access via mobile devices	6	2.20	Availability
Material availability	6	2.20	Usability
Organization of objects and groups	6	2.20	Quality of UI
Communication	6	2.20	Communication
Quizzes	5	1.80	Usability
Connectivity with other systems	5	1.80	Interoperability
Security in data privacy	5	1.80	Security
Possibility of self-verification	5	1.80	Usability
Material quality	5	1.80	Content quality
Support for other browsers	4	1.40	Portability
All information in one place	4	1.40	Usability
Simplicity	4	1.40	Ease of Use
Forum	3	1.10	Communication
Logging in anywhere, anytime and SSO	3	1.10	Availability, SSO
Search tool	3	1.10	Functionality
Live communication	3	1.10	Communication
Exact time	3	1.10	Functionality, Reliability
Publication of old content and exams	3	1.10	Availability
The flexibility window	2	0.70	Adaptability of UI
Archiving, version control	2	0.70	Maintenance capability
FAQ for each subject	2	0.70	Functionality
Explanation of exercises and solved examples	2	0.70	Content quality
Games and playfulness	2	0.70	Playfulness
Fast transfer	2	0.70	Responsiveness
personification	2	0.70	Personalization
Additional content	2	0.70	Content quality
Simply upload files	1	0.40	Ease of Use
Consistency	1	0.40	Consistency
Possibility for remote learning	1	0.40	Availability
The possibility of re-submissions	1	0.40	Functionality
Support for research work	1	0.40	Usability
Subscription to an oral exam	1	0.40	Functionality
Diversity	1	0.40	Adaptability
Direct access to profiles	1	0.40	Functionality
Minimalism	1	0.40	Quality of UI
Exact description of tasks	1	0.40	Content quality
Teamwork	1	0.40	Functionality
Stability	1	0.40	Stability
Smooth operation	1	0.40	Stability
Electronic task submission	1	0.40	Usability
Free entry	1	0.40	Availability
Enough space on the server	1	0.40	Efficiency
RSS news	1	0.40	Web 2.0
Codes together	**279**	**100**	

Table 2 summarizes the list of codes that were identified in the process of coding during the qualitative analysis of responses to the second question ("what features are missing"). The list of codes is arranged in the descending order of frequency codes. For each code, we also determined the percentage of codes depending on the full list of codes. From the list of codes, it is evident that individual codes were identified several times. The code "Satisfaction" had the highest frequency.

Figure 2 presents code shares, depending on their frequency. The chart shows that 31% of codes appeared more than five times, while 25% of codes appeared only once.

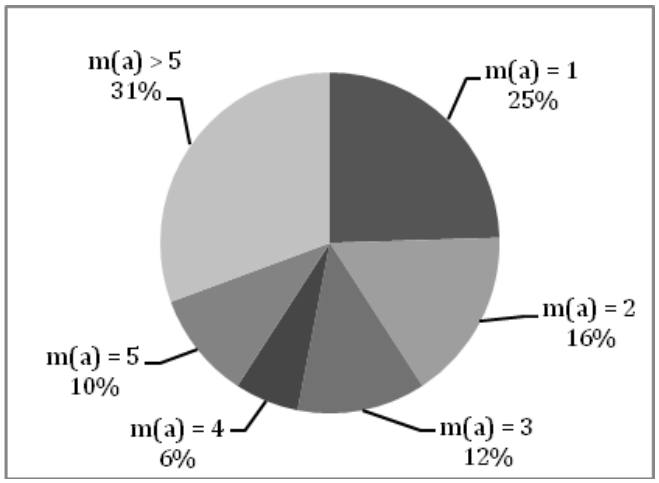


Figure 2. Share of equal codes depending on their frequency (2. Question)

IV. IMPLEMENTATION AND RESULTS OF A SUCCESSIVE APROXIMATION

Entrance to the process of successive approximation was presented by a list of identified codes and an initial list of concepts. This was formulated on the basis of characteristics and sub-characteristics ISO/IEC 9126-1 [11], factors in the design of e-service quality (SERVQUAL [12], Dromey [13], McCall [14]) and concepts in technology acceptance models (TAM [15], UTAUT [16], TTF [17]). We tried to sort each code to a list of initial concepts based on the following semantic relationships (R):

- The code is equal to, or synonymous with, the concept, or
- The code is a hyponym of the concept.

If the code could not be inserted into the list of concepts, a new concept was defined; namely the term hypernym, which was then added to the list of concepts.

Table 3 shows the final list of concepts, arranged based on the relevance of each concept, which were discovered in the set of all concepts in the encoding phase. From the list, it is evident that Moodle users found 'Usability' to be the most important aspect of e-learning. This result is consistent with the results given by a previous meta-analysis of data identified in the systematic review of existing literature. Following this, the most important concepts that affect the use of e-learning are: the quality of the user interface, the quality of the learning content, satisfaction, the quality of e-service, facilitating conditions, availability, uniform appearance and use of the system in various subjects; security, ease of use and stability.

TABLE III. LIST OF IDENTIFIED CONCEPTS, ORDERED BY RELEVANCE

Concept	Model	%
Usability	TAM	41.03
UI Quality	ISO	10.62
Content Quality	ISO	8.18
Satisfaction	/	5.86
E-Service Quality	Quality of e-service	5.49
Facilitating Conditions	UTAUT	4.40
Availability	SERVQUAL	3.05
Uniform Appearance	/	3.05
Security	ISO	2.93
Ease of Use	TAM	2.81
Stability	ISO	2.56
Responsiveness	/	1.95
Functionality	ISO	1.95
Reliability	ISO	1.83
Interoperability	ISO	0.98
Maintainability	ISO	0.49
Personalization	/	0.49
UI Adaptability	ISO	0.49
Efficiency	ISO	0.37
Web 2.0	/	0.37
Perceived Playfulness	/	0.37
Consistency	/	0.37
Understandability	ISO	0.12
Accuracy	ISO	0.12
Interactivity	/	0.12

V. DISCUSSION

The objective of implementing web survey was to answer the questions that were presented in this paper. The study was limited to a specific e-learning system. The study involved 534 users, who used Moodle for educational purposes at various institutions. Based on the 232 responses to the question RQ_1 "What functionality and/or characteristics are most important for the use of Moodle," we identified 459 codes, of which the most common was perceived usability of the system.

Based on the 227 responses to the question RQ_2 "What Functionality and/or features do you miss when using Moodle," we identified 279 codes, in which the most common concept proved to be satisfaction. Students find that an e-learning system should provide a modern and unified user interface for all on-line courses. E-learning system must also provide mechanisms for communication with the professor/teacher and other students.

We performed a successive approximation, and a common qualitative data analysis, over a set of codes that we acquired in the encoding data phase. Using the illustrative method, we tried to connect the identified codes with concepts from existing theories. The basis for the method of successive approximation were the relations "is synonymous with" and "is a hypernym term". Finally, we performed an illustrative method.

As the final result of the qualitative analysis, 25 concepts were identified. Among them, the following concepts/factors have proven to be most relevant and we have included them in the theoretical (causal) model, which is illustrated in Figure 3. We applied the model in the UTAUT model, where we changed the variables from a TAM model with similar variables as a UTAUT model, namely:

- Perceived Usability (TAM) → Performance Expectancy (UTAUT) and
- Perceived Ease of Use (TAM) → Effort Expectancy (UTAUT)

 ISBN: 978-1-61208-120-5

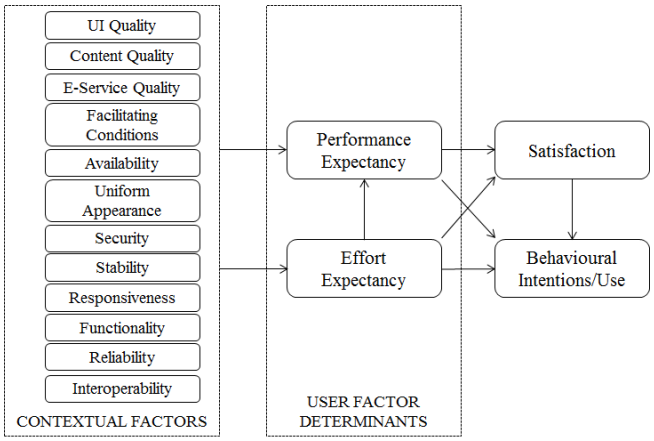


Figure 3. Theoretical model of acceptance of the Moodle system

VI. LIMITATIONS

When interpreting the results we had to take into consideration the following restrictions:

- *Restrictions on the methods of research* – the surveys were conducted through an online survey system, where each respondent expressed their opinion in one answer. The online poll did not allow the development of discussions, so the answers reflect the respondent's current feelings. Still, the survey contained two clearly defined and focused questions, which contributed to the relatively large number of responses and answers.
- *Limitations of the study frame* - the sampling frame of our study was purpose oriented and undetermined. Users responded to the survey based on their own motivations. For this reason, the results are difficult to generalize for the population of all Moodle users. The results do, however, give a general picture, since the sample was relatively large and contained a large variety of respondents coming from various educational institutions. In this study, only learners participated. In order to get the whole picture, the opinion of the instructors should also be included. Users that participated in this study, come from different institutions that may have different Moodle implementations.
- *Restrictions on analytical techniques* - an analysis of qualitative data was conducted in a systematic way, where we tried to nullify subjective influences. In the process of data coding, we identified codes directly from the qualitative data. The results of the qualitative data were obtained analytically by using semantic relationships between codes and concepts.
- *Research repeatability* - it is likely that in the event of performing a re-analysis by using other concepts from existing models of quality and acceptance, we would receive a final list of concepts, where individual concepts and their structure would be significantly different.

VII. CONCLUSION

In this paper, we presented quality research, identifying the factors that influence e-learning system acceptance. We conducted a survey, asking respondents two main questions: what features are important in an e-learning system and what do they miss in the e-learning system that they currently use. With their answers, we defined the main factors. In the case of importance, learning material availability was considered the most important factor that respondents expressed. In the case of missing features, "satisfaction with the system" was the main issue. E-learning system developers and professors/teachers/instructors should therefore search for features that could improve user's degree of satisfaction when using an e-learning system for learning purposes. There are many factors that may have influence on user's overall satisfaction with the system. E-learning system developers must consider how to integrate the e-learning environment with new services and technologies. New technologies with social openness will lead into a social revolution, where learners will actively participate in the learning content creation and learning process. E-learning system developers should therefore consider about how to integrate e-learning system with Web 2.0 technologies and services (Wiki, blogging systems, RSS, Twitter, Youtube, Flickr, Slideshare, Facebook, etc.).

The factors that we identified with a qualitative analysis were used to develop a theoretical model of Moodle system acceptance. In the developed acceptance model, the quality of the user interface and learning materials, functionality, availability, security, facilitating conditions and stability showed an influence on the learner's performance expectancy and effort expectancy, which are both predictors of a user's behavioral intentions in using a specific e-learning system. In our future research work we will conduct a quantitative study in which we will evaluate the research model and try to confirm/reject the proposed causal relationships.

VIII. REFERENCES

[1] M. Yi and Y. Hwang, "Predicting the use of web-based information systems: self-efficacy, enjoyment, learning goal orientation, and the technology acceptance model," *International Journal of Human-Computer Studies*, vol. 59, 2003, pp. 431-449.

[2] C. Ong, J. Lai, and Y. Wang, "Factors affecting engineers' acceptance of asynchronous e-learning systems in high-tech companies," *Information & Management*, vol. 41, 2004, pp. 795-804.

[3] S. Liaw, H. Huang, and G. Chen, "Surveying instructor and learner attitudes toward e-learning," *Computers & Education*, vol. 49, 2007, pp. 1066-1080.

[4] S. Zhang, J. Zhao, and W. Tan, "Extending TAM for Online Learning Systems: An Intrinsic Motivation Perspective," *Tsinghua Science & Technology*, vol. 13, 2008, pp. 312-317.

[5] E. Ngai, J. Poon, and Y. Chan, "Empirical examination of the adoption of WebCT using TAM," *Computers & Education*, vol. 48, 2007, pp. 250-267.

[6] Y. Lee, "The role of perceived resources in online learning adoption," *Computers & Education*, vol. 50, 2008, pp. 1423-1438.

[7] E. Vanraaij and J. Schepers, "The acceptance and use of a virtual learning environment in China," *Computers & Education*, vol. 50, 2008, pp. 838-852.

[8] I.T. Brown, "Individual and Technological Factors Affecting

 ISBN: 978-1-61208-120-5

Perceived Ease of Use of Web-based Learning Technologies in a Developing Country," *The Electronic Journal of Information Systems in Developing Countries*, vol. 9, 2002, pp. 1-15.

[9] "Moodle.org: open-source community-based tools for learning," *http://moodle.org/*.

[10] "QDAMiner." [Online]. Available at: http://www.provalisresearch.com/QDAMiner/QDAMinerDesc.html [Accessed: 21-Oct-2010].

[11] ISO/IEC 9126-1:2001.

[12] A. Parasuraman, V.A. Zeithaml, and L.L. Berry, "SERVQUAL: A Multiple-Item Scale for Measuring Consumer Perceptions of Service Quality," *Journal of Retailing*, vol. 64, 1988, pp. 13-37.

[13] R.G. Dromey, "A Model for Software Product Quality," *IEEE Transactions on Software Engineering*, vol. 21, Feb. 1995, pp. 146-162.

[14] J.A. McCall, P.K. Richards, and G.F. Walters, "Factors in Software Quality. Volume I. Concepts and Definitions of Software Quality," Jul. 1977.

[15] F.D. Davis, "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology," *MIS Quarterly*, vol. 13, Sep. 1989, pp. 319-340.

[16] V. Venkatesh, M.G. Morris, Gordon B. Davis, and F.D. Davis, "User Acceptance of Information Technology: Toward a Unified View," *MIS Quarterly*, vol. 27, Sep. 2003, pp. 425-478.

[17] D.L. Goodhue and R.L. Thompson, "Task-Technology Fit and Individual Performance," *MIS Quarterly*, vol. 19, Jun. 1995, pp. 213-236.

 ISBN: 978-1-61208-120-5

Usage of mobile self-assessment to support a continuous learning process

Thomas Schüler, Karsten Morisse
Dept. of Engineering and Computer Science
University of Applied Sciences
Osnabrück, Germany
Email: [t.schueler, k.morisse]@hs-osnabrueck.de

***Abstract*—In this article we describe the usage of mobile self-assessments to support a blended learning context in higher education. The students have the option to attend self-assessments and use all other provided learning media on their mobile devices. We describe the didactical setting in which the self-assessments are embedded, the development of a mobile application for using the assessments and the implementation and evaluation of it in the current term at our university. Further, we emphasize the benefit of developing special applications to support mobile learning.**

***Keywords*-Mobile Assessment; Blended Learning; Continuous Learning;**

I. INTRODUCTION

The usage of e-assessments is motivated by several facts. E-assessments may be evaluated automatically and therefore provide immediate feedback for the learner. Once prepared, they are easily replicated and used in following courses without extra work for the lecturer. E-assessments are a good way to structure and evaluate the students learning behavior. The Bologna process in Germany has lead to a higher amount of examinations for the students. As a result, the number of examinations and assessments that have to be accomplished within a university increases. Usage of electronic systems may be a way to reduce the amount of time needed to organize and evaluate those.

In higher education e-assessments and examinations can be used for different purposes and in different contexts. Within this article, we focus our view on the usage as a tool for self-assessment for the students. Within our didactical setting the self-assessments are offered every week in our learning management system. They cover the topics that have been discussed in the preceding week and are only accessible for a short time-period. However, participating in the self-assessments is seen as an optional service for the students, i.e. they don't have to participate in them to be admitted to the final examination.

Providing self-assessments in a didactical setting can help to work against a well known danger of e-learning in general: If the teaching material is offered in an electronic way, the students are ensnared to download and gather everything, but work with it just right before the final examination. Learning continuously during the semester involves a very stringent time management, which many students overburdens. These circumstances lead to the procrastination effect: the learning process is postponed, because the teaching material is always available later and more pressing tasks are preferred. [8] sees in electronic self-assessments a very useful and helpful tool for knowledge control by the students themselves. If they are offered continuously and in short time-frames during the semester, they can help activating a continuous learning behavior.

In the last few years, electronic devices are becoming more mobile and this may be a crucial factor to support the adoption of e-learning by students. One of the main benefits of e-learning is often said to be the independence of time and location. This only fully applies, when the devices that are used to access e-learning content and tools are portable and convenient to use at any place. While the hardware of mobile devices is getting more powerful, it is now timely to deliver applications for specific e-learning tools. To make our learning scenario truly mobile, a special development was needed to enable working with the self-assessments on a portable device.

The remainder of this paper is organized as follows: Section 2 of this paper presents our evaluated blended learning approach which uses self-assessments as a regular service and in which video lectures substitute the real lecture. Section 3 presents the development of an application for mobile self-assessment on Apple iPhone and iPod touch devices. In section 4 we describe the implementation and evaluation of this tool in didactical settings in higher education contexts. The paper closes with a conclusion and some final remarks.

II. BLENDED LEARNING BASED ON LECTURE RECORDINGS

We are using a blended learning approach based on video lectures for several years. The development of the concept and an evaluation of it are published in a series of papers ([2], [3], [5], [4], [6]). Within this section, we summarize the didactical modules of that concept. It is used in the lecture *Audio- and Videotechnology* in a computer science study program. The course provides insight in the technical basics of the media types audio and video in the context of computer science. In addition to the theoretical part there is a practical part in which the students have to do some

 ISBN: 978-1-61208-120-5

practical work with audio and video, e.g. the production of a short movie.

Over the years we have been using different technologies for the distribution of lecture recordings, namely live- and on-demand video streaming, synchronized on-demand presentation and podcasting [2]. In the beginning, lecture recordings have been provided supplementary to the classical classroom lecture. Since 2007 the podcast has completely substituted the classroom lectures. At present, the didactical structure of the concept combines podcast lectures with live-coaching, electronic self-assessment and practical sessions to support the students learning process (see [3]). The podcast episodes are published in the Apple iTunes Music Store and are publicly available for everybody. Therefore the students can access them easily and by means of mobile devices use them anytime and anywhere. Additionally, the lecture slides have been annotated in high detail and are available as PDF-documents corresponding to each of the podcast episodes. Both are linked together by integrating the URL of the slide in the corresponding podcast episode.

The modules of the didactical concept are explained in the following (see also figure 1). Results of a thorough evaluation can be found in [5].

A. Podcast

There are more than 40 podcast episodes for this course publicly available in Apple's iTunes Music Store. The content of these podcasts had been recorded during preceding semesters. However, each recorded lecture underwent an intensive postproduction process (chapter marks, dividing into small episodes, integration of animations). They are available anytime and, using portable podcast-player, also anywhere. However, to give some structure troughout the course, a time-schedule on a weekly basis is available. When using this technology, the learning-process can be self-organized to a high degree. Each episode of the podcast offers a fine-granulated access to the content by offering chapter-marks and can be used platform-independent. Each episode includes a reference to a PDF-document with a more detailed explanation of the content.

B. Live Coaching

Live-coaching is a weekly meeting of the students with the lecturer. Instead of pure content presentation sessions, these meetings are organized by means of coaching to support the students' learning process. Certain aspects of the content are discussed, misunderstandings are clarified and practical issues are introduced. Herein, the students have the possibility to ask content-specific questions to the corresponding episodes of the podcast. If there are too many questions, the content is presented in more detail by the lecturer. Within the coaching sessions links to the practical part of the lecture are also given.

C. Electronic self-assessment

To support a continuous learning process of the students, an electronic online assessment system called VIPS is used (see [1]). Within this system there are about 10 to 20 questions about the content of each podcast episode or logical block of episodes. For each week of the semester there is one set of questions corresponding to the specific content of that week. Each set is only available for a short time frame (e.g. two days). These electronic assessments are an essential part of the didactical concept and are organized by means of self-assessment. The students are free to use the assessments to evaluate their learning process. This way the assessments are an important motivation to work with the recordings during the semester. It is up to the students' choice, if they process the assessments every week or if they just work on a few of them. However, a bonus system urges the students to work continuously with the assessments. If they reach more than 50 per cent of the points overall, they can collect bonus points for the final written examination.

D. Practical Work

Weekly lab hours accompany the theoretical part of the lecture. Within this part, the students have to work on a media project, e.g., production of a short movie or the production of a podcast. This active learning or learning-by-doing approach strengthens the theoretical facts of the lecture. Usually, this work is done in small groups of up to three or four students and the result of their work has to be presented at three milestones (storyboard, rough cut as a first version, final version of the movie). These lab hours take half of the overall workload and are used to gain practical experience in video and audio production.

E. Final Examination

To collect credit points for the module, the final examination, which is usually a written examination, must be passed successfully.

III. Mobile Self-Assessments

In this section we describe the idea and development of an application to provide self-assessments on mobile devices. For now, this application is only available on iPhone and iPod touch and works with the mentioned VIPS online assessment system at our university. With this application the online assessments (see chapter II-C) can be attended anywhere.

A. E-learning on mobile devices

Above we described a blended learning concept, which we use already since 2007. In the last few years, electronic devices were becoming more mobile and, especially with the introduction of iPhone and iPod touch, more powerful and versatile. Many of the benefits of e-learning are only truly visible, when provided on mobile devices. The option to

 ISBN: 978-1-61208-120-5

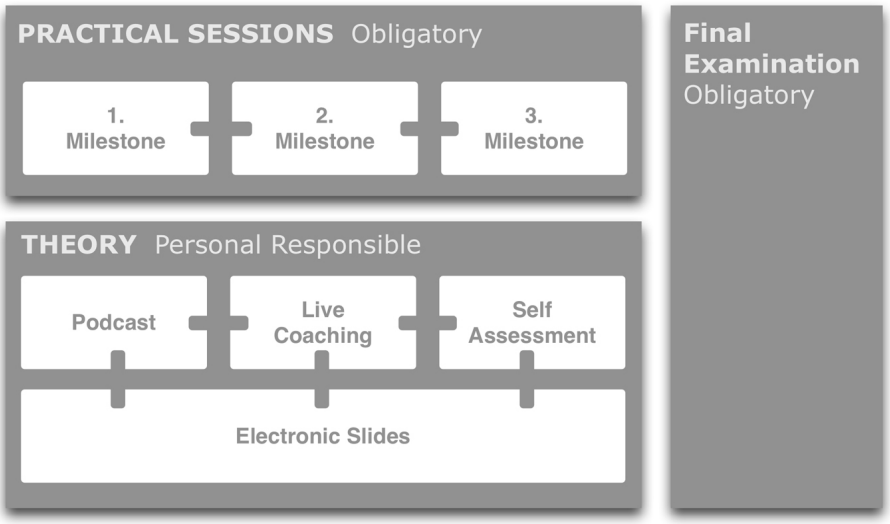


Figure 1. Modules of the blended learning concept

attend classes via video does not mean a true independence of time and space, when one is bound to a stationary computer. It is also often not that easy, to use a laptop in a crowded bus or even likely, to carry it around all day in search for a sunny spot on the campus chill-out lawn. And in the odd case that it's really happening, energy is low after 30 minutes video. Clearly, e-learning is still often limited by technology and infrastructure. Therefore, after experimenting with modern mobile devices, we decided to pay some attention to the possibility of using our learning concept on these. For the beginning we decided to use Apples's hardware.

The lecture recordings and the annotated slides already use standardized data formats, which are provided by most player hardware. Podcasting was introduced with Apple's mobile devices and was adapted by many other manufacturers. The PDF-format is common for electronic documents. Both can be accessed on iPhone and iPod touch as well as on other mobile devices. The VIPS assessment system is designed as a plugin for the Stud.IP Learning Management System [10] and is not available on mobile devices as a native application. Our goal was to develop an application for this missing part of our concept.

B. assessMe - a mobile VIPS application

The development of the *assessMe* iPhone and iPod touch application was started in late 2009. Recently we released a first version, which is limited to be used within our university's structures. This version will not be available in the Apple iTunes App-Store, which will be considered for upcoming versions.

The application integrates with the Stud.IP VIPS assessment system, so that the same data is provided for mobile as well as for stationary users. It may be synchronized to the server, allowing to switch between devices. assessMe only displays the data and handles to solve the assessment questions (see figure 2 and figure 3). The users' responses are then transferred to the server on a sync command and are processed further only there. This way complicated algorithms are used only where enough computing power is available and granted. Moreover usage of storage space on the mobile device is low and it is easier to stay in sync. These are general guidelines for the development of mobile applications. Unfortunately today it also means that the feedback to the assessments is only accessible on the web after the automatic correction was initiated by the lecturer. There is no option to sync this feedback to the mobile application. However, this may also be implemented in the future.

The interface design was kept simple in order to first evaluate functionality. By now 6 basic question types are supported:

- single-choice
- multiple-choice
- open textbox
- cloze exercise
- yes-no question
- association

Each of these types may consist of text and pictures for the question and may be supported by an optional hint. The application shows all active assessments for a student's Stud.IP account sorted by courses in which they are offered. Transfer to and from the server is initiated with corresponding buttons.

 ISBN: 978-1-61208-120-5

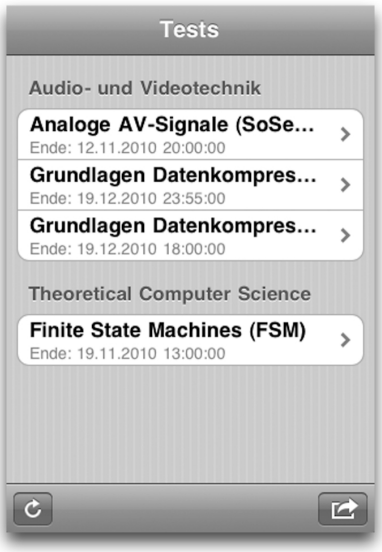


Figure 2. List of available assessments sorted by courses

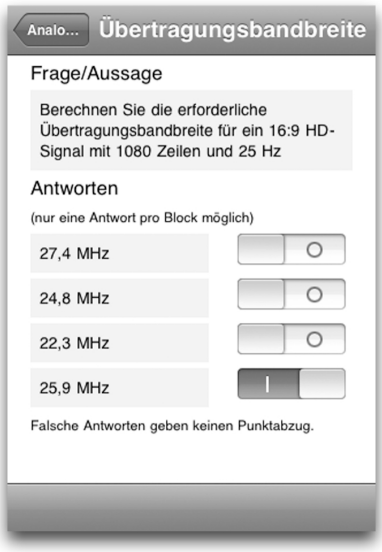


Figure 3. UI of a single-choice question

The application uses XML as the technical basis for description and transfer of the assessments and answers. The XML structure for the assessments is build by the server according to the *IMS QTI (Question and Test Interoperability)* specification (see [9]) and parsed by the mobile application to an internal object structure. On transfer of the solutions, the answers are wrapped by an XML structure and transferred to the server. XML is a common description language, that most programming languages and applications are able to handle.

With QTI the interoperability of the application between systems is supported in general. Universally, the design of interfaces is an important issue when developing an application that should integrate itself in other systems. To gain most of it, it's advisable to use standards so that the application itself is usable in different contexts. We therefore tried to develop an application, that is open enough to support different online assessment systems. However we didn't have enough resources yet, to completely reach this goal. Our application is limited to the VIPS system at our university, but a second development phase has already been started. After the first successful implementation of assessMe in our local learning concept, the goal is now to support different systems on the outside while using the same UI and data-structure on the inside.

IV. Implementation and Evaluation in the current term

Our blended learning scenario was developed over the years within the course Audio- and Videotechnology. Since 2007 we made no changes to it and gathered practical experience with quite different groups of students of the media computer science program. Overall we gained much positive feedback from students and colleagues as well. Also, the average results of the final examination has been improved.

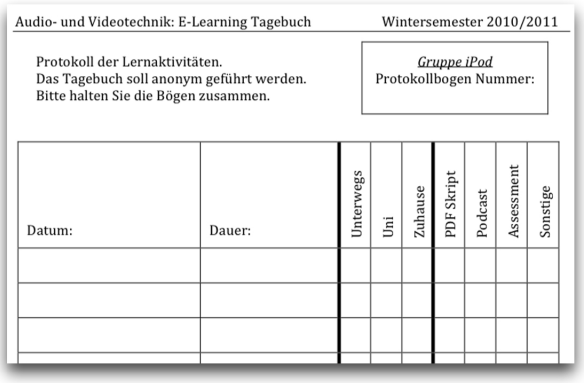
In the last years, smart-phones were becoming more and more popular and many of our students started using the podcasts on these devices. We were wondering, if usage of the e-Learning services improves, when provided on mobile devices.

The first idea for the development of the assessMe application was to fully support the usage of the blended learning scenario from section II on mobile devices. Now that we finished the first development phase, we are going to implement it in the current semester. The course Audio- and Videotechnology will be held according to the blended learning concept in the winter term 2010. To carry on with it's evaluation, we will track the learning behavior of this term's attendees. They are forming two groups: One using mobile devices (iPhone or iPod touch) throughout the semester and one using less portable devices. To balance the groups, some students are provided with iPod touch devices from the university.

Students of both groups are asked to fill a learning diary where they mark their learning activities for this course. This will be differentiated by place of learning and used media-form of our concept. To keep focus on our blended learning concept we won't further differentiate learning activities with other media-forms like textbooks or the WWW. A blank sheet of the learning diary is shown in figure 4.

The data of the diaries will be supplemented by qualitative

 ISBN: 978-1-61208-120-5



Audio- und Videotechnik: E-Learning Tagebuch — Wintersemester 2010/2011

Protokoll der Lernaktivitäten.
Das Tagebuch soll anonym geführt werden.
Bitte halten Sie die Bögen zusammen.

Gruppe iPod
Protokollbogen Nummer:

Datum:	Dauer:	Unterwegs	Uni	Zuhause	PDF Skript	Podcast	Assessment	Sonstige

Figure 4. Blank sheet of the learning diary

data. Students of both groups should answer a questionnaire at the end of the course, where we ask for their subjective experience with the blended learning concept. This way we hope to gather information about the importance of supporting mobile devices within our scenario.

Positive feedback from students of preceding semesters made us believe that self-assessment should be provided in other courses, too. Especially in courses where a wide field of knowledge need to be memorized, students will benefit from a continuous learning process. In the current semester, we therefore provide self-assessments also in the course *Theoretical Informatics*. We distribute the assessMe application among participants of this course and further among other users of the Stud.IP VIPS plugin in our university. This way we have a reasonable group of beta-testers. Their experiences will be evaluated by means of a bug tracking system and based on simple quantitative questionnaires.

V. Conclusion

After several semesters of using the lecture concept described in section II, we realized the need to fully support mobile learning. Therefore we developed the application assessMe, which allows to solve the Stud.IP VIPS assessments on mobile devices. The application was recently released in a first version, which is available only for our universities infrastructure. A second development phase was already started with the goal, to release a more universal version on Apple's iTunes Store. The usage of the assessMe application is evaluated in the current semester in our blended learning scenario as well as among other users of the assessment system. The results of this evaluation will be published in the near future. With our work we emphasize the possible benefit of supporting mobile devices in approved e-Learning scenarios in general.

VI. Acknowledgement

Thanks to our developer Dennis Böckmann for his great work on assessMe. Thanks to all participants in the current studies.

References

[1] P. Huegelmeyer, R. Mertens, M. Schroeder and H. Gust. Integration des Virtuellen Pruefungssystems ViPS in die Lehr-/Lernplattform Stud.IP, Proceedings of the Workshop on e-Learning 2005, HTWK Leipzig, 11.-12. pp. 187-196.

[2] M. Ketterl, R. Mertens, K. Morisse and O. Vornberger. Studying with Mobile Devices: Workflow and Tools for Automatic Content Distribution. World Conference on Educational Multimedia, Hypermedia & Telecommunications (ED-Media 2006), Orlando, FL, USA, Juni 2006. S. 2082-2088.

[3] K. Morisse and M. Ramm. Teaching via Podcasting: One year of Experience with Workflows, Tools and Usage in Higher Education. Proceedings of ED-MEDIA World Conference on Educational Multimedia, Hypermedia & Telecommunications 2007 (pp. 2081 - 2088). Chesapeake, VA: AACE.

[4] K. Morisse and M. Ketterl. User Generated Web Lecture Snippets to Support a Blended Learning Approach. ED-Media - World Conference on Educational Multimedia, Hypermedia & Telecommunications, 2009, Honolulu (USA).

[5] S. Wichelhaus, T. Schueler, M. Ramm and K. Morisse. More than Podcasting: An evaluation of an integrated blended learning scenario. Proceedings of ED-Media - World Conference on Educational Multimedia, Hypermedia & Telecommunications, 2008 (pp. 4468 - 4475). Chesapeake, VA: AACE.

[6] S. Wichelhaus, K. Moeller, T. Schueler, M. Ramm and K. Morisse. Weg von der klassischen Frontalveranstaltung - Podcasts, Live-Coaching und Onlinetests als integrale Veranstaltungselemente in der Lehre. Delfi 2008 - 6. e-Learning Fachtagung der GI, S. 209 - 220, Lecture Notes in Informatics, Vol. 132, Gesellschaft fr Informatik, Bonn, 2008.

[7] S. Wichelhaus, T. Schueler, M. Ramm, K. Morisse. Medienkompetenz und selbstorganisiertes Lernen - Ergebnisse einer Evaluation. In S. Zauchner, P. Baumgartner, E. Blaschitz, A. Weissenbaeck (Hrsg.): Offener Bildungsraum Hochschule, S. 124 - 133, Waxmann-Verlag, Münster, 2008.

[8] K. Wannemacher. Computerbasierte Prüfungen. Zwischen Self-Assessment und Abschlussklausuren. In E. Seiler Schiedt, S. Kälin, C. Sengstag (Hrsg.): E-Learning - alltagstaugliche Innovation?, S. 163 - 172, Waxmann-Verlag, Münster, 2006.

[9] IMS Global Learning Consortium - Question and Test Interoperability Specification http://www.imsglobal.org/question/

[10] Stud.IP LMS http://www.studip.de

 ISBN: 978-1-61208-120-5

Open Educational Resources and the Repository Network edu-sharing

Bernd J. Krämer
Department of Math. and Computer Science
FernUniversität in Hagen
58084 Hagen, Germany
bernd.kraemer@fernuni-hagen.de

Michael Klebl
Lehrstuhl für Wirtschaftspädagogik
Wissenschaftliche Hochschule Lahr
77933 Lahr
michael.klebl@whl-lahr.de

***Abstract*—Education providers increasingly integrate digital learning media into their education processes and thereby recognize the advantages of a sharing and reuse culture. But too many educational resources are still buried in closed content management systems, in local databases or on individual or institutional websites and are often not sustainably maintained. The Open Educational Resource (OER) movement aims to overcome such barriers. It has adopted a rather broad definition of OER including open courseware and content, software tools, and learning object repositories. This article argues that edu-sharing, a portal to a network of repositories for educational resource management provides a comprehensive and suitable infrastructure to support the open education movement, but also communities of practice that cannot freely publish their educational assets, e.g., due to license constraints or other regulatory barriers.**

Keyword: management of open eucational resources; OER; learning tools; open courseware; open content; learning object repositories; edu-sharing

I. THE CAMPUSCONTENT PROJECT

The repository network and portal edu-sharing is an outcome of the four-year research and development project, CampusContent (2009). The project has been funded between March 2005 and July 2009 by the Deutsche Forschungsgemeinschaft (DFG). It set out to conduct transdisciplinary research in a team of computer science and pedagogy experts to:

a) Find answers to the following key research questions:

- How can the visibility and sustainability of digital learning resources be improved?
- How can a sharing and reuse culture for high quality content and pedagogical best practices be promoted and technically enabled across heterogeneous development and delivery systems?
- How can best pedagogical practices be smoothly conveyed to practitioners, including lecturers, course developers, teacher or tutors?
- How can educational resources be designed and adapted to accommodate different application contexts?

b) Support sharing, joint development and reuse of educational resources and pedagogical best practices, both through methodological and technical contributions.

The CampusContent Project was strongly inspired by design principles for component software including cohesion, de-coupling, parameterization, and late composition. If these ideas could be carried over to digital learning resources, there was a good chance that the success of component software would come here, too. Further, we observed that although a plethora of free educational resources exists, suitable candidate content is difficult to find and access because it is hidden on institutional or individual websites, buried in closed content management systems or in local learning management systems or because it lacks meaningful metadata. Even if a promising resource is discovered, important context information, such as the pedagogical context for which it was designed, ownership rights and rights of use, is not documented and thus are likely to prevent its proper reuse.

II. THE REPOSITORY NETWORK EDU-SHARING

As an academic project, CampusContent aimed at higher education initially and was inspired by our experiences with technology-enhanced distance education. In the course of the project, however, other educational institutions like schools and vocational education providers aspired to integrate the methods and technology developed

 ISBN: 978-1-61208-120-5

in CampusContent in their e-learning processes. Especially local and regional school networks that are committed to technology-enhanced learning at different types and ages of schooling raised a strong demand for content sharing technology. Due to the heterogeneous landscape of learning technology there was a need to accommodate a range of learning management systems and authoring tools. To take this wider use of project outcomes into account, the project launched the product version of its repository network under the name "*edu-sharing*" in August 2009.

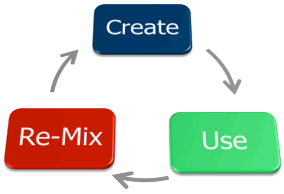


Figure 1. Circle of educational knowledge building and sharing (cf., Brown and Adler, 2008)

The vision behind edu-sharing was to initiate and foster a circle of educational knowledge building and sharing (Fig. 1) by:

- Supporting the development of reusable and sharable learning content and didactic scenarios (*create*).
- Encouraging teachers and lecturers to discover, review, critique and build on others' work (*use*).
- Enable teachers and lecturers to integrate others' work into their own teaching (*remix*).

Currently 9 didactic scenarios, which have been documented comprehensively in pedagogy- and methodology-oriented literature, are available in edu-sharing as scenario templates. Such templates describe learning arrangements in abstract form, i.e., without reference to topical content and specific implementations of communication and collaboration tools. The predefined scenario templates include: strategic problem solving, puzzle method, simulation, problem-oriented learning, project method, or case study. 31 templates for didactic interactions supplement the scenario templates. They include: advocatus diaboli, active structuring, flash light brainstorming and others.

To content authors and instructional designers, edu-sharing offers design methodologies, a range of authoring tools connected to the repository network, a search engine to discover content and predefined scenario templates in the repository network, and a personal workspace and a community portal for cooperative development.

Teachers and lecturers will primarily use their preferred learning management system (LMS) and the search engine to design executable courseware. A specialty of the LMSes integrated in edu-sharing is that they allow the search for content and scenarios from within the LMS. Suitable content can then be referenced in a course and appropriate scenarios can be imported and completed.

Students typically use their school's LMS. If this LMS is an integral part of edu-sharing, they may discover further valuable learning resources, such as open content and open courseware, in the repository network or in attached content pools with the help of the search engine.

A. *Technology*

The core technology is a distributed educational resource repository that is organized as a network of homogeneous repositories (cf. Fig. 2). Each edu-sharing node is typically operated autonomously by a separate institution, e.g., a communal computing center serving the schools in their region or a university computing center. This institution can decide whether it wants to run its edu-sharing repository as an isolated system or connect it with other repositories in the edu-sharing family. In the latter case the users can access content and codified learning arrangements, so-called didactic scenarios (cf. e.g. Krämer et al., 2010), from non-local repositories. They can also form cross-institutional communities of practice (like C_1 in Fig. 2), and give external users access to all open and selected closed resources.

Each node in the edu-sharing repository network comes with a local repository that is enriched by common community services and can be embedded in locally preferred learning environments and authoring tools for content production. The latter include an OpenOffice-based editor for SCORM-compatible courseware and an offline editor for QTI 2.0-compatible tests.

 ISBN: 978-1-61208-120-5

Each edu-sharing repository also includes a license management component that ensures that each resource in the repository has a rights-of-use license attached.

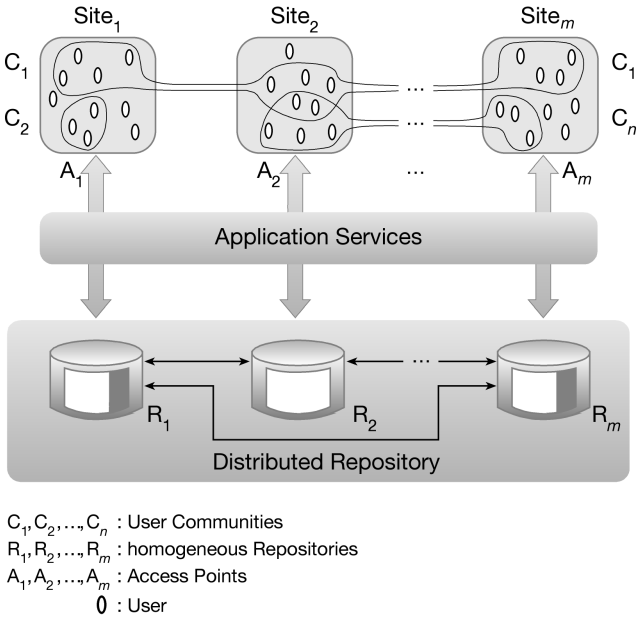


Figure 2. Networked repositories with cross-organizational communities

The edu-sharing system is free open source software, which can be downloaded from www.edu-sharing.net. The default distribution includes several authoring tools and learning management systems (Moodle, metacoon, OLAT).

B. *Sharing and Reuse versus Open and Closed Content*

As CampusContent started with the aim to support the open content movement, it supports Creative Commons licenses. But as we went on, we learned from potential users of edu-sharing that open content and Creative Commons licenses are not always the way to go. Schools, for instance, do not own much digital content. Rather, in their teaching they rely on content bought from educational publishers. In Germany, most likely also in other countries, this led to the situation that different school districts spent money for the same resources that they can only maintain in their local repository and deliver to schools in their district. The heterogeneity of learning management systems and a lack of sharing infrastructure prevents a more cost-effective collaboration here.

To cope with such situations, edu-sharing allows the sharing of resources across heterogeneous learning management and authoring systems. In addition, it provides open interfaces and a trusted interaction protocol. Both together allow the integration of proprietary content pools in such a way that their content can be discovered and used from within edu-sharing while obviating the necessity to maintain copies of such foreign content in the edu-sharing repository. Through the trusted interaction protocol, there is also no need to maintain user data and access rights in edu-sharing. Rather, access rights managed by school servers are directly forwarded to the foreign content pool. Finally, the license management component is extensible to serve other licenses than Creative Commons, as well.

C. *Collaboration in Shared Workspaces*

Besides providing open access to learning content and pedagogical scenario templates, edu-sharing further supports collaborative work processes in networked "communities of practice" (Lave and Wenger, 1991). For each registered user, the local edu-sharing repository provides a personal workspace. Thus, edu-sharing users can manage their own, licensed and discovered open content in collections, which are represented as folders in the workspace and are maintained in the repository. All resources in the workspace only exist once and are just referenced in collections, not copied.

In their personal workspace, educators may simple want to work on their own, first. However, once resources are uploaded into or created within the edu-sharing system, sharing resources with other users or groups is effortless. Particularly for the bootstrapping process of communities of practice, this strategy is promising. Educators can invite trusted peers to access individual resources, selected collections or the whole workspace in read or write mode.

III. OPEN EDUCATIONAL RESOURCES (OER)

From our sketch of the motivation behind the CampusContent Project it should be obvious that it shares the ideas of open educational resources and advances its wider definition of this concept, which includes (OECD, 2007):

 ISBN: 978-1-61208-120-5

- *content* of varying granularity;
- open source software *tools* for developing, discovering, using, adapting, remixing, organizing and delivering learning content and learning arrangements and functionality for organizing communities of practice;
- *implementation resources* supporting interoperability and the design of sharable content and best practices.

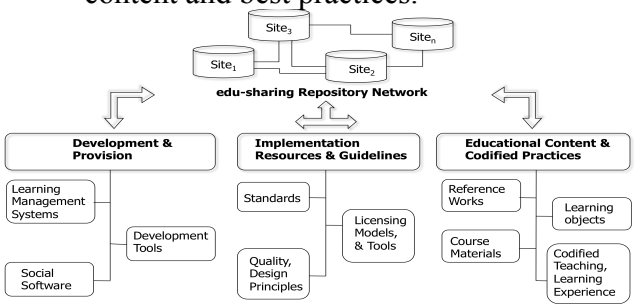


Figure 3. Conceptual map of OER (following OECD, 2007, p. 31)

The conceptual map of OER on Page 31 of the OECD study (2007) inspired the mapping of the CampusContent Project's contributions onto the open educational resources domain (Atkins et al., 2007) as illustrated in Fig. 3.

IV. CONTRIBUTIONS OF EDU-SHARING TO OER

The following discussion is organized along the three components of OER: content, software and implementation resources (OECD, 2007, p. 31)

A. Content

In edu-sharing educational resources of different kinds can be managed: digital media assets including text, illustrations, simulation, video and audio clips, photos, maps, or quizzes; learning objects, which combine topical content, a learning objective and learning activities (Krämer and Han, 2009); courses and course components (Krämer and Klebl 20009); teaching and learning experiences in the form of didactic scenarios (Krämer et al., 2010), and reference works like glossaries or thesauri.

Figure 4 is a screen shot of a section of a course on German postwar history. The course references media assets from within the repository network, such as historical speeches of German and international politicians, facsimile of contemporary newspaper articles and historical documents, and short historical videos related to the establishment of the Berlin Wall (see, Fig. 5).

B. Software Tools

Concerning *development and provisioning software*, edu-sharing comes with a range of end-user tools for creating media assets, authoring courses based on resources and scenario templates found in the repository network or personal workspaces, editing didactic scenarios, or creating QTI-compatible questions and test. The default distribution includes popular open source leaning management systems (LMSes) that are interfaced in such a way that learning resources and didactic scenario templates can be linked into a Moodle. Conversely, resources stored in the LMS can be uploaded in the repository or personal workspace.

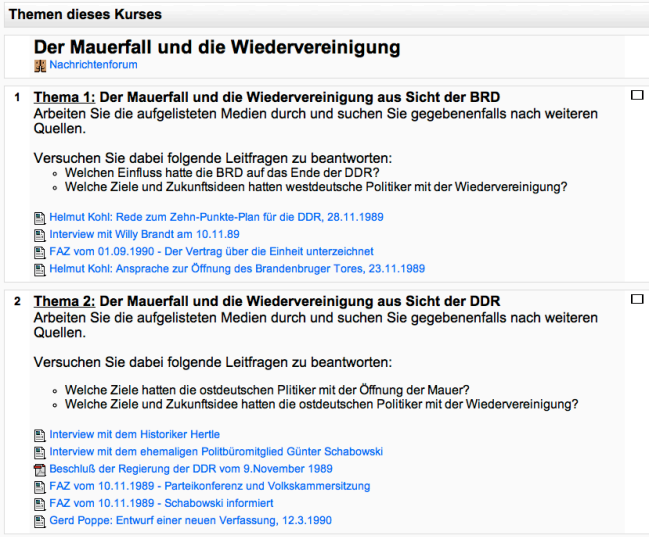


Figure 4. Section of a history course in Moodle referencing edu-sharing objects (in German)

Through edu-sharing's rendering service, repository content can be played in all attached LMSes. It uses special modules for reproducing a range of graphics, sound and video files, QTI-compliant tests and exercises, SCORM, Moodle and metacoon courses. Resources hosted on closed publisher servers play their content on the own server on behalf of the customer's distant LMS-systems.

Currently, social software is realized in edu-sharing in the form of a community portal, with community building and information services. A rudimentary user tracking service collecting dynamic metadata such as the numbers and

 ISBN: 978-1-61208-120-5

contexts of use of resources is also available. Additional community functions like resource rating, user tagging and annotation of resources are under development.

Figure 5. Movie documenting the building of the Berlin Wall

C. *Implementation Resources*

The edu-sharinglicense manager acts like an agent that becomes visible whenever a new resource is uploaded or rights of use are inspected by re-users. Thus our license manager tackles the lack of awareness of copyright issues, which Hylén (2006) considered a challenge for OER.

Best practices are supported from three perspectives:

Didactic scenarios capture best practices in learning design (Klebl et al., 2010). They describe arrangements of learning, teaching and tutoring activities and pedagogical interactions. The didactics group of the CampusContent team has codified widely accepted didactic scenarios in the form of content-free *didactic scenario templates* and made them available in edu-sharing. The learning scenario editor of edu-sharing allows users to edit such templates by adding appropriate learning resources and tool bindings (e.g., wiki, forum, newsgroups, etc.) and refining or modifying predefined learner and tutor activities. Educators can also define their own scenarios and publish them with or without content in the repository.

Configurable and pedagogically parameterized objects implement design principles that were carried over from software engineering and aim at improved reusability and effectiveness in content production (Krämer and Han, 2009). Configurable objects are interactive information or learning objects that can be applied in different topic areas. They are equipped with "leveling-screws" through which they can be adapted to the actual application context.

Design principles, guidelines, help wikis, and useful information about various e-learning topics are collected and summarized in a comprehensive *information portal*. The categories addressed include: e-learning software and tools, best practices in e-learning content production, didactic scenarios, legal issues and other topics. This information portal is jointly developed with DINI (Deutsche Initiative für Netzwerkinformation e.V.).

A third element in the implementation resources branch of the OER concept map copes with interoperability issues, in general, and standards as the IEEE, IMS and other standardization bodies advance them, in particular. We already argued that edu-sharing supports major e-learning standards including the OAI metadata harvesting protocol, web service standards and open interfaces. This will allow us to expand the homogeneous edu-sharing repository network to a heterogeneous network, which will provide access to foreign repositories.

D. *Sustaining Learning Resource Projects*

With its repository network and personal workspace concept, edu-sharing supports both a user-producer and a co-production model of (open) educational resources (cf., OER, 2007, p. 13, 14). Through the coupling of different repositories and the embedding of heterogeneous learning management systems, learning resources will become "searchable across repositories" and can be "integrated and adapted across platforms".

E. *Internationalization and Localization*

Specific challenges of OER in a global setting are issues like internationalization and localization. For large bodies of text, there is currently no other way than translation. If the text

 ISBN: 978-1-61208-120-5

is represented in a specific format like Connexions courses are, appropriate editors should allow translators to keep layout and structural information, if suitable, and just change the language of the text.

For interactive resources including movies, animations, user interaction, graphics and the like we have started to develop design patterns and structure templates that pull all language-and notation-dependent features to the interface such that they can be reconfigured. For instance, technically, inscriptions in graphics or animations can be modeled by variables in the code and bound to specific strings in a particular language at configuration time. Audio explanations of animations should be chopped into segments that are assigned to the appropriate synchronization points in the visual animation. If these synchronization points are visible at the object interface and the audio segments can be cut out, corresponding audio segments in the new language can be resynchronized with the visual animation.

V. CONCLUSIONS

Although close in spirit to the OER idea, CampusContent was not designed as an OER project. Rather it set out to design and construct a portal and distributed repository infrastructure that supports educators in sharing, joint development and reuse of learning resources and best pedagogical practices even if they prefer different end-user systems including content authoring tools, learning management systems and collaboration and communication services.

In the end, as we argued in the main body of this paper, the project's contributions address OER needs to a great extent. Our discussion emphasized technological concerns such as storage, management, retrieval, adaption, remix and delivery of educational content and codified best practices.

With the new version of edu-sharing to be released in October 2010, the user interface is fully accessible at the cost of double development.

As edu-sharing has been launched only a short while ago, however, current weaknesses include a lack of a critical mass of learning resources and a relatively small user community. The sustainability of edu-sharing outcomes, the growth of its content base and its community are not ensured yet, as for other repository and OER projects.

We have also not yet decided about a suitable q*uality assessment process* for open and closed content. Our initial idea was to leave the organization of such processes to upcoming communities of practice to avoid the bottleneck of peer reviews or an editorial committee.

ACKNOWLEDGMENT

We thank the German Research Foundation (DFG) for funding the CampusContent Project under code number 44200719.

REFERENCES

[1] Atkins, D. E., Brown, J. S. and Hammond, A. L. (2007). A review of the open educational resources (OER) movement: achievements, challenges, and new opportunities. Report to The William and Flora Hewlett Foundation. Retrieved August 28, 2010, from http://www.oerderves.org/wp-content/uploads/2007/03/a-review-of-the-open-educational-resources-oer-movement_final.pdf

[2] Baraniuk, R. G. (2008). Challenges and opportunities for the open education movement: a connexions case study. In T. Iiyoshi, M. S. V. Kumar and J. S. Brown (Eds), Opening up education: the collective advancement of education through open technology, open content, and open knowledge (pp. 229–246). Cambridge, MA; London, UK: The MIT Press.

[3] CampusContent.(2009). Project website: http://www.campuscontent.de/

[4] edu-sharing.net (2010). The association edu-sharing.net. Retrieved August 28, 2010, from http://www.edu-sharing.net/mcportal/web/edu-sharing/edu-sharing-verein

[5] Hylen, J. (2006). Open Educational Resources: Opportunities and Challenges. Retrieved August 30, 2010, from http://www.oecd.org/dataoecd/5/47/37351085.pdf

[6] Klebl, M., Krämer, B. J., and Zobel, A. (2010). From Content to Practice: Sharing Educational Practice in edu-sharing, British Journal of Educational Technology, Vol 41(6), 2010

[7] Krämer, B. J. and Han, P. (2009). Educational content creation and sharing in a technology-rich environment. *International Journal on Advances in Software*, 2, 188–201.

[8] Krämer, B. J. and Klebl, M. (2009). Supporting Student Mobility and Collaboration through the E-Learning Portal edu-sharing, Fourth Colloquium on International Engineering Education, pp. 1-14, Research Report 4/2009, Department of Mathematics and Computer Science, FernUniversität in Hagen

[9] Krämer, B. J., Klebl, M. and Zobel, A. (2010). Sharing educational knowledge and best practices in edu-sharing. International Conference on Mobile, Hybrid, and On-line Learning. eL&mL 2010. St. Maarten, Netherlands Antilles.

[10] Lave, J. and Wenger, E. (1991) *Situated Learning: Legitimate Peripheral Participation,* New York: Cambridge University Press.

[11] OECD (2007). Giving Knowledge for Free: The Emergence of Open Educational Resources. Retrieved August 28, 2010, from http://www.oecd.org/dataoecd/35/7/38654317.pdf

 ISBN: 978-1-61208-120-5

A Survey of Visuo-Haptic Simulation in Surgical Training

Felix G. Hamza-Lup
Computer Science
Armstrong Atlantic State Univ.
Savannah, GA, USA
felix.hamza-lup@armstrong.edu

Crenguta M. Bogdan, Dorin M. Popovici
Mathematics and Informatics
Ovidius University
Constanta, Romania
{cbogdan, dmpopovici}@ univ-ovidius.ro

Ovidiu D. Costea
General Surgery
Ovidius University
Constanta, Romania
danielocostea@yahoo.com

***Abstract* – Surgeons must accomplish complex technical and intellectual tasks that can generate unexpected and serious challenges with little or no room for error. In the last decade, computer simulations have played an increasing role in surgical training, pre-operative planning, and biomedical research. Specifically, visuo-haptic simulations have been the focus of research to develop advanced e-Learning systems facilitating surgical training. Visuo-haptic simulations combine the tactile sense with visual information and provide realistic training scenarios, to gain, improve, and assess resident and expert surgeons' skills and knowledge. Choosing the suitable haptic hardware, API or framework for developing a visuo-haptic e-Learning system is an important decision that is based on several factors. We present a survey of the most popular hardware and software components for haptic based laparoscopic surgical training system development. We also discuss the assessment and integration of such systems as e-Learning components in hospitals.**

Keywords - haptics; surgical training; laparoscopy

I. INTRODUCTION

Out of the five human senses, touch is the most proficient. Touch is the only sense capable of simultaneous input and output. Haptics (i.e., haptic technology) is a development of the last two decades that allows the integration of tactile feedback in computer simulations. Visuo-haptic applications are multimodal, allowing the user to receive tactile feedback based on the real properties of simulated objects.

Haptic technology can be applied in a variety of fields but is specifically successful in the gaming industry [1], adding to the entertainment capabilities of existing gaming systems and enriching the user's experience. Another field showing potential for the use of haptics is medical training. The sharp realism needed for effective surgical training, with little or no room for error, makes haptic-based simulators particularly attractive.

Surgical education requires extensive practice on patients with close faculty supervision, and can become financially prohibitive for teaching institutions. Surgical training for specific procedures is often done on animals or cadavers. The Physicians Committee for Responsible Medicine found in a survey of 198 Advanced Trauma Life Support courses nationwide, that more than 90% use human cadavers or simulator dummies for training. The remaining courses use live animals to teach these skills. A critical look at using animals for medical training [2] emphasizes the problems with this approach. The replacement of animal testing and animal experimentation with virtual techniques such as visuo-haptic simulation often yields both ethical and technical advantages. Recent applications of haptic technology include training for simple procedures in dental surgery, or complex procedures for surgical training. Again we emphasize that the rationale for such simulators is also coupled with improvements of ethical and financial nature (i.e., eliminating the need and costs of keeping corpses or live animals for surgical training).

In this paper, we provide a survey of the application of the haptic paradigm in the medical field, specifically in the training and assessment of resident and novice surgeons. We provide a brief survey of existing technology, APIs, and frameworks, and describe the potential of haptics in surgical training.

The paper is organized as follows: Section 2 contains a review of haptic device characteristics. In Section 3, we provide a brief survey of existing technology for laparoscopic surgical training. Section 4 consists of a brief review of existing APIs and frameworks for the integration of haptics and associated algorithms into interactive simulations. In Section 5, we focus on surgical tasks, the skills necessary for their correct execution, and the existing frameworks for skills assessment. We conclude with a discussion on the challenges of developing and integrating such simulators in a genuine hospital environment.

II. HAPTIC DEVICE CHARACTERISTICS

Haptic research originates with the work of Heinrich Weber, a 19th century professor at the University of Leipzig; however, robotics was almost non-existent at that time. A few decades later, Lederman and Klatzky [3] summarized four basic procedures for haptic exploration, each bringing forth a different set of object characteristics. The first one, *lateral motion* (*i.e., stroking*), provides information about the surface texture of the object; the second, *pressure*, gives information about the firmness of the material; the third, *contour following*, elicits information on the form of the object; and last but not least, *enclosure*, reflects the volume of the object.

The haptic devices currently available on the market apply relatively small forces on the user (usually on the user's hands and/or fingers) through a complex system of servoengines and mechanical links. There are numerous haptic devices on the market, and their price has decreased significantly over the past few years due to mass production.

 ISBN: 978-1-61208-120-5

Among the most popular are Sensable's PHANToM® Omni™ and Desktop™ [4] devices that can apply forces through a mechanical joint in the shape of a stylus. As recent as 2007, Novint, a company founded by the researchers of Sandia National Laboratory, marketed the very first commercial haptic device. Falcon Novint [5] has been released on the market at a very low price in conjunction with computer games in the USA, Asia and Australia. Novint licensed key portions of the technology used in Falcons from Force Dimension [6], a leading Swiss developer of high-end haptic devices like the Omega.x or Delta.x family illustrated in Figure 1.

Figure 1. Omega.x (top-left), Falcon Novint™ (bottom-left), PHANToM™ Omni (top-right) and Desktop (bottom-right)

The most important characteristics (i.e., *performance measures*) [7] common to all haptic devices, include:

- *Degrees-of-freedom* represents the set of independent displacements that specify the position of the end effectors.
- *Work-volume* refers to the area within which the joints of the device will permit the operator's motion.
- *Position resolution* is the minimum detectable change in position possible within the workspace.
- *Continuous force* is the maximum force that the controller can exert over an extended period of time.
- *Maximum force/torque* is the maximum possible output of the device, determined by such factors as the power of the actuators and the efficiency of any gearing systems. Unlike continuous force, maximum force needs to be exerted only over a short period of time (e.g., a few milliseconds).
- *Maximum stiffness* of virtual surfaces depends on the peak force/torque, but is also related to the dynamic behavior of the device, sensor resolution, and the sampling period of the controlling computer.
- *Haptic update rate* is the inverse of system latency, measured in hertz (Hz).
- *Inertia* is the perceived mass of the device when it is in use. This should be as low as possible to minimize the impact of the device controller on rendered forces.

A novel approach to implementing haptic feedback is through magnetic forces. Magnetic levitation haptic devices allow users to receive force-feedback by manipulating a handle that is levitated within a magnetic field. Users can translate and rotate the handle while feeling forces and torques from the virtual environment. Compared with traditional haptic devices that use motors, linkages, gears, belts, and bearings, magnetic levitation uses a direct electro-dynamic connection to the handle manipulated by the user. Some of the advantages of this approach are: no static friction, no mechanical backlash, high position resolution, simulation of a wide range of stiffness values, and mechanical simplicity. Magnetic haptics has been considered in relation to surgical training systems [8].

The first commercial integration of a magnetic levitation haptic device is the Maglev 200™ Haptic Interface developed by ButterflyHaptics™ [9], illustrated in Figure 2.

Figure 2. Maglev 200™ Magnetic Levitation Haptics

Multiple problems arise in haptic applications interacting with deformable objects. For example, costly computation time, numerical instability in the integration of the body dynamics, and time delays etc., may occur. Lengthy computations are forbidden in haptic systems which need high simulation rates (around 1 KHz) to obtain realistic force feedback. The update rates of the visual component (i.e., graphic rendering) of the physical objects being simulated is of the order of 20 to 30Hz (frames per second). This difference in the simulation rates can cause an oscillatory behavior in the haptic device that can become highly unstable. Some of these problems can be alleviated with the use of magnetic levitation devices [9]; however, the development of applications in the area is in early research stages.

III. BRIEF SURVEY OF VISUO-HAPTIC SYSTEMS FOR SURGICAL TRAINING

During surgical procedures, tactile exploration improves the surgeon's performance, providing information beyond traditional visual cues and intuition. For example, pressure and force magnitude provide information about physiological preexisting tensions at the organ level, and iatrogenic tensions generated upon the organic structures during diagnostic or therapeutic procedures.

The force applied on the unit surface is directly proportional with the physical resistance of the tissues in diverse physiological and pathological situations. Parenchymatous organs are friable, hence a smaller prehension and/or traction force is necessary in comparison with hollow organs, or organs that pose more resistance at traction/torsion. Blood vessels are fragile structures, and the forces that act on them must be significantly smaller in magnitude than the forces on ligament/bone structures.

An early study by Moody et al. [10] in 2000 demonstrated the effect of a force feedback system in the

 ISBN: 978-1-61208-120-5

training and assessment of surgeons. The visuo-haptic system included a PHANToM Desktop unit and simulated a suturing procedure. After the task was demonstrated and explained to each subject by the experimenter, each of the 20 participants performed two test sutures to familiarize themselves with the task and the experimental setting. Participants were then asked to form one suture across a surgical incision, with the specifications provided by the experimenter. Results revealed that force feedback resulted in a reduction of the time taken to complete the stitch.

Most visuo-haptic simulation systems are designed for specific procedures. For example needle insertion is a common procedure that can range in complexity from a simple venipuncture (i.e., to withdraw blood), to a complex procedure such as vertebroplasty (i.e., medical spinal procedure where bone cement is injected through a small hole in the skin into a fractured vertebra with the goal of relieving the pain of osteoporotic compression fractures). Virtual Veins [11] has been primarily used for venipuncture training while a group of researchers at the National University of Singapore developed a surgical simulator for medical student training in the spinal cement vertebroplasty procedure [12]. In vertebroplasty, the surgeon or radiologist relies on sight and feel to properly insert the bone needle through various tissue types and densities. The biomechanical equipment with haptic feedback was designed to capture a user's hand movement and return the tactile information to his fingers allowing him to feel the forces during needle insertion. Other haptic-based simulators involving the task of needle insertion are used for spinal injections [13] and epidural anesthetics training.

Visuo-haptic prototypes are now being considered in a variety of medical related areas from simulation of deformable tissues and their attached properties for the planning of medical procedures [14], to surgical knot-tying procedures [15] and bone surgery [16]. Moreover, when long distance collaboration is necessary, there are prototypes for remote haptic "guidance" of a novice surgeon's hand by an expert surgeon (i.e., *telepresence surgery*) and other applications of Virtual Reality in medicine [17]. Remote training of surgical procedures [18] can improve performance and reduce costs associated with travel.

One of the most promising areas of application for visuo-haptic simulation is laparoscopy (i.e., laparoscopic surgery, non-invasive/minimally invasive surgery) training. Residents as well as experienced surgeons can use these systems for learning, assessing, and improving their surgical procedures and sharpen their skills. The systems have the advantage of changing and adapting the simulation parameters for training under special, unexpected conditions [19, 20].

With the advent of minimally invasive robotic surgery (e.g., daVinci surgical system), the haptic coordination of robotic equipment during surgery [21] brought forth new research perspectives. A pneumatic system coupled with sensors at the tip of the tools was proposed to provide haptic feedback to the surgeon during the procedure in a clinical setup [22].

For training purposes, several companies developed integrated systems that have a set of training scenarios. For example LAP Mentor™ is a multi-disciplinary laparoscopy simulator that enables simultaneous hands-on practice for a single trainee or a team. The system offers training opportunities to residents and experienced surgeons for everything from perfecting basic laparoscopic skills to performing complete laparoscopic surgical procedures.

Another system, the Virtual Endoscopic Surgery Training System One (VSOne), provides force-feedback employing three PHANToM haptic devices and a virtual endoscopic camera. The components are contained in a user-interface box [23] such that they provide an optimal simulated learning environment, similar to a real one. The system contains two applications: VSOne Cho, for laparoscopic cholecystectomy training, and VSOne Gyn, for laparoscopic gynecologic procedures. The following surgical tasks are modeled: grasping, application of clips with coagulation, cutting, irrigation, suction, suturing, and ligation [24]. A series of studies [25] have shown that training with the VSOne system gives similar results to traditional methods, with the added benefit of reduced time and cost of training.

A comparable system, CAE Healthcare's [26] LapVR surgical simulator, realistically reproduces laparoscopic procedures with haptic technology. The developers claim an accurate simulation of the tactile forces and camera behavior, exactly as it is experienced during laparoscopic surgery.

A survey by Soler et al. [27] claims that the most simulated surgical procedure is the cholecystectomy, available on simulators like LapChole from Xitact, LapSim from Surgical Science, LapMentor from Simbionix, or RLT from ReachIn [28].

While all these development efforts are isolated from each other, and each group developed the systems from basic components and off-the-shelf haptic devices, only a few APIs and frameworks have spawned in recent years. In the next section we provide an overview of the main APIs and frameworks.

IV. HAPTICS APIS AND FRAMEWORKS

The most important frameworks and APIs that support the haptic paradigm, and have been used to develop prototypes for commercial applications can be divided into two categories, open source and commercial. Some of them support deformable objects and allow rapid integration of haptics in surgical training simulators.

A. Open Source Frameworks and APIs

Haptics3D (H3D) [28] is one of the most well known open source APIs. This API is designed mainly for users

 ISBN: 978-1-61208-120-5

who want to develop haptic-based applications from scratch, rather than for those who want to add haptics to existing applications. The main advantages of H3D are the rapid prototyping capability and the compatibility with eXtended 3D (X3D), making it easy for the developer to manage both the 3D graphics and the haptic rendering. H3D API uses the X3D and OpenGL standards and builds on haptic technology from SensAble's OpenHaptics™ toolkit [4]. It allows users to focus their work on the behavior of the application, and ignore the issues of haptics geometry rendering as well as synchronization of the graphic and the haptic rendering cycles. The API is also extended with scripting capabilities, allowing the user to perform rapid prototyping using the Python scripting language.

Developed with medical applications in mind, the Computer Haptics & Active Interfaces (CHAI) 3D [28] is an open source set of C++ libraries supporting haptic-based systems, visualization, and interactive real-time simulation. The API facilitates the integration of 3D modeling with haptic rendering. Moreover, the applications are portable and can be executed on different platforms. This quality attribute is obtained by saving object characteristics in XML files. The applications can be tested using a real haptic device (e.g., PHANToM Omni), or a virtual representation using the mouse as a substitute for the haptic device. The API was recently extended with a simulation engine for rigid/deformable objects.

The need for standardization and inter-project cooperation gave rise to the Simulation Open Framework Architecture (SOFA) [28]. SOFA is targeted at real-time simulation, with an emphasis on medical simulation. It allows the development of multiple geometrical models and the simulation of the dynamics of interacting objects using abstract equation solvers. An additional advantage of this framework is the use of the XML standard to streamline the parameters of the simulation like deformable behavior, collision algorithms, and surface constraints.

Another effort targeted at applications of haptics in surgical simulators is the General Physical Simulation Interface (GiPSi) [29]. It is a general open source/open architecture framework for developing organ level surgical simulations. The framework provides an API for interfacing dynamic models defined over spatial domains. It is specifically designed to be independent of the specifics of the modeling methods used and therefore facilitates seamless integration of heterogeneous models and processes. The framework contains I/O interfaces for visualization and haptics integration in applications.

B. *Commercial Frameworks and APIs*

The ReachIn API [28] is a modern development platform that enables the development of sophisticated haptic 3D applications in the user's programming language of choice, such as C++, Python, or VRML (Virtual Reality Modeling Language). The API provides a base of pre-written code that allows easy and rapid development of applications that target the specific user's needs. UK Haptics [28], a recently established medical software development company, used ReachIn API as the core haptic technology platform for their Virtual Veins, a medical simulation package for training medical staff in catheter insertion.

To test the flexibility and ease of use of the API, we developed a simple simulation using VRML, Phyton and the ReachIn. In Figure 3, a screenshot of the liver model as seen through the laparoscope camera is illustrated.

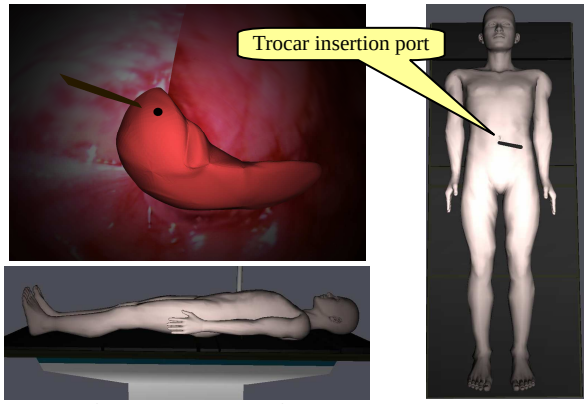


Figure 3. Deformable liver model from SOFA integrated with a humanoid model from MakeHuman [28]

The camera and the light models follow the real laparoscope camera. The haptic feedback is simulated in conjunction with the deformable liver model as well as the humanoid skin surface. The movement of the camera is constrained by the trocar. The light source model follows the camera position and orientation. The conclusion was that ReachIn API is robust and easy to integrate allowing rapid prototype development.

V. LAPAROSCOPIC SURGICAL PROCEDURES

In the following section we focus on the surgical tasks and on the assessment methodology for visuo-haptic surgical simulators. We present the main skill set and a new framework for assessment of visuo-haptic simulation in laparoscopic surgery based on a taxonomy of metrics for the evaluation of surgical abilities and skills defined by Satava[30].

A. *Surgical Task Set*

Laparoscopic surgical procedures are complex activities that can be decomposed into simple activities called tasks. These tasks can be classified into *basic tasks* and *procedural tasks*. In the laparoscopic cholecystectomy case for example, one encounters the following basic tasks:

- Laparoscope attachments manipulation
- Camera manipulation and navigation
- Light source manipulation and navigation
- Tissue manipulation (e.g., grasping)

 ISBN: 978-1-61208-120-5

- Tissue properties investigation (e.g., soft touch)
- Knot-tying

In the same surgical procedure we also encounter the following procedural tasks: suturing, clip application (pre/post resection), surgical cutting, dissecting and separating organs. Some procedural tasks involve basic tasks. For example, the suturing task involves knot-tying tasks.

B. Skill Set

To execute laparoscopic procedures the practitioner must have a series of abilities and skills. For the tasks above, the surgeon must have the following skill set:

- *Basic skills*: e.g., spatio-visual orientation and exploration ability, perceptual abilities, hand-eye coordination, two handed maneuvers, objects relocation.
- *Intermediate skills*: knowledge and correct utilization of the laparoscopic surgery tools for specific cases and the ability to correctly execute the surgical procedure.
- *Advanced skills*: knowledge of the laparoscopic procedures, manual dexterity and precision control.

The above skill classification is based on the performance level of the surgeon and reflects the instruction level (i.e., novice, competent and expert) as well as technical proficiency.

C. Skill Assessment

Currently the students' skill evaluation is performed by expert surgeons. This makes the evaluation process costly and subjective. However, using a visuo-haptic system which supports skill assessment reduces this subjectivity issue and the probability of human error.

A taxonomy of metrics for the evaluation of surgical abilities and skills was proposed in 2001 [30]. This taxonomy is based on two main concepts: *validity* and *reliability*. Each test is designed for a specific objective. The first concept, validity of a test, refers to accepting a test if it is in compliance with five validity measures. The second concept, reliability of a test, refers to the consistency of the results as the test is performed multiple times by the same person or by different persons.

Based on Satava et al. [30], there are five validity measures: face, content, construct, concurrent and predictive. These *validity* metrics endorse the test fulfillment of the objective. Each metric determines the objective fulfillment from a different perspective:

- *Face validity* is determined by the appearance of the interface of the simulated task addressed by the test.
- *Content validity* is determined by the expert surgeons based on the detailed examination of the test content.
- *Construct validity* is determined by the capability of the test to differentiate among performance levels.
- *Concurrent validity* is determined by the capability of the test to return equivalent results with other similar tests.
- *Predictive validity* is determined by the predictive capability of the test. The evaluated surgeon will have the same performance level in a real scenario.

Two complementary metrics are defined for test *reliability*:

- *Inter-rater reliability*. When the test is performed by two independent evaluators, their results are sufficiently close (if not similar).
- *Test-retest reliability*. Repeating the test at different times and dates should return comparable results for multiple evaluators.

The validity metric can also be applied in the case of visuo-haptic simulations for laparoscopy procedures. In this case each test is designed for a specific skill, and each validity metric has the following meaning:

- *Face validity*: is determined by the visuo-haptic characteristics of the interface (i.e., how the simulated objects look and feel in comparison with the real objects)
- *Content validity*: if the test measures a certain skill.
- *Construct validity*: the test results should be able to allow differentiation between an expert and a novice surgeon.
- *Concurrent validity*: the capability of a test to return equivalent results with other similar test for the same skill.
- *Predictive validity*: certainty that, after passing the test, the surgeon will have similar performance in a real environment.

In the next section, we conclude with some of the challenges for the development and integration of visuo-haptic simulators in a genuine hospital environment.

VI. CONCLUSION

From the development point of view, the APIs and frameworks are currently not interoperable, since they do not provide seamless and automatic connections from one API or framework to another. Simply put, they cannot work together to solve tasks or problems. The solution could be the usage of XML-based standards to achieve syntactic and structural interoperability or of semantic models, such as ontologies, for semantic interoperability.

Even though some effort has been invested recently in developing open frameworks (e.g., GiPSi, SOFA), the software components available are not sufficient to allow rapid development of robust simulation scenarios.

From the integration in a hospital setup perspective, the main challenges are: *budget* - the medical institution/hospital has to allocate funds and faculty "buy-in" time to facilitate the integration of such complex simulators in a clinical setup; *time commitment* - for the

 ISBN: 978-1-61208-120-5

faculty, expert surgeons and residents; *suitable space* for setting up training laboratories and required resources. Solutions exist to overcome these challenges from partnerships between industry and education, to employing lower fidelity, inexpensive simulators that can be as effective as expensive simulators for specific tasks.

In conclusion, this paper presented a succinct overview of existing visuo-haptic laparoscopic surgical training systems, the existing APIs and frameworks for haptic integration in simulations. We also discussed one of the most important components of visuo-haptic simulators, assessment. We are currently in the process of developing a cost effective battery of visuo-haptic simulation scenarios for laparoscopic surgery as part of a medical e-Learning system. We will report on the progress in future articles.

ACKNOWLEDGEMENTS

This study was supported under the ANCS Grant "HapticMed – Using haptic interfaces in medical applications", no. 128/02.06.2010, ID/SMIS 567/12271 number. We would also like to thank Adrian Seitan, Costin Petre, Alexandru Dinca and Mihai Polceanu for their contributions.

REFERENCES

[1] H. Farley and C. Steel. "A quest for the Holy Grail: Tactile precision, natural movement and haptic feedback in 3D virtual spaces". In *Same places, different spaces - Proceedings of ASCILITE, Auckland 2009*, pp. 285-295, 2009.

[2] C. Anderegg, K. Archibald, J. Bailey, M. J. Cohen, S. R. Kaufman, and J.J. Pippin. "A Critical Look at Animal Experimentation". *Medical Research Modernization Committee*, (online at: www.mrmcmed.org), 2006.

[3] R.L. Klatzky, J. Lederman, and V.A. Metzger. "Identifying objects by touch: An expert system". *Perception and Psychophysics*, Vol. 37, pp. 299-302, 1985.

[4] Sensable Haptics - *www.sensable.com*. Last access date: 12/03/2010.

[5] Novint Haptics - *home.novint.com*. Last access date: 12/03/2010.

[6] ForceDimension Haptics - *www.forcedimension.com*. Last access date: 12/03/2010.

[7] S. Wall. "An Investigation of Temporal and Spatial Limitations of Haptic Interfaces". *Ph.D. Thesis*, Department of Cybernetics, University of Reading.

[8] J. Hu, C. Chang, N. Tardella, J. English, J. Pratt. "Effectiveness of haptic feedback in open surgery simulation and training systems". *Medicine Meets Virtual Reality*, Vol. 119, pp. 213-218, 2005.

[9] ButterflyHaptics - *butterflyhaptics.com*. Last access date: 12/03/2010.

[10] L. Moody, C. Baber, and T.N. Arvanitis. "The Role of Haptic Feedback in the Training and Assessment of Surgeons". In *Proceedings of Eurohaptics*, Birmingham, UK, pp. 170-173, 2002.

[11] S. Smith and S. Todd. "Collaborative evaluation of a haptic based medical virtual environment". In *Proceedings of the 4th Intuition International Confrerence on Virtual Reality and Virtual Environments*, pp. 102-110, 2007.

[12] C.K. Chui, J.S.K. Ong, Z.-Y. Lian, Z. Wang, and J. Teo. "Haptics in Computer-Mediated Simulation: Training in Vertebroplasty Surgery". In *Simulation and Gaming*, Vol. 37, pp. 438-451, 2006.

[13] M. Farcas. "Development of a Virtual Reality Haptic Veress Needle Insertion Simulator for Surgical Skills Training", *Medicine Meets Virtual Reality*, Jan.19-22, Longbeach, California, 2009.

[14] J. Romano. "Real-Time Graphic and Haptic Simulation of Deformable Tissue Puncture", *Medicine Meets Virtual Reality*, Jan.19-22, Longbeach, California, 2009.

[15] S. Kurenov. "Development and Initial Validation of a Virtual Reality Haptically Augmented Surgical Knot-Tying Trainer for the Autosuture ENDOSTITCH Instrument". *Medicine Meets Virtual Reality*, Jan.19-22, Longbeach, California, 2009.

[16] D. Morris, C. Sewell, F. Barbagli, K. Salisbury, N. Blevins, and S. Girod."Visuohaptic simulation of bone surgery for training and evaluation". *IEEE Computer Graphics and Applications*, Vol. 26(4), pp. 48-57, 2006.

[17] R.M. Satava and S.B. Jones "Current and Future Applications of Virtual Reality for Medicine". *Proceedings of the IEEE*, Vol. 86(3), pp. 484 – 489, 1998.

[18] P. Boulanger, G. Wu, F. Bischof, and X.D. Yang. "Hapto-audio-visual environments for collaborative training of ophthalmic surgery over optical network". *IEEE International Workshop on Haptic Audio Visual Environments and Their Applications*, pp. 21-26, 2006.

[19] E. Dutson. "Simulation in Training for Laparoscopic Surgery", *Medicine Meets Virtual Reality*, Jan.19-22, Longbeach, California, 2009.

[20] C. Hourie. "LACROSS – Laparoscopic Robotic Surgical Simulator", *Medicine Meets Virtual Reality*, Jan.19-22, Longbeach, California, 2009.

[21] S. Suzuki, N. Suzuki, M. Hayashibe, A. Hattori, K. Konishi, Y. Kakeji and M. Hashizume. "Tele-Surgical Simulation System for Training in the Use of da VinciTM Surgery". *Medicine Meets Virtual Reality 13: The Magical Next Becomes the Medical Now*, IOS Press, pp. 543-548, 2005.

[22] M. L. Franco, C.H. King, M.O. Culjat, C.E. Lewis, J.W. Bisley, E.C. Holmes, W.S. Grundfest, E.P. Dutson. "An integrated pneumatic tactile feedback actuator array for robotic surgery". *International Journal of Medical Robotics and Computer-Assisted Surgery*, Vol.5(1), pp.13-19, 2009.

[23] U.G. Kuhnapfel, C. Kuhn, M. Hubner, H.-G. Krumm, H. Maass, and B. Neisius. "The Karlsruhe Endoscopic Surgery Trainer as an Example for Virtual Reality in Medical Education". *Minimally Invasive Therapy and Allied Technologies*. Vol.6, pp. 122-125, 1997.

[24] U.G. Kühnapfel, H.K. Çakmak, H. Maass, S. Waldhausen. "Models for simulating instrument-tissue interactions". 9th *Medicine Meets Virtual Reality*, Newport Beach, California, Jan. 23-27, 2001.

[25] U.G. Kühnapfel, H.K. Cakmak, B. Chantier, H. Maass, G. Strauss, C. Trantakis, E. Novatius, J. Meixensberger, K. Lehmann, H.J. Buhr, M. Lawo, G. Bretthauer. "Haptic I/O: Haptic interface-systems for virtual-reality training in minimally-invasive surgery", *Internat Statustagung "Virtuelle und Erweiterte Realität"*, Leipzig, 2004.

[26] CAE Healthcare - www.cae.com/en/healthcare/. Last access date: 12/03/2010.

[27] L. Soler, N. Ayache, S. Nicolau, X. Pennec, C. Forest, H. Delingette, D. Mutter, and J. Marescaux. "Virtual Reality, Augmented Reality and Robotics in surgical procedures of the liver". In *Perspectives in Image-guided Surgery. Proceedings of the Scientific Workshop on Medical Robotics, Navigation and Visualization*, RheinAhrCampus Remagen, Germany, pp. 476-484, 2004.

[28] APIs: H3D – *h3d.org* , CHAI 3D - *www.chai3d.org* , SOFA - *www.sofa-framework.org* , ReachIn - *www.reachin.se* , UK Haptics - *www.ukhaptics.co.uk* , MakeHuman - *www.makehuman.org*.

[29] M. C. Cavusoglu, T. G. Goktekin, F. Tendick, and S. S. Sastry. "GiPSi: An Open Source/Open Architecture Software Development Framework for Surgical Simulation." In *Proceedings of Medicine Meets Virtual Reality*, Newport Beach, California, pp.46-48, 2004.

[30] R.M. Satava, A. Cuschieri, and J. Hamdorf. "Metrics for Objective Assessment". *In Surgical Endoscopy*, Vol. 17(2) , pp. 220-226, 2003.

 ISBN: 978-1-61208-120-5

Blue-QTI: A Mobile Learning System Using Bluetooth and IMS QTI Specification

Luis A. Álvarez-González, Erick Araya, Ricardo Nuñez, and Fabiola Cárdenas
Grupo de Investigación en Tecnología de Aprendizaje
Universidad Austral de Chile
Valdivia, Chile
lalvarez@uach.cl, earaya@uach.cl, rnunez.navarrete@gmail.com, fabiolacardenas@uach.cl

***Abstract*—The paper shows the development of a system; called "Blue-QTI"; it uses low cost mobiles phones with Bluetooth and J2ME. The system allows questions and answers under IMS–QTI specification, to do that, the AquRate authoring tools is used. The lecturer installs the software Blue-QTI in his/her laptop and the students, in the classroom, using mobile phones to interact with the lecturer. Only simple interactions are implemented, because limited phones are used. The interactive learning is the pedagogical approach used to develop this tool. Three workshops with lecturers and students were used to test the tool.**

Keywords-Mobile–learning; Interactive learning; Bluetooth; IMS-QTI.

I. INTRODUCTION

According to Alfred Bork, "the psychologists agree that the best feedback is that which comes immediately after the event" [2]. So, to increase interactivity in the classroom, it seems appropriate to include questions and quick answers. However, in a classic verbal scheme, to ask a question to several students takes a few minutes, because for reasons of clarity it should be answered in sequence. If we change the scenario to a system of questions and answers in written form, the teacher takes several minutes to evaluate the answers. This is the reason why the inclusion of mobile devices equipped with wireless communication (m-learning), would help provide the desired level of interactivity. This way, the results to the questions, designed to obtain short answers can be answered quickly and personally by the students (each with a mobile device), can be seen immediately by the teacher. If this is added the fact that most mobile devices have the Bluetooth technology then an opportunity to incorporate interactive learning in the classroom appears, with a common personal device (mobile phone). The solution to do that is to have a mobile learning system based on Bluetooth to be used in a classroom [9][10].

Some others applications are:

- Eduinnova software [11]. It is based on Wi-Fi communication for PocketPC and ClassmatePC, which uses a PDA to gather real time information about the performance of different groups of students. This information is displayed graphically.
- Interwrite [3] - A global company that develops solutions for interactive learning in different educational levels. The company has developed software that supports multiple devices through wireless communication. The device type is selected according to the number of students. This application works on Windows XP SP2, Windows Vista SP1 and Mac OS X 10.4.1 or higher. The software associated is the InterwriteResponse [5].
- Promethean [7] - Company of interactive learning technologies. The software performs wireless communication with devices using a USB device called ActivHub connected to a computer or laptop, and works with Windows, MAC OS and Ubuntu Linux.

The previous applications are based on proprietary specifications. And even more, the use of standards in educational software has not been sufficiently considered in the development of software for mobile devices, which adds value to the development of a solution that includes this options.

The solution presented in this paper considers the IMS-QTI specification; the software is developed using J2ME and Bluetooth technology.

A. The IMS-QTI specification

The IMS-QTI is one of the IMS Global Consortium standards for developing software in the field of learning technologies. IMS-QTI specification [4] describes a structure to represent questions or items (assessment item), manages assessments or complete reviews (assessment test) and reports the results. IMS-QTI presents a model that defines the main components that make up the evaluation process and provides a content format for storing the questions independently of the system architecture or authoring tool used to create them. For the interconnection between systems through IMS-QTI, it is recommended the use of XML. In this case of IMS-QTI, the term "question" is replaced by "interaction". An interaction allows the teacher to specify the tool that the student will have to build a response with. Because there are multiple types of

 ISBN: 978-1-61208-120-5

questions, there are many types of interactions, some of which are explained below.

1) Simple Interactions: These kinds of interactions are based on the selection of an option or multiple options. Some of the interactions in this category are "choiceInteraction", "orderInteraction", "associateInteraction", "matchInteraction".

2) Text Interactions: These kinds of interactions allow answers in text. Some of the interactions in this category are "inlineChoiceInteraction", "textEntryInteraction", "extendedTextInteraction".

3) Graphic Interactions: Graphic interactions have an image as the main element to be used as the background of the statement, and on which all actions performed allow the user to build a response. Some of the interactions in this category are "hotspotInteraction", "selectPointInteraction", "graphicOrderInteraction".

To implement the questions according to the IMS-QTI specification, the AquRate[1] authoring tool is used [1].

B. The J2ME Platform

J2ME is a collection of technologies and specifications that can be combined to build a Java runtime environment to meet specific requirements of a device or particular market [6]. For the proposed solution, the configuration CLDC (Connected Limited Device Configuration) is used. This configuration is for memory-limited devices, low-processing capacity and limited graphics capabilities, such as mobile phones. In addition to this configuration, the profile MIDP is required. The specification MIDP (Mobile Information Device Profile) was created to work with devices with small screens and batteries. With it, you can use programs called "MIDlets" to define the user interface. Also, in the option packages available on J2ME, there is a set of standards application programmer interfaces (API) for various technologies such as Bluetooth.

C. The Bluetooth Technology

The three major wireless communication standards are the infrared (IrDA), Bluetooth and WLAN (Wireless Local Area Network), also known as IEEE 802.11, and its variants. Both 802.11b and Bluetooth connections operate in the frequency band of 2.4 GHz., but they target different markets. The 802.11 technology consumes substantially more power than Bluetooth and is more common to see it implemented in laptop and smartphones with large capacity. On the other hand, there are Java APIs to implement Bluetooth technologies, including the API offered by J2ME to implement it in mobile phones.

The Bluetooth operates normally in the radio frequency spectrum of 2.4 GHz. If Bluetooth enabled devices are in a distance supported by the specification (between 1 and 100 meters), a PAN network (Personal Area Network) is formed. In order to make connections via Bluetooth, the mobile device must have an API. In this case, the API used is the JSR-82. It is used mainly for high-level programming Bluetooth devices.

II. THE PROTOTYPE

The prototype allows to ask questions, under IMS-QTI Version 2.1 specification, using the authoring tool AquRate over Bluetooth technology, it includes a server computer used by the teacher and mobile phones used by students, The prototype was called Blue-QTI, the name was originated from the combination of Bluetooth and IMS-QTI.

The tools used for development are open source or free distribution. Thus, the development cost is very low. The criteria for selecting the tools were:

- Quality of IDE (Integrated Development Environment): Appropriate code editor with syntax highlighting, possibility of RAD (Rapid Application Development) and the customization option to add new services such as compiling various programming languages.
- Cross-platform: it required that the written code is portable between Windows and Linux directly.
- Appropriate GUI: graphical user interfaces usable and friendly to meet the functions arising from the requirements capture process. For this, libraries are also needed with visual components such as menus, dialog boxes, buttons, text boxes and drop down boxes at least.

To design the prototype, UML was used. Figure 1 shows the use case related to the client application and Figure 2 illustrates a use case of the server application.

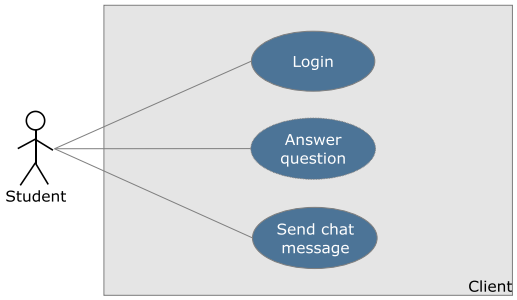


Figure 1. Use Case Diagram Client Application.

Three roles were defined to access the system, identifiable by a user authentication process.

Considering this, the overall architecture of the system is shown in Figure 3 which consists of three basic components:

Client. Resident application on a mobile device that gives students the opportunity to answer questions sent from the server application and send text messages to the server. The device must have Bluetooth and Java support.

[1] http://aqurate.kingston.ac.uk/

The protocol available is piconet that allows eight connections, so only seven mobiles phone can be used.

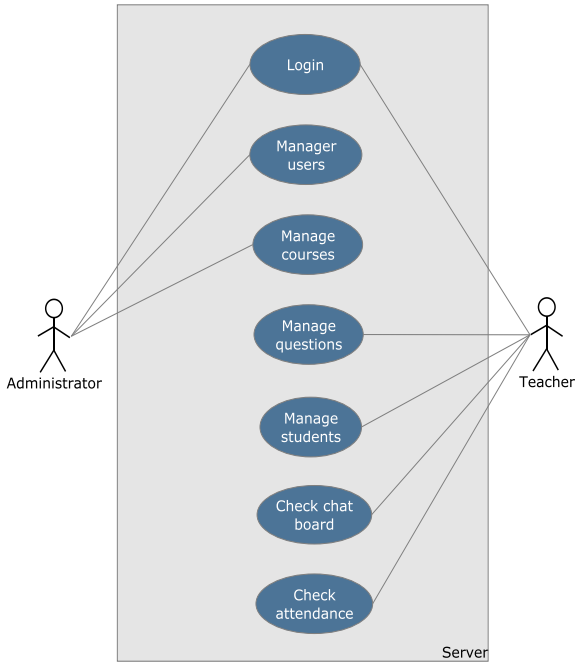


Figure 2. Use Case Diagram Server Application.

Server. Managed application by a teacher which manages the sending of questions to mobile devices of students, according to the IMS-QTI specification. The computer or laptop where you run the application must have Bluetooth connectivity.

Bluetooth communications channel. It is the wireless technology used to make the connection and data transmission between server and mobile clients. Its implementation is developed in Java.

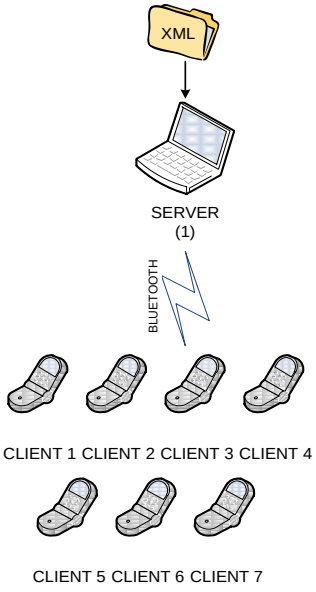


Figure 3. General System Architecture Blue-QTI.

The components and tools used correspond to two separate entities that communicate with each other, corresponding to the client application and server application. The relationship between these components is shown in Figure 4.

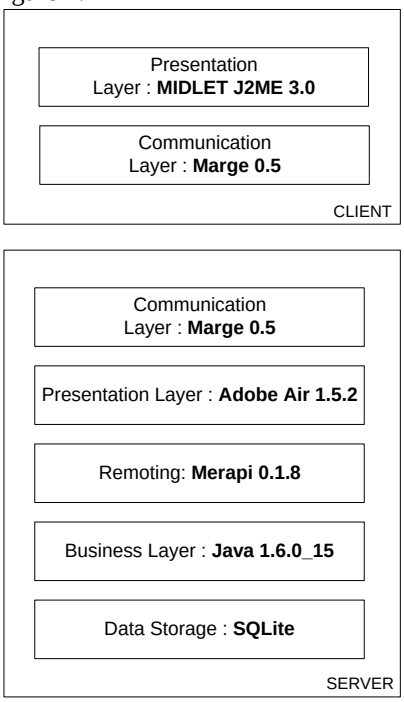


Figure 4. Layers diagram of software components of the system Blue-QTI.

The Server application consists of two executables compiled using the Adobe AIR and Java languages. It interacts to send and receive questions quickly and safely to the student's mobile devices, under IMS-QTI specification. The Client application side is a MIDlet written using the J2ME platform capable of receiving the IMS-QTI questions from the server. The MIDlet sends the answer on the same Bluetooth channel. Text messages are an extra functionality that is deployed in the application server. The database model that implements the Data Storage was built after the consolidation of requirements and use cases, which identified all the concepts involved at the Blue-QTI system. Basically, the database was built to handle the management of students, courses and teachers. This is shown in Figure 5.

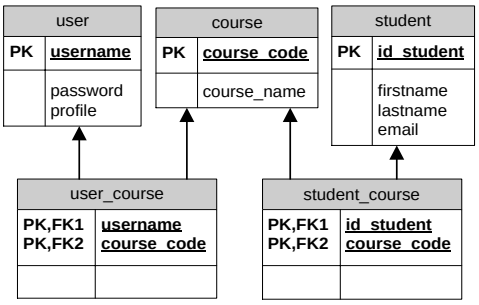


Figure 5. Blue-QTI data model.

 ISBN: 978-1-61208-120-5

The tables “user”, “course” and “student”, representing the users or educational entities, courses and students, respectively. Table “user_course” is an intermediate table, to assign users to courses and allow them access. Finally, the table “student_course” is a link between students and courses.

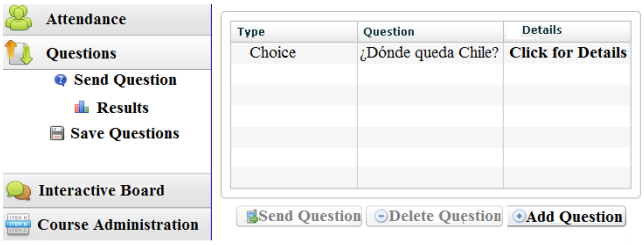


Figure 6. Screenshot associated to the use case “Send Question”

The Blue-QTI system is to ask questions under IMS-QTI specification, so the use case “Send Question” is the most important artifact. The teacher selects a question from an XML file; previously created by AquRate authoring tool; and then sends it to the students whose mobile phones are connected to the computer server. The use case describes the interface and functionality associated with the system. Figure 6 illustrates the use case "Send Question".

III. SYSTEM REALIZATION

The development of the system was conducted in three stages: the first one was related to the server (database and AquRate for interactions under IMS-QTI specification), the second one with the client and the third one aimed at optimizing the client code using the obfuscation technique, so it can be used in mobile phones with low memory capacity [8].

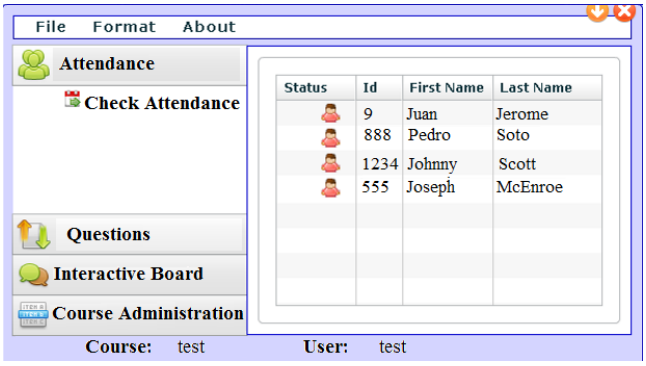


Figure 7. Screenshot showing the students associated to a course.

Figure 7 shows the presence of students connected to the system Blue-QTI. In the “Status” column, the red icon means that the student is disconnected and the green icon indicates that the student is connected. The “Id” column is the identification number of each student given by the teacher. The “Questions” section (see Figure 6) is where the teacher sends questions and also can see the results to the question in graphical way (see Figure 8). The “Interactive Board” section shows the chatting between students. The “Course Administration” section is where the administrator can administrate the course which means add, modify or delete teachers, students or courses and also assign students to a course.

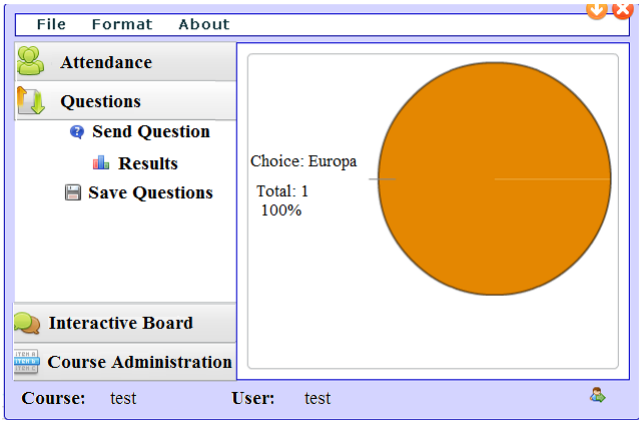


Figure 8. Screenshot showing with the graphical result of a question.

Figure 9 shows photos of the client application running in a mobile phone.

Figure 9. Client application photos.

Only seven mobile phones can be used at once, because the piconet only allows eight devices and one of them must be the teacher's laptop. To increment the number of mobiles phones it is necessary a scatternet. However, a scatternet requires special devices.

 ISBN: 978-1-61208-120-5

IV. CONCLUSION AND FUTURE WORKS

A mobile learning system to ask questions under the IMS-QTI Version 2.1 specification was developed using J2ME and Bluetooth. Three workshops were carried on with students and teachers to test the Blue-QTI system, the teachers had the server installed in their laptop and the students had the client installed in their mobile phones. These workshops were intended to test the Blue-QTI prototype from the technical point of view and also its usability. More specifically, these workshops were aimed to answer some questions e.g. how difficult it is for teachers and students to use the prototype?, what happens when a student turns off his/her mobile phone? or what happens when several students try to answer one question several times?, etc. Low cost mobile phones were used in this experiment. Only seven mobiles phones were used in each workshop because the piconet protocol which is the protocol used by Bluetooth can only handle eight connections. All tools used were either open sourced or free.

For future work is necessary to implement the scatternet in order to increase the number of connections. The number of connections will depend on the topology of the scatternet network. It is also necessary to improve the Blue-QTI system to allow other interactions of the IMS-QTI specification.

From the learning point of view is necessary to build pedagogical experiments to implement interactive learning based on the concepts of learning designs in order to test the system in the real world.

V. ACKNOWLEDGMENTS

The authors wish to thank the Research and Development Office of the Universidad Austral de Chile through project No. S-2007-15 entitled Learning Designs and Classroom Management, project DID S-2007-02 entitled Algebra Learning Units using ICT. Additional wishes to acknowledge the valuable comments of all members of the Research Group on Learning Technologies (www.gita.cl)

VI. REFERENCES

[1] Alsop G., Annesley J., Cai Z., Campos A., Colbert M., and Orwell J. (2008). "AQuRate Final Report. JISC Capital Programme". Available in http://www.jisc.ac.uk/media/documents/programmes/elearningcapital/aquratefinalreport.pdf. [last access: 14.10.2010]

[2] Bork, A. (1980). "Interactive Learning". In R. Taylor (Ed.), The computer in school: Tutor, tool, tutee pp. 53-66. New York: Teachers College Press. Available in http://www.citejournal.org/vol2/iss4/seminal/CITEBorkSeminal1.pdf. [last access: 14.10.2010]

[3] Educational Technology Center-Davis School District, Farmington, Utah (2008)."Interwrite Workspace". Available in http://www.columbiaschools.org/technology4u/documents/IWHandout.pdf. [last access: 14.10.2010]

[4] IMS Global Learning Consortium. (2006). "IMS Question and Test Interoperability, Assessment Test, Section and Item Information Model Version 2.1 Public Draft. revision 2". Available in http://www.imsglobal.org/question. [last access: 14.10.2010]

[5] Information Technology Services Ithaca College. "Interwrite Response–Understanding Classes and Lessons. A Quick Guide to complete before you begin using Response in the classroom". Available in http://www.ithaca.edu/its/quickguides/pdfs/response_understanding_classes_and_lessons.pdf. [last access: 14.10.2010].

[6] Java Sun. "Java ME Platform Overview". Available in http://java.sun.com/javame/technology/index.jsp. [last access: 14.10.2010]

[7] Marzano Research Laboratory (2009). "Preliminary Report. Evaluation Study of the Effects of Promethean ActivClassroom on Student Achievement". Available in http://www.prometheanworld.com/upload/pdf/Preliminary_Report_on_ActivClassroom.pdf. [last access:14.10.2010].

[8] Mihailescu P., Lee H., and Shepherdson J. (2005). "Optimisation Techniques for J2ME based Mobile Applications". Proceedings of the 5th WSEAS Int. Conf. on Applied Informatics and Communications, Malta, September 15-17, 2005 pp. 181-186. Available in http://www.wseas.us/e-library/conferences/2005malta/papers/499-339.pdf. [last access: 14.10.2010]

[9] Yanhui, Z., Wu, L., and Yingzi, F. (2007). "A Mobile Learning System Based on Bluetooth". Third International Conference on Natural Computation (ICNC 2007), vol.5, no. pp.768-771, 24-27 Aug. 2007.

[10] Zhang Y., Zhang S., Vuong S., and Malik K. (2006). "Mobile learning with bluetooth-based E-learning system". Proceedings of the 2006 international conference on Wireless communications and mobile computing. Vancouver, British Columbia, Canada, pp. 951 – 956. ISBN:1-59593-306-9

[11] Zurita, G. Nussbaum, M. (2004). "Computer supported collaborative learning using wirelessly interconnected handheld computers". Computers & Education, v.42 n.3, pp. 289-314, April 2004.

 ISBN: 978-1-61208-120-5

Creating an Artificial Context Based on Video-Recorded Competitive Games for Supporting the Learning of Tacit Skills

Harald Kjellin
Computer and Systems Sciences Department
Kristianstad University and Stockholm University
Stockholm, Sweden
harald.kjellin@hkr.se

Houssam Toufaili
Computer and Systems Sciences Department
Stockholm University
Stockholm, Sweden
toufaili@dsv.su.se

Abstract— **It is easier for students to learn tacit skills if they get much feedback on their behavior. Extensive resources are required for providing students with enough quantities and qualities of a specific feedback that is directly related to the students' skills or lack of skills. We demonstrate how the demand for extensive feedback resources can be decreased by allowing the students to review film-clips from situations when they and their fellow students received qualified feedback. We will demonstrate a strategy in which we can film students' behaviors by using cost effective filming techniques. The films allowed the students to study their own behavior in detail. Our conclusions from the study is that the presented type of strategy for supporting learning works very well and we advise other researchers to test similar strategies when they need to mass-produce teaching of tacit skills.**

Keywords- tacit knowledge; video-clips; filming; feedback structures.

I. BACKGROUND

Learning based on transfer of explicit knowledge is easier to adjust to hybrid learning technology, than is the type of learning that is based on transfer of tacit knowledge. The explicit knowledge can be transferred via symbolic representations of knowledge while the tacit knowledge often requires a number of socializing factors to be successfully transferred. An an example of tacit knowledge is to know how to ride a bicycle. The formal knowledge that is written about riding a bicycle might not be enough to successfully know how a person can balance himself/herself while on it.

The challenge of sharing tacit knowledge in a systematic way is that such sharing is a result of constant interactions among individuals and their environments. Tacit knowledge is a form of skill or competence that is acquired by extensive training and repeated activity. Explicit knowledge, on the other hand, is easier to teach because it can be articulated, while the tacit knowledge cannot be explained. Michael Polanyi describes this phenomenon: "We can know more than we can tell" [1] [2].

The use of mainstream media like PowerPoint presentations have shown how important are visual displays in the teaching/learning process. Nevertheless, it is not an example of an effective way to transfer tacit knowledge, due to its short phrases, and summarized information. This is another example of a relationship between explicit and tacit knowledge. The explicit knowledge may provide us with main directions, but if we do not understand the deeper context of the directions we may be totally lost. Visualization of knowledge is a useful way of creating a context but in the form of Power-Point pictures may not provide us with enough background information to enable us to understand the context of the theories. If we instead have visualizations in the form of content intensive film-clips we may be able to understand a difficult theory related to the film-clip just because the film provided us with such a distinct context for a specific piece of knowledge. [3]

There exists a type of tacit skill that combines several other tacit skills. An example of such a skill is the art of negotiation in situations when the opponents try to win advantages by manipulating a discussion to their favor. Negotiation skills often combine the skills of rhetoric, communication, emotional intelligence, strategic thinking, system thinking, social maturity, etc.

In ordinary classroom situations it is possible to design exercises in repeated training sessions combined with extensive feedback to secure that this type of tacit skill associated with negotiations can be learned. If students do not have the possibility to regularly attend to the classroom, or if there is not enough resources for extensive teacher training, it is very difficult to teach the practical side of tacit skills. In this paper we are investigating to what extent one can use hybrid video film techniques to overcome some of these obstacles. We focus on the use of video clips from filming students' spontaneous behavior. Such video-clips can be available online to enable the students to reflect on their behavior when they are not in the classroom.

The starting point for our interest in video-clips as a means to systemize feedback to students was our discovery that students could have very good grades on the theoretical parts of the course and still have severe difficulties with the practical implementations of the theories.

 ISBN: 978-1-61208-120-5

Moreover, as discussed in [4], students increasingly prefer video podcasts more than traditional media like papers and slides. Figure 1 shows the aforementioned claim.

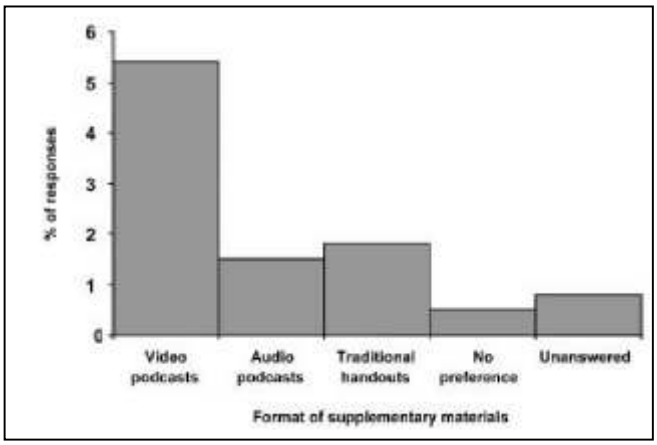


Figure 1: Students responses indicating their preferred format for lecture material [4].

Some of the students could just not make it all the way to demonstrate that they have learned the skills. In situations like this, it is usually concluded that a substantial period of training is needed. However, the problem with training at universities is that for the training to be really successful, each trainee needs to have enough feedback to understand what s/he did right or wrong. An individual trainer/coach can, for instance, give direct feedback about what was good and what needs to be improved in a person's behavior. Such resources are rarely available at universities and this is especially true in on-line/distance or hybrid courses. In such courses there is a delay in the feedback, which makes it difficult to provide the necessary feedback when it is needed. This is especially valid in situations when the student cannot remember or is not aware of which specific behavior was demonstrated during the training.

To remedy the shortcomings of lack of individual feedback as described above the teachers at a course for negotiation at Stockholm University designed competitive games that were all focused on students testing their negotiation skills while giving each other extensive and immediate feedback as a part of how the game was played.

Course evaluations showed that the videos and the games became very popular among students because they could use the videos to be inspired to test similar approaches when they were competing in the games. It became evident for the teachers that the students could learn very difficult tacit skills if they were incrementally given more difficult and also provided with an environment where they could train their skills until they were satisfied with their progress. The artificial context of filmed games with other students supported them in their training since they could compare their own behavior with the behavior of the other students. To combine an eLearning approach of studying other students' behavior on filmed clips on the web as a preparation for their own game playing was a successful combination that we have classified as hybrid learning. To first study films and then test it directly in action seemed to be an efficient way of transferring tacit knowledge. We were told that such training resembled contact sports, where the trainees repeat a behavior over and over and compare their behavior with the behavior of others until they are satisfied with the correctness and speed of their behavior.

However, some students complained that they felt lost when playing the games. They said they did not know what to say, or what to do, and asked for more specific instructions to be able to handle the complexity of the training situation. Since the practiced skills were tacit and based on the players intuition it seemed difficult to provide the students with enough instructions and feedback on their behavior.

The paper is structured as follows: Section 2 describes the problems with video recording students. Section 3 presents the conclusions from the test of course games in university courses. Section IV shows the results that were reached after performing the video recording experiments. Finally, Sections 5 makes conclusions and suggestions for future research steps.

II. PROBLEM

The problem with video-filming each individual student was that this also seemed to require more resources than what could be available at the university. We realized that there was a need for developing some kind of artificial context based on video-filming that would not require extra resources and would in one way or the other be integrated in the ordinary studies. Moreover, effort of just producing video recording is costly. [6]

III. CONCLUSIONS FROM INFORMALTESTS OF THE GAMES IN UNIVERSITY COURSES

It was concluded that there was a need for a thorough analysis of why certain tacit strategies among students worked well, while others did not work so well. It was also concluded that the reflective discussions concerning what was right behavior and what was wrong behavior could not be discussed while the games were going on, due to the intensity of the exercises, but should instead be analyzed in detail after a game was over.

There was a need for extensive iterative practices and reflections after each practice on each student's specific behavior if some of the students should be able to learn the very difficult skills taught during the course. It was, however, assumed, that such extensive training resources would not be feasible with the restricted resources provided at the university. So we started looking for other means to secure that each student could get a detailed response to his/her own behavior after they had participated in negotiations.

 ISBN: 978-1-61208-120-5

We had received some hints that video-filming of the students' behavior could solve the problems since it was a well-known fact that video-filming behavior enables the student to reflect on his own behavior. [5]

A. Purpose

The purpose with the study was to investigate to what extent it could be socially and economically motivated to film students when they were engaged in training their skills. One aspect of this purpose was to investigate to what extent the students could learn from each other and from each other's comments while watching the films.

B. Method

Experiments with game playing among students have been tested for the last three years at Stockholm University and at Kristianstad University. Most of the experiments were of the type trial and error, i.e., we tested various types of hybrid technology support during the courses and then we asked the students questions about their experiences via the course evaluation sheets. Step by step our games developed to an extent where we could be quite certain during the start of a course that the majority of students would appreciate the games and would claim that they could detect an improvement in their tacit skills. We were not able to argue for the value of the games from a scientific viewpoint since we could never be sure that students felt motivated solely by the entertaining aspects of the methods. Some critics even voiced the hypothesis that maybe game playing during courses is negative since it may distract students from a more serious approach towards learning and instead motivating them to a more childish approach to their studies.

We discovered one distinct shortcoming with the game playing and that was the difficulty in giving enough of the needed feedback to students that were too defensive to create a response, or too shy to ask for a response, or too detached to act in a way that motivated a response from other students. So, we began by designing controlled experiments with the aim of finding indications of the filming activity as a substantial addition to the level of useful feedback that the students could get during the courses.

The practical setting of the experiments was quite simple. Initially all students were trained over and over at training sessions for at least six weeks until they reached a minimum proficiency in basic skills like: 1) Focusing on the essence of the selling part of the message, 2) Displaying their own motives in a suitable way, 3) Being able to react to provocations without any unnecessary delay in time, 4) Being able to give feedback to other students in a way that was appreciated or respected by the other students.

Once most students reached an acceptable level of communication skills, we started to film the games. One of the strongest constraints on the whole idea of filming was that it was not realistic to spend too many resources for filming. It is well known that high quality films could easily be an expensive adventure [7]. The combination of the following standardized way of filming was the assumed solution to the economic aspects of the experiments:

- All films were produced in a real-time editing environment with a studio-tool called Tri-Caster. This enabled one single student to edit the games in real-time, i.e., when the games were over there was no need to edit the films.
- All games included extensive presentations of the artificial context of each game. This was designed by allowing the students to win points by requesting explanations to any student that was not clear enough in the presentations.
- Students could win the games by giving much constructive feedback, and they could also win the games by being skilled at a quick and instant response to provocative behavior.
- The moment the games were completed they were put online to allow the students to reflect on their own behavior in the filmed video clips
- Finally students were interviewed and were also answering inquiries about their opinion of the value of watching films of their behavior.

C. A description of the rules in the filmed games and how the rules promoted extensive feedback

The rules of the filmed games were similar to those of the practice games, which helped the students get acquainted to the game rules without much explanation from the teachers, during the filmed games. The rules were as follows:

- The judges, who are the teachers, will start by asking a rhetorical question about a topic that was covered during the course. This step is important to first, make sure that students are not memorizing mechanized answers to straightforward responses. Second, they wanted to see new skills, learned from the practice competitions, being utilized in different situations
- The team that reacts first to the question will be given the chance to answer. During the answering time, the teachers, are looking at how that team is presenting the answer. In addition, the opposing team is trying to seek flaws in the answer, as well as weak points in the answering team's presentation skills, and whether they are using the skills that they learned or not.
- The opposing team gets the turn to reply to the answering team by giving them extensive feedback about presenting the answer, as well as its content. The answering team gets the chance to listen to the feedback, and also how it can be done in a better way, by the opposing team. The importance of this

 ISBN: 978-1-61208-120-5

lies in the fact that the answer, in its context and content, is being done over and over so that students can internalize skills.

- After going back and forth with the answer, between the two teams, the teachers intervene to stop the debate. Then, they give each team feedback about what was good about the presentation and content, and what can be improved. Based on the feedback, they grant each team a score.
- Each team has a personality that they are trying to convey during the game. The opposing team would try to react to the other team's personality by adopting a counter personality. Here, the teams will have to adjust to each other's strategic behaviors to shows the judges how they are using their acquired skills in action.

IV. RESULTS

The students used the films for many purposes:

- To see themselves and the way they acted. This was probably the major contribution of the films to each individual student. We concluded that it supported the student in seeing himself/herself as being an active role- player in the course, which in turn enabled the student to reflect on his/her behavior.
- To play the specific parts of the films where they got much feedback from the other students and from the teacher. The students could play these clips over and over in order to understand why they were evaluated and appreciated in a certain way.

80 students were filmed and many of them were participating in a number of games and were therefore filmed at several occasions. We do not want to tire the reader here with the extensive evaluation material, but it may suffice to say that out of the 80 students 74 of them provided us with much material concerning how they had benefitted from the films. Instead we will just show some examples citations that illustrate some opinions of students:

- "When playing the games there was never any time to reflect about my behavior so I could not manage to understand the essence of the feedback I got until I was able to replay the film".
- "The films showed clearly how all people in the room reacted to my behavior. I often found that the looks on their faces was more useful to me than the feedback I got about my behavior".
- "I have never before so clearly seen talents and defects in my own behavior. Probably because the games forced us all to act spontaneously".
- "We simply did not have time act in a controlled way during the games, and this made us reveal our true nature when communicating".

Another way of trying to interpret the value of the films was to check how often they were watched. We discovered that each single little film-clip was viewed between 5 – 20 times.

V. CONCLUSIONS AND FUTURE WORKS

Our general conclusion is that film-clips of students' behaviors, when they play games, can be reused to support learning. The filmed clips create a distinct artificial context which supports the students learning process. The film-clips can also be used to give an intensive feedback to the students who can see themselves in the films. All in all we believe it is an efficient way of transferring tacit knowledge. Almost all students in the experiments claimed that they learned much from the course. About one third of the participants claimed that it was the most rewarding course they have ever attended. We have no other reflections about this response from students other than concluding that it highlights the possibility to motivate students with a standardized workflow for mass production of film-clips. However, our most important conclusions came from the statements from students, where they claimed that they learned from being able to clearly see all the responses they had received from all other students. As this could be achieved in a filming strategy that did not require extensive technical support, we feel that we stand on firm ground when we recommend other teachers to test similar approaches to support tacit learning of skills.

The results that were achieved have spurred us to continue researching about ways to make those produced video clips reusable on a larger scale. In this way, it makes others, not familiar with the course, grasp the games concept and rules, as well as learn about the knowledge being shared. Moreover, we believe that a future research in context development of fully online courses can help students, studying the course online, manage to perform the games virtually while making sure that tacit knowledge is being shared.

REFERENCES

[1] M. Polanyi, Personal knowledge: towards a post-critical philosophy. Chicago, University of Chicago Press, 1974.

[2] M. Polanyi, The tacit dimension. Chicago, University of Chicago Press, 2009

[3] L. Prusak and E. Matson, Knowledge management and organizational learning- A Reader. New York, Oxford University Press, 2006.

[4] J. Copley, "Audio and Video podcasts of lectures for campus-based students: production and evaluation of student use" Innovations in Education and Teaching International, vol. 44, 2007, pp. 387-399

[5] D. Zhang, L.Zhou,B. Briggs, and J.F. Nunamaker, "Instructional video in e-learning: assessing the impact of interactive video on learning effectiveness" Information & Management, vol. 43, 2006, pp.15-27

[6] J.P. Shim, J.Shropshire, S. Park, H. Harris, and N. Campell, "Podcasting for e-learning, communication, and delivery" Industrial Management and Data Systems, vol 107, 2007, pp. 587-600

[7] M. Davis, "Editing out video editing" IEEE Multimedia, vol. 10, 2003, pp. 54-64

 ISBN: 978-1-61208-120-5

Serious Games: Between Training and Entertainment

Andres Navarro, Juan Vicente Pradilla and Sebastian londoño
I2T Research Group
Universidad Icesi
Cali, Colombia
e-mail: anavarro@icesi.edu.co

Patricia Madriñán
MIKOS Lab
Parquesoft
Cali, Colombia
e-mail: patri@elsitiomio.com

***Abstract*— The game industry has suffered an impressive explosion of popularity, becoming the largest entertainment industry in the world. Games have become a sophisticated extension of the reality and an interesting way for complementing human mind utopias. Training software allows the trainee to immerse in quasi-real controlled situations that could be measured by trainers. In this work we discuss the duality existing between the training based on a serious game and a simple game, based on state of the art technologies. Then we show a training system for telecommunications technicians based on a combination between serious games and "traditional" e-learning platform.** *(Abstract)*

Keywords-component; games, serious games, e-learnning, training software.

I. INTRODUCTION

The term Serious Game sound like a contradiction; play is about simulation, a game is fun, pleasant and free. Then the question is: How can a game be serious? To take something seriously means that you are talking honestly and it is well known that in a game you have to lie, knowing that you are lying. It differs from a "true lie" because all the people involved in the game know that you are lying, because it has been arranged from the beginning [4]. However, if the game is used with a specific finality, beyond the game itself, then we can say that is a Serious Game [7].

Generally speaking, the game searches for the satisfaction of the player [5]. Any additional consequence is far beyond the game finality. It means that the use of this recreational experience with a learning goal, then we are talking about serious games [7]. This special kind of game has shown an especial interest in the consequences of the game, conceiving those experiences as training processes or development guides [3]. Playing is a quite fun way of training, is the way as a lion learns hunting. Without training games, perhaps a young lion will not survive, or die while learning. Another example of this kind of "Serious Games" is combat pilots, because you cannot train a pilot in a real combat without a high risk of losing human lives or pay a high cost. A previous simulated training process is quite important, before passing to the real life. Simulation conditions are quite real, but simulated. If the plain crashes, nobody gets hurt. One of the characteristics of a serious game is that the goal is a serious one; they are not designed for leisure or entertainment but for learning.

Otherwise, conventional training software does not consider the user preferences or interest. They presume that if a user is using the software, then he needs to learn about such issue. For this reason, there is no interest for developing an "emotional" interface. Perhaps boring is one of the premises of this kind of software, converting these developments in a digital version of a traditional lecture imparted in a classroom. Finally the result is a new format for teaching, not a change in the learning process where the human contact is lost and the potential of new virtual media is not exploited.

In this paper, we discuss about the use of the concept of serious game for training, try to suggest some differences between serious games, training software and entertainment games. We describe some characteristics of a serious game and show a serious game for learning telecommunications and an evolution of such game in a training tool used for training technicians in Radio Frequency related activities in the field.

The paper is organized as follows: Section II, discuss aspects of training software and serious games; in section III, we discuss the evolution from entertainment games to serious games; in section IV, we propose some characteristics of a serious game; in section V, we briefly describe a serious game previously presented [5]; in section VI, we describe a training tool based on serious games and finally the conclusions and further work.

II. FROM TRAINING SOFTWARE TO SERIOUS GAME

A training program or conventional education, like used in lectures, typically use a behaviorist approach; i.e. the system guides the student through a series of pre-defined steps which goal is to take the student in a "A" grade of knowledge or competence and lead him to a competence "B", guiding the student through a series of steps or data that lead to the same final point, using almost always the same predetermined way. Behaviorist approach knows the learning goal and the shortest way to guide the apprentice to reach the goal.

 ISBN: 978-1-61208-120-5

On the opposite side, the constructivist approach gives more relevance to the learning experience than the way from A to B. The learning experience is more important than the knowledge itself. The learning goal is important but not the most relevant. The ways to reach the goal have the same importance than the goal. The apprentice experience during the learning process is quite important as the learning itself.

Then, the serious game is proposed as a tool with a constructivist approach, where the immersion grade is high enough as in real training process. Besides, the player (apprentice) is influenced with an emotive load and surprising situations, exploiting the advantages of virtual media and gaming technology, with it sensorial richness.

The basic idea is that serious games act in similar way as entertaining games. A good example of this kind of games are Flight Simulators, originally designed for pilot training but later used also for entertainment to add other aspects such challenging missions. The difference is only the goal of the game: Training or leisure.

III. FROM ENTERTAINMENT GAME TO SERIOUS GAME

An entertainment game just seeks the experience of playing itself. If some abilities are acquired with the game, is not relevant. Meanwhile, a serious game has a challenge or an objective (or a dream), consisting on generating knowledge from the user experiences.

In this way, in a serious game, the practitioner must lead their own process. Is sitting in front of a computer and his dialog is with a computer, not another person. Besides, insert the user in a context or simulated situation, which have as a characteristic to be based in real facts and try to emulate real situations with good fidelity. Perhaps, this is the main difference between a serious game and an entertainment game. A serious game needs real data and accurate results, similar to those got by a player in the real world; meanwhile an entertainment game does not.

Likewise, a serious game requires a high interaction grade; the user is leaded to participate with a high grade of control, making it impossible to be passive respect to the game: if the user does not involve itself, the game does not work. In this way, the learning experience begins with a real situation, but without the risks of the real consequences of a real training, being: interesting, surprising and even fun. Finally, it is a good fusion between an emotional experience and knowledge acquisition.

IV. SERIOUS GAME CHARACTERISTICS

Serious game has both entertaining game and training software characteristics. A serious game is aware of the consequences (the learning process), real data and the accuracy of the results, in a similar way as training software, besides of the contextualization and the player activity, as in entertainment games.

A serious game emphasises:

- User experience (self lead) and high interactivity
- Player requirements: knowledge, capacities, skills, venturing
- Software requirements: precision and data and images processing capability
- Visualization requirements: efficient management of content and development of an attractive and friendly interface
- Simulation using real data: situation predictability
- Specific object: results are important

The table 1 presents a comparison between entertainment games, serious games and training software.

TABLE I. COMPARISON BETWEEN ENTERTAINMENT GAMES, SERIOUS GAMES AND TRAINING SOFTWARE

	ENTERTAINMENT GAME	TRAINING SOFTWARE	SERIOUS GAME
Goal	Nothing further the pleasure, fun and entertainment	Learning , skills and knowledge aquisitions	Player training
User requirements	venturing and skills	Knowledge and capabilities	Knowledge, capabilities, venturing and skills
Interactivity	High (could be difficult) more challenging implies a better experience	Low: more easy is better.	High level of player interactivity
Visualization requirements	Efficient management of content, development and an attractive interface	Friendly interface	Efficient management of content and development of an attractive and friendly interface.
Software requirements	Fast processing of dynamic data and images	Evaluation from comparisons with real data	Precision: comparisons with real data simulation. High data and images processing capability
Methodology	Surprise and interest	Clear and predectible	Surprise, interest and clarity

 ISBN: 978-1-61208-120-5

V. A SERIOUS GAME: COMCITY

COMCITY [2],[5], could be considered a serious game, because it has been conceived as an educational game; it is supported in real environments and has a mix between reality and entertainment. In COMCITY, game engines capabilities are fully exploited in order to obtain a dynamic environment, with a rich experience, and, at the same time, introduce the student to complex concepts related with wireless planning.

WalfishBertoni OkumuraHata Saunders

Figure 1. Avatars of propagation models in COMCITY

At the same time, the game absorbs the complexity of the mathematical propagation models like avatar or characters in the game (Figure 1), related with the mathematical behavior of such models. Besides, it is supported in real maps, obtained from Digital Terrain Models from real cities that usually represents a challenge for radio planning. All these features are linked with several missions, oriented to improve the abilities of the player.

Moreover, the game is supported by a real planning tool [1], the results are similar to those obtained from a commercial planning tool (Figure 3), like those used by mobile operators. Towers, antennas (Figure 2) and other elements are modeled with high realism. In this way the concept of a serious game is fully applied to this tool.

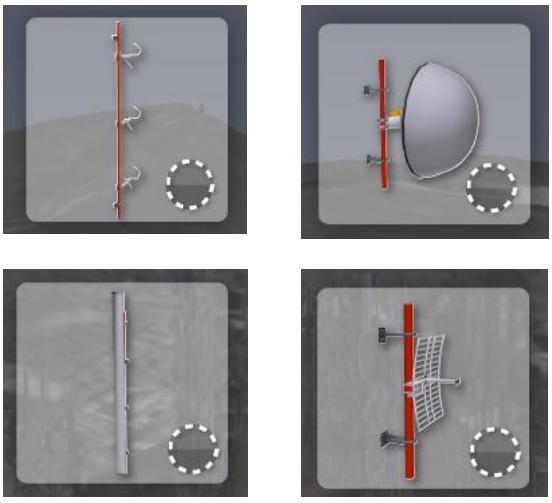


Figure 2. An example of 3D models of antennas

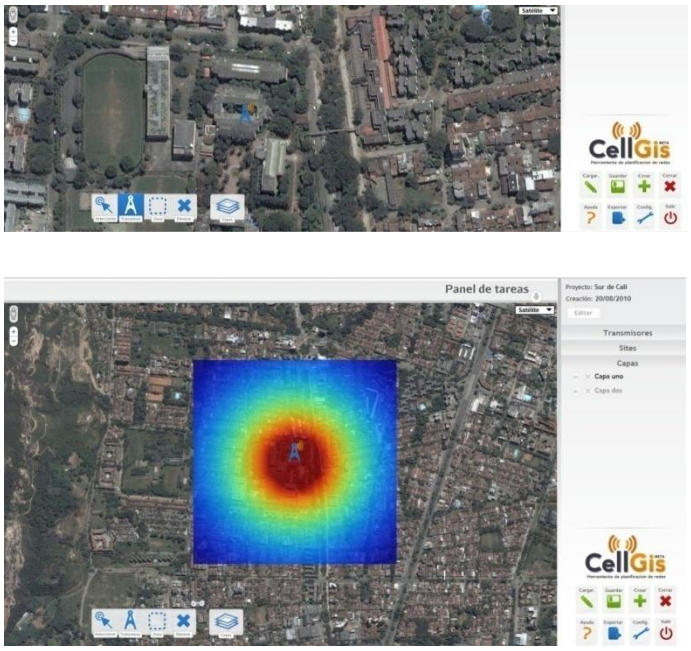


Figure 3. Results from CellGIS Planning Tool

VI. SERIOUS GAMES AS TRAINING SUPPORT: TEST

From the experience obtained with the development of COMCITY [5], we begin the development of a training system for radio technicians that develop activities in the field, as installations or technical surveys on radio stations. This work requires some specific skills, and then the system has some specific requirements. This system was called TEST (TESAmerica Software Training), from the name of the company that will use it.

 ISBN: 978-1-61208-120-5

TEST is a series of "virtual learning objects" running on a learning platform that combines serious games with training software. The goal of the system is to train people for a specific job and evaluating the most qualified people for the field job. TEST is in part an application of COMCITY for specialized training.

In order to complain with TEST requirements, we modify some aspects in COMCITY, specifically some missions and scenarios with problems oriented to some typical task that the trainees will perform in their field jobs. In these missions, the trainee must solve problems related with radio technologies (Wimax, UMTS, etc), antenna type (panel, monopole, dipole, etc) and frequency bands.

For example, in the antenna identification mission the player must solve eight cases (Figure 4), including: telecommunications support to the army, coverage of a transmission of cycling tour and restore communication for the public transport service. The player navigates between cases and by selecting the most suitable antenna for each case, taking into account: environmental conditions, radio technology needed and available frequency band (Figure 5).

Figure 4. Cases for antenna identification mission

In this serious game, we try to reproduce real situations that the apprentice will face in their real activities, preparing them to recognize potentially dangerous situations. Each activity that the player executes is associated with typical activities performed in real situations in remote areas where the trainee will work in a future, if the training is successful.

In this way, the player (trainee) makes associations between real objects that will find in a real situation, but through simulated situations in a 3D environment.

VII. CONCLUSIONS

Serious games are an excellent tool to acquire new knowledge and an approach to real skills, applicable directly in job environment.

Figure 5. Capture of a mission for antenna identification

TEST has become is an excellent experience for the creation of mechanisms for training and evaluation of candidates. Expected that the candidates are to carry out the training process and meet the assessment objectives have an excellent performance in field.

The maturity of development tools influence the use of 3D games and allows designers, developers and educators to find a common place to obtain important results in knowledge generation.

The simulation of real situations gives us an efficient and inexpensive way to training by experience.

The experience in the creation of serious games in COMCITY and TEST, allowed transform the complex concepts of an area of knowledge and make them available to students in ways simple and striking, in a multimedia environment that involves different learning styles. It is expected that the outcome of this process have a positive impact on the acquisition of new knowledge by students.

ACKNOWLEDGMENT

This work is supported by the National Department of Science and Technology from Colombia (Colciencias).

REFERENCES

[1] CellGis: Radio Planning Tool. Revised on October 10, 2010, from http://sourceforge.net/projects/cellgis/

[2] i2T. (2009). COMCITY. Recuperado el 10 de Octubre de 2010, de http://COMCITY.icesi.edu.co/

[3] J. Bruner. Acción, pensamiento y lenguaje, Madrid: Alianza Editorial, 1989.

[4] R. Caillois. Les Jeux et les hummens. Los juegos y los hombres : la máscara y el vértigo, México: Ed. Fondo de Cultura Económica, 1986.

[5] J. Huizinga. Homo Ludens. Madrid: Alianza editorial,1938.

[6] A. Navarro, P. Madriñan and J.V. Pradilla. A 3D Game Tool for Mobile Networks Planning 2010 Second International Conference on Mobile, Hybrid, and On-Line Learning ,Saint Maarten, Netherlands, Antilles February 10-February 16.

[7] C. Abt. Serious games, New York, Viking Press, 1970

 ISBN: 978-1-61208-120-5

Integrating Social Media in Tertiary Education

Experiences and Predicaments

Werner Beuschel
University of California
Bren School of Information & Computer Sciences
Irvine, CA 92697, USA
beuschel@ics.uci.edu

Susanne Draheim
University of Hamburg
Office of Quality Management and Legal Affairs
20354 Hamburg, Germany
Susanne.Draheim@verw.uni-hamburg.de

***Abstract*—High hopes and positive assumptions accompany the advent of social media use in learning and teaching environments. The careful examination of social aspects of technology and experiences based on case studies show nevertheless that there are predicaments that should be pondered when courses for tertiary education with hybrid learning concepts are set up. This paper outlines an introductory freshmen course at a university, shows its evaluation, and discusses sensitive areas for successful social media use.**

Keywords - case studies; educational implications; hybrid learning; social media; tertiary education; weblogs.

I. INTRODUCTION

A whole new generation of internet users grows up using applications like Weblogs, Social Networking Sites, Wikis, and other web-based technologies on a day-to-day basis [1, 7]. Some of them may opt to use a system for very personal reasons like a photo and video sharing service. Others may sign up to a system for finding people with similar ideas and interests and still others may use an application to buy and sell items. The personal, group and economic aspects form different and nevertheless intertwined aspects of applications, usually combined under the umbrella terms of social media, social software or Web 2.0 [6, 12, 17]. The greater social context supports ideas of people interacting to accomplish personal aims, exploring and shaping their identity through social groups, and exploring online marketplaces. They may become persistent users and invite others to use the application, due to the social opportunities.

In the educational context the question evolves, how these recent internet phenomena could and should be used for teaching and learning purposes [2, 3, 8, 14]. High hopes have been expressed by educators on using social media in education, expressed by the term "Education 2.0". But it seems that in a pedagogical context the appropriation of social media is different from everyday applications and possibly more difficult. Creating learning environments that foster social interaction is not such an easy task. While there is reason to assume that we are only in the early stages of a very broad movement towards user-generated data production, implications for the educational system seem nevertheless to be important if we do not want to risk an ever widening gap between learners and teachers, not only but specially in institutions of tertiary education where students usually have all media freely at hand.

The topic at stake is whether or not the undoubted relevance and promise of social media and software applications hold up in the context of educational use, specifically in tertiary education. To answer this question, three aspects shall be reflected in this paper, derived from case studies: what are prerequisites of using social software successfully under institutional and formal circumstances? How well does an application support the user's need for social exchange and integration? What conclusions can we draw in relation to designing didactic scenarios for courses?

The paper starts with a literature review, putting special focus on experiences with Weblogs as one of the main instances of social media. Then a course is outlined which provided the background for two case studies at a medium-sized German university of applied sciences. Analysis and evaluation of the studies follow suit. The discussion brings up six pedagogical issues. The conclusion considers inherent tensions and predicaments in applying social media in education; a number of open research questions are articulated.

II. LITERATURE REVIEW

The following theories are considered with regard to our main focus, integration of social media for tertiary education: Web 2.0 as „two-way-web"[1], namely as place, structure, tool, and media for social networking and digital self-expression [4, 5, 6]. Weblogs considered as "micro publishing tools" [7, 8] in (informal) learning environments. Hence, we will concentrate on aspects of Weblogs as one important and well-researched tool in the sphere of Web 2.0.

Literature research provides the following characteristics of Weblogs:

Weblogs can be viewed as tools of publication, based on the principles of hypertext. That means they are "fringeless text", oscillating between the traditions of oral and written communication [16]. They transcend formal teaching and learning contexts and are not immediately amenable to a direct representation of analogue practices in the World Wide Web. This could also be interpreted as "liminal space" as described by Boyd [4].

 ISBN: 978-1-61208-120-5

The individual perspective (personalized expression) is central for blogging [10, 11]. Activities comprise: doing research, processing information, building knowledge, reflecting, commenting, and representing personal identity. Thus, the process of fabricating thoughts becomes visible and in this course vulnerable, by means of its own sequential documentation.

Identity representation seems to be the central motivator for the widespread adoption of social software tools. But it is not immediately clear how we can use this in learning environments. Proposals to use Weblogs comprise learning diaries, e-portfolios, comments for projects or courses.

Social software tools, being offered by teachers for learning purposes, are not self-sufficient. The adaptation through learners has to be strongly motivated and moderated, so that something like a ritualized routine is reached [15].

A reverse way to use social software tools could refer to those tools which were adopted by students beforehand and are being used as support for informal learning and communication [2]. Examples are instant messaging, Social Networking Platforms, Wikis, podcasts, RSS, peer-to-peer exchange. This requires a high degree of media competency on either side, teacher or learner, and the consideration of privacy aspects. This approach incorporates as well the conflict between motivation and control.

Media competency means to support the ability to handle personal data turned public. According to many stories in current media reports this fluctuates between "too much" and "not enough" of personalized information. So students need to develop sensitivity toward the specifics of social and communicative aspects in Web-based environments. Context-specificity makes the task even more difficult, determining an ever-shifting but appropriate amount of data and information, represented by style or scenario.

III. CASE STUDIES WITH SOCIAL MEDIA IN TERTIARY EDUCATION

Insights drawn from the relevant items above led to designing the following course, which was also the basis for the case studies. In addition, prior to the project case studies, an exploratory study on integrating Weblogs into courses was executed [3] and results were also employed for the course design. Especially a cautioning experience from the exploratory case study was considered, namely that Weblogs cannot be ascribed to students like any ordinary learning tool. They demand active participation in discussions, what in the class room is not every student's strength. As course participants realized that entries are possibly visible to the outside world - and the lecturers - not everyone was eager to join in contributing or commenting.

The following two case studies describe an effort to integrating social software tools, in this case Weblogs, into regular courses. In the background they employ a variety of didactic concepts (self-organized learning, group work, feedback groups). Evaluation results are lined out in quantitative as well as qualitative ways. The courses relate to the curriculum of informatics, which is a subfield of applied computer science. The overarching goal of the courses was to find ways to enhance coordination and collaboration of freshman student groups.

Case study 1: Project course for Computer Science freshmen (Bachelor of Science)

This case study drew on the evaluation of the exploratory study, probing the use of Weblogs as part of a regular course. The course and study took place in the winter semester of 2006/07. Beginners at the department of Informatics and Media at a medium-sized German university of applied sciences are generally required to start with the course "Project-oriented Studies". Right at the beginning, course concept and the purpose of Weblogs within this framework are explained. At the end, the course is evaluated and the results presented to the students.

Didactic intentions and their objectives of the course were defined as:

- Social event: beginners get to know each other
- Propaedeutics: introduction for students of the program with relation to practical application
- Learning competency: the ability of "learning to learn" is supported through group processes and self organization
- Experimental culture of learning: project-oriented studies are an integral part of the department, providing innovative impulses for teaching and learning.

These objectives were intended to ease the introduction process for beginning students and help them to get acquainted with each other. Furthermore, the practice-oriented claim of the department should be related to students. Finally, focussing on student group work as one of the essentials from the beginning should help the willingness to cooperate as well as the motivation to actively participate in the studies.

Within this context the introduction of a Weblog was aimed at serving students to organize the temporal and local requirements of their group work. Based on an earlier investigation in which one of the authors took part [9] the hypothesis was defined that upper-division students are able to use Weblogs for self organization and personal knowledge management. This supported the introduction of Weblogs in the beginner's course.

The project oriented study started with a first phase of orientation where students need to be present. Topics of this first and second day are workshops for scientific writing, library usage being an integrated part, information on the IT-infrastructure in the department, curricula and enrolment procedures, touching even mathematical and logical riddles. The second day concludes with a kick-off meeting for the eight-week part that represents the complex phase of the study, where lecturers present themselves with their projects. Their topical tasks can be chosen by the students in combination with enrolling in the basic study modules. These group processes are presented by students in a rotating procedure. The challenge of this procedure is that the traditional roles and frameworks of studies are transcended and both sides, lecturers and students, are required to organize themselves in flexible ways and meet "in between" the formal structures.

 ISBN: 978-1-61208-120-5

A Weblog from Wordpress was used to support this process, serving as a blackboard for news as well as a platform for information exchange on project results. Group supervisors sent e-mail to students to make them aware of this new tool at the beginning of the project phase. They were asked to register after groups were set up. Supervisors received different access rights for the Blog being "editors" while students represented "authors". Certain fixed posts in the Weblog were installed to serve as basic information for use procedures and the concept of project-oriented studies.

Following the introduction phase the student groups were required to organize themselves via Weblog communication for another phase of about 8 weeks. The participating observation of the study organizer provided data for a provisional analysis, depicted in the items below:

- *Participants:* 37 registered users, 5 writing, about 20 reading guests
- *Who is writing:* 6 lecturers, 25 students, of which 5 are actively writing, out of 11 groups
- *Weblog content:* 53 posts, 3 pages, 74 comments (work results, schedules for work and coordination, announcements, feedback, social comments, hints for usage, polls, informal items.
- *Who writes in which style*: Students comment posts, questions are frequent; lecturers inquire about group organization and work results.

The following paragraphs show results of the student questionnaire. One of the somewhat unexpected results was that the general evaluation received positive grades, while Weblog use did not.

Regarding Weblog usage in the course[1] only 14 persons (n=78) stated to use the Weblog in a regular manner. 11 did not see any necessity as they claimed to meet face-to-face, while 23 indicated to use "other" media – specifically a forum created by the same cohort of students. In sum, 19 persons answered the question on improvement suggestions, stating that the Weblog should be replaced by a forum. Reasons given were "better overview" and the opportunity to stay anonymous in face of the supervisors and lecturers. 23 persons suggested improving the Weblog according to criteria like „better introductory information, surveyability, usability, group areas, and more motivation".

The following table shows results from the quantitative evaluation[2] of three closed questions on Weblog usage, concerning the course of winter 2006.

TABLE I. QUANTITATIVE EVALUATION OF WEBLOG USAGE

	Question 1:	**Question2:**	**Question 3:**
Number of answers "1"	5 (7%)	3 (4%)	**17** (23%)
Number of answers "2"	12 (16%)	8 (11%)	**23** (32%)
Number of answers "3"	**20** (28%)	10 (14%)	14 (19%)
Number of answers "4"	16 (22%)	**24** (33%)	9 (12%)
Number of answers "5"	**20** (27%)	**28** (38%)	10 (14%)
N =	73	73	73

Question 1: 23% of participants answer „to a high degree" or „to a large degree". 28 % think the answer is „neither correct nor incorrect", while 49% subscribe to „a low degree" or „not correct".

Question 2: 15% of participants agree with „to a high degree" or "to a large degree", 14 % think it is "neither nor". 71% find the statement to be "correct to a low degree" or "not correct".

Question 3: 55% of participants answered with 1) and 2). 19 % choose 3), while 26% statements 4) or 5) assume.

Being an integral part of this course „Project-oriented Studies", the Weblog has only been used selectively by students, though it was introduced with much enthusiasm by course organizers and lecturers. 2 out of 11 groups participated regularly, 3 on occasion. The active groups were "very content" with the tool. Reasons for non-usage or rejection were "not accustomed/not clear", pointing to the new course structure. Also the previous knowledge of beginners with regard to their internet-related skills turned out to be very uneven, so that other media were preferred or the groups met face-to-face.

[1] Cf.: http://zeus.fh-brandenburg.de/pst2006.

[2] Legend:
1) Is correct to a high degree
2) Is correct to a large degree
3) Is neither correct nor incorrect
4) Is correct to a low degree
5) Is not correct

 ISBN: 978-1-61208-120-5

Case study 2: Project course for Computer Science freshmen, B. Sc.

In the subsequent winter semester of 2007/8 the course was repeated at the same German university, just a few elements were changed. In order to support all working groups the learning management system MOODLE was integrated. Version 1.8.2 of MOODLE includes Web 2.0 components (such as Weblog, Wiki, RSS, etc.) as a standard.

Drawing consequences from the preceding year's evaluation result that students in their first semester should be made familiar with communication tools as Weblogs or Wikis (which only seem to be self-explanatory), a special workshop on using these tools was provided in the context of the introduction of MOODLE. Two teachers were selected to present the communicative principles of Weblog and Wiki technology first in an intuitive way, without using computers. The students had to produce paper prototypes for Weblogs, Wikis, and - as the so far best known tool - forums.

The title of this experiment was „Social Software Tools", its aim being to confront the students with the communicative, cooperative and social specificity of the respective medium. As for Weblogs, the principles of personalization (presenting identities) and connectivity (interlinking and tagging) were central. Wikis were presented as mainly concerned with the principle of cooperation and the production of knowledge. The prototype of the Forum gained a certain autonomy in the course of group work, since the students were already relatively familiar with its principles. They began to use the question-response structure of the diverse threads for getting into contact with one another (e.g. with questions such as „Who lives in the dorm?", „Where may I go sailing?", or „Who has a free room to offer?").

In the second part of the introductory workshop the students began to adopt MOODLE step by step, from the first login and course enrolment to the design of a personal profile. They also transferred the content of the paper prototypes to the respective medium to create initial content for the group work phase. Interestingly, in this phase only the general POS Forum was successful as a group connecting communication platform, while personalized Weblogs remained practically unused and Wikis only where put to practice when teachers and their assignments motivated their use.

Evaluation: Table 2 shows the results for the learning system MOODLE in context of the students' evaluation of "Project Oriented Studying" in winter semester 2007/8. As in the preceding year, this was a questionnaire exploring the acceptance and subjective satisfaction of the students with the whole teaching unit. Concerning the use of MOODLE, the following questions were to be answered on a scale from 1 to 5[3].

[3] Legend:
1) Is correct to a high degree
2) Is correct to a large degree
3) Is neither correct to a high nor to a low degree
4) Is correct to a low degree
5) Is not correct

1) MOODLE supported the individual organization of learning within POS.
2) MOODLE supported group communication within POS.
3) MOODLE supported content-oriented group work within POS.

The compressed results show as follows:
Question 1) = 31% (1+2), 29% (3), 40% (4+5), n= 108
Question 2) = 20% (1+2), 23% (3), 57% (4+5), n= 107
Question 3) = 21% (1+2), 28% (3), 51% (4+5), n= 107

The numerical data unequivocally show that there was no majority accepting the learning environment MOODLE as supportive or satisfactory. With 31% assent (meaning a 1 or a 2), the function of "individual learning support" (question 1) is still relatively well evaluated, compared to the functions of "group communication support" (question 2) and "content-oriented work support" (question 3), where assent was only given by 20% respectively 21%, that is one fifth of the whole cohort. Questions 2 and 3 also strike with more than one half of the students, 57%, respectively 51%, who could confirm the proposed statement only to a low degree or not at all.

More specific information about the background of these results may be gained indirectly from the way the four open questions were answered:

1) What, on the whole, did you find especially positive?
2) What, on the whole, did you find especially negative?
3) Which propositions for enhancing and optimizing the learning program would you like to make?
4) Which further comments, hints, and ideas do you have concerning POS?

Results of the open questions: Comparable to the POS Weblog in the preceding year, MOODLE was only used selectively by the POS groups. Although heavy users were quite content with the tool, a majority of all students whished that MOODLE would be used "more uniformly and more content-oriented", i.e. more groups should mainly work with the system, for coordinating purposes as well as directly and visibly content-related (for instance in filing documents).

Within MOODLE, students especially used the Forum as an "informal" discussion platform. The effort of some committed students to establish an own, access restricted Forum failed. The individual Weblogs MOODLE offers were basically not used, and the Wiki was used only in cases of its use being required by the teachers. Still MOODLE did perform its function as a supporting tool of learning organization for at least 31% of the participants. It was also MOODLE where links to external social networking platforms as StudiVZ (the German social networking site equivalent to Facebook) were published.

On the platform StudiVZ, students create and cultivate their personal networking profile, connect and communicate with friends and fellow students on the basis of shared

 ISBN: 978-1-61208-120-5

attributes like the same institution, photos, likes and dislikes, and so on. Communicating in StudiVZ is rather informal, oral and ephemeral, textual messages are akin to SMS messages with only a few signs, while emoticons and abbreviations find rich use. Communication seems to consist more of *poking* than constituting a coherent conversation, or hinting to other contexts as the math course or the last party which are digitally edited at other places.

IV. DISCUSSION

Although expectations are generally high, it seems that the use of Weblogs (and to a certain degree all of social media) in formal tertiary education creates some predicaments that need attention:

- According to their media character, Social Software systems are not just tools to be used. As new media they need time, motivation and careful preparation if used in education.
- Requirements in formal education sometimes run the opposite way of activities in Social Software use: ability to ascribe results to single students versus cooperation.
- The work-in-progress character of Weblogs makes it difficult to evaluate and archive results.
- The expectations towards the reflective aspect of Weblog use are usually too high and need more support.

One important result, supported by earlier investigations on learning environments is that social software media cannot just be "prescribed" in an institutional setting. The share of informal activities, non-planned and spontaneous, is higher than with other application. The target groups need time to appropriate the systems. As a consequence the early process in the course should devote more time to explain blogging and the specifics of Weblogs. Informal media need much extensive work on motivation and moderation.

The purpose of the case studies was to find out about the challenges with which lecturers are confronted who are willing to include instances of social software into their regular courses, in our case Weblogs. These examples may not be representative in all circumstances, but they should provide the basis for some conclusions. The following theses are derived from the material, pointing to requirements of social media use in education:

Thesis 1:

Usage of social media by students cannot simply be administered. A unified and obliging policy for both, users and administrators, needs to be developed and applied, especially if there are several lecturers involved. If this is not available, active users can get discouraged by non-actives.

Thesis 2:

Severely recommended for any course is an introduction into media aspects and usage of social software tools, especially for beginner's courses. Beginners will be more at ease to question and change their organizational competence when it comes to learning.

Thesis 3:

When students acknowledge the added value of social media for their own learning organization, group communication, or knowledge management, their satisfaction is significantly high. In concordance with thesis 1 intrinsic motivation seems to be an important factor for dealing with social software tools successfully.

Thesis 4:

Social media tools are suitable to bridge the „empty space", that frequently occurs in collective activities. The tools are able to fill these gaps by means of their "digital orality", a quality of their media character. This aspect can be used as motivating support for the learning process, provided the communication policy stays intact.

Thesis 5:

Social media tools enable - for the first time in education - a digital representation of oneself that is based on the presumptions of continuous exchange and expandability. Supposedly, this is what makes these tools so attractive for young people. The challenge still is to incorporate this communicational fervor into a didactic framework in a way that the boundary between private and public data becomes negotiable.

Thesis 6:

Building up media competency is usually imagined to be the remedy for the field of tension as described in thesis 5. But, as every teacher may experience by him- or herself, the development in the realm of social media is so versatile, diverse, and dynamic, that it is not easy to keep pace. From a pedagogic point of view the reflection of one's own "Web-persona" could be a good starting point. Teachers could establish scenarios for discourse, which are critical and emancipatory by reflecting on key issues of privacy, identity and anonymity. Aspects of privacy in the realm of commercial use of personal data should be discussed as well. Styles of communication and group processes in specified platforms and systems should be analyzed.

Thesis 7:

The field of tension between individual achievement of students using social media and collective action by a group remains at all times. Students like to work in groups, but they are aware of grading necessities. The tension may be eased in the framework of this course, as cooperation on projects is introduced and argued as being the main goal. Nevertheless, social media seem to create this predicament as soon as any individual attribution comes into play. Interestingly enough, this tension is also present in professional activities. Here, collective cooperation with electronic media is even more valued, while individual assessment is usually a stable element of organizational and personnel development. Any objective policy in any environment needs to take that inherent double tension into account: within a cooperative situation and along development from student to professional.

 ISBN: 978-1-61208-120-5

V. SUMMARY AND RESEARCH PERSPECTIVES

The paper set out to investigate the implications for using social software as media in tertiary education. Along two case studies, which employed Weblogs and other tools in diverse student classes and group work, the analysis showed that the promises of Web 2.0 are not easily fulfilled. Rather it can be seen that dilemmas arise from the transfer of social media into educational environments.

Based on the analysis we discussed how these predicaments could be avoided by carefully reflecting the lecturer's position and adapting the didactic framework.

For school teachers and university docents alike it may be interesting as well as confusing to observe that students are sharing private details of their lives with unknown people by means of Weblogs or Social Networking Sites. At the same time we observe that other students in the same environment are hesitant to collaborate on a project Weblog in a *formal* learning environment. That leads to the conclusion that the "communicative hub on the web" [16], which Weblogs are supposed to constitute, is limited in formal settings.

One of the main characteristics of Weblogs, described as "unedited personal voices" by Efimova and Fiedler [7], seems to be controlled and repressed by the formality of context in a tertiary learning environment. That induces an ambivalent tension between blogging as a self-determined and social activity [10, 11] and the necessity of a didactic framework.

We stated in the beginning that media competency means to support the student's sensitivity of handling personal data turned public, among other things. That ability might be the key to overcome problems in lacking student's participation. Thus, further course concepts need to support the development of knowledge toward the specifics of social and communicative aspects in Web-based environments.

Another continuing research question is to what *degree* non-controlled environments are a necessary prerequisite for broad and successful student contributions. One of our evaluation results is that a small number of students are very enthused about blogging in their project study group. We do not know much about their motivations yet because our present data did not bring them out. Future students may develop a better understanding of what their personal surplus is, but meeting the grading demands might be a plausible reason for them as well.

Although the course that served for the studies had its fair share of problems in experiencing integration requirements, it was and still is successful in introducing freshmen into organizational matters of their studies. It is part of the regular curriculum since several years now. Following up on the first courses described here, onto the present year, another department of the university adopted the course, serving freshmen introduction as well. So the course can also be seen as an example for the ongoing necessity to adapt and co-develop the web-based and face-to-face elements in didactic frameworks for hybrid learning.

REFERENCES

[1] T. Berners-Lee, "Weaving the Web". San Francisco, Harper, 2000.

[2] W. Beuschel, B. Gaiser, and S. Draheim, "Communication Needs of Online Students. In Aggarwal, A. (ed.). Web-based Education, Learning from Experience. Idea Group Publ., Hershey/MA: pp. 203-222, 2003.

[3] W. Beuschel, "Weblogs in Higher Education". In: Hatzipanagos, S. and S. Warburton (eds.). Handbook of Research on Social Software and Developing Community Ontologies. IGI Global, Hershey/MA: pp. 41-52, 2009.

[4] D. Boyd, "Broken Metaphors: Blogging as Liminal Space". Paper presented at Media Ecology Conference, New York NY, 2005 http://www.danah.org/papers/BrokenMetaphors.pdf (12/02/2010).

[5] D. Boyd, "A Blogger's Blog: Exploring the Definition of a Medium". In Reconstruction 6 (4), 2006. http://reconstruction.eserver.org/064/boyd.shtml (12/03/2010).

[6] D. Boyd, "Social Media is Here to Stay... Now What?" 2009. http://www.danah.org/papers/talks/MSRTechFest2009.html (12/02/2010).

[7] L. Efimova, and S. Fiedler, "Learning webs: Learning in weblog networks". In P. Kommers, P. Isaias, & M. B. Nunes (Eds.), Proc. IADIS International Conference Web Based Communities, 2004: pp. 490-494. Lisbon, Portugal: IADIS Press.

[8] S. Fiedler, "Introducing disruptive technologies for learning: Personal Webpublishing and Weblogs". Proc. World Conference on Educational Multimedia, Hypermedia and Telecommunication: pp. 2584 ff, 2004.

[9] B. Gaiser, S. Panke, and S. Draheim, „Blogs in Aktion: private, berufliche und pädagogische Einsatzpraktiken". Proc. GeNeMe 2006, 9ter Workshop Gemeinschaften in Neuen Medien. Dresden: TUDpress: pp. 63-74, 2006.

[10] B. Nardi, D. Schiano, M. Gumbrecht, and L. Swartz, "Why we blog". Communications of the ACM, 47 (12): pp. 41-46, 2004.

[11] B. Nardi, D. Schiano, and M. Gumbrecht, "Blogging as Social Activity, or, Would You Let 900 Million People Read Your Diary?" Proc. CSCW'04, ACM 6 (3): pp. 222-231, 2004.

[12] T. O'Reilly: "Web 2.0 Compact Definition, Trying Again". 2006. http://radar.oreilly.com/archives/2006/12/web_20_compact.html (12/02/2010).

[13] T. O'Reilly, "What is Web 2.0?" 2005. www.oreilly.de/artikel/web20.html (10/13/2010).

[14] L. Press: bpastudio.csudh.edu/fac/lpress/471/blogfeedback.htm, 2005 (09/30/2010).

[15] R. Trimarco, "Use of Blogs in Online College Classes". In B. Hoffmann (Ed.), Encyclopedia of Educational Technology, 2004 http://coe.sdsu.edu/eet/articles/blogonlineclass/start.htm (02/20/2008).

[16] E. Wijnia, "Understanding Weblogs: a communicative perspective". In T. Burg (Ed.): Blog Talk 2.0: The European Conference on Weblogs: pp. 38-82. Norderstedt, 2004.

[17] Wikipedia, en.wikipedia.org/wiki/Weblogs (11/20/2010).

 ISBN: 978-1-61208-120-5

Load Balancing Procedure for Building Distributed e-Learning Systems

Marian Cristian Mihăescu, Dumitru Dan Burdescu
Software Engineering Department
University of Craiova
Craiova, Romania
{mihaescu, burdescu}@software.ucv.ro

Mihai Mocanu, Costel Marian Ionascu
Software Engineering Department /
Analysis and Statistics Department
University of Craiova, Craiova, Romania
mocanu_mihai@software.ucv.ro, icostelm@yahoo.com

***Abstract*— Nowadays e-Learning environments manage and deliver high volumes of data. Under these circumstances it becomes highly advisable shifting towards distributed software systems. This approach may bring high benefits regarding the average response time and therefore the overall quality of the e-Learning environment. One possible solution is represented by load-balancing. This means that the workload is distributed among two or more web servers such that a faster response is obtained in proposed scalable system. The load balancing is performed according with the results obtained after putting the e-Learning system under stress that is performed by a simulation tool.**

Keywords- load balancing, e-learning, distributed systems, simulation tool

I. INTRODUCTION

This paper addresses the problem of building a high quality distributed e-Learning system. The proposed solution regards balancing the workload among two or more servers.

Currently, most of the e-Learning systems do not have a distributed infrastructure. All software components (e.g. web server, database server, objects repositories, etc.) usually reside on the same machine. One of the key issues in the design of scalable and high quality e-Learning systems is represented by the workload balancing problem. This problem consists of efficiently distributing hardware and software resources such that average system response is acceptable.

This paper presents solution for workload balancing a specific e-Learning system. For proving right decisions are taken a web based simulation architecture is used for determining the way an e-Learning system may shift towards a distributed architecture. The outcome of such a process may regard resource distribution, the quality of service offered by the system and the distributed software architecture. The simulation tool is intended to be used only in a testing environment not in a productive one. Any e-Learning platform that is scheduled for shifting towards a distributed architecture may pass through the process that is described in this paper. After the simulation process is performed there may obtained conclusions regarding the resources that need to be distributed and the fashion in which distribution needs to be accomplished.

Resource identification and distribution across different computers represents one of the main outcomes. The quality of service regards the performance, availability and reliability. The software architecture describes how the application functionality and data is distributed among available hardware and software resources.

The presented architecture enables an e-Learning system to be tested with custom designed usage scenarios. Building and running different scenarios is aimed to produce valuable information regarding how the e-Learning platform will actually perform when put under different stress conditions. The obtained information will represent the starting point regarding all decisions about how the platform will shift towards a distributed architecture.

The second section presents the state of the art regarding presented issues. The third section presents the e-Learning infrastructure that has been used for testing. Section four presents the functionality of the simulation tool. Section five present the methods that are used for building the simulation framework. Section six presents early and expected results. Finally, conclusions are presented.

II. RELATED WORK

For the some services provided by some popular web sites, the web sites may receive a huge number of client connections in a very short period. Because of this, the huge connections will incur the network congestion or rise response time and even cause the operation of web sites under the unstable situation [5]. This is why building distributed environments represents a clear objective that is spread around many different application areas. Among them, we mention civil and military distributed training applications [1], collaborative design [2], commercial multiplayer game environments [3] and e-learning [4].

The key addressed issues regard data modeling, communication model, data consistency, network traffic reduction, partitioning problems.

Data modeling presents specific modalities of distributing persistent or semipersistent data in a distributed environment. Generally speaking, data may be distributed using replicated, shared, or distributed strategy [7].

The communication model regards the way learners interact with the system in terms of performance. The employed communication model has a direct influence over response times. Different communications schemes (e.g. broadcast, peer-to-peer or unicast) determine different response times [6]. Communication model also regards establishing in details the way different software and hardware resources relate one to each other.

 ISBN: 978-1-61208-120-5

Data consistency is already defined in the area of database management [7]. Data consistency consists of ensuring that all involved parties (e.g. learners, course managers, administrators) that use the system (e.g. the e-Learning environment) must have the same vision on all the data they are working with.

Another key issue for designing a scalable and efficient e-Learning system is the partitioning problem [8]. The approach must lead to an efficient assigning of workload among resources of the system. In short, we consider that learners may be considered as clients of a distributed system. All learners compete over the same non-distributed system.

The partitioning scheme will allow the workload to be efficiently distributed among the components of the distributed architecture. The partitioning mechanism is based on determining the overall performance of the e-Learning environment taking into consideration the workload each resource in the system is assigned to but also on the inter-resource communication. A resource may be software or a hardware component.

Some methods for solving the partitioning problem have already been proposed [9], [10]. However, there are still some features in the proposed methods that can be improved. For example several heuristic search methods can be used for solving this problem [11], [12].

Blackboard e-Learning platform [13] uses load balancing within their content system in order to optimize performance and reliability [14].

A-Tutor Learning Management Tool [15] offers a hosted solution with load balancing across all systems, 24x7x365 monitoring, and nightly backups [16].

Load balancing may be found in Apache Tomcat server as well as in J2EE Web Applications. This paper presents a custom load balancing procedure for e-Learning applications in general and to Tesys [17] e-Learning platform in particular.

Designing distributed learning environments [18] is becoming increasingly popular. Many of the currently existing systems neglect the quality the offered. The offered services are loosing quality due to the increasing number of users that need to be served simultaneously and due to everyday increasing size of the data that needs to be managed.

The problem of building distributed e-Learning environments has been addressed by many important developers. This paper presents an elaborate process in the form of a load balancing procedure. The presented procedure makes sure that obtained solution is optimal for the system that is taken into consideration. This paper presents the way of obtaining a custom solution rather a general one.

The aim of the paper is to present an analysis framework which decides the most efficient way of designing the distributed system started from a non-distributed one.

III. E-LEARNING SYSTEM

E-Learning systems are mainly concerned with delivery and management of content (e.g., courses, quizzes, exams, etc.). Since we are speaking about a web platform the client is represented by the browser, more exactly by the learner that performs the actions.

Defining the e-Learning infrastructure or the presented purpose represents the first and the most important step. In this phase, all the possible actions that may be performed by a learner need to be presented. There are also identified the resources that are delivered by the e-Learning system. Finally, there are identified the highly complex business logic components that are used when actions are performed by learners.

Each implemented action needs to have an assigned weight. In the prototyping phase, the assignment of weights is performed manually according with a specific setup. This assumes that we have an e-Learning system that is already set up. The main characteristics regard the number of learners, the number of disciplines, the number of chapters per discipline, the number of test/exam questions per chapter and the dimension of the document that is assigned to a chapter. The data that is obtained from analyzing a certain setup will represent the input data for the simulation procedure.

Another type of activities regarding learners are represented by the communication that take place among parties. Each sending or reading of a message is assigned a computed average weight.

A sample e-Learning setup infrastructure may consist of 500 students, 5 disciplines, 5 to 10 chapters per discipline, 10 to 20 test/exam questions.

For this infrastructure here may be established a list of costs for all needed actions that may be performed by learners. The weight assigned to an action takes into consideration the complexity of the action and the dimension of the data that is obtained as response after the query is sent.

For obtaining reasonable weight, a pre-assessment procedure is performed. The simulation tool performs this procedure from a computer that resides in the same network as the server such that response times are minimal. Each request that is composed and issued to the e-Learning platform is measured in terms of time and space complexity. A scaling factor will assign each action a certain weight such that the scenarios that will be created when real time testing starts will have a sound basis.

The pre-assessment procedure firstly loads all the data regarding the analyzed e-Learning platform. This means the data about all managed resources (e.g. disciplines, chapters, quizzes, etc.) are loaded such that the simulation tool may build valid requests for the e-Learning environment.

IV. SIMULATION TOOL

The simulation tool emulates one or more learners that access the e-Learning platform in a specified timeframe. The setup of the tool defines the stress level that put on the e-Learning platform.

The main parameters that set up the simulation tool are: *timeframe*, *noOfLearners*, *stressLevel* and *weightLevel*. Timeframe represents the period for which the simulation tool will issue requests. *noOfLearners* represent the number of learners that issue requests for the e-Learning platform. *stressLevel* represents the level of stress put on the

 ISBN: 978-1-61208-120-5

platform by learners. The stress level may be from 0 to 3 where 0 represents a low stress level and 3 represents a high stress level. When stress level is set to 0 this means that each learner will issue one request per minute. When stress level is set to 3 this means each learner will issue 7 requests per minute. *weightLevel* represents the level of weight put on the platform by learners.

The weight level may be from 0 to 3 where 0 represents a low weight level and 3 represents a high weight level. The weight level represents the average weight for actions that are performed in a certain amount of time. According with the weights presented in table 1, the level 0 weight level corresponds to 5 units per minute and level 3 weight level corresponds to 500 units per minute.

The main goal of the simulation tool is to perform the actions of one or more learners. Instead of having the platform tested by real students the simulation tool is used. There are many advantages of this approach although there are not used real data. The main advantage regards flexibility and scalability. The behavior of the simulation tool is managed through setup parameters. Thus, the level of stress that is put over the system may be easily set and thus the behavior of the e-Learning environment under certain conditions may be evaluated. The first outcome of the simulation tool is in the form of a custom usage scenario that complies the setup parameters. This scenario consists a suite to http requests that are to be issued by a certain number of clients.. The simulation tool is regarded as a multithreaded client where each thread will represent a learner that interacts with the e-Learning platform. The main features and software components are: pre-assessment procedure and the following software components: virtual learner, scenario builder and dispatcher.

The pre-assessment is the first performed. Its main task is to build an in-memory representation of the assets that are managed by the e-Learning environment. The outcome of this step produces an XML file with all assets (e.g. disciplines, chapters, quizzes, etc.). The data representing existing assets will be used by the scenario builder module to create valid HTTP requests. Pre-assessment step also computes average weights for HTTP requests. This step

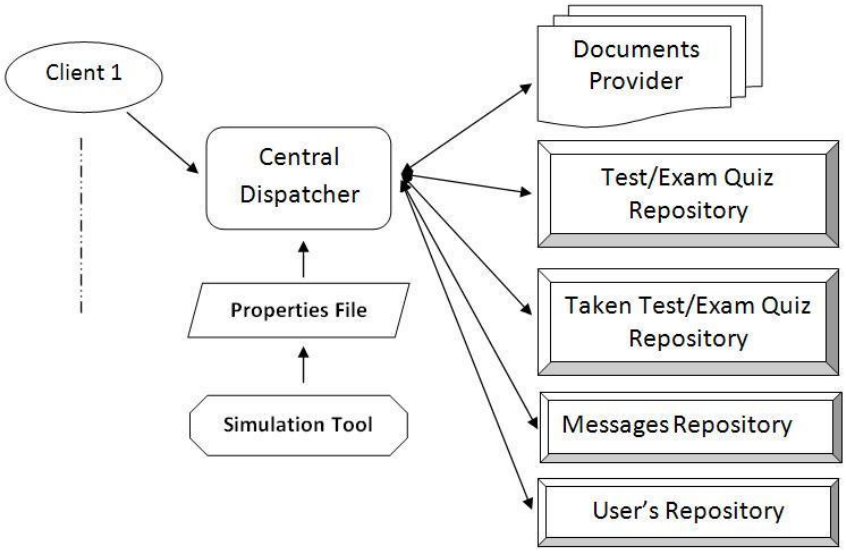


Figure 1. The architecture of a distributed e-Learning system

along with loading the data about managed assets and the configuration file represent the setup phase.

Building the XML file with assets representation and the setup is performed as a scheduled job with a predefined frequency. This approach is due to the fact that the assets are dynamically created by the simulation tool itself. For example, in a scenario may be included that HTTP requests that are needed for simulating a testing or an examination. One of the outcomes of this procedure is a record in the database with the data regarding the taken test. Unfortunately, this test may not be yet included in scenarios the want to display tat taken test. At the next running of the pre-assessment procedure the data about the taken test will be included in the XML file that contains the assets and thus the action that represents the display of that test may be included in one or more scenarios.

A virtual learner software component is regarded as an autonomous agent. In fact, the virtual learner represents a complex entity that performs predefined custom business logic within the environment. The set of all actions that will be performed constitute its behavior. Modeling the behavior is the task of the scenario builder component. The learner itself is regarded as a software component that interacts with the e-Learning environment. The main functionalities implemented for learner software component regard issuing HTTP requests, getting the HTTP response and logging the

 ISBN: 978-1-61208-120-5

transfer data. Request and response date and the amount of transferred data are among the data that are logged.

The scenario builder software component is responsible for building the scenarios that will run against the tested e-Learning environment. The input for this module is represented by the XML file containing the assets, the file containing the weights for each action that may be performed and the configuration file. The configuration file contains the values for the parameters that are to be used when creating the scenarios. The main parameters that may be found are presented in section 4 as general setup parameters of the simulation tool.

The dispatcher software component is responsible for managing and coordinating learners. The input data is represented by the scenario that is build by the scenario builder component. The dispatcher creates the pool of learners that will issue requests and receive responses from the e-Learning environment. It will also gather and centralize the data from all learner components that interact with the e-Learning environment in a structured format.

V. LOAD BALANCING ARCHITECTURE

Here will be presented the architecture of the distributed e-Learning system. The distribution is performed by using several web servers. The servers have full duplicated data content. This means each server has the ability to answer to any of the possible requests. The decision to have a full duplicated data content rises a very difficult problem regarding data synchronization. For this prototype solution we use an active replication scheme in which clients communicate by multicast with all replicas. The full duplicated data scheme enables the system to answer the client from any replica. Still, the goal of the obtained load balancing architecture is to allow a shift towards a passive replication scheme. This means certain type of requests will always end up being answered by a certain replica that manages the needed data. In this process, the simulation tool has an important role. Each issued request may generate a signature that contains an indication regarding the replica and the asset that has been accessed. The signatures may thereafter be used for assessing the quality of the distribution process and therefore the quality of the load balancing architecture.

Figure 1 presents the architecture of the entire system where different web servers and the relationships between them are presented. There are considered five different types of requests. Each web server has the ability to answer to any request that may be sent to the central dispatcher. The dispatcher works as a scheduler between clients and web servers. The architecture virtually consists of 5 web servers that work as: (1) documents provider server, (2) test/exam quiz repository, (3) taken test/exam repository, (4) messages repository and (5) users repository. All 5 servers work as a web server cluster and perform their activities in a transparent manner for the users

When the clients issue requests, the requests are delivered to the central dispatcher first and then forwarded to

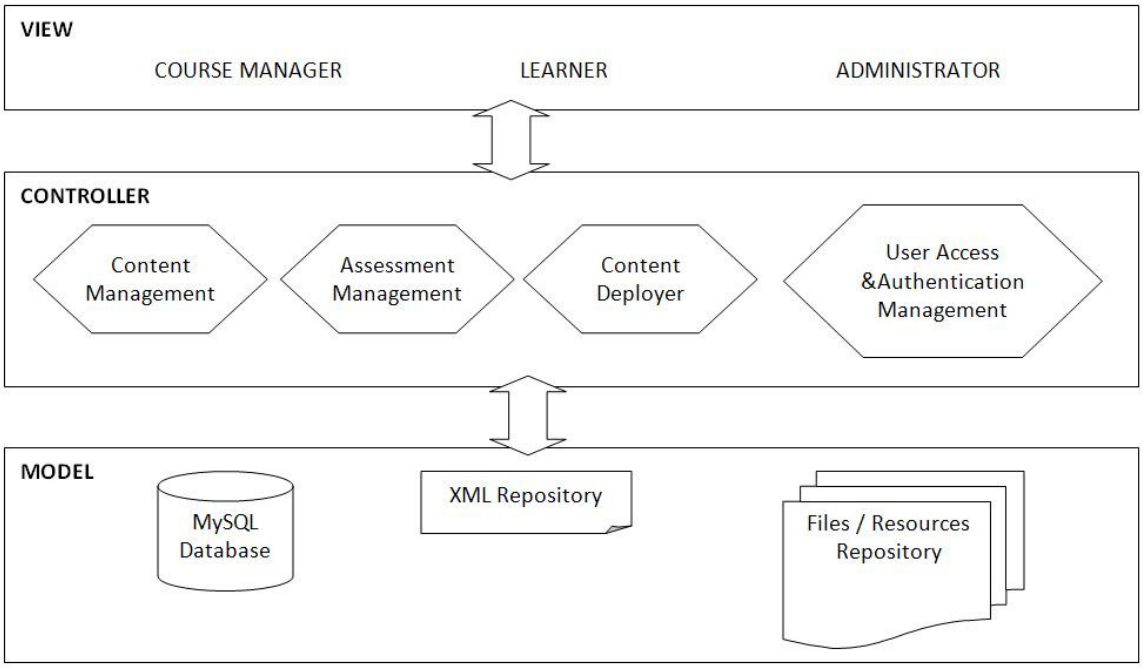


Figure 2. The MVC architecture of the e-Learning system

the backend web servers for processing. Thus, it is important for us to design an efficient load balance algorithm in the dispatcher in order to direct the incoming requests to backend web servers. Synchronization issues are also managed by the central dispatcher.

Under above presented circumstances it is obvious the importance of load balancing algorithm. The algorithm will

 ISBN: 978-1-61208-120-5

decide which resource is to be allocated for performing the requested task. According with presented architecture, the algorithm is highly dependable upon the content/service that is needed. The requests are differentiated based on the contents needed by clients.

The documents associated to courses are regarded as static content. Whenever a static content is requested, its associated cost is estimated. The cost value is added in the weight matrix to the position representing the assigned web server. Once the job is finished the cost value is subtracted from the matrix. The matrix that holds the weights is called load balancing matrix. In presented procedure, pos represent the position within load balancing matrix which holds the minimal value. If *load-balancing-matrix[pos]* has value 0 this means the web server associated with position pos is 100% available for incoming task. If *load-balancing-matrix[pos]* is greater than 0 this means the web server associated with position pos is handling a request of weight equivalent with the stored value. The web server has itself a maximum available computational power expressed as a weight that may be found in a properties file. The properties file holds the maximum computational power values for each web server that will be part of the load balancing infrastructure. If the available weight is greater that the weight of the incoming task than the task may be assigned to the corresponding web server.

The procedure dispatchTask, which runs over load balancing matrix, is:

```
procedure dispatchTask (task t){
    cost = computeCost(t);
    pos = findMinimumValue(load-balancing-matrix[]);
    if (cost + load-balancing-matrix[pos] > MAX_ALLOWED_COST)
        throw("WAIT");
    else {
        load-balancing-matrix[pos] += cost;
        StartTask(t, WebServer[pos]);
    }
}
```

Figure 3. The procedure for dispatching tasks

The incoming requests are classified according with the five category set presented in Figure 1. The requests that need to access and download documents or messages are classified as static requests. The requests that need to access and manage test/exam quizzes or users are classified as dynamic.

The metrics that define the weight of an action that is performed on a web server relate to the average number of requests of a certain type in a specified timeframe. Another metric is represented by the number of requests of a certain type that are executed at a certain moment by a server. This represents the currently executed tasks on each server. Another metric is defined by the estimated weight of a certain task. The weight value is pre-evaluated during simulation.

Figure 2 presents the architecture of the e-Learning platform from the MVC (Model-View-Controller) point of view. Within each layer there are presented the main building blocks in a non-distributed fashion. This view of the e-Learning platform is the starting point in the distribution process. The simulation tool must take into consideration the number of modules from each level and the needed distribution granularity.

For the implementation of e-learning system a distributed architecture is proposed. In this design, multiple E-Learning modules provide e-learning functionalities to clients. In this architecture, we have designed our e-learning system with 3-layer architecture: View Layer, Controller Layer and Model Layer. The view and controller layers are deployed on an application server. Model layer represents the persistent storage for data and is represented by a database, an XML repository and a file/resource repository.

The view layer is represented by the user interface of system and provides the interface of the tools and applications of the e-Learning platform.

In controller layer, the logical and control functions of e-learning system are implemented. In addition, this layer provides access for data source (mySQL database, XML repository and files/resources repository) for view layer and connection between view layer and model layer.

The Content Service Requester is implemented in E-Learning Service Provider and initiates interaction with Content Service Provider. This layer uses the web service to provide data sources for higher layer.

Obtaining content from data sources (data bases, repositories of XMLs or files) is implemented within the control layer in the form of a data access layer. The communication between layers is accomplished in a client/server fashion. The data sources are the persistent and heterogeneous data repository, which usually are designed with the focus on distribution.

VI. CONCLUSIONS AND FUTURE WORK

In this paper we presented an e-Learning infrastructure for which a load balancing infrastructure is designed. For designing a feasible architecture a simulation tool is presented. The tool acts as a pool of virtual users. The actions are performed according with a specified properties file. There were identified 5 type of actions: file transfers, test/exam quiz management, taken test/exam quiz management, messages management and users management. That is why the proposed architecture consists of 5 web servers that contain full duplicate data and business logic. In front of them there was placed a central dispatcher that actually performs the load balancing procedure.

The central dispatcher uses as input data a properties file that is filled with data by the simulation tool and by the system administrator. The business logic is mainly concerned with finding the appropriate web server that will execute the needed action.

The adoption of distributed design regards the future possibility of integrating additional functionalities without affecting the overall quality of service offered by the platform. This design meets the scalability requirements. Integrating a service within the overall design (e.g. a

 ISBN: 978-1-61208-120-5

recommender service) may be accomplished with minimal affecting of the overall response times.

As future work we plan: (i) provide a scaling procedure such that the central dispatcher may work with any number of web servers; (ii) enhance the simulation tool such that weight task estimations to be more accurate; (iii) to extend the design for integrating other services (e.g. a recommender service) within the architecture; (iv) change the active replication scheme to a passive replication scheme in which clients communicate with a distinguished replica; (v) have an evaluation strategy for the system that has been shifted towards a distributed architecture. We shall report on our progress in subsequent papers.

ACKNOWLEDGMENT

This work was supported by the strategic grant POSDRU/89/1.5/S/61968, Project ID61968 (2009), co-financed by the European Social Fund within the Sectorial Operational Program Human Resources Development 2007 – 2013.

REFERENCES

[1] D.C. Miller and J.A. Thorpe, "SIMNET: The Advent of Simulator Networking", Proc. IEEE, vol. 83, no. 8, pp. 1114-1123, 1995.

[2] J.M. Salles Dias, R. Galli, A.C. Almeida, C.A.C. Belo, J.M. Rebordao, "mWorld: A Multiuser 3D Virtual Environment", IEEE Computer Graphics and Applications, vol. 17, no. 2, pp. 55-65, 1997.

[3] M. Lewis and J. Jacboson, "Game Engines in Scientific Research", Communications of the ACM, vol. 45, no. 1, pp. 27-31, 2002.

[4] C. Bouras, D. Fotakis, and A. Philopoulos, "A Distributed Virtual Learning Centre in Cyberspace", Proc. Fourth Int'l Conf. Virtual Systems and Multimedia, VSMM '98, pp. 18-28, 1998.

[5] M. Zari, H. Saiedian, and M. Naeem, "Understanding and Reducing Web Delays", IEEE Computer, Vol. 34, No. 12, pp. 30-37, 2001.

[6] Y. Kawahara, H. Morikawa, and T. Aoyama, "A Peer-to-Peer Message Exchange Scheme for Large Scale Networked Virtual Environments", Proceedings of the The 8th International Conference on Communication Systems (ICCS'02), pp. 957-961, 2002.

[7] Philip A. Bernstein, Vassos Hadzilacos, and Nathan Goodman, Concurrency, Control and Recovery in Database Systems. Addison-Wesley, 1997.

[8] C.S. John, M.F. Chan, K.Y. Oldfield, K.Y. So, and T.S. Tam, "Dynamic Partitioning for a Distributed Virtual Environment", Department of Computer Science & Engineering, Chinese University of Hong Kong , 1998.

[9] Jonh C.S. Lui and M.F. Chan, "An Efficient Partitioning Algorithm for Distributed Virtual Environment Systems", in IEEE Transactions on Parallel and Distributed Systems, Vol. 13, No. 1, pp. 193-211, 2002.

[10] Sandeep Singhal and Michael Zyda, Networked virtual environments: design and implementation, ACM Press/Addison-Wesley Publishing Co. New York, USA. 1999.

[11] P. Morillo and M. Fernandez, "A GRASP-Based Algorithm for Solving DVE Partitioning Problem", Proceedings of the 17th International Symposium on Parallel and Distributed Processing, pp. 22-26, 2003.

[12] P. Morillo, M. Fernandez, and J.M. Orduna, "A Comparison Study of Moder Heuristics for Solving the Partitioning Problem in Distributed Virtual Environment Systems", Proceedings of the 2003 international conference on Computational science and its applications, Springer-Verlag, pp. 458-467, 2004.

[13] Blackboard Inc., http://blackboard.com [retrieved: December 8, 2010].

[14] Lara Oerter and Deborah Everhart "Blackboard Content System™ - Product Overview White Paper", Blackboard Inc., http://library.blackboard.com/docs/contentsystem/Content_System_wp.pdf [retrieved: December 8, 2010].

[15] ATutor is an Open Source Web-based Learning Content Management System (LCMS),http://atutor.ca/ [retrieved: December 8, 2010].

[16] EduTools Course Management System Comparisons, Product details, http://www.edutools.info/compare.jsp?pj=4&i=624 [retrieved: December 8, 2010].

[17] D.D. Burdescu and M.C. Mihăescu, "Tesys: e-Learning Application Built on a Web Platform", Proceedings of International Joint Conference on e-Business and Telecommunications, Setubal, Portugal , pp. 315-318, 2006.

[18] M. Ganzha, "E-learning with Intelligent Agents," IEEE Distributed Systems Online, vol. 9, no. 2, art. no. 0802-o2004, 2008.

.

 ISBN: 978-1-61208-120-5

Supervision of Heterogeneous e-Learning Environments: the case of the International E-MI@GE Project

Supervision of International E-MI@GE

Julien Broisin, Valentin Butoianu, Philippe Vidal, Daniel Marquié
Institut de Recherche en Informatique de Toulouse
IRIT
Toulouse, France
{broisin,butoianu,vidal,marquie}@irit.fr

***Abstract*—**The International E-Miage project (IEM) is an engineering curriculum composed of more than twenty international sites that deliver official French degrees. The IEM computational environment comprises many tools, platforms and users that make it very difficult to establish an up-to-date global overview of the whole set of learning entities implied into this digital campus. Therefore, we present in this paper a tracking framework able to produce, exchange and store in a unified way all activities performed by users on the various IEM learning systems and resources. A rich Internet application has been designed to demonstrate how the collected data can be computed to build a real-time and detailed cartography of each IEM partner, or to produce useful statistics information about a (set of) partner.

Keywords- e-learning environments; distributed architecture; supervision; user context information

I. INTRODUCTION

The digital campus International E-Mi@ge (IEM) [5] aims at offering a distant teaching version of the MIAGE curriculum (*Méthodes Informatiques Appliquées à la Gestion des Entreprises*) in order to (1) reach a new public, (2) improve the current modes of teaching, in particular by providing online resources to traditional students and by catching academic and professional teachers attention on new teaching methods based on ICT, and (3) give the MIAGE curriculum the opportunity of being a privileged e-learning actor in the field of data processing and information systems.

We focus here on the computational aspect of the IEM project. The consortium currently comprises about 150 to 200 people (authors, teachers, learners, technical administrators, etc.) involved in the process of creation, indexation, presentation and consultation of the content, and is composed of about ten heterogeneous systems. These systems comprise several Learning Management Systems (LMS) deployed within the IEM sites and used to offer some learning services to learners and teachers, one Learning Object Repository (LOR) that stores all the versions of the sixty IEM SCORM packages, and a Content Management System (CMS) to allow members to exchange and share information related to the exams. Thus, the various phases from the creation to the deployment and maintenance of a learning resource involve an important number of e-learning actors and systems that makes it very difficult, even nearly impossible, to produce an up-to-date computational view of the whole set of learning systems and resources. This can lead to unacceptable mistakes such as a student that complained during an exam session to misunderstand the question because several notions where not even introduced into the online course. Indeed, the exams are common to all students of the consortium, but the LMS manager of each site has to deploy, at the beginning of each semester, the last version of all SCORM modules available within the learning object repository; in the above case, an author uploaded a new version of a module within the LOR without notifying the others sites that did not updated their resources on the learning management system.

A solution to this issue consists of tracking users' activities and analyzing these activities in order to supervise the whole set of IEM learning tools. Current systems that tackle this issue such as Mendeley [8] or APOSDLE [2] are restricted to a specific system and can hardly integrate data produced by a third-party application. Therefore, the main contribution of this paper resides in the design and integration of a tracking framework within the existing IEM computational environment. The resulting distributed architecture is able to record activities performed by users on each tool of the IEM environment, and to externalize these records to a central repository. Then, tracking information that has been collected can be visualized in a uniform way and correlated together to establish a cartography of the whole set of sites or to produce relevant statistical data.

The paper is organized as follows: the next section exposes IEM from a computing point of view and focuses on the heterogeneous nature of the tools implied into this e-learning environment. Section 3 introduces the main principles and architecture of the tracking framework, and demonstrates how the various tools integrated within the IEM project can be supervised in a uniform way. In section 4, we show how it is possible to get an overview of all actions and activities operated by users on these tools, and present an application dedicated to the visualization of traces and able to produce statistical information. Finally, we conclude and expose some future works.

 ISBN: 978-1-61208-120-5

II. ARCHITECTURE OF THE IEM ENVIRONEMENT

The computing environment of the IEM project is illustrated in Figure 1. It comprises, from top to bottom:

- Some authoring tools dedicated to the creation of the pedagogical content.
- A Content Management System based on XOOPS to share exams and related information between the IEM administrative staff. Since this kind of system is not compliant with ubiquitous metadata standards dedicated to learning objects, it can hardly be used as a space to store the pedagogical IEM content.
- A Learning Object Repository stores both the pedagogical resources created by the authors and the metadata that describe the content. A graphical user interface associated to the repository allows users to retrieve, edit, download and index learning objects.
- A Learning Management System deployed within each site; some of them exploit INES (a specific platform developed by the University of Amiens) and others are based on the well-known MOODLE platform.

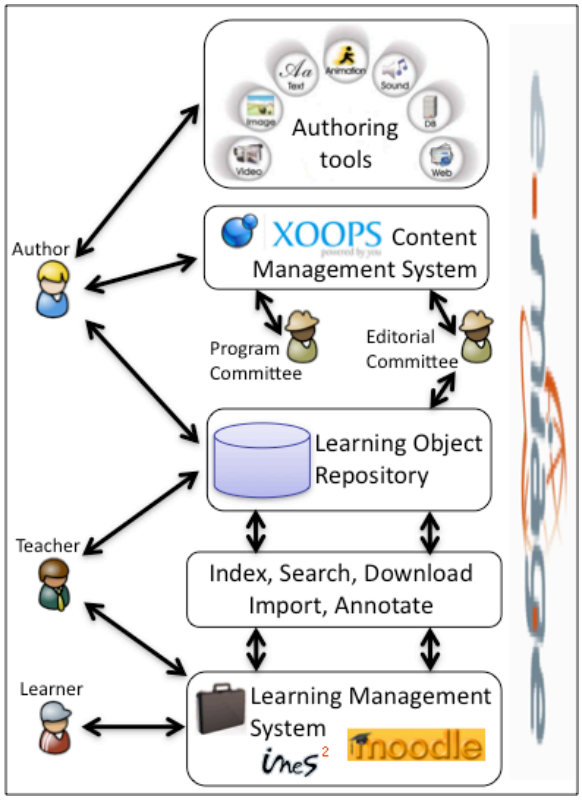


Figure 1. The computing environment of the IEM project.

In addition to these components, we developed an intermediate layer between the storage and the learning environments comprising a set of services that allow transparent communication between these two kinds of systems [3]. These services that are accessible from the LMS focus on learning objects and comprise:

- The indexation service: it allows users to index new learning objects into the LOR so that they can be easily reused by all sites.
- The search service: users can browse the LOR and consult metadata associated with the results returned by the search engine.
- The download service: through this service, end-users are able to download on the local host the content matching with the metadata returned by the search service.
- The importation service: it allows users to import the pedagogical content stored into the LOR within the current course of the LMS so that it is straightly available to learners.
- The annotation service: once a learning object has been deployed within a course, learners, teachers and tutors have the opportunity of suggesting comments and ratings related to the content.

Thus, the IEM project implies a large number of e-learning tools and actors geographically distributed that make it very difficult and time-consuming to establish an overview of the computational environment. To overcome the issues of heterogeneity and repartition of applications, our proposal consists of supervising all activities performed by users on each system and resource implied within the IEM computing environment, and then to externalize and transfer these data to a central component. Two main objectives must then be achieved: the common representation of data produced by the heterogeneous IEM tools, and the elaboration of a distributed architecture ensuring the production, exchange and storage of the tracking information.

III. THE E-MI@GE TRACKING FRAMEWORK

The works presented here are based on some previous works in which we introduced a generic framework able to capture users' activities within a web-based learning environment [4]. In the following sections, we briefly present the general approach and focus on how it is applied to the E-MI@GE context.

A. The Basis for our Approach

A standard initiated by the Distributed Management Task Force (DMTF) brings a solution to unify supervision of distributed computing environments, and facilitates exchange of data across otherwise disparate technologies and platforms. To uniformly represent data that are supervised, the DMTF standard adopts a Common Information Model (CIM) [14], a metamodel that exploits object concepts for modeling systems, networks and applications. Moreover, the DMTF recommends a distributed architecture called Web-Based Enterprise Management (WBEM) [16] to support the CIM metamodel. The main components of the WBEM architecture include (1) a manager responsible for storing and managing the supervised information (stored as instances of the CIM models), (2) some providers which are pieces of software that communicate with some supervised resources such as disk drives and CPUs, and (3) a client

 ISBN: 978-1-61208-120-5

application which interacts with the manager in order to retrieve and exploit the collected information.

Starting from this basis, we elaborated several models extending the native CIM models and focusing on learning systems, resources and activities.

B. A Common Representation of Data to Supervise

Our previous works defined three generic models to represent entities to supervise within a web-based learning environment:

- The model *TEL_Environment* focuses on learning systems and resources. Systems are described in terms of *name*, *location*, *version* and *description*, whereas resources are represented according to their *title*, *description*, *dates of creation*, *modification* and *deletion*.
- The model *TEL_User* is precisely detailed in [12], and includes the IMS-LIP standard [10] together with some additional cognitive and metacognitive information. This user model describes a user from a learner, teacher or tutor point of view.
- The model *TEL_Activity* links the two previous models by describing interactions between users and systems/resources. In other words, this model represents the activities performed by a user on a system or resource.

Each of these models presents a high abstraction level and offers the opportunity of defining specific models according to specific objectives. Since our ambition is to establish an overview of the IEM computational environment during the operational phase, the authoring tools are not taken into account within our modeling of systems; indeed, these tools are used during the preparation phase in order to design the learning resources, but they are not involved in the exploitation process. Therefore, in order to meet the requirements of the IEM environment, we specialized the above generic models:

- Three system classes respectively describe learning object repositories (the property *metadata* has been introduced), learning management systems (two specific properties related to their conformance to the *SCORM* and *IMS-LD* standards have been introduced) and content management systems.
- Three classes represent the resources manipulated by the three above types of systems: learning objects, courses (characterized by the property *category*), and exams.

There was no need to extend the user model, as it was exhaustive enough to integrate the user profiles defined within the IEM learning systems. However, depending on the systems, information that is available to describe users may differ:

- Within the learning object repository, a user is defined according to the OpenID standard [15]. Thus, the following information is available: *fullname*, *nickname*, *timezone*, *language* and *gender*.
- The user profile specified in XOOPS includes some basic information such as the *first* and *last names*, *postal* and *electronic addresses* and *country*, but also defines other interesting information from a learning point of view such as the *list of interests*, the *personal web page*, or some *social networks identifiers* that can be further reused to build recommendation and social learning services [6][7].
- The user model specified within INES and MOODLE are different: INES comprises the same basic information as XOOPS, but MOODLE also defines the others interesting (social) learning information together with the *blog entries* a user has produced and the *courses* he/she is enrolled in. The *role* of the user within a course is also gathered.

Finally, the activity model has been specialized to take into account various activities that can be processed on the supervised resources through the learning tools; the whole set of activities we defined for the IEM learning context is listed in Table I. Thus, each action appearing in Table I matches with a class of the specific IEM activity model derived from the generic *TEL_Activity* model, and establishes a link between a user and a resource integrated into a system.

TABLE I. SUPERVIZED ACTIVITIES WITHIN THE IEM FRAMEWORK

	Learning Tool		
	CMS	***LOR***	***MOODLE and INES***
Activities	- Upload and Deletion of an exam - Update of the user profile	- Search for learning objects - Consultation of metadata - Download of content - Indexation of a new LO	- All LOR activities - Creation of a course - Deployment, Consultation, Download and Annotation of a SCORM package

To support this data model, we set up a distributed architecture conform to the WBEM standard and depicted in the next section.

C. A Distributed Architecture

The aim of this architecture is to ensure production, exchange and storage of the tracking information. Therefore, three distinct types of components in our architecture are respectively responsible for processing the above-mentioned tasks. The resulting framework is illustrated in Figure 2 and comprises:

- The learning context from which tracking information is collected; in the IEM environment, it comprises the CMS, the LOR and several MOODLE and INES servers. These tools embed direct access sensors responsible for capturing the values of the information defined within our tracking models; sensors correspond to the data-gathering layer of the six-layered architecture of [9].
- The tracking environment represents both the storage/management and the query layers. Indeed, the tracking repository is an object-oriented database storing tracking information (it contains classes and instances of the models), whereas the tracking manager is able to manipulate the data stored into

 ISBN: 978-1-61208-120-5

the repository using the CIM Query Language (CQL).

- The intermediate layer (reception layer) acts as a proxy between the learning and the tracking environments to offer an easy access to the tracking repository: the tracking service is able to receive tracking information sent by learning tools, and to search for information stored into the tracking repository.

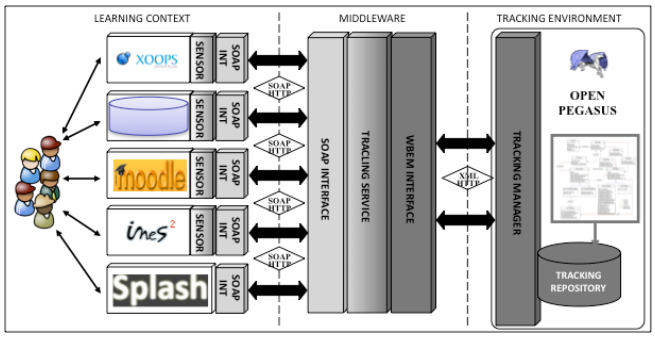


Figure 2. The global tracking architecture.

To make the role of each component of the architecture clearer, the next section details interaction between these entities for a specific use case.

D. Use Case: Inegration of a Learning Object into a MOODLE Course

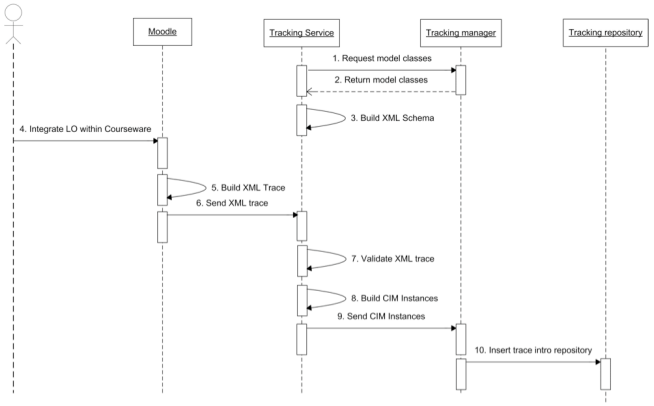


Figure 3. Collecting a trace from a MOODLE server.

Figure 3 represents the UML sequence diagram illustrating exchanges and treatments required to ensure production, exchange and storage of a trace translating the integration of a learning object within a MOODLE course by a teacher. When the tracking service is started, it queries the tracking manager (1) in order to retrieve classes of the tracking model (2), and finally creates the XML schema according to the models' specifications (3). When the teacher integrates the learning resource into the MOODLE course (4), the sensor extracts the tracking information from MOODLE and creates the matching XML trace (5); this trace contains information about the user, the learning object, the course, the learning system and the activity. The sensor then sends a request to the tracking service (6) which validates the XML trace against the XML schema produced in step 3 (7), and finally builds the matching instances of the models (8). These lasts are sent to the tracking manager (9) and stored into the tracking repository (10).

In this architecture, the gathering sensors only are specific to the systems to supervise. The next section details how the sensors have been designed for the IEM context according to the information they have to collect, and shows how a map of the whole E-MI@GE consortium can be established from these data.

IV. SUPERVISING E-MI@GE SITES

A. Designing the gathering sensors

The gathering sensors are responsible for capturing the values of the information defined within our tracking models. According to these models, a certain amount of data summarized in Table II must be located and extracted from the various tools of the IEM framework; to achieve this task, we studied the databases and session variables of each IEM learning system.

TABLE II. TRACKING INFORMATION AVAILABLE WITHIN THE IEM FRAMEWORK

Entity	Learning Tool		
	XOOPS	***LOR***	***MOODLE and INES***
Users	First name, last name, postal adress, electronic address, country, list of interests, personal web page, social network identifiers	Full name, nickname, time zone, language, gender	All XOOPS properties, blog entries, courses, role
Systems	Name, location, version, description	All XOOPS properties, metadata	All XOOPS properties, SCORM, IMS-LD
Learning objects		Title, description, location, date of creation, date of modification, date of deletion	Title, description, location, date of creation, date of modification, date of deletion
Courses			Title, description, location, date of creation, date of modification, date of deletion, category
Exams	Title, description, location, date of creation, date of modification, date of deletion		

A gathering sensor is only between 50 and 100 lines of source code, as the main treatments operated on the trace (transformation of the XML trace into the matching instances of our model, and storage of these instances into

 ISBN: 978-1-61208-120-5

the tracking repository) are ensured by the tracking service; the communication between the sensor and the tracking service is established using the web services technologies). The process of delegating tasks presents two main advantages: the original behavior of the learning system is not altered (the XML trace is very short string, and the AJAX technologies used to send the request from the sensor to the tracking service reinforce this capacity), and the tracking information is collected in real time as soon as the user performs a supervised activity. Moreover, XOOPS, MOODLE and INES are all PhP-based software, so the integration of the sensors within these tools was facilitated by the reuse and adaptation of the source code.

Let us note that data integrity is ensured within the IEM tracking framework by the models themselves. As an example, even if data describing users are gathered from several applications, they are merged together into the tracking repository so that a user is described by a single profile containing information gathered from XOOPS, MOODLE, INES and the LOR.

B. Visualizing status of the IEM computional environment

The collection of tracking information from the IEM applications started recently, but the set of data already available within the tracking repository makes it possible to build applications to exploit these data. A first prototype of SPLASH (Secured and Personal Learning dASHboard) has been developed and acts as a client application that queries the tracking service to retrieve and correlate data in order to provide end-users with relevant and interpretable information.

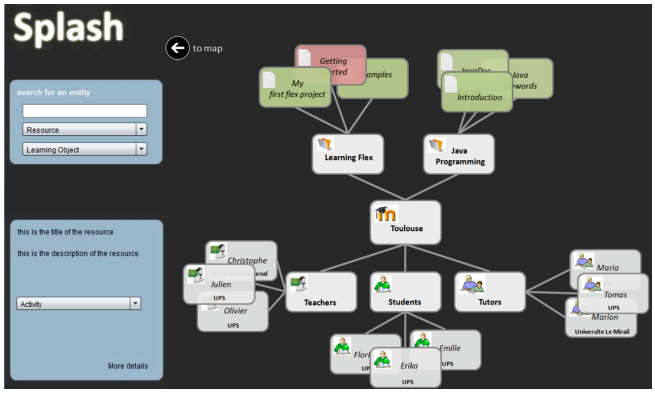


Figure 4. Visualizing the Status of a Site.

The main feature of SPLASH establishes a global overview of the whole IEM computing environment by drawing, on a world map, some points representing the sites (the sites match with the MOODLE and INES instances stored into the tracking repository, and points are drawn according to the location property). When a user activates such a point on the map, several interesting information are available and illustrated on Figure 4:

- The list of courses deployed within the site (*Learning Flex* and *Java programming*). Courses are identified by selecting all associations between the given site instance and the course instances.
- The list of teachers, tutors and students enrolled in the site (a user has to log at least once in MOODLE or INES). Starting from the site and its list of courses, the algorithm selects all associations with user instances.
- The list of SCORM modules deployed within each course (on top of Figure 4); here, the algorithm searches for learning objects instances associated with the given course.

Even if the detailed information appearing in Table II are displayed on the GUI for each entity, the information listed above allows us to get a global point of view on systems, courses, learning objects and people involved into the IEM community only. These data are not precise enough to ensure that all IEM sites are deploying the "correct" SCORM packages. Thus, each learning resource integrated into a course is colored on the GUI: a green color means that the version of the resource matches with the most recent version of the same resource stored into the LOR, whereas the red color denotes a mismatch. SPLASH thus provides the IEM editorial committee with the opportunity of checking the current status of all courses regarding the versioning issue, and to alert the site(s) concerned by a mismatch.

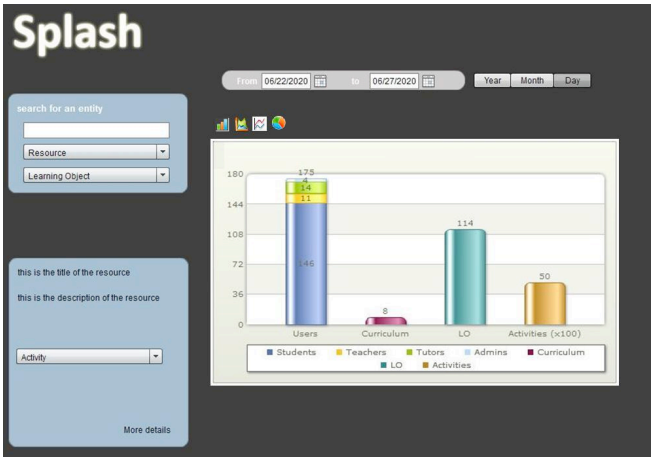


Figure 5. Visualizing Statistical Information about an IEM Site.

Much statistical information can also be computed and displayed with respect to different chart formats (area, pie or stacked column). These statistics can be produced at a raw level (users, systems, resources, activities) or at an abstract level (site, set of sites). The algorithm that computes the raw level statistics implements some basic computing methods, whereas it intelligently correlates the raw level data to build the statistics of a (set of) site. The Figure 5 depicts the statistics of the site of Toulouse as a state column chart: 174 users are registered in the INES platform (146 students, 11 teachers, 14 tutors and 3 administrators), 8 curriculum are currently deployed, 114 learning objects are integrated within these courses, and more than 5,000 activities have been performed. The row level statistics can then be displayed as a pie chart by clicking on the matching column on Figure 5: if the "Activity" column is clicked on, a piece of the pie represents a specific activity, and the weight of a

 ISBN: 978-1-61208-120-5

piece is defined according to the number of times the activity has been performed.

As mentioned before, the deployment of the whole IEM tracking framework happened recently. Even if the functionalities currently implemented within SPLASH reveal fundamental information regarding the good health of the computing environment, much more advanced features can be built on top of the tracking information. Thus, several advanced services focusing on the pedagogical area are currently being elaborated into SPLASH. One of these services allows learners to be aware of their colleagues' progress during the learning process, thus increasing their motivation level. Another service encourages the social learning by recommending relevant tools, persons and resources to a specific learner according to his profile, difficulties and context.

V. CONCLUSION AND FUTURE WORKS

We presented in this paper a solution to supervise users' activities within the International E-MI@GE digital campus, a curriculum delivering a French engineering degree. Our proposal stands on a common representation of data collected from the heterogeneous learning tools, together with a distributed architecture managing traces from their creation to their storage and visualization. The content management system, the learning object repository and most of the learning management systems of the IEM computational environment are now integrated into the tracking framework. A visualization application exploits the data collected from these systems to build an up-to-date overview of the whole set of users, systems and resources involved in the project, thus facilitating its management and preventing some important issues to occur.

A short-term perspective consists in tracking the RELOAD authoring tool [13]. Since the IEM pedagogical resources are packaged within SCORM modules using this application, it will be easy to automatically index the whole package into the LOR by extracting the metadata mentioned within it; this process would considerably facilitate the indexation mechanism, since the IEM authors would not have to manually perform this task. Furthermore, we plan to disaggregate the package in order to index learning objects characterized by a smaller granularity level. This would encourage e-learning actors to reuse the IEM content and help promoting the quality of this digital campus: some studies [1] shown that this kind of learning objects are easier to share and reuse by others e-learning actors than resources characterized by a high level of granularity.

Another perspective concerns the user privacy. Indeed, to protect the privacy of the IEM actors, the solution we adopted consists of displaying the users' first name only. But last names are also recorded into the tracking repository, making it easy for a third application to query the tracking service and to retrieve confidential information such as the set of activities performed by a user identified by his first and last names. To tackle this issue, we plan to set up a federated identity mechanism by delegating the management of users' authentication and authorization to a third party; the most common solutions in this area such as the Security Assertion Markup Language (SAML) [11] elaborated by the OASIS consortium or the OpenID protocol [15] have to be considered.

REFERENCES

[1] P. Baumgartner, "The ROI Paradox," Keynote Presentation, Gesellschaft für Medien in den Wissenschaften Conference, Autriche, 2004.

[2] G. Behama, B. Kumpa, T. Leya, and S. Lindstaedt, "Recommending Knowledgeable People in a Work-Integrated Learning System," Procedia Computer Science, vol. 1, issue 2, 2010, pp. 2783-2792, doi:10.1016/j.procs.2010.08.003.

[3] J. Broisin, P. Vidal, D. Marquie, and O. Catteau, "The International E-Miage project: from an Isolated Framework to an Architecture Based on Learning Standards," Proc. Advanced International Conference on Telecommunications and International Conference on Internet and Web Applications and Services (AICT-ICIW'06), Feb. 2006, pp. 10, doi: 10.1109/AICT-ICIW.2006.189.

[4] V. Butoianu, P. Vidal, K. Verbert, E. Duval, and J. Broisisn, "User context and personalized learning: a federation of Contextualized Attention Metadata," Journal of Universal Computer Science, John Wiley and Sons, vol. 16, issue 16, 2010, pp. 2252-2271.

[5] G.M. Cochard and D. Marquie, "An E-Learning Version of the French Higher Education Curriculum 'Computer Methods for the Companies Management'", Proc. IFIP International Federation for Information Processing, vol. 156/2004, 2004, pp. 557-572, doi: 10.1007/978-1-4020-8157-6_52

[6] S. Downes, "E-learning 2.0," eLearn Magazine, Association for Computing Machinery, Oct. 2005, available at http://www.elearnmag.org/subpage.cfm?section=articles&article=29-1, consulted on Dec. 2010.

[7] R. Farzan and P. Brusilovski, "AnnotatEd: A social navigation and annotation service for web-based educational resources," New Review of Hypermedia and Multimedia, vol. 14, issue 1, Jan. 2008, pp. 3-32, doi:10.1080/13614560802357172.

[8] V. Henning and J. Reichelt, "Mendeley - A Last.fm For Research?," Proc. Fourth IEEE International Conference on eScience (eScience 08), Dec. 2008, pp. 327–328, doi: 10.1109/eScience.2008.128.

[9] K. Henricksen and J. Iadulska, "Developing context-aware pervasive computing applications: Models and approach," Pervasive and Mobile Computing, vol. 2, issue 1, pp. 37-64, Feb. 2006, doi:10.1016/j.pmcj.2005.07.003

[10] IMS Learner Information Package Best Practice & Implementation Guide, 2001, available at http://www.imsglobal.org/profiles/lipbest01.html, consulted on Dec. 2010.

[11] N. Ragouzis, J. Hughes, R. Philpott, E. Maler, P. Madsen, and T. Scavo, "Security Assertion Markup Language (SAML) V2.0 Technical Overview," OASIS Committee Draft, March 2008, doi:sstc-saml-tech-overview-2.0-cd-02.

[12] T. Ramandalahy, P. Vidal, and J. Broisin, "Opening Learner Profiles across Heterogeneous Applications," in IEEE International Conference on Advanced Learning Technologies (ICALT 2009), July 2009, pp. 504-508, doi:10.1109/ICALT.2009.153.

[13] Reusable eLearning Object Authoring & Delivery (Reload), 2008, available at http://www.reload.ac.uk/, consulted on Dec. 2010.

[14] Systems Management: Common Information Model (1998). Open Group Technical Standard C804, DMTF, ISBN: 1-85912-255-8, 1998.

[15] The OpenID Foundation, "OpenID Authentication 2.0 – Final," Dec 2007, available at http://openid.net/specs/openid-authentication-2_0.html, consulted on Dec. 2010.

[16] Web Based Enterprise Management (WBEM), 1999, available at http://www.dmtf.org/standards/wbem/, consulted on Dec. 2010.

 ISBN: 978-1-61208-120-5

Towards Validating a Toolkit of Bilingual Interprofessional Healthcare Education Assessment Tools: Data

Colla J. MacDonald, Douglas Archibald, David Trumpower, Betty Cragg, Wilma Jelley
University of Ottawa
Ottawa, Ontario, Canada
cjmacdon@uottawa.ca, darch080@uottawa.ca,
david.trumpower@uottawa.ca, bcragg@uottawa.ca,
wjelley@uottawa.ca

Lynn Casimiro
Montfort Hospital
Ottawa, Ontario, Canada
lynncasimiro@montfort.on.ca

***Abstract*— There is a need to create validated evaluation strategies for interprofessional education (IPE) in order to continue to improve IPE education, gather evidence of learning and transfer knowledge to the point of care. In this paper we present the findings from our data collection(to date) over an 18 month period in a variety of IPE courses and program (university and college credit courses in nursing, medicine, various healthcare courses, and continuing education courses for healthcare professionals in four countries). The two quantitative tools used in both English and French were validated and are reported in this paper.**

Keywords- interprofessional education; assessment; evaluation instruments

I. INTRODUCTION

The purpose of this project (funded by a Health Force Ontario Research Grant) was to design, develop, pilot, refine and validate a toolkit of qualitative and quantitative assessment tools to assess interprofessional education (IPE). The four qualitative and quantitative evaluation tools used in both English and French included an evaluation survey based on the W(e)Learn framework, a survey to access changes in attitudes and behaviour and a team and learner exemplar and companion contract [1]. The process of developing our tools has been published elsewhere [2]. Descriptions of the instruments can be found in Table 1.

TABLE I. TOOLKIT OF EVALUATION INSTRUMENT

Assessment Tool	Purpose
ICCAS – Interprofessional Collaborative Competencies Attainment Survey	This quantitative survey has been designed to document learner's perceptions of changes in their attitudes and behaviors with regard to IPC competencies as a result of IPE. Learners reflect back after completing the IPE experience and identify (in hindsight) where they perceive they were before and after the learning experience [2]
W(e)Learn Assessment	This quantitative instrument is designed to align with the W(e)Learn framework http://www.ennovativesolution.com/WeLearn/ Learners rate their experiences in an IPE program using the dimensions of IPE identified by the W(e)Learn framework (content, media, service, structure and outcomes) [2].
Learner Contract	This qualitative tool has been created to help individual learners develop the core competencies needed to collaborate effectively with other healthcare professionals. Specifically, the contract will: (a) document how learners plan to develop their knowledge, skills and activities associated with IPC; (b) assist learners in identifying and documenting learning outcomes associated with the learning activities. This tool will facilitate learner's planning, monitoring, and assessment of their IPE experience [2].
Learner Contract Exemplar	The Learner Contract exemplar provides ideas, appropriate language and suggestions for how to plan and implement strategies to facilitate and assess IPE activities. Facilitators may choose to share this tool with learners to guide them in their IPC planning or to use some or all of it to support their teaching [2].
Team Contract	This qualitative tool has been created to help teams work together effectively. Specifically, the contract will: (a) document how teams plan to develop knowledge, skills and activities associated with (IPC);(b) assist teams in identifying and documenting learning outcomes associated with the learning activities. This tool will facilitate team's in planning, monitoring, and assessing their IPE experience [2].
Team Contract Exemplar	The Team Contract exemplar provides ideas, appropriate language and suggestions for how to plan and implement strategies to facilitate and assess IPE activities. Facilitators may choose to share this tool with teams to guide them in their IPC planning or to use some or all of it to support their teaching [2].

This study is unique because (a) all instruments are aligned with a Canadian, nationally validated set of IPE core competencies and an IPE framework (W(e)Learn), (b) the post/post design of our quantitative ICCAS tool, we believe, will be sensitive to changes in IPE attitude and behaviour, and (c) the learner contract is a teaching/learning tool to help teams or individual learners plan their learning and becomes a qualitative self-reflection assessment tool after learning.

In this paper, we present the findings (to date) from our 18 month validating process in a variety of IPE courses and programs (university and college credit courses in nursing, medicine, various healthcare courses, and continuing

 ISBN: 978-1-61208-120-5

education courses for healthcare professionals in Canada, and New Zealand. Data collection and analysis will continue over the next six months. The two quantitative tools used in both English and French were validated and are reported in this paper. Data collection is still in process for the learner and team contracts.

II. METHODOLOGY

A letter of invitation was emailed to potential participants met at various IPE and healthcare conferences who expressed an interest in participating in the validation process. Letters were sent to various IPE educators in Canada, the United States, England and New Zealand between November 2009 and June 2010. A copy of the letter can be found in the Appendix. Through word of mouth and additional conference presentations, growing interest to participate in the study emerged. Response to the invitation to participate in the study was enthusiastic as many programs revealed that they need and want assessment instruments for their IPE projects.

The four instruments in both French and English were emailed to programs in October 2009 with a list of criteria that needed to be met in order to be involved in the study. The criteria included completion of a brief (approximately 10 minute) survey providing a course description and feedback on the instruments. Programs were requested to provide an MS Excel template for each assessment instrument completed by learners within the programs to assist with validation. Ethics approval was obtained and confidentiality of the participants was ensured.

For their participation in the project, programs were promised an electronic version of the four final instruments (in either French or English or both), with a synopsis of the psychometric properties. Programs also received a small stipend ($300.00 Canadian) to be used as needed (e.g., to pay a research assistant to input data).

Data started to emerge in February 2010. The project manager was in contact with the participating program coordinators via telephone and email. On several occasion the participating cites were visited by the project manager to discuss the instruments with instructors. Table 2 shows the participating programs to date.

Results of the validation process of the two quantitative instruments are reported in the next section of this paper. The validation process included calculating the internal consistency of the resulting scales on the planning and assessment tools with Cronbach's alphas [3]. Any scales with poor internal consistency (alphas < .7) were then subjected to item analysis. Item-total correlations were computed between individual item responses and respective total scale scores. Items with low item-total correlations were discarded from their respective scale. This process was then repeated in an iterative fashion until all scales displayed adequate internal consistency.

Construct validity of the tools was assessed with confirmatory factor analyses. Criterion related validity was assessed by comparing scores on the various subscales of the survey with other related measures. Divergent validity evidence was sought by computing correlations between scores on the quantitative tools and non-related demographic variables, such as education level.

TABLE 1: PARTICIPATING PROGRAMS TO DATE

IPE Program	N	Country
Jeux Interprofessionnels Francophones 2010, à la Cité Collégiale	29	Canada
IPE Program, Northern Ontario School of Medicine	15	Canada
IPE showcase, à la Cité Collégiale	58	Canada
Hybrid IPE course, Algonquin College	60	Canada
IPE project with Nursing and Library students, Algonquin College	74	Canada
Transdisciplinary Community Health Program – University of Ottawa	22	Canada
Rural Interprofessional Clinical Education Project – University of Ottawa	6	Canada
IPE program, Faculty of Health and Environmental Sciences, Auckland University of Technology	945	New Zealand
IPE project – Elisabeth Bruyere Research Institute and the University of Ottawa	25	Canada
Clinique universitaire interprofessionnelle de réadaptation Université d'Ottawa	7	Canada
en formation interprofessionalisme Hôpital Montfort	5	Canada

III. DATA ANALYSES

A. *Internal Consistency*

The internal consistency of resulting scales on the planning and assessment tools assessed with Cronbach's alphas. The reliability analysis showed that all items on the W(e)Learn instrument are very highly correlated. The reliability analysis also showed that all items on the ICCAS instrument are very highly correlated.

Items of the W(e)Learn were grouped under the constructs of structure, content, service, and outcomes. All items had Cronbach's alphas over .90 with the exception of the five items under the service construct which were approaching .90 (r=.88). Items of the ICCAS were grouped under the constructs of the competencies for IPC: communication; collaboration; roles and responsibilities; collaborative patient/family centred approach; conflict management/resolution; and team functioning. Cronbach's alphas for all items were above .90, ranging from r=.90 to r=.93

Item-total correlations were computed between individual item responses and respective total scale scores. Items with low item-total correlations were to be discarded from their respective scale. This process would be repeated in an iterative fashion until all scales display adequate internal consistency. However, it was determined that if any item were deleted on the W(e)Learn , the Cronbach's alphas of the remaining items would not increase. Likewise, if any

 ISBN: 978-1-61208-120-5

item were deleted on the ICCAS, the Cronbach's alphas of the remaining items would not increase. Thus, no items on the W(e)Learn and ICCAS were deleted.

B. Construct Validity

Construct validity of the tools was assessed with confirmatory factor analyses. It was expected that items would load strongly onto the factors in accordance with the model variables. Further, it was expected that items from the same subscale will load onto the same factors.

Confirmatory factor analyses were conducted for both the W(e)Learn and ICCAS assessment instruments. In fact, two factor analyses were conducted for the ICCAS; for the "before" items and then the "after" items. Items of the W(e)Learn instrument loaded onto three factors. As expected, the factor analyses for the ICCAS showed items for each sub-scale loading onto six factors with some overlap.

For the W(e)Learn, factors did not correspond perfectly with the 4 subscales. This was not entirely surprising, as the theoretical model upon which the W(e)Learn is based proposes that both Content and Structure are dependent upon various aspects of Structure. Results suggest a possible regrouping of some Structure items with Content (those related to collaborative pedagogical strategies), some Structure items with Service (those related to facilitation strategies). Items for the Outcomes subscale, as well as items for the Structure, Content, and Service subscales that relate to practical/authentic IPE content and resources loaded onto factor 1 (factor loadings > .50). Items for the Structure and Content subscales that relate to collaboration and teamwork loaded onto factor 2 (factor loadings > .50), whereas items for the Structure and Service subscales that relate to facilitation loaded onto factor 3 (factor loadings > .50).

Regarding the ICCAS, results suggest that, before IP training, individuals tend to focus more solely on their interactions with the patient/family in planning care, whereas following training, individuals better understand the interactions with other IP professions in effective team functioning.

For the "before" results of the ICCAS, items related to team functioning and collaborative patient/family-centred approaches loaded on factor 1 (factor loadings > .70); communication items loaded onto factor 2 (factor loadings > .56); conflict resolution/management items loaded onto factor 3 (factor loadings > .73); collaboration items loaded onto factor 4 (factor loadings > .73); and, roles and responsibilities items seemed to load onto factors 5 and 6(factor loadings > .65).

For the "after" results of the ICCAS, items related to collaborative patient/family-centred approaches loaded on factor 1 (factor loadings > .70); communication items loaded onto factor 2 (factor loadings > .53); conflict resolution/management items loaded onto factor 3 (factor loadings > .63) with team functioning items also showing relatively high factor loadings (.56 -.59); collaboration items loaded onto factor 4 (factor loadings > .60); roles and responsibilities items seemed to load onto factor 5 (factor loadings > .40); and some roles and responsibilities and communication items loading onto factor 6 (factor loadings > .40).

Correlations were computed between subscales of the ICCAS and a related instrument, the IEPS, using responses from after training.

C. Criterion Related Validity

Criterion related validity was assessed by comparing scores on the various subscales of the survey with other related measures. Factors 2 and 4 of the IEPS, measure understanding the need for interdisciplinary cooperation and understanding the value of other professions.

It may be hypothesized that individuals who score higher on the Communication, Collaboration, Roles and Responsibilities, Conflict Management, and Team Functioning subscales of the ICCAS would be more likely to see the value in and need for cooperation with team members from other professions. This hypothesis was partially supported, as Factor 2 of the IEPS was significantly positively correlated with all scales of the ICCAS. However, factor 4 of the IEPS did not correlate significantly with subscales of the ICCAS.

D. Divergent Validity

Divergent validity evidence was sought by computing correlations between scores on the quantitative tools and non-related demographic variables, such as education level. Correlations were computed between subscales of the ICCAS and a related instrument, the IEPS, using responses from after training.

Factors 1 and 3 of the IEPS measure perceptions of the competence and cooperation within one's profession but not one's own ability. It may therefore be hypothesized that individual's scores on the subscales of the ICCAS should not be related to the IEPS. This hypothesis was partially supported, as neither Factors 1 nor 3 of the IEPS was significantly positively correlated with any scales of the ICCAS.

IV. CONCLUSIONS AND FUTURE WORK

Validating instruments and processes will increase the likelihood that IPE experiences are planned and delivered effectively and increase justification and accountability for healthcare educational experiences and clinical practice.

In summary, assessment is an important, and often overlooked, element in designing an IPE initiative. These instruments are intended to make the assessment process easier and more effective. Although these instruments were designed with interprofessional healthcare teams in mind, we feel the validated instruments could readily be transferable to a variety of interdisciplinary tasks and settings such as social work and human services education. Next steps include collecting more data over the next year, conducting the validation analyses again, and making any refinements to the instruments if necessary.

REFERENCES

[1] C.J. MacDonald, E.J. Stodel, T-L. Thompson, and L. Casimiro, "W(e)Learn: A framework for interprofessional education,"

International Journal of Electronic Healthcare, vol. 5, issue 1, 2009, pp. 33-47.

[2] C.J. MacDonald, D. Archibald, D. Trumpower, E. Cragg, L. Casimiro, and W. Jelley, "Quality standards for interprofessional healthcare education: Designing a toolkit of bilingual assessment instruments," Journal of Research in Interprofessional Practice and Education, vol. 1, issue 3, 2010, pp. 1-13.

[3] L.J. Cronbach, "Coefficient alpha and the internal structure of tests," Psychometrika, vol. 16, issue 3, 1951, pp. 297–334.

APPENDIX

Dear (type name),

Thank you for agreeing to participate in the validation study of our interprofessional education (IPE) assessment instruments. Enclosed you will find the IPE instruments, as well as a brief survey about your IPE program(s), a copy of our ethics approval letter, and an Excel file to be used for entering your data. A brief description of each enclosure is included at the end of this letter.

Your participation in the validation study involves the following steps:

1) Begin using the IPE instruments in your IPE program(s) at any time. You may choose to use the instruments in one program or in multiple programs. As well, you may choose to use all of the instruments or just a subset of them.

2) Enter the data that you collect with the IPE instruments into the enclosed Excel template. If you are using the instruments in multiple, distinct programs, please save the data from each program in a separate Excel file, and name each file using a unique label (e.g., If you are using the instruments in 2 different courses, you might name the Excel files with the associated course code: EDU5191.xls and EDU7395.xls).

3) Complete the Program Description and Instrument Feedback Survey. If you are using the instruments in multiple, distinct programs, please complete a separate survey for each, and be sure to include the program labels that you used for naming the associated Excel files.

4) Return the Excel data file(s) and the completed Program Description and Instrument Feedback Survey(s) to:

When we receive your data, we will send you a $300.00 CDN stipend for your participation. If you use at least 3 of the IPE instruments (the ICCAS, W(e)Learn, and either the Team or Learner Contract) in your program we will send an additional $300 CDN stipend. In order to receive the stipend and be included in the initial validation report, your data must be received before September 1st, 2010. After analyzing the data, we will send you our initial report on the psychometric properties of the instruments as well as revised instruments for your use.

If you have any questions about the process or about the instruments, we encourage you to contact us at. Again, we sincerely thank you for your participation.

 ISBN: 978-1-61208-120-5