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Proceedings

Edited by:
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11th INTERNATIONAL CONFERENCE
ON
MOBILE LEARNING 2015

PROCEEDINGS OF THE
11th INTERNATIONAL CONFERENCE
ON
MOBILE LEARNING 2015

MADEIRA, PORTUGAL

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Edited by Inmaculada Arnedillo Sánchez and Pedro Isaías

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FOREWORD

These proceedings contain the papers and posters of the 11th International Conference on Mobile Learning 2015, which was organised by the International Association for Development of the Information Society, in Madeira, Portugal, March 14 – 16, 2015.

The Mobile Learning 2015 Conference seeks to provide a forum for the presentation and discussion of mobile learning research which illustrate developments in the field. In particular, but not exclusively, we aim to explore the theme of mobile learning under the following topics:

- Learning analytics and mobile learning
- Cloud computing and mobile learning
- Pedagogical approaches, models and theories for mLearning
- mLearning in and across formal and informal settings
- Strategies and challenges for integrating mLearning in broader educational scenarios
- User Studies in mLearning
- Learner mobility and transitions afforded by mlearning
- Socio-cultural context and implications of mLearning
- Mobile social media and user generated content
- Enabling mLearning technologies, applications and uses
- Evaluation and assessment of mLearning
- Research methods, ethics and implementation of mLearning
- Innovative mLearning approaches
- Tools, technologies and platforms for mLearning
- mlearning: where to next and how?

The Mobile Learning 2015 received 63 submissions from more than 23 countries. Each submission has been anonymously reviewed by an average of 4 independent reviewers, to ensure that accepted submissions were of a high standard. Consequently only 10 full papers were approved which means an acceptance rate of 16%. A few more papers were accepted as short papers, reflection papers, posters and doctoral consortium. An extended version of the best papers will be published in the International Journal of Mobile and Blended Learning (ISSN: 1941-8647).

Besides the presentation of full papers, short papers, reflection papers, posters and doctoral paper, the conference also features a keynote presentation from an internationally distinguished researcher. We would therefore like to express our gratitude Dr. Gitte Bang Stald, Associate Professor, IT University of Copenhagen, Denmark, for accepting our invitation as keynote speaker.

The conference also includes a panel entitled "Wearables and the “Anatomy” of Information: Biodata, Privacy, and Ethics " by Amber Hutchins and Jake McNeill.

A successful conference requires the effort of many individuals. We would like to thank the members of the Program Committee for their hard work in reviewing and selecting the papers that appear in this book. We are especially grateful to the authors who submitted their papers to this conference and to the presenters who provided the substance of the meeting. We wish to thank all members of our organizing committee.

Last but not least, we hope that everybody has enjoyed Madeira and their time with colleagues from all over the world, and we invite you all to next edition of the International Mobile Learning in 2016.

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Conference Program Chair

Pedro Isaías, Universidade Aberta (Portuguese Open University), Portugal
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Madeira, Portugal
March 2015

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KEYNOTE LECTURE

EVOLUTION OR REVOLUTION? DIFFUSION AND ADAPTATION OF (SMART) MOBILE PHONES AMONG CHILDREN AND ADOLESCENTS

By Dr. Gitte Bang Stald,
Associate Professor, IT University of Copenhagen, Denmark

Abstract

The emergence of new media and communication technologies and the subsequent potential and actual changes in social practices are often associated with revolutionary consequences. When advanced digital communication devices reach a certain level of diffusion within society they become very visible as obvious choices for information, communication, entertainment and management of everyday life. It is definitely important to expose and explain the qualitative transformative consequences of the diffusion and adaptation of in this case especially the smart mobile devices. It is, however, often less prominent to identify and explain the process of continuity, appropriation and normative adjustments of new technologies as they blend into the everyday routines and practices. I claim that there are good reasons to try and to discuss the simple correlation between diffusion and adaptation of new media and processes of change. The aim of this presentation is to provide such insights based on empirical data and to raise adequate questions for research and debate. Empirically I draw on results from the two European projects Net Children Go Mobile and EU Kids Online and from a five time repeated study of young Danes uses of mobile phones.

I present two main arguments: First, that European children's and adolescents' appropriation of smart mobile communication technologies predominantly take place in an evolutionary process which is rooted in continuity of adaptation processes, in everyday routines, and in patterns of social interaction rather than in a revolutionary transformation of communication strategies. Secondly, following the first argument, that we must understand the emergence and momentum of digital communication technologies in society in the context of media and communication history, culture, and social structures. Hence, the diffusion of (smart) mobile phones may have revolutionary consequences in some cultures, whereas it is obviously the result of a long process and continuity in others. The social consequences differ according to context.

PANEL

WEARABLES AND THE “ANATOMY” OF INFORMATION: BIODATA, PRIVACY, AND ETHICS

By Amber Hutchins and Jake McNeill
Kennesaw State University

Abstract

While educational institutions work to create secure online learning environments and address privacy issues within university owned and managed course management systems, students and educators are using a variety of mobile devices and third-party apps to access online courses, complete coursework, and store files. Mobile users often cite privacy and security as a top concern, but we often make decisions to adopt new technology based on cost, convenience, and functionality. Even when an app or device appears “safe,” an individual’s data might be vulnerable to privacy breaches, loss, and other misuse. By overlooking terms of service, we might inadvertently allow third-party government or corporate entities access to data that we assumed was private or anonymous. Further, as wearable devices and biometric devices become more prevalent, the concept of data has expanded, extending to physiological, biometric, and even genetic data.

This panel will address the following questions:

- How can educators help students navigate mobile privacy issues while encouraging students to embrace innovation?
- Which applications and devices offer the best privacy & security options?
- What rights to privacy can we reasonably expect?

The panelists will identify and review specific apps designed to enhance privacy, especially in public WiFi situations. We will also discuss the use of personal devices for secure communication, and how encryption services can serve as an effective security precaution for information stored locally or in decentralized, cloud-based storage. Privacy and ownership of physiological/ biometric and genetic data (“biodata”), collected by wearable technology devices including Google Glass and FitBit, will also be explored, including the private companies (23andme.com) and government agencies whose policies and procedures regarding biodata set precedants for others to follow.

Full Papers

SCAFFOLDING JAVA PROGRAMMING ON A MOBILE PHONE FOR NOVICE LEARNERS

Chao Mbogo, Edwin Blake and Hussein Suleman
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ABSTRACT

The ubiquity of mobile phones provides an opportunity to use them as a resource for construction of programs beyond the classroom. However, limitations of mobile phones impede their use as typical programming environments. This research proposes that programming environments on mobile phones should include scaffolding techniques specifically designed for mobile phones, and designed based on learners' needs. This paper discusses the effectiveness of theoretically-derived scaffolding techniques to construct Java programs on a mobile phone. The results indicate that even though scaffolding techniques could support learners to program on a mobile phone, further modifications of the designed scaffolding techniques may be necessary in order to more effectively support programming on a mobile phone.

KEYWORDS

Computer Programming, Scaffolding, Mobile, Evaluation.

1. INTRODUCTION

Computer programming is a difficult subject for most novice learners (Piteira & Costa 2012). In order to contribute towards tackling learning difficulties in the subject, learners can be supported to construct programs while they are outside the classroom. *Support* is emphasized because any such support should be additional to the learners' classroom learning and not a replacement. *Scaffolding* refers to support provided so that a novice learner can carry out a task, solve a problem or achieve a goal that would otherwise be beyond the learner's unassisted efforts (Wood et al. 1976).

Most learners at institutions in Africa are in resource-constrained environments where they have limited access to PCs and laptops while they are outside the classroom. The ubiquity of mobile devices provides an opportunity to use them as a resource for construction of programs beyond the classroom. A study in a developing country shows that mobile phones are the most available technological tools among learners (Kafyulilo 2012). Therefore, the mobile phone was selected as the resource that can be used for construction of programs outside the classroom. However, limitations of mobile phones, such as small screen size and small keypads, impede their use as typical programming environments.

In addition to addressing limitations of mobile phones, the challenges faced by learners of programming should be considered in order to maximize the potential of meeting learners' needs. Consequently, this research proposes that programming environments on mobile phones should include scaffolding techniques that are specifically designed for mobile phones and designed based on learners' needs.

In order to provide scaffolding techniques in a mobile programming environment, an Android application was designed based on a theoretical scaffolding framework, challenges faced by learners of programming, and limitations of mobile phones (Mbogo et al. 2014). The application supports construction of Java programs. In this paper, this application will be referred to as ScafFold. ScafFold provides 5 types of scaffolding techniques: (i) representation of a program in parts; (ii) restricting a learner to complete a program in a certain order; (iii) enabling construction of programs one part at a time; (iv) error correction; and (v) supportive scaffolding such as steps to guide the learner on how to interact with the application, provision of default code, and examples and hints related to the different program chunks.

Figure 1-left shows representation of a Java program in parts that indicates the structure of a program before a learner interacts with the different parts. At this screen a full program tab is also provided, which can be selected in order to view the full program at any time. The figure also shows the main class as the only

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one currently active; the learner has to successfully complete this before the next part is activated. An illustration of completion of a program one part at a time is shown in Figure 1-centre where only the main class is being constructed. The full program can also be viewed at this editor. Figure 1-right shows an error prompt if a void method is completed with a return statement. An example of supportive scaffolding is illustrated with the step instruction 'Tap on main class' at Figure 1-left. To compile the program, the learner presses the green run button at the top of Figure 1-left and the full program is sent to the ideone[1] online compiler and debugging tool. The results and output are sent back to the mobile interface.

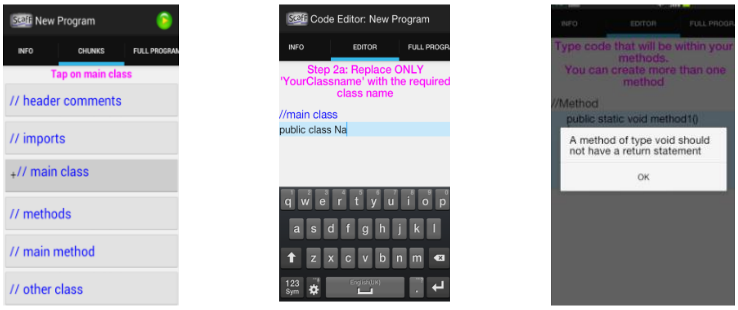

Figure 1. Interfaces of ScafFold showing examples of scaffolding techniques

To evaluate effectiveness of the scaffolding techniques, an empirical evaluation was conducted where some learners attempted Java programming tasks using ScafFold (the experimental group), and other learners attempted similar programming tasks using a mobile programming environment that did not offer any scaffolding (the control group). Java was selected as the language for construction of programs because it was the common language taught across the universities that participated in the study. ScafFold is not yet available for public download since it is still an experimental prototype. The data from the two groups of learners were analyzed to measure: (i) the number of tasks completed; (ii) the amount of time spent on the tasks; and (iii) the errors from the tasks. In addition, learners' reflections were collected on the usefulness of the scaffolding techniques that they had interacted with to complete programs on the mobile phone. The contribution of this study is threefold: (i) to demonstrate the effectiveness of scaffolding techniques to support programming on a mobile phone; (ii) to highlight further modifications on the already designed scaffolding techniques; and (iii) to share learners' reflections on the usefulness of the scaffolding techniques.

2. RELATED WORK

Test My Code (TMC) (Vihavainen et al. 2013) is a PC programming environment that enables learners to submit code created on IDEs to a remote server, from which instructors can perform manual code reviews. TMC offers scaffolding in the form of exercises with code snippets to be completed by the learner, and feedback that is displayed on the IDE once an instructor reviews the code. Similarly, PETCHA (Queirós & Leal 2012) a teacher-learner learning management system, works with Eclipse to scaffold a learner's programming process by automatically creating a project on the IDE and performing code validation.

Indeed, significant work has been done on scaffolding learners while they use PCs to program, starting from earlier work by Gudzial (Guzdial et al. 1998). Yet, little work has been done to extend the implementation of scaffolding in order to support construction of programs on mobile phones. However, there are several mobile IDEs for Java programming available on the Google Play store, such as Sand IDE. However, the interfaces of these IDEs mostly mimic PC-based IDEs and do not offer scaffolds that would support a novice learner or address the limitations of mobile phones. Recent work by Microsoft (Tillmann et al. 2011) enables development of mobile apps using a new language - TouchDevelop - on the TouchDevelop programming environment where much of the code is created by tapping through menus. TouchDevelop also offers a guide to a user using an interactive tutorial that fades at some point. Even though TouchDevelop employs some scaffolding, it is a specialized language that was designed for a visual programming environment. Therefore, the techniques cannot be applied trivially to Object Oriented languages such as Java. In contrast, the aim of this research is to support construction of programs that are typically taught in an introductory course taught using Java, as opposed to creating mobile apps such as in TouchDevelop.

[1] http://ideone.com/

3. STUDY METHODOLOGY

In order to evaluate the effectiveness of scaffolding techniques, experiments were conducted with a total of 70 learners of programming from 3 universities in South Africa and Kenya: 27 learners at University of Western Cape (UWC); 14 learners at Kenya Methodist University (KeMU); and 29 learners at Jomo Kenyatta University of Agriculture and Technology (JKUAT). Despite the geographical and background differences between South Africa and Kenya, all learners were taking an introductory course in programming using Java. The teachers were asked for a set of 5 Java exercises relating to introductory topics that they had already taught in the course. At the time of the evaluation, all 3 groups had covered the topics of Java syntax, input-output, loops, methods, and classes.

Programming tasks for UWC group

1. Write a program that calculates the total cost of an item that is R159.72 and incurs a VAT of 14%.
2. Write a program that uses a for-loop to calculate the sum of the numbers from 1 to 50 and displays the sum and average.
3. Write a program that uses a method name() to print out your name.
4. Write a program that uses the Scanner input to ask for the user's name and age, and prints "Hello" + name " your age is" + age;
5. Write a program that uses a method input() to ask for height and width of a rectangle, and calculates and displays the area using height x width.

Programming tasks for KeMU group

1. Write a program that initializes x to 10 and prints out its double value.
2. Use the appropriate control structure to print the first 10 natural numbers.
3. Write a program that accepts two numbers as input and calculates the average.
4. Overload a method to print one and two integer values. Call these methods from the main method to output the integers 34, and 12 and 23, respectively.
5. Write a program that creates a class that contains the constructor below
   Item (int id, String title) { }.

Programming tasks for JKUAT group

1. Write a program that outputs "Scaffolding at JKUAT."
2. Write a program that computes the sum and average of the numbers 1-20.
3. Write a program that captures and displays the age of two students.
4. Write a program that uses a method to capture two integers and outputs their sum.
5. Write a program that initializes default values of name and age of a person in a constructor and outputs these in a main class.

The learners were issued with Android phones. All the phones used during the experiments were touchscreen smartphones with popup keyboards. A majority of the phones were Samsung Galaxy Pockets (S5300) and a few others were Samsung SIIs. The learners were randomly split into control groups and experimental groups and were then guided on how to download the respective application; the applications had been stored on Google drive. The learners were issued with printed copies of the exercises. Table 1 shows the distribution of the number of learners in the control and experimental groups in the three participating institutions. At JKUAT, the number of learners in the control group was higher than that in the experimental group because 2 learners used the download link for the non-scaffolded application.

Google Analytics was used to collect logs of the learners' interaction with the applications. At the end of the experiment the learners filled an online questionnaire. The questionnaire was designed using LimeSurvey and consisted of two parts: (i) Demography; this section was filled by all 70 learners; and (ii) reflections and perceptions on scaffolding techniques; this section was filled by the 37 learners in the experimental group.

Table 1. Distribution of learners across control and experimental groups.

Institution	Control	Experimental
UWC	13	14
KeMU	7	7
JKUAT	16	13

4. EVALUATION CRITERIA

Evaluation was done while learners interacted with the scaffolding techniques to construct programs on a mobile phone. Therefore, data was collected from learners' interaction with the application. In fact, evaluation models such as the CIAO model (Jones et al. 1999) have outlined that while evaluating educational technology one should consider data about learners' interaction with the software. This points to measuring performance because performance is all about what the user actually does in interacting with the product (Albert & Tullis 2008) and consists of five types of metrics: task success; time-on-task; errors; efficiency; and learnability. In this paper, task success, time-on-task, and errors will be discussed. Learnability and efficiency will be discussed in future work. In addition, qualitative feedback was obtained from learners on their reflections on the scaffolding techniques.

4.1Task Success

Task success measured if learners were able to complete a task. A *complete* task is a programming task that met three criteria: (i) a program that had at least the main class, the header, and the main method completed; (ii) a program that successfully compiled after completion of at least the parts in (i); and (iii) a program that produced the required output. To evaluate overall task success, measurement was done of: (i) number of attempted tasks; (ii) number of incomplete tasks; and (iii) number of completed tasks.

4.2 Time-on-task

Time-on-task is the time elapsed between the start of a task and end of a task. Time-on-task was measured between the start and end of a program for both complete and incomplete programs. For complete tasks, the end time refers to the first time the program was successfully compiled and produced the desired output.

4.3 Errors

Errors were evaluated by measuring: (i) the number of errors encountered after compiling and running the programs; and (ii) errors that triggered scaffolding techniques that offered support for error correction, for the experimental group.

4.4 Qualitative Feedback

Self-reported data was collected by learners reflectively indicating which scaffolding techniques they felt supported the construction of programs on the mobile phone. These subjective measures gave an indication of which scaffolding techniques learners felt could be useful.

5. RESULTS AND DISCUSSION

In KeMU and JKUAT, learners took part in 2-hour experiment sessions. At UWC, learners took part in a 1-hour experiment session. The difference in time was dependent on how long the groups of learners were available. Due to a technical challenge, the logs from the KeMU session were not obtained. However, the number of tasks that were completed was manually logged during the session, and the learners completed the online questionnaire at the end of the session. For this reason, KeMU's data was analyzed to measure only task success and subjective feedback.

5.1 Task Success

At KeMU, all the 7 learners in both experimental and control groups attempted the first and second tasks, with more learners in the experimental group completing these tasks (Table 2); a total of 71% in the experimental group compared to 21% in the control group. This indicates that the scaffolded environment enabled the learners to attempt more tasks than in the un-scaffolded environment. The learners at KeMU were not able to attempt the last two tasks and they indicated that they also struggled with topics of methods, classes and constructors in the classroom, considering that for most of them this was the first time they were learning programming using Java. This indicates that even though scaffolding could be useful in programming on a mobile environment, the learner has to be able to link what they learn in the classroom with the programs they need to write in a mobile programming environment.

Table 2. Number of learners who attempted (A) and completed (C) each task in control and experimental groups.

	KeMU				**UWC**				**JKUAT**			
	Control		**Experimental**		**Control**		**Experimental**		**Control**		**Experimental**	
	A	**C**	**A**	**C**	**A**	**C**	**A**	**C**	**A**	**C**	**A**	**C**
Program 1	7	3	7	6	12	7	14	12	11	9	13	9
Program 2	7	1	7	4	6	2	10	6	14	11	10	5
Program 3	2	1	4	1	1	0	6	2	12	2	5	1
Program 4	0	0	0	0	1	0	2	0	2	1	2	1
Program 5	0	0	0	0	0	0	0	0	1	0	1	0

At UWC, 12 learners in the control group attempted the first programming task, with 7 of them successfully completing it. The 14 learners in the experiment group attempted the first programming task with 12 learners completing it. In addition, more learners in the experimental group were able to attempt tasks than those in the control group. This indicates that the scaffolded environment offered the support the learners needed to attempt more programming tasks. No learner was able to attempt the last program, perhaps due to the time constraint of the experiment session being conducted in just 1 hour.

Table 2 indicates that more learners in the control group were able to complete the second task at JKUAT. Further, more learners in the control group were able to attempt the third task. However, it was observed that the learners in the control group accessed previously attempted programs that were stored on the mobile phone, and reloaded them to the interface in order to edit them, as opposed to constructing them from scratch. This could be attributed to how the learners construct programs on a PC by copying old programs to the programming environment and editing to suit a new program. Learners reloading and editing previously completed programs could have contributed to them attempting more tasks than the experimental group, where the interface was more restrictive.

5.2 Time-on-task

Table 3 shows the average time taken on each program at UWC and JKUAT, in minutes and seconds, for attempted and completed tasks. Learners in the experimental group at UWC took longer to complete the first program than those in the control group, perhaps due to familiarizing themselves with the application. However, the learners in the experimental group took a shorter time in the subsequent programs. This indicates two things: (i) after the initial familiarization with a scaffolded environment, the time taken by learners to complete a program reduces in subsequent programs; and (ii) learners using scaffolded environment complete programs quicker than learners using a non-scaffolded environment.

Table 3. Average time on each task for attempted (A) and completed (C) tasks in control and experimental groups.

	UWC				**JKUAT**			
	Control		**Experimental**		**Control**		**Experimental**	
	A	**C**	**A**	**C**	**A**	**C**	**A**	**C**
Program 1	22:54	20:19	14:12	25:42	21:21	15:15	29:52	14:10
Program 2	19:19	20:33	10:47	15:30	43:11	29:10	56:03	35:12
Program 3	5:20	-	6:35	14:47	49:51	19:30	16:13	39:05
Program 4	1:18	-	7:07	-	28:01	16:00	4:13	19:42
Program 5	-	-	-	-	6:39	-	47:38	-

At JKUAT, learners in the experimental group took longer on tasks than in the control group for the first two tasks. This also explains why there were more attempts at tasks in the control group at JKUAT, as previously indicated in Table 2. Further analysis shows that learners in the experimental group went back and forth between the chunks, therefore spending more time on the program. For example, Figure 3-left shows a program in which a learner went back to the created 'main class' a total of 5 times (in bold), did a test of the program once (in italics), before finally starting on creating the header. In Figure 3-right, the learner attempted to create the main class three times (in bold), including encountering two errors (in italics), before finally succeeding (at 'Main Class Button Post'). In both cases the learners did not view the full program while going back and forth in the chunk. This indicates that learners may need to be more effectively supported to view the current full program while they are moving between the chunks.

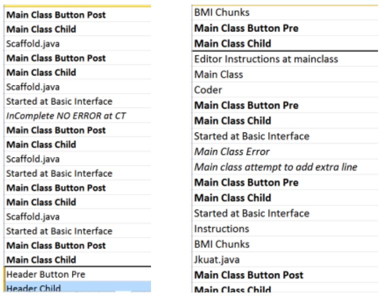

Figure 3. Demonstration of learners going back and forth on the same chunk of a program (in bold).

5.3 Errors

Table 4 shows the number of learners who encountered multiple compile/run (C/R) errors and errors that were captured as a scaffolding technique (Scaffolded errors) for each attempted task, for both groups at UWC and JKUAT. At UWC, a higher number of learners in the control group than in the experimental group encountered multiple compile/run errors. At JKUAT, 12 learners in the experimental group encountered errors that generated an error prompt as a scaffolding technique in the first programming task, and then 10 learners had no compile/run errors in the same task. This indicates that if errors are captured earlier in the program creation as a scaffolding technique, the learners are likely to encounter fewer errors during compiling and running the program.

Table 4. Number of learners who encountered multiple compile/run(C/R) errors and scaffolded errors in attempted tasks in control and experimental groups.

	UWC			**JKUAT**		
	Multiple C/R errors		**Scaffolded errors**	**Multiple C/R errors**		**Scaffolded errors**
	Experimental	**Control**	**Experimental**	**Experimental**	**Control**	**Experimental**
Program 1	0	4	2	3	7	12
Program 2	3	4	0	5	10	6
Program 3	2	2	0	3	11	2
Program 4	1	2	0	0	2	0
Program 5	-	-	-	1	1	0

In addition, it was observed that learners in the control group had syntactical errors that could be reduced by scaffolding techniques found in ScafFold. For example, Figure 4 shows a program of a learner in the control group in which the keywords 'String' and 'System' were written with a lower case 's' (in bold). In ScafFold, a scaffolding technique that provides such default statements as 'System.out.println()' that a learner can reuse, reduces the occurrence of such syntax errors. Lastly, it was noted that none of the programs written by learners in the control group contained header comments (as can be seen from Figure 4); this, as opposed to ScafFold which guides the learner to create header comments.

```
import java.util.Scanner; import java.util NoSuchElementExeption; class
Compute{ public static void main(string[]args){ int num = 1, sum = 0, avg; for
(num = 1;num< 21; num ++) { sum+= num; } avg=sum/20;
system.out.println("The sum is "+ sum); system.out.println("The average is"+
avg); } }23/07/2014 16:43:18:621
```

Figure 4. A program showing syntactical errors ('s' in bold).

5.4 Qualitative Feedback

Excerpts of some of the learners from the experimental group are cited verbatim, on their reflections on the use of scaffolding.

'I really enjoyed the program. It is structured, there's a tab for methods, a tab for main, a tab for classes. And it allows you to go through them by order. It highlights where you made a mistake and allows you to go back and fix errors.'

'The application divides the program or code into sections then one can the track and write the code properly by following the sections.'

'Preset statement helped in typing. The sections are well laid out. The hints helped in where to type. The error handling is accurate in pinpointing errors.'

Learners indicated that the following scaffolding techniques could further support programming on a mobile phone:

'I didn't see the part that creates a "constructor as simple as creating the main method…., the double clicks makes one lose patience....at this i can only recommend it to a friend if they are writing a very short program.'

'Would be great if there were a few imports (packages) that are commonly used that are in the preset menu.'

6. CONCLUSION

This paper has reported on results of an evaluation with 70 learners of a programming course taught using Java, in 3 universities. To attempt programming tasks using Java, some learners used a scaffolded mobile programming environment, while others used a non-scaffolded mobile programming environment. The data from these experiments were analyzed for each group to measure the number of tasks attempted and completed, time-on-task, and the errors encountered.

The results indicate that specifically designed scaffolding techniques for mobile phones can enable learners to construct programs on a mobile phone and meet learners' needs. For example, learners were able to interact with the restricted interface and created complete programs, once chunk at a time. In addition, the results show that learners using a scaffolded environment can be supported to avoid errors that would otherwise be encountered in a non-scaffolded environment. Further, learners indicated that they found the scaffolding techniques useful in supporting construction of programs on a mobile phone. Specifically, learners indicated that scaffolding techniques such as: restricting the order of program completion; guiding the learner to complete a program; enabling construction of programs one part at a time; provision of default code; and provision of examples and hints, as most useful to support construction of programs on a mobile phone.

However, the results indicate that even though creation of the program one part at a time, as a scaffolding technique, could support learners of programming to construct programs on a mobile phone, learners may need to be more effectively supported to view the full program at all times while working on the different chunks. Also, the results show that scaffolding techniques may not be useful if learners cannot link programming knowledge from the classroom to the program they are attempting in a mobile environment.

Although the findings are encouraging and useful, the study in this paper has certain limitations. Firstly, the study did not evaluate if learners who used ScafFold eventually performed better in programming than those who used the non-scaffolded environment. Secondly, a future experiment needs to ensure that learners in the control group write programs from scratch (instead of reloading previously completed programs) in order to ensure an equal baseline with the experimental group. Third, further work will conduct a finegrained analysis of the specific errors encountered in both the scaffolded and non-scaffolded environment. In addition, further work will conduct analysis on learnability and efficiency. Fourth, learners in the control group will be asked on their reflections on the use of a mobile phone to construct programs. Lastly, additional experiments will be conducted in order to increase the confidence of the conclusions and to capture feedback from learners in the control group on perceptions of writing programs on a mobile phone.

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IMPLEMENTATION OF AN INTELLIGENT TUTORIAL SYSTEM FOR SOCIOENVIRONMENTAL MANAGEMENT PROJECTS

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ABSTRACT

The agents responsible of execution of physical infrastructure projects of the Government of Antioquia must know the theories and concepts related to the socio-environmental management of physical infrastructure projects. In the absence of tools and the little information on the subject, it is necessary to build a m-learning tool to facilitate to public functionaries, contractors and communities assimilate the knowledge and contribute to generate the minimum environmental impacts on the environment. The objective of this paper is to present MGSAI Tutorial System, designed to support the learning process and appropriation of knowledge to public functionaries, contractors and communities. This work is divided in three parts; in the first, it presents the results of the review of the state of the art; in the second, the methodology used in the construction of the intelligent tutorial system (ITS), in the third part explains MGSAI tutorial Expert System as a case of application.

KEYWORDS

M-Learning, infrastructure projects, socioenvironmental management, intelligent tutoring systems.

1. INTRODUCTION

Intelligent Tutorial Systems (ITS), as a branch of applied artificial intelligence (AI), are applications for computers whose main objective is to simulate the process of teaching of a human-tutor, both in the domain of a specific theme as in the aspects related to pedagogy and communication with the user. ITSs are designed to guide the learning process for a user in an area of knowledge at any time and place, without the need to interact directly with an expert.

The Government of Antioquia executes many physical infrastructure projects that require the domain and knowledge of concepts and theories on which the activities are founded. Considering the large number of concepts and theories related to the socio-environmental management of infrastructure projects that public functionaries, contractors and communities need to know MGSAI Tutorial System is built.

MGSAI Tutorial System is one of the results of the research project "Socioenvironmental Management Manual of Infrastructure Projects" (MGSAI), which stems from the idea that the physical infrastructure projects contribute to the development of the regions. Due to the importance of this class of projects, it raises the need to build an application for mobile devices such as mobile phones, PDAs, tablets, PocketPC, Ipod and other handheld devices that have some form of wireless connectivity, which facilitates the process of teaching and learning to the agents involved in the development of physical infrastructure projects.

MGSAI Tutorial System was designed to facilitate the teaching and learning process in four main themes: management, licenses, studies and socio-environmental impacts. In each thematic presents the theories and concepts, accompanied by activities and interactive resources that facilitate the learning, understanding and memorization of the user, giving you the option to access the application at any time and place.

This work is divided in three parts; in the first, we present the results of the review of the state of the art; in the second, the methodology used in the construction of the intelligent tutorial system (ITS), in the third part explains MGSAI tutorial Expert System as a case of application.

2. INTELLIGENT TUTORING SYSTEMS

Intelligent Tutoring Systems were first used in the 70s as a way to provide greater flexibility to the learning strategy and to achieve better interaction with the user (Aguilar et al. 2011). The aim of ITS is to capture the knowledge of experts to create dynamic interactions with the users, allowing them to make decisions, even those that may not have been anticipated by the experts (Aguilar et al. 2011).

Intelligent Tutoring Systems are computer-based instructional systems with models of instructional content that specify what to teach, and teaching strategies that specify how to teach (Murray 2003). They make inferences about a student's mastery of topics or tasks in order to dynamically adapt the content or style of instruction. Content models give ITSs depth so that students can "learn by doing" in realistic and meaningful contexts. Models allow for content to be generated in real time. ITSs allow "mixed-initiative" tutorial interactions, where students can ask questions and have more control over their learning. Instructional models allow the computer tutor to more closely approach the benefits of individualized instruction by a competent pedagogue (Murray 2003).

The main advantage of ITS versus traditional tutoring systems is that they are more flexible in both their approach to the learning domain as well as in their adaptation to the student. In traditional systems, which contain a large amount of rules, and therefore of information, the student can find herself lost and improperly guided by the tutorial (Aguilar et al. 2011).

The design of Intelligent Tutorial Systems is founded on two fundamental assumptions about learning (Ferreira & Atkinson 2009). First, individualized instruction by a competent tutor is far superior to the classroom style because both the content and the style of the instruction can be continuously adapted to best meet the needs of the situation. Secondly, students learn better in situations which more closely approximate the situations in which they will use their knowledge, i.e. they learn by doing, by making mistakes, and by constructing knowledge in a very individualized way (Ferreira & Atkinson 2009). The design of an ITS can focus on various issues, including the tutoring decisions which take place in the tutoring module and the facts and rules represented in the expert module (Ramesh & Rao 2012).

In brief, Intelligent Tutoring Systems for mobile devices have the potential to introduce advancements in the area of learning and education. The essential concept of mobile learning is to have m-Iearning facility anywhere and anytime (Kalhoro et al. 2010).

2.1 M-Learning Applications for Socio environmental Management Projects: Related Works

The basis of this section is present the search method of literature reviews, conference proceedings, state of the art, articles and journals. The section offers a survey of socio-environmental mobile learning projects based on a systematic review of publications from: MLearn 2012, 2013, 2014.

We also reviewed the papers from the following journals: *Journal of Computer Assisted Learning* (JCAL), *Computers and Education*, *Journal of the learning science*, *International Journal of Mobile Learning and Organisation*, *International*, *Journal of Computer-Supported*, *Collaborative Learning* and the *International Journal of Learning Technology*.

We started with the review of journal articles in the year 2009. We scanned 110 papers of MLearn conferences and 15 papers of journals. The search included the key words: m-learning, mobile learning, infrastructure, projects, socioenvironmental management. In sum, we scanned 125 papers. The equations of search used were:

(1) **(TITLE-ABS-KEY** (m-learning) **OR** (mobile learning) **AND** (((projects) **OR** (infrastructure)) **OR** (((management) **OR** ((social) **OR** (environmental))))

(2) **(TITLE-ABS-KEY** (m-learning) **AND** (mobile learning) **AND** (((projects) **AND** (infrastructure)) **AND** (((management) **AND** ((social) **AND** (environmental))))

(3) **(TITLE-ABS-KEY** (mobile learning) **AND** (((projects) **AND** (infrastructure)) **OR** (((management) **AND** ((social) **OR** (environmental))))

(4) **(TITLE-ABS-KEY** (m-learning) **AND** (((projects) **AND** (infrastructure)) **AND** (((management) **AND** ((social) **OR** (environmental))))

(5) **(TITLE-ABS-KEY (**mobile learning**)** **OR** **((** **(**projects**)** **OR** **(**infraestructure**)** **) OR** **(((**management**)** **OR ((**social**)** **AND (**environmental**))))**

The any related publication found in the review was developed by Attwell (2010). This developed an application to contribute to a socio-cultural ecology for learning, and the interplay of agency, cultural practices, and structures within mobile work-based learning. In sum, we can say that the development of this work is addressing an issue that has not been treated with m-learning.

2.2 Relationship of MGSAI Tutorial System with M-Learning

MGSAI Tutorial System is a learning tool for socio-environmental management of physical infrastructure projects. It is based on the methodology of teaching and learning with the use of mobile devices that have some form of wireless connectivity Mobile learning is defined as learning across multiple contexts, through social and content interactions, using personal electronic devices (Crompton, 2013).

The mobile learning developed in this work is a form of e-learning distance education, where public functionaries, contractors and communities can use mobile device educational technology in many locations at their time convenience for to learn the large number of concepts and theories related to the socio-environmental management of infrastructure projects. In brief, m-Learning applications for mobile devices have the potential to introduce advancements in the area of learning and education in socienvironmental management projects. The essential concept of mobile learning is to have m-Learning facility anywhere and anytime (Kalhoro et al. 2010).

The three standard factors for mobile learners are: the learner (subject), the learning goal (objective) and the tools that are used to mediate the learning goals to the learner (Frohberg, Göth, & Schwabe, 2009). Figure 1 presents the task model for mobile learners.

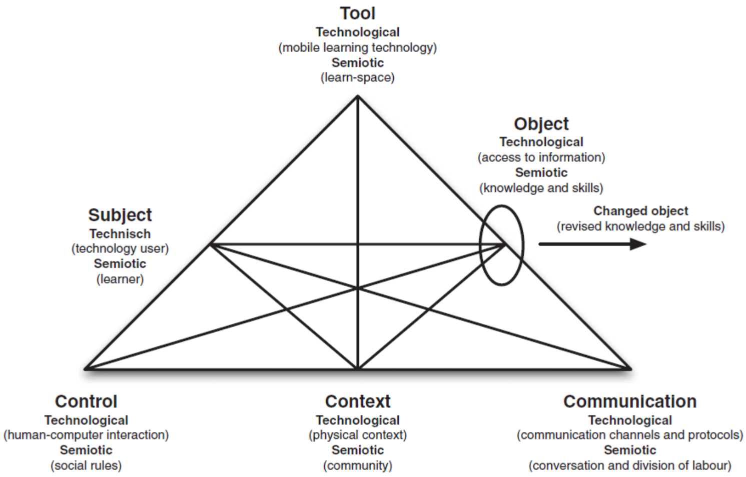

Figure 1. Task model. Source: Taylor et al. 2006; Sharples et al. 2007b

Taylor, Sharples, & Malley (2009), defined the others components of the task model for mobile learners:

- **Control:** The putting learners in control of their learning is one of the much vaunted benefits of technology enhanced learning. To a certain extent this is a technological benefit which derives from the way in which learning is delivered – if the learners can access materials as and when convenient, they can work through the materials at their own speed, revising and re-checking as they wish (Taylor et al., 2009)

- **Context:** The context in which learning takes place is clearly a significant factor, but the term has many connotations for different theorists. In the Task Model, we aim to pin down two important aspects of context – the physically embodied technological context, and the human, semiotic context within which learning takes place (Taylor et al., 2009).
- **Communication:** The dialectical relationship between the technological and semiotic worlds is perhaps the easiest to see in the Communication node, if the system enables certain forms of communication, learners can adapt their communication behaviour accordingly, and sometimes find ways to subvert the technology (Taylor et al., 2009).

3. METHODOLOGY

For the construction of MGSAI Tutorial System was conducted a systematic literature review. A systematic literature review (SLR) is a means of identifying, evaluating and interpreting all available research relevant to a particular research question, or topic area, or phenomenon of interest. Individual studies contributing to a systematic review are called primary studies; a systematic review is a form a secondary study (Kitchenham 2004). In other words, is a defined and methodical way of identifying, assessing, and analysing published primary studies in order to investigate a specific research question (Staples & Niazi 2007).

Kitchenham (2004) describes the three main phases of a systematic review process: planning the review, conducting the review, and reporting the review. Each of these phases contains a sequence of stages, but the execution of the overall process involves iteration, feedback, and refinement of the defined process (Staples & Niazi 2007):

- ***Planning the review:*** The output from this phase is a systematic review protocol that defines the purpose and procedures for the review.
- ***Conducting the review:*** This phase ultimately generates final results, but also generates the following intermediate artifacts: the initial search record and archive, the list of selected publications, records of quality assessments.
- ***Reporting the review:*** Reporting the review is a single stage phase. Usually, systematic reviews are reported using two formats: in a technical report and in a journal or conference papers.

The main advantages and disadvantages of a Systematic Literature Review are: SLR requires considerably more effort than traditional reviews. Their major advantage is that they provide information about the effects of some phenomenon across a wide range of settings and empirical methods. If studies give consistent results, systematic reviews provide evidence that the phenomenon is robust and transferable. If the studies give inconsistent results, sources of variation can be studied (Kitchenham 2004). A second advantage, in the case of quantitative studies, is that it is possible to combine data using meta-analytic techniques. This increases the likelihood of detecting real effects that individual smaller studies are unable to detect. However, increased power can also be a disadvantage, since it is possible to detect small biases as well as true effects (Kitchenham 2004).

For the construction of the tutorial system was conducted a systematic literature review on the scientific database Scopus on two main themes: intelligent tutorial systems and socio-environmental management of infrastructure projects. The search words used were: m-learning, infrastructure projects, socioenvironmental management. The equation of search used was:

(6) **(TITLE-ABS-KEY** (m-learning) OR (mobile learning) **AND** (((projects) **AND** (infrastructure)) **OR** (((management) **AND** ((social) **OR** (environmental))))

The range of dates of publication considered in the review of the state of the art was from 2008 until the present. In total four publications were collected between articles, conference articles, abstracts, book chapters and articles in press. In the review was collected 1 article and 3 Conference articles. The year 2014 was presented the largest amount of publications on the topic, with a total of 2. To perform the same analysis for the authors, *Madjarov, I.*, is who has the largest number of publications, with one in total and the journal with the largest number of publications is *Information Technology for Development.*

As a result of the search for grey literature was compiled books sections and manuals on socio-environmental management of infrastructure projects, published by the Roads National Institute (INVIAS), the Area Metropolitana del Valle de Aburrá and the Mayoralty of Medellín, which were used in the construction of MGSAI Tutorial System. In addition, a review was conducted of the environmental regulations in force for Colombia, identifying the most important issues to be considered in each thematic of tutorial system. Table 1 presents the main results of the search of normativity classified by type:

Table 1. Normativity. Source: Autor Development

Norma type	Total
1991 Political Constitution Articles	15
Laws	20
Decrees	29
Resolutions	26
CONPES	20
Environmet Guides	6
Court Constitucional Judgments	10
Total	126

Furthermore, there were reunions and interviews with functionaries of the Physical Infrastructure Secretary of Antioquia (SIF) between September 2013 and June 2014, with the objective of conceptualizing the most relevant aspects of the environmental management infrastructure projects. All the gathered information was used for the design and implementation of the intelligent tutorial system ITS ending with the testing. MGSAI Tutorial System is still in the phase of construction and development, by which is subject to future modifications and improvements.

MGSAI Tutorial System, presents the basic concepts of socio-environmental management of infrastructure projects in the form of question/answer. Then, presents activities and interactivity resources that seek to assess the level of understanding, assimilation and memorization of the user, such as fill in black, multiple-choice question, feedback, button sequence, quiz, timeline, matching pairs, animations, etc. The other thematic areas of the system are: licenses, studies and socio-environmental impacts. Finally, there are videos and other multimedia resources that present the main environmental problems that are presented in the world. For the construction of MGSAI Tutorial System were considered different points of view of specialist teachers in environmental management, identifying for each thematic axis the information that would be of interest to the user.

MGSAI Tutorial System is constructed using the XERTE software (Xerte 2014c). This software provides a full suite of open source tools for e-learning developers and content authors producing interactive learning materials (Xerte 2014a). XERTE is a fully-featured e-learning development environment for creating rich interactivity. XERTE is aimed at developers of interactive content who will create sophisticated content with some scripting. Among the various applications that can be performed with the software highlights the belonging to the field of medicine, the statistical and problem-based learning (PBL) (Xerte 2014b). The phases of the creation of MGSAI Tutorial System were acquisition and representation of knowledge.

The information used in the construction of MGSAI Tutorial System was obtained from specialized publications in scientific data bases and grey literature of socio-environmental management of infrastructure projects. In addition, interviews and meetings with functionaries of the Physical Infrastructure Secretary of Antioquia (SIF). The thematic axes of the systems are environmental management, licenses, studies and socio environmental impacts. Firstly, the user select the thematic axis; environmental management, licenses, studies or environmental impacts, which are mutually exclusive. Next, the system presents the concepts, theories and the activities that seek to assess the level of understanding, assimilation and memorization of the user. Finally, the system presents the option to return to the main menu or exit of the system.

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- **Verification**: built the structure of the model, it is proceeded to verify that each activity presented by the system were correct according to the information of the knowledge base. For this, tests were performed with interested people, facilitating the identification of conflicts and problems presented by the system for later correction.
- **Validation**: a preliminary validation of the tutorial system was conducted by teachers specialized in socio-environmental management of the National University of Colombia - Medellin. At this stage they were allowed to explore their operation and make suggestions for changes in the design of content and the interface.

3.1 MGSAI Tutorial System Validation

In order to validate the effectiveness of MGSAI Tutorial System, a comparative test will be conducted with 30 university students from different programs randomly assigned to two groups of the same size. The first group will use the tutorial system, while the second will receive a text document that contains the crucial topics on socio-environmental management projects. After that, each participant will answer a knowledge test about the subject under study. The results of the test will allow us to validate the effectiveness of MGSAI Tutorial System, and after that we will make some improvements to the tool.

4. APPLICATION CASE

Due to the great diversity of physical infrastructure projects that develops the Physical Infrastructure Secretary of Antioquia, was built MGSAI Tutorial System, whose main objective is to support the process of learning and assimilation of concepts and theories related to the socio-environmental management of projects. The thematic axes of the system are socio-environmental management, licenses, studies and socio environmental impacts. To begin, the user selects the theme you want to know: basic notions, licenses, studies or socio-environmental impacts. Next, the system presents a series of activities that seek to assess the level of understanding, assimilation and memorization of users, accompanying and feeding back to the user in real time. At the end of each thematic axis, the system presents the option of return to main menu or exit the system.

4.1 What are the Main Elements of the MGSAI Tutorial System?

Knowledge Base (BC): Gathers all the information about the basic concepts of socio-environmental management, licenses, studies and socio-environmental impacts. Figure 2 presents an example of the type of information present in each thematic axis:

Management	**Licenses**	**Studies**	**Impacts**
What is the socio-environmental management?	What are the environmental licenses?	What are the environmental studies?	What are the environmental impacts?
What is the object?	How can I apply for?	What are they used for?	What types are there?
What are the principles?	In what cases are required?	In what cases are required?	How can I apply for ?

Figure 2. Thematic Axis. Source: Autor

4.2 How Does it Work MGSAI Tutorial System?

To execute MGSAI Tutorial System, the user must enter to the next link: http://mgsai.net63.net It is necessary to have installed on your mobile device the 11.1 version of Adobe Flash Player. The user progresses with the buttons or navigation arrows available at the top of the system. Figure 3 presents the second interface of the system, which specifies the objectives, the audience and how to use it.

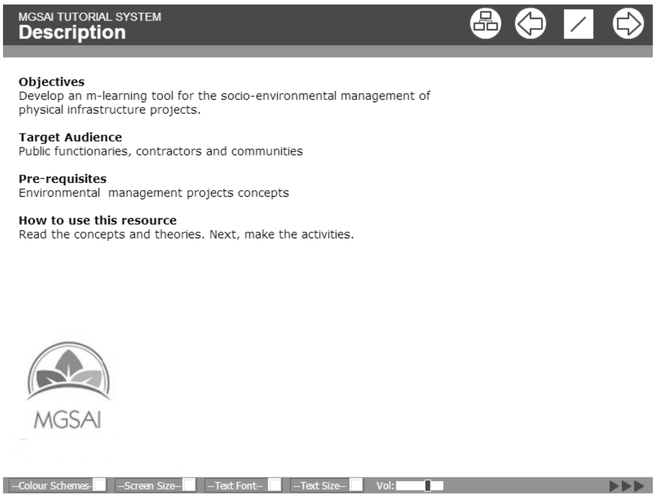

Figure 3. Second Interface. Source: Autor Development

Figure 4 presents the first activity of the environmental licenses thematic axis. Each thematic axis has five activities; multiple choice question, gap fill, quiz, timeline, button sequence.

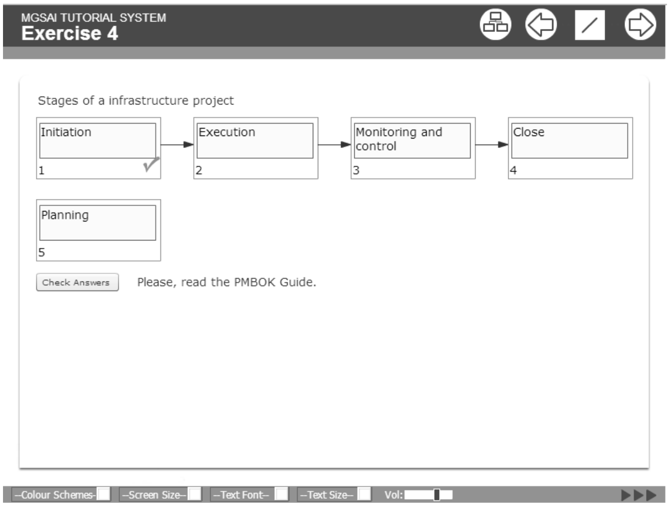

Figure 4. Activity 1. Source: Autor Development

5. CONCLUSIONS

The Intelligent Tutoring Systems applied to socio environmental management of infrastructure projects facilitate the learning process of concepts and theories to public functionaries, contractors and communities. The ITSs have the ability to provide individualized instructions or feedback to users without the intervention of human-tutor. The key feature of ITSs is the ability to adapt presentation of teaching materials to a particular student by using methods of artificial intelligence (AI) to make pedagogical decisions and to represent information about each user.

m-Learning is a different pedagogical approach and opens diverse dimensions of effective learning in the student to student, student to teacher and teacher to student scenarios. It allows flexible learning by being at a distant place but still being a part of the classroom activity.

The main expected benefits of MGSAI Tutorial System are the learner engagement, the collaborative learning and the easy access. The main limitations are the display and some connectivity problems.

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PATTERNS OF MOBILE TECHNOLOGY USE IN TEACHING: A PILOT STUDY

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ABSTRACT

The use of mobile learning spaces is an opportunity to break the boundaries of the classroom and to prepare student-teachers towards teaching classes tailored to the future teaching market, while providing the tools and inspiration to lead change in schools. The purpose of this precursor study is to examine the subject of implementing mobile technology and usage patterns in the mobile technology space among the students and lecturers in a teacher training college. Another objective is to set the potential of mobile technology for teaching on the challenges which this combination conveys. Accordingly, patterns of teaching and learning were examined in the mobile learning space, as well as the role of pedagogical support and guidance in relation to the methods used and the attitudes of the lecturers and students toward teaching and learning in the mobile learning space.

The paradigm of the present study is the mixed research model combining quantitative and qualitative research. The study included the faculty members teaching in the course of the year and the students studying in this learning space. The research tools included a questionnaire administered to teachers and students at the end of the two semesters, discussions with five of the lecturers and with the support staff as well as meetings with the leading faculty in the college. Simultaneously, three lessons in the mobile learning space were videotaped and then analyzed.

The findings show that most of the lecturers do not use hybrid computers in the learning space for various reasons: some need technological and / or pedagogical support, some believe that it is not relevant to their teaching; also the number of student users is low. As a result of this study, the findings obtained can highlight models for implementing mobile technologies in teacher education institutions and contribute to decision making in the acquisition and design of the technological learning space in the teacher education college.

KEYWORDS

Mobile technologies, hybrid computers, learning space, tablets

1. INTRODUCTION

As a result of the accelerated technological development that transpires all around us in the digital age, we are required to adapt to frequent changes in our environment. The majority of teaching staff in teacher education programs were not born into the digital-informational revolution, and so must undergo training themselves to prepare for digital proficiency.

For the increased incorporation of technologies, Daggett (2005) argues that a shift in focus is necessary, from teacher-centered instruction to student-centered learning in which teachers take a secondary position as directors, guides and supporters of the learning process. According to Daggett, this will help students develop leadership skills, teamwork and other competences necessary and relevant to challenging issues related to everyday life and to the needs of the future workforce. The education system must therefore modify its teaching methods for the oncoming wave of digitally-proficient students, their skills, experiences and needs.

The benefits of mobile learning to the training of pre-service teachers can be numerous and are expressed in different facets of education, including cooperative learning, contextual, constructivist and authentic learning. Mobile-based learning facilitates location-based learning, among other flexible, unconventional teaching strategies.

Teaching in the 21st century requires teacher and student preparation for educational settings by using relevant, meaningful and challenging teaching methods, and by leading innovative pedagogy. This requires to empower educators to realize the potential of anytime, anyplace mobile learning through disruptive schooling transformation (Dede, 2011). The use of mobile learning spaces is an opportunity to break the boundaries of the classroom and to prepare student-teachers towards teaching spaces tailored to the future teaching market, while providing the tools and inspiration to lead change in schools.

2. THEORETICAL BACKGROUND

2.1 Traditional to Innovative Pedagogy in School Context

Mobile learning can be implemented 24 hours a day, 7 days a week. It allows mobility at five levels: mobility in the physical space, technological mobility, mobility in the conceptual space, mobility in the social space and decentralized learning (Sharples et al., 2007). Naismith et al. (2004) define six theory-based categories of mobile activities, including behaviorist, constructivist, situated, collaborative, informal/lifelong, and support/coordination. According to Squire & Klopfer (2007), individuality is the most unique feature which distinguishes between mobile devices and other technologies. The learners can attain a sense of ownership of the learning process and feel that they are independent and autonomous learning agent in their learning environment (Kearney et al., 2012). The features of mobile technology require educators' attention in order to harness these resources to teaching and to formulate and adopt an updated pedagogy. The innovative pedagogy focuses on the transition from teaching to knowledge building and changes the power foci of teachers and learners, of the learning activity and of the role of technology. According to the model conceived by Shulman (1986), "teachers' knowledge" cannot be defined without the relation between the area of knowledge content and pedagogy. Teachers are expected to acquire the required unique knowledge which will allow them to teach various content areas in a unique way by means of technology. Moreover, they can choose appropriately between learning contents, technological means and pedagogical aspect (TPACK – Technological Pedagogical and Content Knowledge) so that they make an informed pedagogical use of technologies (Koehler & Mishra, 2005). Conole & Culver (2010) argue that, although new technologies evoke varied opportunities for innovative, proactive and effective learning, in practice teaching duplicates the traditional teaching and does not exploit the possibilities offered by the technology. The researchers maintain that this stems from the fact that teachers are unaware of the potential embodied in the new technologies and lack competences to design learning activities which effectively make use of the technology. Educators need to think about adapting teaching methods to the changing world, whereby ICT activities are currently integrated into teaching. Puentedura (2011) suggests the SAMR framework for characterizing the level of technology-integrated teaching. This model consists of four levels: Substitution, Augmentation, Modification and Redefinition – a level which is parallel to the high levels of thinking – synthesis and assessment – leading to teaching and learning models which are different from those not using technology. As with the integration of any technology, integrating mobile technologies in teaching raises concerns regarding the exploitation of technology capabilities and effective ways of integrating education technology.

2.2 Pedagogical Uses of Advanced Mobile Devices

Incorporating mobile technology in teaching can provide a chance for educators to bridge the gap between the school environment and the extracurricular environment. Allowing learners to use technologies in which they are versed can empower students, enrich learning, and make it more meaningful and relevant. In this context, Laurillard (2007) suggests adopting a pedagogy that both promotes quality learning and is more sustainable and flexible than traditional teaching methods. It is crucial trying to understand the type of exercises required for learning complex concepts and higher-order thinking skills, and develop pedagogical applications that yield the desired learning results. Like Laurillard, Sharples (2007) also claims that in order to develop innovative educational activities, it is necessary to integrate technology and learning in a manner whereby pedagogy and learning theories rather than the technology are the driving forces. Naismith & Corlett (2006) also provide a review of technologically-oriented pedagogies. They suggest taking advantage of the unique technology affordances that can contribute to an enhanced user experience.

The purpose of this precursor study is to examine the issue of implementing mobile technology and usage patterns in the mobile learning space (MLS) among the students and lecturers in a teacher education college. Furthermore, another objective is to set the potential of mobile technology for teaching on the challenges which this combination conveys. Accordingly, patterns of teaching and learning were examined in the MLS, as well as the role of pedagogical support and guidance in relation to the methods used in the MLS and the attitudes of the lecturers and students to teaching and learning in an MLS.

The research questions were:

1. What practices are implemented by lecturers who teach in the mobile technologies' space, including hybrid computers (tablets and laptops)?
2. To what extent do lecturers implement in their teaching practices the use of mobility features of hybrid computers (tablets and laptops) in the MLS and beyond the MLS boundaries?
3. How do students experience learning in the mobile learning space?

3. METHODOLOGY

The research participants included the faculty members teaching in the course of the year (29 taught and 13 responded to the questionnaire), and the students studying in this learning space (21 of which responded to the questionnaire). Two related technical supporting people and a pedagogical supporting person also participated in the study.

The research tools included a questionnaire administered to instructors and students at the end of the two semesters, personal conversations with five of the lecturers and with the support staff as well as meetings with the leading faculty in the college and information minutes of meetings held throughout the year. Simultaneously, three lessons in the MLS were videotaped and then analyzed.

This study employed a mixed-method approach which combines quantitative and qualitative research methods (Johnson & Onwuegbuzie, 2004; Keeves, 1998). Data was obtained regarding the practices applied by lecturers who teach in the mobile technologies' space, teachers' level of using the mobility features of hybrid computer (HC) and the way students experience learning in the MLS. The HCs are devices that can switch between acting as a tablet and a laptop, being more powerful than standalone tablets and facilitating portability and flexible use in and beyond the MLS. The quantitative data were collected by analysis of the pre and post questionnaires. In addition to the quantitative findings, students and lecturers expressed their opinion in the open-ended questions. Additional data were collected through the conversations with the lecturers, the support staff, the video tapes of the lessons and the information minutes of meeting scheduled through the year. The design was useful as it enabled to further analyze unpredicted quantitative results and provided an expanded understanding of the results (Creswell, 2009).

4. THE LEARNING SPACE AND THE RESEARCH PROCEDURE

During the academic year 2014 a mobile learning space comprising 26 computers was built. The planning of the space was underpinned by the thought that perhaps this space was not necessary for the purpose of teaching mobile learning applications. The lecturers and students can settle for available mobile computers and tablets which will serve for a variety of applications and activities, independently of the space and the lesson time. Following the contribution of HCs, the college has decided to make use of this space as modeling for the pre-service teachers for varied uses and for creating an innovative and diversified teaching, including teaching and learning processes beyond the class boundaries as well as examining models to be used in this kind of space. The college made arrangements for launching the space, which consisted of technical and pedagogical aspects. The first semester was mainly designed for providing a technological response. Only towards the second semester pedagogical thinking was initiated with some of the lecturers who taught in the space. Towards the planning of the space, several aspects had to be considered: the space location, space organization, staff training, managing the use of the space, technical support during the hours of using the space, pedagogical support, safety of the equipment and interactive board.

Most of the 29 lecturers who taught in the MLS (22 lecturers) taught one course, four lecturers taught two courses and three lecturers taught three courses. As for the students, as some have learned more than one course, it was difficult to estimate their numbers. At the end of the first semester, 7 lecturers responded to the questionnaire. At the end of the second semester 6 lecturers and 21 students responded to the questionnaire. In order to maintain anonymity of the participants, the students' names were replaced by numbers and the names of the lecturers were replaced by other names.

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5. FINDINGS

This chapter presents the quantitative and qualitative findings with respect to lecturers and students as derived from various data. A few themes emerged throughout the analysis of the qualitative and quantitative data: 1. The extent of use and the type of use of the HCs, 2. Pedagogical and technical support, 3. Technical difficulties, 4. Organization of the learning space, 5. Attitudes towards teaching and learning in an MLS.

5.1 Pedagogical Uses of Advanced Mobile Devices

Three main patterns of use by the lecturers were identified: Use of the HC as a laptop or desktop (common use), use of the HC for running applications (reasonable use) and the use of the HC for location-based activities (limited use). Table 1 presents the three patterns of use and the students and lecturers excerpts.

Table 1. Students (N=21) and lecturers (N=13) excerpts regarding HC usage

Type of Use of HC	Excerpts
As a portable computer or a desktop computer	"Mobile technology enables individual work and work carried out in the classroom, sending email to the lecturer and there is no need to rewrite..."; "... I'm not a big believer in computers. If I integrated them it would be from fourth grade and up, and this is not the population I work with..."; "... instead of bringing one's laptop, the tablets can be used".
To run computer applications	"... You can use this class to implement the use of new software applications and for the use of cooperative learning... ".
Location based activities outside the classroom	-

Some of the lecturers who did not intend to use the computers at all, used them due to their availability in the MLS for surfing the Internet, writing and editing, as part of their planned lessons. Some of the lecturers made use of HC to work collaboratively and a few made use of social networking and of the computer cloud. Although most students indicated that they did not use the HC, some of them were aware of the applications that can be performed by using mobile technologies. Most suggestions for implementing mobile technology options came from students who studied in the technology track or with ICT lecturers. Suggestions included Internet applications, writing joint papers, and working in groups on Google Drive. Analysis of the observations of the three videotaped lessons revealed diverse use of the HCs. One lesson involved collaborating in class through the use of playlists on YouTube, as well as the students creating and communicating through their own discussion threads on Facebook. In the second lesson the HCs were used for drawing and presenting the drawings on the interactive whiteboard. In the third lesson the HCs were used for an activity based on QR Codes which students conducted beyond the class boundary. In the current year there was a limited use of HCs by lecturers and students.

Students' responses were similar to the lecturers' answers about the limited amount of their use of the hybrid computers (about 50% did not use the HC, about 35% used the HC for a lesson or two, about 10% used the HC in a large number of lessons and about 5% used the HC in all lessons). Although the use of HC was limited, some of the lecturers who had used the hybrid computers reported a variety of uses and applications. Some students wrote on Moodle blogs on their HCs and shared their writing on the whiteboard/screen. Others created collaborative Google Docs on their HCs, which their lecturer then shared on the whiteboard for all of the class to see and give feedback. Another activity involved explaining meaningful teaching and learning through text, pictures, video and sharing them via the Padlet application. Finally, one classroom utilized online document management and cloud services via their HCs. The quantitative data provided information on the extent to which the HCs were used by faculty and students, and the type of use they implemented. Table 2 presents the type of use of hybrid computers lecturers made during their lessons.

Table 2. The type of use lecturers did with HC (N=13).

Amount of use	Number of lecturers (%)
Did not use	6 (46.2)
Running applications	3 (23.1)
Run Office and access to the Internet	2 (15.4)
Location-based activities outside the classroom	2 (15.4)
Total	13

The few lecturers who used the HC during their lessons mainly used them for running applications (23.1%), for using Office software and accessing the Internet to retrieve information (15.4%) and for location-based activities (23.1%). These findings show that most of the lecturers did not use HC in the learning space for various reasons: some need technological and / or pedagogical support, some believe that it is not relevant to their teaching; also the number of student users is low.

5.2 Pedagogical and Technical Support

The lecturers were asked to which extent they wished to receive technical and pedagogical support. Lecturers' answers are presented in Table 3.

Table 3. Lecturers' wish to receive technical and pedagogical support (N = 13).

Category (Likert 1-4)	Technical support N (%)	Pedagogical support N (%)
Not relevant	5 (38.5)	3 (23.1)
Not at all	2 (15.4)	2 (15.4)
To a small extent	-	-
Reasonably	5 (38.5)	7 (53.8)
To a great extent	1 (7.7)	1 (7.7)
Total	(100) 13	(100)13

Table 3 shows that about half of the lecturers are interested in technical support (46.2%) and over half of them (61.5%) are willing to get pedagogical support. Lecturers that did not receive pedagogical and / or technological support regarding the use of HC, did not use them during their lessons. The importance and necessity of support becomes very prominent. Some of the lecturers are interested in getting practice time in order to get familiar with the learning space, equipment and functionality.

Some of the lecturers (30%-40%) say that hybrid computer and / or laptop are not relevant to their work and therefore they have no interest in technical or pedagogical support. Sometimes they also explain the lack of relevance from their perspective. Some of the lecturers demonstrate a wish to get pedagogical support in the use of HC for the purposes of teaching. Prior to getting pedagogical support, lecturers are primarily using the HC for Internet access, using Office, drawing, introducing applications to their students with special needs and downloading applications. Half of the lecturers who responded to the questionnaire have the intention to use mobile technology in the future, given the appropriate support. Some of the lecturers have raised the challenge of the need to rethink the lessons' properties and means of transmission. Limor offers: "... It is important to rethink characteristics of the lessons and of teaching methods".

5.3 Technical Difficulties

Although the technical support was available, lecturers reported technical difficulties which included: sensitivity of interactive whiteboard leading to unexpected situations and difficulties operating it, sound problems, the fact that the room is not always opened on time, difficulty writing on the board. 6 says: "There are problems with electricity on the desks around the classroom, it is very difficult to connect everything and the electrical wire causes a mess". 14 says: "Improving the wireless network which does not always functions well… we used it in one lesson and what we had to do was to photograph with the camera in it but the photography software did not function in most of the tablets". Dana, a lecturer in the course sums this up: "… the biggest challenge is starting the lesson on time when all the functions are working and the room is arranged according to my request… ".

In order to overcome part of the difficulties, it is very important to support lecturers and aid them gain a feeling of comfort when using technology. Lecturers prefer mentoring and do not find interest in guidelines relevant to the use of space. Lack of control and familiarity with the implementation and harnessing of mobile technology in favor of teaching brought students to such sayings: says 4, "We used only once the tablets and the smart board. It is a shame we did not make more use of the learning space.", says 6, "... Today, as every student has a laptop this MLS is redundant...", says 11, "... I would very much appreciate getting to know how to implement them in my school".

5.4 Organization of the Mobile Learning Space (MLS)

Organization of the learning space often dictates the ways of usage and is also derived from the application of teaching methods. The lecturers were asked about the degree to which the learning space meets their needs. Table 4 presents lecturers' answers.

Table 4. The degree to which the Learning Space meets the instructors' needs (N = 13).

Category (Likert 1-4)	**Number of lecturers**	**Percentage (%)**
Not relevant	3	23.1
Not at all	3	23.1
To a small extent	1	7.7
Reasonably	6	46.2
To a great extent		
Total	13	100

As shown in Table 4, some of the lecturers were not satisfied with the space design. Some of the lecturers were disturbed by the fact that the space design prevented the sense of the group while working in groups. Suggestions regarding the organization of the learning space were made by the lecturers.

Says Neta "... As for the chairs, on the one hand, I would recommend bringing flexible chairs that come along with a small table. On the other hand, high mobility can cause distraction to students with learning disabilities...". 11 says: "... The MLS is very easy to use with laptops. There are many electrical outlets and the special interactive board is very convenient and practical for lecturers who use it properly...". It was proposed to have a larger MLS with more flexible arrangement, so that the space is suitable for working in groups as well as in a circle of chairs or in a u-shaped format. The lecturers mentioned the challenges that such MLS poses to lecturers – the lecturers mentioned a few issues: a. Need to rethink the characteristics of their lessons and the teaching methods B. The need to know how to apply the different functions and gain pedagogical and technical support,. C. The possibility to conduct advanced lectures while typing on the tablet and presenting in the interactive whiteboard while moving around the space.

5.5 Attitudes of Teaching and Learning in an MLS

The main objective in teacher education is to prepare the pre-service teachers to implement at school what they have learnt. Only students in their technology courses were inspired to implement similar processes in the school. Despite the fact that findings indicate that there was a low rate of teaching with HCs, the answers to the open-ended questions and the conversations held demonstrate a desire to study and learn the use of HCs and the operation of the MLS. Still, the level of implementation mostly remained using the HC as a laptop. Instructors were able to run applications with technical support, but for conducting collaborative and location-based activities exploiting the mobility of the technology outside the learning space, lecturers needed pedagogical training and assistance.

Lecturers were mostly positive in implementing mobile learning after receiving technical and pedagogical support. As for the students, it is important to expose them to a variety and innovative teaching models as well as help them develop attitudes and deal with mobile technology implementation in their classrooms. Some students expressed their views about the use of HC and about computers in general. A number of students thought that integrating technology into teaching is unnecessary. 8 assumes that teachers are good enough and does not consider technology as part of an educational social reality. "... We teachers are good enough. ". Some students think that suitable conditions for innovative technology implementation do not exist yet in school. 2 says: "... The condition for this application is not yet here... There are very few localities in the periphery without computers and the Internet at home... ". 19 comments: "... Class tablets showed us a new and varied teaching, and I enjoyed the class." As appears from the following students: 14 says: "... You can try new ideas, teaching with tablets and after the attempt to implement it in the classroom... ".

6. CONCLUSIONS

The study emphasizes the fact that students and instructors should be made aware of the potential encompassed in the new technologies and get help in developing competencies necessary for shaping learning activities which effectively use the technology. When they gained pedagogical and technological support, lecturers tended to incorporate more constructivist and collaborative activities, as described also by Naismith et al. (2004). Out of the five levels of mobility described by Sharples et al. (2007), this study found two major patterns of HC implementation. The first is technological mobility in the social space, as demonstrated by the facilitation of collaboration. The second pattern of mobility involves the physical space, which prior to HC implementation had been restricted to the classroom. It is suggested to explore all five levels of Sharples et al.'s of mobility as part of the teacher training in the LMS.

Following this study, it is important to provide resources to lecturers who promote innovative teaching models and help them become acquainted with the properties and benefits of this technology. They should also be aware of the difficulties that are part of the process of implementing a new technology. The more educators are aware of the potential of the usage of mobile technologies, the more they can rethink their current pedagogy and implement the technology efficiently. The model of Peuntedura (2006), with its several levels of ICT integration, provides a useful tool to map this transformation of technology-based learning. Technology-based learning activities should not be aimed merely at replacing older tools, but should aspire to re-define the learning process and learning method and hence increase the level of interest and engagement of both pupils, students and lecturers.

Laurillard and Sharples argue that pedagogy and learning theories should drive the use of technology; this study too emphasizes the importance of providing close, personal, constant assistance to lecturers. In this study, technological and pedagogical support was offered to all teachers. Only some lecturers responded to this offer, and it was these lecturers who reported a high level of comfort and competence with the technologies, and went on to implement them successfully in the classroom. Lecturers who did not take advantage of the support services offered, were not as comfortable with the technologies and the learning space they created was that of a traditional classroom. There is a need for further experimentation with the motivation of lecturers who are less technologically-inclined, so that the potential of a broader learning space is made clearer to them.

We are now in the second year of teaching in the MLS. At this early stage, we have focused on observing and defining learning needs, and providing support for the lecturers in implementing these relatively new practices. Some technological challenges have been resolved. For instance, since the devices belong to the institution and not to the students, lecturers and students are offered the option of using the college cloud computing, so that they can access the learning space from their own devices as well. There is still much to be examined, however. A similar study should be performed with a larger population of lecturers, and in-depth interviews performed to determine the technological and pedagogical needs of different disciplines.

The findings obtained can highlight the best suitable models for implementing mobile technologies in teacher education institutions and contribute to decision making in the acquisition and design of the technological learning space in the teacher education college.Another benefit derived from this experience is thinking about the design of technological spaces in the institution while relating to the different teaching preferences as well as to the learners' differentiation. Through slow, gradual introduction of the technology into the classroom, lecturers can gain pedagogical experience without being overwhelmed.

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DEVELOPING STUDENTS' PROFESSIONAL DIGITAL IDENTITY

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ABSTRACT

In contrast to the myth of the 'Digital Native' and the ubiquity of Facebook use, we have found that students' digital identities are predominantly social with their online activity beyond Facebook limited to being social media consumers rather than producers. Within a global economy students need to learn new digital literacy skills to prepare them to become active participants of professional networks. In this paper we explore a case study consisting of the development of a six-week elective course that aims to develop students' professional digital identity, by leveraging a community of practice network of global educators modeling the educational and critical use of mobile social media.

KEYWORDS

Digital identity, digital literacy, mobile social media.

1. INTRODUCTION

Since Prensky (2001) postulated the rise of digital natives the concept has taken on almost normative acceptance among higher education (Lang, Vargas, & Conover, 2007; Moore, Moore, & Fowler, 2005). The digital native myth has had the dual effect of lulling students into a false sense of techno-superiority and scaring technophobic lecturers into avoiding the use of mobile and social media. However the concept of digital natives has been debunked by several critiques (Helsper & Eynon, 2010; Sheely, 2008; White & Le Cornu, 2011), and recent studies (Beetham & White, 2014) have shown that students are predominantly consumers of social media and do not automatically translate their social Facebook usage into the development of critical and professional online networks or communities. Thus we argue that the crucial role of the lecturer has not been superseded by mobile and social media, but is made even more necessary by the demonstrable lack of student critical skills in these spaces.

1.1 Digital Identity Formation

In today's globally connected society employers are increasingly checking potential employees online profiles in order to determine their suitability as a part of the employment process. Thus digital literacies are now a core skillset for students and lecturers (Littlejohn, Beetham, & McGill, 2012; McLoughlin & Burgess, 2009; Walsh, 2008). The formation of digital literacy skills involves several conceptual shifts, including: moving from teacher-centred pedagogies towards student-determined pedagogies or heutagogy (Luckin et al., 2010), a focus upon epistemic knowledge construction (Danvers, 2003), moving from technology adoption as substitutionary towards enabling task redefinition (Puentedura, 2006), and a focus upon creativity as reinitiation of new ideas (Sternberg, Kaufman, & Pretz, 2002). We have attempted to scaffold these conceptual shifts by the development of a framework for creative pedagogical design.

1.2 A Framework for Creative Pedagogies

Laurillard (2012; 2013) argues that curriculum design should be treated as a design science and become a collaborative process, rather than an ad hoc solo pursuit undertaken by lone educators. The authors of this

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paper have found that a collaborative curriculum design process that is informed by a chosen set of theoretical pedagogical frameworks is a creative way to breath new life and fresh ideas into course design. We have detailed the development of a mobile social media framework for designing creative pedagogies (Cochrane & Antonczak, 2014; Cochrane, Antonczak, Guinibert, & Mulrennan, 2014), and summarise the latest version of our framework in table 1.

Table 1. A mobile social media framework for creative pedagogies (modified from (Luckin, et al., 2010))

	Pedagogy	**Andragogy**	**Heutagogy**
Locus of Control	Teacher	Learner	Learner
Course timeframe and goal	Initial establishment of the course project and induction into the wider design community	Early to mid-course: Student appropriation of mobile social media and initial active participation	Mid to end of course: Establishment of major project where students actively participate within an authentic community of practice
Cognition Level (Danvers, 2003)	Cognitive	Meta-cognitive	Epistemic
Knowledge production context	Subject understanding: lecturers introduce and model the use of a range of mobile social media tools appropriate to the learning context	Process negotiation: students negotiate a choice of mobile social media tools to establish an ePortfolio based upon user-generated content	Context shaping: students create project teams that investigate and critique user-generated content. These are then shared, curated, and peer-reviewed in an authentic COP
SAMR (Puentedura, 2006)	Substitution & Augmentation Portfolio to ePortfolio PowerPoint on iPad Focus on productivity Mobile device as personal digital assistant and consumption tool	Modification Reflection as VODCast Prezi on iPad New forms of collaboration Mobile device as content creation and curation tool	Redefinition In situ reflections Presentations as dialogue with source material Community building Mobile device as collaborative tool
Supporting mobile social media affordances	Enabling induction into a supportive learning community	Enabling user-generated content and active participation within an authentic design COP	Enabling collaboration across user-generated contexts, and active participation within a global COP
Creativity (Sternberg, et al., 2002)	Reproduction	Incrementation	Reinitiation
Ontological shift	Reconceptualising mobile social media: from a social to an educational domain	Reconceptualising the role of the teacher	Reconceptualising the role of the learner

The framework was used to guide the design of a six-week intensive elective course that focuses upon students developing professional online profiles and digital literacies.

2. CASE STUDY

During 2013 the authors collaborated on the development of a series of four courses to be part of a mobile social media minor. In semester one of 2014 the authors collaborated on developing a short six-week introduction to the mobile social media minor. We decided to base the course design upon modeling the formation of professional global networks by inviting input into the course from members of our own established open educator networks: icollab (Cochrane et al., 2013) and MoCo360 (Cochrane, Antonczak, Keegan, & Narayan, 2014). By inviting members of these networks to become guest lecturers throughout the elective we created an authentic example of the professional use of mobile social media tools for global communication and collaboration.

2.1 Designing the Elective

The context of the elective was a six-week optional course in the second year of a bachelor of Art and Design degree. The predominant demographic of the potential enrolling students were second year graphic design students, however the degree also attracts moving image and video production students. The design of the elective was based around several desired student outcomes, whereby students will be able to:

1. Demonstrate understanding of mobile 'smartphone' (and tablet) device technology and the unique affordances of mobile social media.
2. Create a range of mobile 'pathways' in relation to moving image
3. Establish a collaborative mobile social media ePortfolio
4. Establish a professional digital identity and online presence

Table 2 outlines the modified shortened schedule of the mobile social media minor redesigned as a six-week intensive elective course.

Table 2. Developing a new media elective based upon our mobile social media framework.

Topic	Week	Guest Lecturer	Cognition level	Assessment activities	Conceptual shift	PAH alignment
Introduction to mobile social media and the power of collaboration	1	Colombia	Cognitive	Establish personal digital identity via G+ and Twitter. Introduction to a global network	From social to professional identities	Pedagogy
The power of an online profile	2	AUT Journalism	Meta Cognitive	Creating promotional videos via Vine	Teacher guided	Andragogy
The power of social media curation	3	UK	Meta Cognitive	Establishing a shared personal workbook via Wordpress	Student negotiated	Andragogy
The power of an eportfolio	4	Design Professional	Meta Cognitive	Establishing identity within a global professional community (Behance)	Student negotiated	Andragogy
The power of collaborative production	5	Mobile App Developer	Meta Cognitive	Collaborate in a team-based project as content creators using Vyclone	Student negotiated	Andragogy
Participation in a shared journey	6	Ireland	Epistemic	Presentation of ePortfolios and reflection on new digital identity perspectives	Student directed	Andragogy to heutagogy

In the following section we expand upon the summary within Table 2.

2.1.1 Assessment Activities

As the course was a short six-week elective we wanted to keep the assessment activities as practical as possible, and focus upon students developing skills that they could build upon in their later courses within the degree. The key points covered during the six weeks of the elective included:

• An overview of the paper and the ethics of the expected course culture of open sharing and collaboration
• A critical introduction to Mobile Social Media
• Smartphone and tablet technology affordances
• ePortfolios and Web2 tools
• Exploring creativity enabled by Mobile Social Media
• Exploring mobile tools to use for future online collaborations
• Discussing some examples via a series of case studies

These were assessed by three activities including: the production and sharing of a six-second self-promotional video using Vine (summative), evidence of engagement in the course community via mobile social media (formative: evidenced by posts on Google Plus community, Twitter, and creation of a video channel on either YouTube or Vimeo), and the collation of students' online profiles and work in progress using Behance as an ePortfolio (summative). A course outline and assessment criteria were shared with the students on Google Docs and linked into the course Google Plus Community.

2.2 Participants

The first iteration of the elective course involved fifteen-second year bachelor of design students and the two authors as collaborative lecturers. One of the first course activities was a survey of the students designed to identify their previous experience of mobile social media. The results indicated that while the majority of students considered themselves "digital natives", their mobile social media activity was mainly limited to Facebook (100%), text messaging (93%), Web browsing (93%), Calendar (86%), YouTube viewing (86%), Google Maps (72%), and Instagram (64%) usage, with limited use of mobile social media within educational contexts. All of the students owned a mobile phone, with 85% smartphone ownership (64% iPhone, 21% Android), all of the smartphone owners used 3G/4G mobile broadband as well as the University WiFi network. All students also owned either a laptop (64%) and/or a tablet (43% iPad, 7% Android). Table 3 provides a summary of the Surveymonkey results of students' use of mobile social media within education, indicating that the majority of the elective course activities were new to their educational experience.

Table 3. Student participants' mobile social media usage in education survey results

Activity	Usage %	Activity	Usage %
Watched PODCasts of lectures	10%	Created your own PODCasts	0
Mobile Web searches	50%	Twitter	20%
Text messaging	40%	Mobile Blogging	10%
Recorded & uploaded mobile video	20%	Recorded & uploaded mobile photos	30%
eBooks or iBooks	20%	iTunesU	0
Augmented reality	0	Soundcloud	0
Blackboard App	30%	QR Codes	10%
Skype	0	G+ Hangouts	0
Google Drive	0	Geolocation activities	0
Collaborative Wiki editing	0	None of these	10%

2.3 Results

In this section we briefly analyse some of the curated course content that included: mobile social media streams, student workbooks and reflections on their Wordpress blogs, student ePortfolios on Behance, livestreams of face to face guest lecturers, and archived guest lecturer hangouts on YouTube.

2.3.1 Mobile Social Media Analysis

We used a Google plus Community as a course hub, and curated social media streams via a course hashtag (#autmsm2014) using TAGBoard for student activity on Google Plus, Twitter, and Vine. Table 4 provides a summary of mobile social media use associated with the elective.

Table 4. #autmsm2014 mobile social media activity summary

Mobile social media	**Activity**
Map of geotagged #autmsm2014 Tweets http://goo.gl/maps/vvBgm	179 tweets from 20 users
Google Plus Community http://is.gd/Vy5NHY	96 posts and 150 comments
TAGBoard https://tagboard.com/autmsm2014/182047	320 posts
Vine video production http://vinebox.co/tag/autmsm2014	30 Vine videos
Example ePortfolio interaction on one Behance profile	187 views 26 appreciations 7 follows
Wordpress workbooks	14 Wordpress workbooks with an average of 12 pages each.

TAGSExplorer (Hawksey, 2011) was used for a more detailed graphical Twitter analysis of the course hashtag usage (#autmsm2014), shown in figure 1.

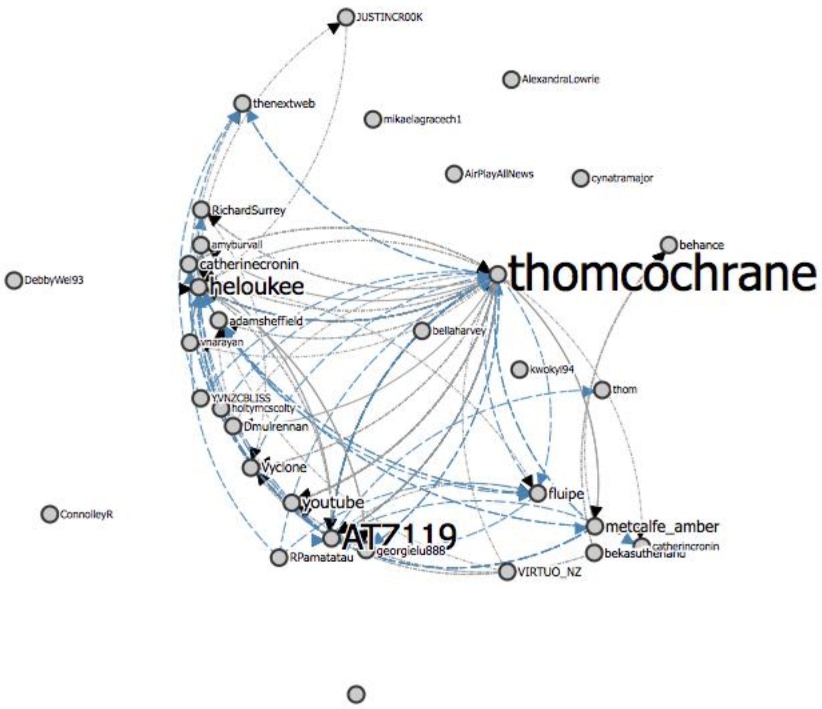

Figure 1. TAGSExplorer for #autmsm2014

Figure 1 illustrates that the key conversational nodes using the course hashtag were the lecturers, While many students are represented by isolated nodes Figure 1 also identifies the beginnings of a couple of students becoming conversational nodes as they built up confidence throughout the six weeks of the course. Figure 1 also illustrates the reach of Twitter as a tool for facilitating a connected network with associated social media sites and guest lecturers from around the globe.

2.3.2 Examples of Student Work

As an introductory course activity students were invited to collaboratively edit an interactive course Google Map by locating links to their online profiles and examples of Vine videos as points of interest. The map data was also exported into a mobile augmented reality browser as an example of the contextual affordances of mobile social media. Students used Vine to create a short six second stop motion representation of their design expertise, reflected on their course experiences and establishment of their social media profiles on their own Wordpress blogs, and curated the beginnings of a personal professional portfolio on Behance.

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Links to example student work:

- Example Student Promo Videos http://www.youtube.com/playlist?list=PL2-TasqEeWBuEwDsfLIrnjyug9g1L9ICl
- Example Student Workbook: http://richardsurrey.wordpress.com
- Example Student Behance ePortfolio: https://www.behance.net/RichardSurreyDesign

Overall we were pleased with the level of creativity and reflection evidenced in student contributions to the elective community (see Table 4 for a summary). Table 5 provides a summary of summative course assessment results for the first elective cohort in 2014.

Table 5. #autmsm2014 course assessment results summary

Assessment	**Results**
Vine video	B average
Behance Portfolio	A- average
Course pass rate	100%

The assessment criteria for the two summative assessment activities was broken into four categories:

- *Media:* Demonstrate care and control of appropriate media and materials through every stage of the design process, including final work and workbook, showing attention to detail.
- *Design effectiveness:* Demonstrate the ability to resolve macro- and micro-aesthetic issues, with a particular focus on visual features (images, semantic).
- *Design content*: Demonstrate an understanding of the experience of a viewer or an audience.
- *Process and participation*: Demonstrate the ability to critically reflect on your work and that of peers by actively participating in class discussions and critiques.

Submission required students to post the following in the elective Google Plus Community:

- *Behance* URL
- *Brand Yourself* video URL
- Wordpress workbook link containing reflective statement, references, tests, experimentations, work documentation, self-analysis, and course content with annotations.

2.3.3 Student Feedback

Student feedback on the elective course was very positive, and students posted reflections on their course experiences on their Wordpress blogs and/or as short video reflections. Two indicative examples are included here.

> When coming into this course I personally thought that it was about designing apps and had no idea to what we actually were going to do. When first explained what the course was about I thought I knew a lot already as was on a few social media platforms but I was wrong!! This course brought forward so many ideas and creative ways into how we can brand ourselves on social media platforms in a professional way, not only this but how to connect and interact with other devices to make life so much easier! I thought this course was really good as our generation seem to think they know everything about technology because we have grown up with it and experienced change first hand. I have learnt so many new techniques to get my work out in the open, portray myself and also most importantly to me tools that will help me save a lot of time in the future for working on projects together with people. I thought that the interaction with other lecturers and interested parties all over the world was amazing, it was awesome to get an insight from people on the other side of the world and find out the similarities and differences in teaching and learning platforms but also learn from what they had to say to heighten our interest and knowledge of our particular course. Thank you so much! I will definitely benefit from this course and hopefully will see you again in the future. (Student1, 2014)

> Working as a creative person in today's industry requires an in-depth knowledge of how mobile social media is intrinsically linked to how we work and how we promote ourselves as professional people. Without this class I would have a hard time creating an active online presence which could potentially become a job opportunity, I am grateful to *my lecturers* for helping me realise the importance of social media and Its real life application. I feel as though I am now equipped with the basic tools to move forward as a professional designer and promote myself as a brand more effectively. (Student2, 2014)

The impact of the elective course on the formation of students' digital identity was evident in student reflective feedback on their Wordpress blogs as illustrated above.

3. DISCUSSION

We attempted to design the course as a potentially transformative learning experience and measure this by integration within the course assessment criteria that included recording of student process and participation: "Demonstrate the ability to critically reflect on your work and that of peers by actively participating in class discussions and critiques as well as engaging online via *Google+ Community".* Table 4 provides a summary of the course activity, and it was clear that students' previous lack of active participation with online networks and communities beyond Facebook meant that their first engagement in a Google Plus Community was definitely a learning experience.

Students expressed the wider curriculum impact of their #autmsm2014 elective experience as they sought to integrate some of these experiences into other courses and projects. Thus the elective course built students' self-esteem and confidence in the professional and critical use of mobile social media, particularly with respect to moving from local networks and interaction with their classmates to experiencing a network of international experts and support groups.

One of the limitations of the six-week elective format has been Time. In spite of a general positive feedback from the students, we noticed that there wasn't much participation and engagement outside the class time. Based on previous experiences, we believe that this situation could be improved by scheduling an open three-hour session or open workshop for better support and one-on-one mentoring in-between each new guest-lecturer intervention.

3.1 Future Developments

While Laurillard (2012) highlights that "The basic argument is that a 21st century education system needs teachers who work collaboratively to design effective and innovative teaching, and digital technologies are the key to making that work" (Laurillard, 2012, p1), we argue that students and lecturers need more professional and disciplinary guidance in terms of online Ethos and practices. Therefore, we shall further investigate issues relating to ethics and privacy within a creative environment. The next design step is to take these findings into consideration and to refine the strategies and schedule of the *Mobile Social Media* minor.

We received interesting feedback from one of the guest lecturers who suggested converting this academic Elective series into an industry-based workshop to support professional development and to enhance mobile knowledge and proficiency as well as mobile social media engagement beyond the context of higher education.

4. CONCLUSION

By using a framework to explicitly design an elective to explore digital identity formation we found that students underwent an authentic transformative experience by actively participating in the elective. By becoming an active member of a supportive community of practice the students' initial misrepresentations, fears or reservations were mitigated and new forms of open online practice became part of their professional toolkit. We hope to extrapolate this experience across the wider curriculum in the future.

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IMPACT OF CONTEXTUALITY ON MOBILE LEARNING ACCEPTANCE: AN EMPIRICAL STUDY BASED ON A LANGUAGE LEARNING APP

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ABSTRACT

The mobility of both the device and the learner will determine how mobile learning takes place. Mobile learning offers new educational opportunities that allow for autonomous, personalized and context aware learning. This paper focuses on contextualized features for mobile language learning apps. Context-awareness is seen as a particularly important app feature in order to create a meaningful mobile learning experience as it adapts learning activities to the learners' real world environments. The scope of this paper is to explore students' perceptions of contextualized mobile language learning. An extended Technology Acceptance Model was developed to analyze the effect contextual app features would have on students' usage intention. The suggested app applies context-triggered push notifications to initiate learning sessions based on a location-aware vocabulary. Partial Least Squares Structural Equation Modeling (PLS-SEM), was used for an empirical validation of the proposed research model. The results of the analysis revealed, that students perceived the proposed app as beneficial for their learning endeavors. The location-aware feature is essentially relevant to improve the perceived usefulness of the system, as it may increase the learning effectiveness of the app in their everyday life.

KEYWORDS

Contextual Learning; Mobile Language Learning; Empirical Study; Mobile Prototyping; User Centered Design; Up-front User Research; Technology Acceptance Model.

1. INTRODUCTION

Today, mobile applications (apps) are one of the main drivers of the ongoing proliferation of mobile learning. Especially apps for mobile assisted language learning evolved broadly, and have become increasingly interesting to many mobile learners due to the availability of inexpensive or even free apps for language learning. However, the full potential of mobile learning has not been fully leveraged to this point. Accordingly this paper will focus on contextualized features for mobile language learning apps. As context-awareness adapts learning activities to the learners' real world environments, it is seen as an important app feature in order to create a meaningful mobile learning experience. Although it is not a new phenomenon, Huang et al. (2013) state that, the domain of mobile learning lacks endorsement from studies that explore context-aware language learning systems and research the users' perspective on such systems (Huang et al., 2013). This paper ties in with Huang et al.'s statement and intends to contribute to empirical research on student's perceptions on contextual mobile vocabulary learning systems and the impact of this contextuality on the acceptance of such systems. The scope of this study is therefore to analyze to what extent a contextual app feature influences the students' behavioral intention to use a context-aware mobile language learning app. Building on the Technology Acceptance Model (TAM), the objective of this study is to derive empirical findings on the importance of contextuality on usage intention for mobile language applications as well as its influence on the perceived ease of use and the usefulness of such applications. Based on these findings, recommendations for the future design of mobile learning applications and the need to integrate context-aware features can be derived.

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The study consists of five chapters. After this introduction, the second chapter discusses the research background on mobile language learning and context-aware mobile app features. The research approach and the proposed research model are expounded in chapter three. Chapter four presents the research findings of the study and summarizes the results of the hypotheses testing, before conclusions and implications are drawn in chapter five.

2. RESEARCH BACKGROUND

Contextual mobile language learning can be categorized as an advanced form of electronic learning (e-learning), which has its roots in technology enhanced learning (TEL) and the advent of information and communication technologies (ICT). The following section briefly discusses theoretical foundations and important characteristics of mobile learning. This is used as a basis for introducing and substantiating the factor of context-awareness and the role of contextual app features to mobile language learning.

2.1 Context Awareness in Mobile Learning

Today, mobile learning is seen from a *learner-centric* perspective, which emphasizes the focus on the mobility of the learner as well as the mobility of the learning process itself. Herein, the concept of context with its different aspects for mobile learning becomes an essential factor. With the mobile device at hand, learners can learn in various different scenarios. Hence, it is important to focus on learning activities, which on the one hand are facilitated by the type of device, and on the other hand are determined by the physical and social contexts the activity takes place in. Herein, the informal and context-based learning experience evolve to important factors given by the mobility of the learner (Traxler, 2007). By means of the context notion, the mobile device becomes a mediator-tool that offers personalized learning activities adequate for the leaner's mobile status. The scope of context awareness in mobile learning is, as stated by Brown et al. (2010), to connect the real world with digital media to support the learner. Context-awareness as a technological phenomenon is usually referred to as context-aware computing. According to Abowd et al. (1999) context-aware mobile computing is "… the use of context to provide task-relevant information and/or services to a user, typically [based on, notation of the authors] the location, identity and state of people, groups, and computational and physical objects". Zimmermann et al. (2007) argued that context is of dynamic nature and defined five different context categories, which they described as individuality, activity, location, time, and relations. The dynamic mesh of context information that is woven around the learner has led to a paradigm for context-awareness in the domain of mobile learning, which Sharples et al. (2005) have summarized as follows: "Context should be seen not as a shell that surrounds the learner at a given time and location, but as a dynamic entity, constructed by the interactions between learners and their environment."

In order to adapt the learning activity to the learning context, context-acquisition due to sensor technology plays an important role. Modern sensor technologies such as cellular networks, GPS, WLAN, Bluetooth/Beacons, RFID (Radio Frequency IDentification) or cameras generate important input information for contextualization (Wang, 2004). Mobile devices use these context inputs for the design and development of learning activities and functionalities, and in addition offer possibilities for the customization respectively personalization of learning activities.

2.2 Contextual Mobile Language Learning

In mobile language learning, the language learning process is assisted and enhanced by the use of a mobile device. Often, the acronym MALL – Mobile Assisted Language Learning – is understood to describe this approach of language learning. Kukulska-Hulme (2012) defined MALL as the use of "… mobile technologies in language learning, especially in situations where device portability offers specific advantages". The use of mobile devices in the learning process enables spontaneous and interactive learning activities across multiple contexts. For the most parts, mobile language learning occurs outside of formal learning settings, such as while commuting, instead of within a classroom. Thus, it gives way for a shift from a mainly formal oriented learning activity to a rather informal learning approach. Among the most common areas for mobile-based language learning are vocabulary learning, listening tasks, grammar tasks, phonetics and reading comprehension (Miangah, 2012). Educational apps for mobile language learning are becoming more and more accepted and popular among mobile users. Sweeney/Moore (2012) discuss four major aspects which need to be considered for the design of such mobile language learning apps: (1) The mobile app design should allow for interactivity, (2) the learning resources should include multimedia contents, (3) utility and functionality of the learning resources should be fostered by contextual relevancy, and (4) the app design should increase autonomous and personalized learning. In this perspective, the impact of the learning context on the learning process as proposed in aspect (3) is crucial to the subject of this paper. Wang (2004) also emphasized the importance of developing context-aware, wireless and mobile learning apps. After sensing the learning context, e.g. location, activity, or learner state, the system can react to changes in the learning environment, with the scope to provide learners "…more relevant information to meet their dynamically changing contextual requirements" (Wang, 2004). Hence, the mobile device can be seen as a mediator to provide language learning opportunities in real-world interactions through context-aware app features that enable new modes of contextualized mobile learning.

3. RESEARCH OBJECTIVE AND MODEL

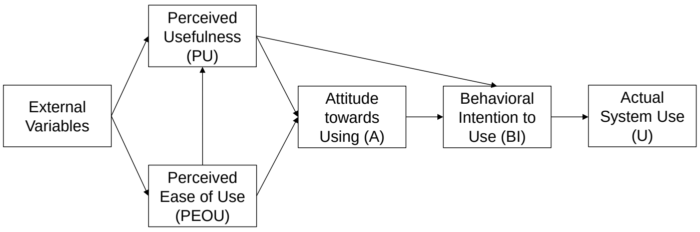
The objective of this paper is to empirically analyze the importance of contextuality on mobile learning acceptance. For this reason, the study is based on an app concept for a "Contextual Language Learning (CoLaLe)" app. The concept of the CoLaLe app and the proposed research model are discussed in the following sections of this paper.

3.1 CoLaLe App Prototype

The proposed app intends to use the location-context dimension to provide language vocabulary learning activities for German and Thai. The motivation to implement such a feature in a language learning app was to utilize the advantages of personalized learning (Duo and Ying, 2012) and make the app usage more independent from the learners' initiative by introducing an external and context-aware trigger. Another aim was to increase the user acceptance of such an app by providing learning content with a high relevance to the user and his or her actual usage context. For this reason the app concept introduced location triggers that induct game-based vocabulary learning activities. The learning activities are based on sessions with flashcards containing textual, visual and audible representations of the vocabulary. The flashcards are deposited in predefined categories (e.g., study, home, food etc.), which are linked to certain contexts, such as location dependent learning sessions (e.g., home, university, restaurants). The linkage of those sessions to the app's location-filtering function can be personalized via a map-based user interface. In a first step this contextual feature allows the user to localize the actual position (e.g., GPS based). In a second step the user can then define an area around this position as relevant for the selected session. This area is then used as a "geo-fence" to trigger learning sessions by sending a push notification on the smartphone each time the user is entering this area. This context-aware feature of the app provides a new learning experience in which the learning content is directly coupled with the actual user context. However, at the time of the study at hand, the CoLaLe app was in the concept phase and not available as a market-ready mobile application to be tested in the field. For this reason, a high-fidelity prototype was developed to present the study participants with the intended user interface design and functionality. To expose the participants to the CoLaLe prototype, they were shown a short video that demonstrated the key features mentioned above. The video allowed a very realistic presentation of the visual design and a simulation of the app usage. The prototyping approach was also chosen to provide a standardized stimulus in order to prevent bias from usability problems or varying app usage in the test situation.

3.2 Proposed Research Model

In order to answer the research question in this study, a structural equation modelling (SEM) approach was chosen. In SEM, a path model illustrates the hypothesized relationships among the variables of the research subject. The constructs of the structural model and their hypothesized relationships derived in this paper are adopted from the use of Davis' (1989) TAM in prior mobile learning acceptance studies. TAM has successfully been implemented to predict behavioral intention of mobile learning usage and is therefore the basis of the structural model development in this paper. TAM uses the two main constructs perceived usefulness (PU) and perceived ease of use (PEOU) as the accounting determinants of the actual system use (U), which is further predicted by the key constructs user attitudes towards use (A) and behavioral intention to use (BI) in Davis' model. Figure 1 illustrates the TAM and the relationships between the different constructs. In his initial survey to verify the influence of TAM's key factors PU and PEOU, Davis (1989) found that PU as well as PEOU are indeed key determinants of BI to use an information system.



Source: Davis et al., 1989.

Figure 1. Davis' Technology Acceptance Model

Lee/Jun's (2007) provided the first impulse for the derivation of a perceived contextual value (PCV) construct to extend Davis' TAM. Lee/Jun added the context dimensions of personalization, location, and time to measure PCV, though not specifically applied in a mobile learning context. A similar construct in the mobile learning context was proposed by Huang et al. (2007) who created the perceived mobility value (PMV) construct in order to evaluate BI to use a mobile learning system. Huang et al. postulate that efficiency and availability of mobile learning services are perceived as main advantages of mobile services, and conclude that PMV is "…a critical factor of individual differences affecting users' behaviors" (Huang et al., 2007). In line with this PMV construct is Akour's perceived mobile convenience (PMC) construct to measure the impact of contextual app features. Akour proposed to add the dimensions of mobility, convenience, and ubiquity (Akour, 2009). Thus, this study proposes to add PCV as a mobile learning specific construct to predict BI in the mobile adapted TAM. As a result, the research model in this paper was based on three exogenous latent variables which were perceived usefulness (PU), perceived ease of use (PEOU), and perceived contextual value (PCV). The model was also based on an endogenous latent variable which was behavioral intention (BI) of learners towards using the CoLaLe app. Figure 2 illustrates the structural model, which depicts the research hypotheses and illustrates the relationships between the assigned exogenous and endogenous latent variables.

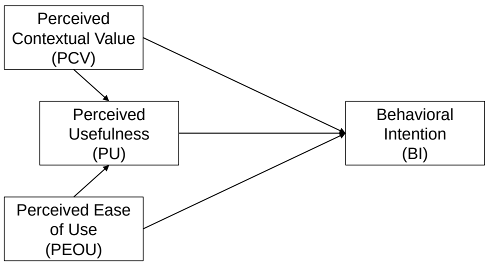


Figure 2. Proposed Research Model

The operationalization of PU, PEOU, and BI was based on reference questionnaires as applied in Venkatesh/Davis' (2000) TAM study. The PCV construct used manifest variables that were adapted from different studies that investigated contextual factors in mobile learning acceptance, i.e., from Akour (2009), Huang et al. (2007), as well as Lee/Jun (2007). Each of the four constructs were based on reflective measurement models. The items had to be translated into German in order to be applicable for the survey and were measured on a five-point Likert-scale. All the TAM-related questions were included in a section of the questionnaire which was presented to study participants following the demonstration of the CoLaLe app by the video prototype as discussed in Section 2 of this paper.

4. EMPIRICAL FINDINGS

The online survey was published on June 1st 2014 and accessible for three weeks until June 21st. The survey focused on students and young professionals between 18-29 years who were familiar with mobile technology. After the data collection phase, the data was examined for potential collection issues, such as missing data, followed by data distribution for the path model evaluation. At first, the total sample (n=92) was checked for aborted cases, which resulted in a reduced net sample size of 45 completed cases (n=45). Almost 96 percent of the survey participants indicated that they use a smartphone, whereby 51 percent own an Android phone and 47 percent an iPhone. Fifty three percent of the participants have already used their smartphone for mobile learning purposes. When asked about the area of application, the participants reported they used mobile learning for study purposes (58 percent), private purposes (33 percent), or job related purposes (4 percent). Eighty three percent of the mobile learning users reported installing a mobile app dedicated to mobile learning on their devices. When asked about their perceptions towards the effectiveness of language learning supported by a mobile language learning app, 50 percent of the respondents were indecisive, twenty five percent had a positive attitude towards mobile supported language learning and the same percentage disagreed with this statement. Mobile assisted language learning seems to play a rather subsidiary role in the participants' language learning approaches. From the 31 percent of the respondents who already used a mobile language learning app, vocabulary learning is the most supported language skill (93 percent), followed by comprehension (71 percent), reading (57 percent), and speaking (50 percent).

The software package *SmartPLS 2.0* was used for the empirical validation of the research model (Ringle et al., 2005). Before being imported into *SmartPLS*, the net sample was examined for missing values and non-normality of the data. Missing data was not an issue, but the tests on *skewness* (distribution symmetry) and *kurtosis* (distribution summits), as suggested by Hair et al. (2014), revealed conspicuous indicators with values exceeding the acceptable range. Hence, the respective indicators measuring the reflective constructs PCV and PEOU were removed from the measurement model. The model evaluation in PLS-SEM was based on a two-step process. The first step intended to assess the quality of the measurement model. The second step contained the assessment of the predictive ability of the structural model (Hair et al., 2014). Unlike other methods in multivariate SEM analysis, PLS-SEM cannot be assessed by a single goodness-of-fit criterion to indicate the predictive ability of the model or its quality. Rather the evaluation of measurement and structural models rely on a set of nonparametric evaluation criteria and procedures to indicate the model quality. The first step in evaluating the reflective measurement model was to attest construct reliability which shows how well a construct is measured by its assigned indicators (Götz et al., 2010). For construct reliability, the outer loadings of each indicator should be higher than 0.70. All outer loadings of the 13 measurement items were tested and the results were above this threshold value. The reliability of the measurement model is evaluated based on its *composite reliability* (CR), which assumes that all construct indicators jointly measure the respective construct adequately. The CR values can vary between 0 and 1. CR values above 0.70 are acceptable (Hair et al., 2014). As Table 1 indicates, the CR values exceeded the threshold value 0.70, whereby all reflective constructs possess acceptable levels of internal consistency reliability. The measurement model was also tested for convergent validity by the consideration of the *average variance extracted* (AVE) on the construct level. AVE threshold values of 0.50 or higher indicate that the respective construct explains more than half of the variance of its assigned indicators. AVE values lower than 0.50 are considered insufficient, because more error variance remains in the items than indicator variance explained by the construct. As shown in Table 1 the AVE for all latent variables are well above the level of 0.50. Hence, all indicators in the reflective measurement model have high levels of convergent validity. Finally, the *discriminant validity* was assessed based on the Fornell-Larcker criterion. The *discriminant validity* describes the extent to which a construct in the measurement model is indeed dissimilar to other constructs by empirical standards (Hair et al., 2014).

Table 1. Measurement Model Reliability and Validity Analysis

Latent Variable	Measured Item	Outer Loadings	Composite Reliability	AVE
BI	BI_1	0.9664	0.9664	0.9349
	BI_2	0.9675		
PCV	PCV_1	0.7719	0.914	0.6805
	PCV_2	0.8583		
	PCV_3	0.8310		
	PCV_5	0.8017		
	PCV_7	0.8584		
PEOU	PEOU_1	0.8960	0.8969	0.8131
	PEOU_2	0.9073		
PU	PU_1	0.9062	0.9362	0.7859
	PU_2	0.8578		
	PU_3	0.9119		
	PU_4	0.8688		

According to the Fornell-Larcker criterion, a latent construct's AVE has to be higher than the highest squared correlation of this construct with any other latent construct in the measurement model (Götz et al., 2010). Table 2 depicts the results of the Fornell-Larcker assessment. The AVE's square root values of each latent construct (on the diagonal) are higher than the correlation coefficients (lower left triangle) between the latent constructs in the path model. This supplies evidence that the measurement model's measures are reliable and valid. A revision of the measurement model was not necessary.

Table 2. Results of the Fornell-Larcker Criterion Assessment

	BI	PCV	PEOU	PU
BI	**0.9669**			
PCV	0.5976	**0.8249**		
PEOU	0.3101	0.2819	**0.9017**	
PU	0.7351	0.5582	0.4582	**0.8865**

In a second step the structural model, comprising the hypothetical relationships among the proposed constructs, needs to be evaluated. The examination of the structural model will concentrate on the assessment of the R^2 measures and the evaluation of the significance of the path coefficients as the primary evaluation criteria. In our path model, the two endogenous constructs are PU and BI. Following the threshold value of 0.20 (Hair et al., 2014), the R^2 values for PU (0.401) and BI (0.593) can be considered moderately high. Hence, the predictive capability of the parsimonious model, in general terms, can be interpreted as acceptable. Path coefficients, corresponding to the hypothesized relationships among the constructs, are expressed by standardized values between -1 and +1. In order to determine the quality of the structural model, the path coefficients' significance has to be assessed. Here the significance was tested based on an error probability of five percent ($p<0.05$), assuming a critical value of 1.96 for the two-tailed t-test. The standard error in PLS-SEM is obtained by bootstrapping in order to compute t-values to apply the two-tailed test. The results in Table 3 indicate that all path coefficients in the structural model, besides PEOU towards BI, are significant.

Table 3. Path Coefficients' Significance Testing (Bootstrapping Results)

	Path Coefficients	t-Value	Significance
PCV → BI	0.2737	2.2317	*
PEOU → BI	-0.0428	0.3594	n.s.
PU → BI	0.6019	4.8197	*
PCV → PU	0.4660	4.3288	*
PEOU → PU	0.3269	2.6545	*

Note: n.s.=not significant; *p<0.05

In summary, the path model showed satisfactory explanatory power for the behavioral intention (BI) to use the CoLaLe app. All path coefficients showed sufficient values that exceeded the zero-mark for rather weak relationships, except the relationship of PEOU on BI. However, the significance testing of the path coefficients in the path model revealed high significance, besides the aforementioned path of PEOU on BI being non-significant. Overall, the results of the analysis showed that PU had the strongest magnitude on BI with a path coefficient of 0.6019, followed by the high impact of PCV on BI with 0.2737. In contrast, PEOU has very little bearing on BI (-0.0428). Moving on in the model, PCV (0.4660) was the primary driver for PU compared to the influence of PEOU (0.3269) on PU. After having conducted the acceptance study, the findings provided sufficient evidence for the viability of the path model, and showed mostly consistent correlation with the proposed theoretical foundation.

The overall capability of the model to predict BI echoes the results of prior mobile adapted TAM studies as cited by Huang et al. (2007) and Akour (2009). In fact, the results revealed that PU possessed the strongest predictive relevance for BI relative to the other independent constructs PCV and PEOU. Thus, the findings indicate that PU is a key driver for the prediction of the user's intention to use the system, as suggested by *Davis* (1989) or subsequent studies on mobile learning systems. However, the analysis also revealed that PCV has a strong relationship to BI and is a key predictor for PU as well. As hypothesized, increased PU and positive BI to use the contextual mobile language learning service can be traced back to a perceived contextual value (PCV). According to that, it can be assumed that the proposed contextual value delivered by the contextual app feature does indeed contribute positively to the overall intention to use the app. The observation confirms the findings by Huang et al. (2007) who recommended that to maximize the usefulness of mobile learning, system features should be added to increase the perceived mobility value of the user. With regards to the CoLaLe app, this would increase the users' intention to use the app as well as their perceived learning effectivity. The findings indicate that the students understood that the location-aware feature of the CoLaLe app was a driving factor in their perceived usefulness of the system. The perceived easiness of the system plays no significant role in the adoption and use of the contextual mobile language learning service. Additionally, the predictive relevance of PEOU for PU in comparison to PCV was rather meager. Venkatesh et al. (2003) made a similar observation, and found that the predictive importance of PEOU in the model diminishes over time.

5. CONCLUSION

The scope of this paper was to explore students' perceptions of contextualized mobile language learning. Therefore, mobile adopted TAM models where used to construct the research model. The main interest of the study was to evaluate the extent to which the contextual app feature would contribute to the prediction of the students' intention to use the proposed CoLaLe app. The results of the PLS-SEM analysis revealed, on the one hand, that students perceived the proposed CoLaLe app as beneficial for their learning endeavors, while the targeted students in the sample where mainly concerned about the perceived usefulness of the system. Herein, the a priori hypothesized strong impact of the students' perceived usefulness on their intention to use the CoLaLe app was found to be a major influencing factor in the model. The students aspired to support their language learning routine with technology only when it offered genuine assistance. On the other hand, the results emphasized the overall magnitude of the perceived contextual value in the model. The students expressed that the location-aware feature of the CoLaLe app was essentially relevant in regard to their perceived usefulness of the system, as it may increase the learning effectiveness and contribute to usage scenarios in their everyday life. Moreover, situated learning activities that pervasively transfers language learning into the immediate informal learning context of the student may increase the motivation of the student to engage in a learning activity. As a next step, it would be interesting to survey whether the perceived effectiveness of the students when using the CoLaLe app for language learning factually results in increased learning success. It is persistently believed by the authors of this paper that contextual app features applied in mobile language learning can impact the success of, in this case vocabulary learning, if applied appropriately.

The study presented in this paper was subject to a range of limitations. One major constraint was the collection of the survey data. The survey solely took place among technology- and media-affine students, which inevitably resulted in quite a homogenous population in the sample that otherwise would not be desirable. Moreover, the sample size of the survey was rather small (n=45). Although this was enough to run the PLS-SEM analysis of the path model in *SmartPLS*, the net sample size should be increased for future research. Further limitations that have to be noted regard to the deduction of the path model. Although in the spirit of Davis' (1989) to treat TAM as a parsimonious model, the path model in this paper excluded further external variables in the adoption of the TAM model that have been validated in prior mobile learning studies. Further research may tie in to this and include external variables in the path model that refer to social, cognitive, or environmental factors in the context of mobile learning.

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DO MOBILE LEARNING DEVICES ENHANCE LEARNING IN HIGHER EDUCATION ANATOMY CLASSROOMS?

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ABSTRACT

Recently there has been an increased volume of research and practice of mobile Learning (mLearning) and in particular of the tablet device. The question of how, when and where to best incorporate the tablet device into the learning environment in Higher Education remains largely unanswered. The article presents the findings of an empirical study that examined the effect of integrating mobile learning tablet devices into first year University anatomy seminars in a group of Sport and Exercise students. Data on student achievement, attendance and feedback was collected over two academic years and two cohorts, comparing seminar groups taught with tablet devices (iPads) integrated with traditionally taught anatomy seminars. The results indicate that the iPads had a positive effect on attendance, achievement and retention, highlighting the need for a framework as to how the tablet should be incorporated to maximise the learner experience. This article offers insight into the implications of successful mLearning using tablets and into how we, as educators might use the tablet device as a tool to provide a more engaging, successful learning environment which positively impacts on student achievement and independent truly mobile learning outside of the classroom.

KEYWORDS

Tablet, mobile Learning, iPad, Higher Education, anatomy, engagement

1. ANATOMY EDUCATION IN HIGHER EDUCATION (HE)

Anatomy is an integral part of any Sport and Exercise programme of study as well as core to medical and veterinary degrees. Within a Sports Science/Rehabilitation programme students are required to construct a comprehensive and sophisticated understanding of basic anatomy, and then apply that information to the athlete for performance, health or rehabilitation (Ward and Walker, 2008). Anatomy requires students to learn a large volume of Latin terminology and functions including muscle names, origins, insertions, joint, connective tissue and cellular gross and micro anatomy. Students traditionally use a rote or surface learning approach and have suggested anatomy is “boring, hard, dull” in previous literature (Noguera, 2013; Hopkins, 2011). Miller et al., (2002) discusses the perception of anatomy as a subject, primarily for health practitioners but agrees that the common misconception is the reliance on memorising words and facts without the subsequent gross understanding and fundamental concepts.

In medical students, a high workload, volume of new information, and the pressures of a vocational course often cause students to prepare for exams using ineffective study methods for long-term recall potential which could limit understanding (Radcliffe and Lester, 2003). Moreover, some learners continue using the first study method they adopt, no matter how detrimental such practices eventually become to their success and long-term recall (Newble and Gordon, 1985). The integration of study skills into most degree programmes has hopefully positively influenced this. There is, however, still evidence of single method and reliance on copying, memorising and visualisation (Ward and Walker, 2008; Miller, 2002).

2. MOBILE LEARNING IN HIGHER EDUCATION

Traxler, (2013) defines mobile learning (mLearning) as learning using mobile technologies such as mobile phones, smartphones, e-readers and tablets, and argues that these devices offer ‘unparalleled access to communication and information'. The suggestion that the increased affordability and functionality of mobile technology compared to technologies previously used in education means they can support learning in new ways within the classroom and at home. Much of the research into tablet education has been done in school-aged learners but the integration into HE has been less uniform, mirroring the inconsistent use by HE academics (Nguyen et al., 2014).

mLearning is purported to educate the learner to identify how and where they learn best hence increasing the autonomy of the learner. Personalisation of learning is highlighted as an important factor in engagement and mobile technologies claim to allow the student to contextualise and take ownership of their own learning (Clarke and Svanaes, 2014). They also bridge the gap between formal and informal learning environments and transcend environmental limitations.

Smartphone and tablet devices have also been highlighted as being influential in improving the feedback process between staff and students allowing greater understanding of the wider learning process. Mobile applications such as Skype, audio playback, FaceTime and other social media and communication portals have been identified in the feedback process and therefore in the students' increased ability to achieve their potential. Furthermore, mLearning allows students to access education in a flexible and seamless manner, at any time and any place, which substantially increases their access to learning. Moreover, m-learning offers the potential for significant innovation in the delivery of even more flexible education by allowing for the personalisation and customisation of the student learning experience (Johnson et al., 2011).

Mobile devices and apps are critical in the potential of provision and adoption of m-learning (Mang & Wardley, 2012). Not surprisingly, there have been many attempts to explore how iPads or other tablet devices could be used in the education sector around the world (Lindsey (2011)); Brand, et al., (2011)) but mainly in school-age students.

2.1 The Role of the Mobile Learning Device in Teaching

The tablet has been found to help engagement and potentially enhance students' learning experience (Brand et al, 2011; Perez et al, 2011). The concept of engagement has been contested as to how it can be measured and is therefore not a reliable outcome and although students perceived them to be positive to learning they had no measurable effect on achievement of learning outcomes in final module results. (Perez et al, 2011). Other research of various designs agrees that tablets generally receive a positive reaction from students, however cannot directly be linked to an impact on their grades. Positive areas identified from the research are deeper learning material resources from YouTube, Google Scholar and Blackboard (Alyahya & Gall, 2012). In addition, students often used tablets for information seeking (Geist, 2011;Wakefield & Smith, 2012) notetaking and presentations in class. Photos and videos (Hahn & Bussell, 2012; Mang &Wardley, 2012; Sloan, 2012) were seen to be a positive and generally seen to increase efficiency in group work (Geist, 2011). A consistent finding, however, across several studies was that the tablet could potentially be a distraction because of non-educative usage (Kinash et al, 2012;Wakefield & Smith, 2012) agreeing with many academics. The scepticism of many academics of the research (Hargis et al, 2013; Link et al, 2012) was most often because of its role as a potential distraction, however, this may highlight behavioural management and pedagogical limitations rather than a direct association with the tablet device. Link et al (2012) reported additional concerns including regarding percentage of tablet ownership and the need for a clear role and space of the mobile learning device in the classroom to avoid its distraction. The proportion of academics utilising tablet devices in classes ranges from 20% (Yeung & Chung, 2011) to 37% (Lindsey, 2011) but many more reported using it for administrative tasks and meetings. Vu et al., 2014 investigated student-teacher use of the tablet in secondary aged classes finding that interactive time increased with one tablet for each group as opposed to one tablet for each student, leading to improved group work. The least positive teacher comments from the qualitative data was from those who used the tablet as a teacher tool, one per class and therefore the level of active learning increase was not apparent.

In a review by Nguyen et al., (2014) they suggest that not only do the long term effects of the iPad and tablets need to be investigated further but also the pedagogical transformation they can have on teaching methods, curriculum and classroom dynamics. The aim of the current study is to investigate the impact of integrating group mobile learning tablet devices in first year Higher Education Anatomy seminars on achievement and attendance.

3. METHODS

No data was collected that was not part of the normal academic procedure, and so deemed ethical by the University Department sub-committee and an action research methodology was used for practitioner inquiry. The study was part of a wider project where this study was based on grounded theory as the initial phase of a long term action research project. 6 iPads were bought using a successful Teaching and Learning bid by the department which were all enabled with Wi-Fi and the relevant apps needed for the module uploaded prior to the module run.

There were 12 whole group lectures, 24 seminars and four assessments throughout the course which is part of a 24 week core level 4 module of an Undergraduate Sport and Exercise (SES) degree programme. The lectures were taught during semester one by the module leader. In the 2012-13 academic year the level 4 module was split into eight seminar groups of 20 students as per the normal timetabling for the module. Six seminar groups were taught with iPad activities integrated into the seminars, two used traditional teaching methods with no classroom orientated technology; this was repeated in 2013-14. No students were knowingly disadvantaged and all students followed the same content and online learning activities, the only difference being the addition of the iPads. The iPads were available in all seminars but were utilised as part of group tasks depending on the session. This included Socrative™ teacher-paced plenary quizzes, Real Bodywork™ Muscles and bone and skeletal 3D apps as well as the video features and apps such as Flipagram™ and Magisto™ alongside more traditional tools such as Youtube™ and Safari/internet. In each session, a lesson plan was used as is normal which was the same across all eight seminars; the six iPad groups had the tablet specific tasks integrated at specific points. Tasks were designed to encourage group learning and opportunities for independent mLearning. For example, students were encouraged to use the Real bodywork apps outside of the seminars and videos made in class were published on the VLE via Youtube to allow student owned revision aids to access autonomously.

3.1 Anatomy Assessments

There are four points of assessment throughout the course, A1, A2, A3, and A4 as shown in Table 1. The module aims to give students the fundamental anatomical knowledge to apply to the Sports Science arena and is assessed on Moodle using a time limited multiple choice quiz (MCQ) (A1, A2, A3) that the students completed in a controlled examination environment. A4 is a viva voce lasting 15 minutes where students were asked to utilise the skeleton and coach exercises to show applied knowledge and understanding on the topic.

Table 1. Anatomy assessments

Assessment	**A1**	**A2**	**A3**	**A4**
timing	8	14	20	24
type	Online MCQ	Online MCQ	Online MCQ	Viva voce
Content	Anatomical microstructure	Applied gross anatomy (lower limb)	Applied gross anatomy (upper limb)	Applied gross anatomy (trunk and nervous system)

3.2 Participants

In 2012-13 the total number of students completing the module was (N=128); the iPad group (N= 101) and the Traditional group (N=27) and in 2013-14 the total number of students (N=123) split into traditional (N= 33) and iPad (N=90) students for seminar teaching. Therefore whole group data (N=251) consisted of the iPad group (N=191) and traditional group (N=60). Students who did not complete two or more assessments were excluded from the data analysis as non-completers. All students had access to online activities and suggested independent mLearning activities from the lead lecturer. Learning Style was suggested from the Learning Style Preference questionnaire (Reid, 1992) measured as part of the professional skills module. Measures of Achievement and Engagement were recorded; Attendance, Achievement, completion and qualitative online feedback. There was a discussion board and feedback questionnaire which allowed the students to provide feedback throughout the year.

No significant differences between the groups for Learning Style or Group vs individual Learners ($p>0.05$); 34.9% Individual Learners; 65.1% Group Learners were identified. The numerical data was tested for normality using a Kolmogorov–Smirnov test and was assumed to be parametric ($p>0.05$). The data was analysed using independent t- tests and within-subject ANOVAs using a 95% confidence level.

The online qualitative feedback was voluntary with only 3 open questions; asking for positives, areas for improvement and any areas where they felt they needed additional help. Feedback was analysed with respect to themes being identified from the responses. The positive themes identified were; fun, iPads, models, quizzes. Only 2 areas for improvement were stated out of the 96 responses and therefore deemed too few for analysis.

4. RESULTS

4.1 Retention

The mean completion rate for the module was 94.6%, the iPad group 96.3% and the traditional group, 93.6% after the resubmission board. The completion rate was 89.4% for the iPad group and 87.1% for the traditional group prior to the resubmission board. The iPad group had 6.1% non -submission for one or more assessment, the traditional group 9.6%.

4.2 Teaching Method

The mean whole group data was analysed for iPad (N= 191) and traditional groups (N=60) where the mean values for final grade revealed a significantly greater grade ($p<0.05$) for the iPad groups (57.9 ± 13.0 %) compared to those taught using traditional methods (52.2 ± 12.5%). A1, A4 and the A1-A4 difference were also highly significantly greater for the iPad group ($p<0.01$). Using an independent t-test all of the values were shown to be significantly greater ($p<0.05$) at the 95% confidence level (Figure 1). There was no significant difference between the two years and therefore only whole group data is presented.

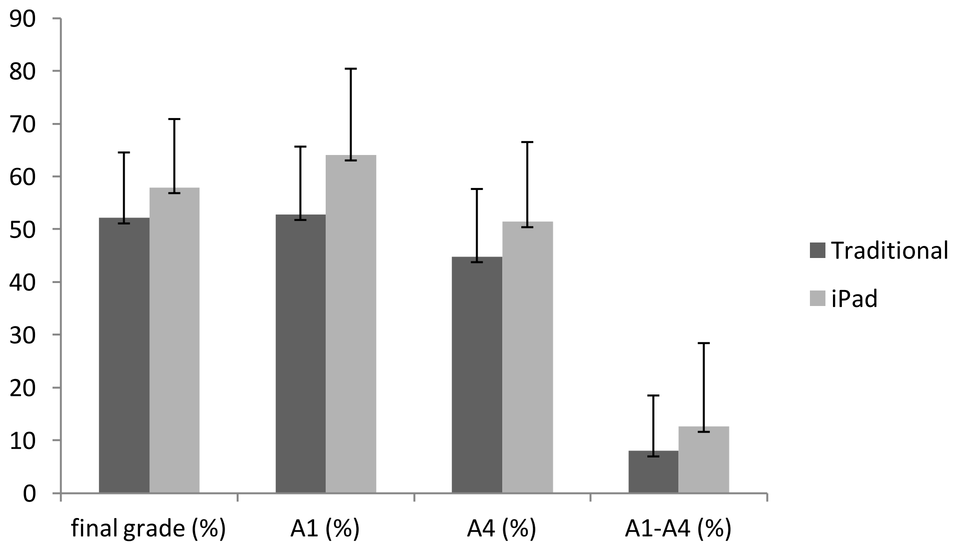

Figure 1. SES achievement scores for iPad and traditionally taught groups

A1 was used as the baseline reading as the first assessment based on anatomical theory; a within subject ANOVA followed by a Tukey post hoc test was used to compare achievement between A1, A2, A3, A4 assessment points to see how the two groups (tablet and traditional) performed at each. In the iPad group there was a highly significant improvement at all assessment points compared to their baseline A1 score ($p<0.01$). In the traditional group there was a significant improvement between A1 and A4 ($p<0.05$), but at no other assessment points. The mean improvements between A1 and A2 were 4.8± 24.0% in the traditional group and 7.7± 20.1% in the iPad group. Between A1 and A4 the improvement was 9.4±21.4% in the traditional group and 13.8±19.8% in the iPad group.

4.3 Attendance

Attendance data was analysed for iPad (88.6 ± 8.9 %) and Traditional groups (77.4 ± 9.8 %) across both years revealing a significantly greater attendance in the iPad taught groups compared to the traditional groups ($p<0.01$).

5. DISCUSSION

The purpose of this investigation was to identify whether using tablets in first year Anatomy seminars was beneficial to student achievement, attendance and retention. The initial hypothesis was that the groups being taught with tablet activities and access integrated into seminars would have better achievement scores than those who did not. This was accepted for where those students using tablets in classes had consistently greater scores across all of the assessment points in the year. The students were randomly assigned to their groups as per normal timetabling and no differences in standard entry point criteria or learning style was observed. A1 was performed in week eight of semester one and therefore no true baseline data for the two groups was measured so it can only be assumed that the level of knowledge in week one would have been consistent between the two groups.

Weekly strategies employed in the tablet integrated seminars included using Real Bodywork Muscles and Skeletal 3D apps which are highly visual anatomical learning tools with quiz and labelling games functions. Quizzes were used at the beginning of each session to stimulate knowledge recall from their previous learning as well as after a task to further assist in learning the new topic. Quizzes have been suggested to help motivate students to complete autonomous learning tasks, increase participation in class discussion, and improve performance on exams for material covered both on the quizzes and in class (Hillman, 2012; Brothen & Warmback, 2004; Johnson & Kiviniemi, 2009). Although we cannot specify how the tablet increased achievement, the use of quizzes as a group learning tool could potentially have an effect. The traditional and iPad groups both had access to all online learning material and weekly quizzes on the VLE and again, If our students behaved like those in Johnson and Kiviniemi, (2009) it could be suggested that use of mLearning quizzes in class could increase interaction with the VLE quizzes independently therefore positively impacting on out of class engagement. Measures of interaction with the VLE (by number of clicks, visits and external links accessed) and attempting to measure the use of the sources introduced in seminars accessed via mLearning on student owned tablets or smartphones independently are areas requiring further investigation to look at the effect on true mLearning.

However, the increased achievement seen in our students who were taught using tablets disagrees with Perez et al., (2011) who found no direct link to achievement even though they were seen to be a positive addition to classes. This study was performed on engineering students where the focus was on problem based learning whereas the fundamentals of anatomy requires a large volume of surface learning prior to application which may account for the differences in achievement recorded. This could also be an indication of the successful integration of the tablets to complement traditional teaching methods which is an area that requires further investigation.

A1 was used as an indication of baseline knowledge; A4 was a traditional viva voce examination where students were asked to apply the theory. The drop in grade between A1-A4 was significantly less in the tablet taught group compared to the traditionally taught groups suggesting that the Tablets were a positive in terms of knowledge retention and their ability to apply information or deeper learning. It has been suggested that students actively adapt their study approaches to suit the demands of a particular subject where anatomy requires some degree of both surface and deep processing to achieve (Willis, 1993). Developing classroom activities that draw information from multiple sources is thought to encourage students to adopt deep-processing methods that will improve retention. The tablet is a tool that allows this to occur via a common vehicle with multiple functions and apps alongside traditional classroom activities. Achievement was compared within-student between A1,A2,A3 and A4 assessment points where the tablet taught students showed a significant improvement at all points, the traditional, only between A1 and A4. This further compounds the suggestion that the tablets helped increase achievement and possibly allowed a faster transition from surface to deeper learning strategies or just as tools for engagement resulting in deeper learning.

In employing new technology in the form of tablets in class, there was always a risk that the learning itself would be eclipsed by the novelty of the delivery platform or that it could be the novelty value that has the positive or Hawthorne effect (Brand et al., 2011). However, this was not the case as the increases in grade were maintained across all assessment points indicating that the effect of the tablets was consistent throughout the year in both 2012-13 and 2013-14 cohorts. The novelty factor of the tablet has been discussed across all ages of learners (Mitchell, 2014) but there seems to be an agreement that the novelty factor should be utilised by the educator. The increased sensory input and novelty factor of the tablet to provide a fun, visual way of active learning can lead to increased engagement and if they are embedded into a course carefully this motivation should be maintained.

The second hypothesis was that tablets would improve student engagement. This could be construed to be in part measured by achievement but in this case attendance was used as a partial measure of engagement. Tablets have been found to help engagement and potentially enhance students' learning experience (Brand et al, 2011; Perez et al, 2011) which our study is in agreement with. If students are more engaged in their classes, attendance has been shown to improve, although it does not indicate independent outside class engagement (Junco et al., 2011). Attendance was significantly greater in the tablet classes suggesting that the results of our study agree with the bulk of the literature. Attendance can of course be affected by many things but students who enjoy and are active in their learning experience maintain higher contact levels.

As in other studies utilising this form of technology, the introduction of tablets into seminar sessions seems to have been an overwhelmingly positive experience for the student group, with 97.2% of students in this study in agreement that their addition was positive (Bonds-Raacke and Raacke, 2008). The qualitative feedback suggests that mLearning using tablets is being utilised effectively to complement traditional practice.

"I really liked the variety in the seminars. That we use bones, blue-tack, make video, iPads and worksheets. It makes the learning more fun, and I find it easier to understand. I also enjoy that we work in groups" (Participant A).

"Anatomy seminars are the sessions i look forward to most. I learn kinaesthetically and visually so the use of the iPad fits my needs perfectly. I feel comfortable answering questions whether it's right or wrong as i know you'll push me towards fixing any wrong answers i may provide :)" (Participant B)

"I find that the seminars are far more useful in learning anatomy. Although the lectures were useful to bring people to the same level for the first few weeks, I am glad we no longer have them as the seminars offer more direct and hand on learning through the skeletons and iPads"(Participant C)

The feedback would suggest that the tablets added value to the learner experience and classroom environment without detracting from other pedagogical methods. iPads featured in 42 of the 96 responses in the online feedback and was the most occurring theme identified. Previous research has identified iPads as a possible distraction in class (Hargis et al, 2013; Link et al, 2012; Rossing et al, 2012), however, due to the structured manner in which they were integrated into the seminars this did not seem to be the case; if anything they were seen as a group cohesion tool. Link et al., (2012) identified the requirement for a clear role and time for the tablet to be used; the results from this study consolidate this as a necessity.

The only negative comment regarding tablets was that there should be more of them or given out individually by the university. This is an area that should be studied further, as to whether the tablet is similarly positive for the student as an independent tool or whether using a tablet or smartphone in class increases autonomous mLearning.. This was of course constrained by the budget of the project but it is thought that individual tablets could detract from the group learning environment and therefore limit peer feedback and sharing of ideas. This was the case in the study by Vu et al., (2014) where the most effective use was one per group as opposed to individual devices.

The study has a number of limitations inherent in this type of pedagogical research. The study has limited generalisability because it was only performed on two cohorts over two years in a single module at one University. It has, however, the advantage of having a control group, in part due to circumstance and timetabling. Furthermore, students' previous experiences of mobile learning and tablet use were not established and the qualitative feedback was voluntary and unstructured.

6. CONCLUSIONS

We can conclude from this study that integrating tablets and app-related learning material into Higher Education anatomy classes had a positive effect on student achievement and attendance. In a subject already utilising active learning through traditional methods the addition of technology via quizzes, 3D visual material and access to the internet could be an alternative method of engaging students in the learning process. Group learning environments can stimulate a positive learning environment through peer feedback, knowledge sharing and discussion, resulting in deeper learning; the tablet is a tool which can facilitate this. We need to develop a framework in agreement with Nyugen et al., (2014) setting out how tablets are best used in the classroom environment to maximise the effect on engagement and achievement. This will then enable researchers to take the next step and investigate whether facilitated use of mLearning devices in class transitions the students to increased independent use and autonomous engagement with mLearning outside of the classroom. Educators should look to use tablet devices and the applications it enables as part of an integrated seminar experience to enhance the learner experience and provide a vehicle for further use of mLearning via tablet or smartphone device. Educators may want to view seminar or taught experiences as a tool for students to "learn to learn" how to effectively use mLearning as opposed to expecting independence away from the classroom without this facilitation.

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IT'S NOT JUST THE PEDAGOGY: CHALLENGES IN SCALING MOBILE LEARNING APPLICATIONS INTO INSTITUTION-WIDE LEARNING TECHNOLOGIES

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ABSTRACT

Whilst m-learning pedagogy has received considerable attention (e.g. Sharples et. al. 2007, Kukulska-Hulme, 2012), the process of adopting this potentially disruptive innovation within universities has been neglected. Based on a PhD thesis (Bird, 2014), this paper presents some of the findings from a longitudinal study which examined the adoption of m-learning projects in five UK higher education institutions in the period 2008 to 2011. Many m-learning projects have been started as pilots often as a result of external research funding. Using Actor-Network Theory to model embedding trajectories, this paper looks at how the outputs of these projects are encapsulated into wider institutional IT strategy to become institutionally embedded learning technologies.

KEYWORDS

M-Learning, Embedding Actor-Network Theory

1. INTRODUCTION

This research has treated m-learning as an innovation and considered a number of appropriate theoretical approaches including Rogers' innovation diffusion framework (Rogers, 1962), Actor-Network Theory (Latour, 2005) , Activity Theory (Engeström, 1987), Structuration Theory (Giddens, 1984), Disruptive Innovation (Christensen, 1997) and the Technology Acceptance Model (Venkatesh and Davis, 2000). Actor-Network Theory (ANT) was chosen as the most promising theoretical lens for an in-depth investigation of m-learning embedding, and a participative fieldwork approach was developed using the Law and Callon's ANT notion of 'points of passage' between local and global networks (Law and Callon, 1991) to illuminate factors that affect embedding. Examples of two institutional m-learning embedding trajectories taken from a three-year, longitudinal case study involving five universities using smartphone applications to assess students in medical practice, show a contrast in outcomes between institutions which have encapsulated project results in IT strategy and those which have lacked a process to achieve this. Several institutional issues are identified that help or hinder embedding, such as fragmentation of IT strategy and decision-making, and the need to provide students with access to multiple institutional services on their mobiles. The role of people and artefacts in forming a link, or 'point of passage', between m-learning projects ('local networks') and institutional IT strategies and services ('global networks') was found to be key to understanding processes of embedding.

2. M-LEARNING AND EMBEDDING

Although mobile learning researchers use the term embedding, they are mostly focusing on the learning method or model and how that can be maintained in the learning environment (e.g. Attewell, 2005, Kukulska-Hulme, 2012) asking the question is the pedagogy effective and can it blend with other learning methods? However, Traxler (2005) has discussed issues of mobile learning and institutional strategies and processes and gave pointers to potential problems such as impacts on teaching and work-life balance. He also pointed to issues around the technology in that it was unfamiliar to IT support staff and has different infrastructure issues than with PCs, in that mobile devices have a shorter useful life and cannot be installed in fixed areas (Kukulska-Hulme and Traxler, 2005). Traxler also discusses the challenge that m-learning brings to a university IT provision model which has been designed as a 'benign industrialisation and electrification of learning' (Traxler, 2010, p. 156) in order to deliver mass learning. M-learning is seen here as a potential shift in control from the institution towards the learner, requiring new ways of managing IT provision. A recent study of European mobile learning projects also acknowledges the apparent lack of strategy for handling this situation, asking 'to what extent are e-learning policy and initiatives taking account of research project results and the potential of mobile learning?' (Kukulska-Hulme et al., 2011, p. 152). However only Traxler (2005, 2009, 2010) has consistently referred to how such learning interacts with the university business model and especially its model of IT provision.

3. ACTOR NETWORK THEORY AND THE LAW/CALLON PROJECT TRAJECTORY

Actor-Network Theory (ANT) states that agency resides both in people and objects such as innovations insisting that all entities, both human and non-human, be subjected to the same process of social analysis (Law, 1994). ANT identifies the set of processes involved in projects of social ordering as networks and looks at the changes that take place in those networks through a project. ANT also has the concept of translation where the people, objects and processes have specific needs that then get translated into more general and unified needs which are all met by one solution. It also has the concept of irreversibility where a network is established and can resist competing translations to become irreversible. Actor-Network Theory provides a useful model for looking at m-learning as the various actors (the university, teachers, students, IT services, the innovation itself etc.) go through a process of translation to find a stable way of working together.

Actor-Network Theory has gained popularity as an IS research approach, particularly in looking at situations where technology is an agent of change (e.g. McMaster et al., 1999, Walsham and Sahay, 1999). Activity Theory (Engestrom, 1997) has been widely applied to m-learning (e.g. Sharples et al., 2007). As a theory it is well positioned to look at learning solutions but is it a good choice to model institutional embedding? Spinuzzi's (Spinuzzi, 2008) study of developing knowledge networks in US telecommunications organizations uses both ANT and Activity Theory to look at how a telecommunication service provider operates. He concludes that Activity Theory is better suited to looking at networks of learning and learning activities but that it had weaknesses in looking at links between networks, 'the boundary objects' (Spinuzzi, 2008, p. 206). As this research had a goal of looking at how m-learning projects became linked to overall university strategy then links or boundary objects were a key focus and hence ANT as opposed to Activity Theory was chosen.

Looking at project failure in the aircraft manufacturing industry, Law and Callon proposed the concept of local and global networks and the boundaries between the two (Law and Callon, 1992). They identified three factors which influenced the success or failure of a project with the most significant being 'the capacity of the project to build and maintain a global network which will for a time provide resources of various kinds in the expectation of an ultimate return' (Law and Callon, 1992, p. 46). They also talk about points of passage between the two networks and the effectiveness of points of passage could be a key issue in the embedding of m-learning. Significant factors will be the ability of the local network to build links with the global network and influence the global network to approve and support the innovation and develop institutional policies to support it. Actors, be they individuals or even artefacts, need to become points of passage between the two networks for that influence and support to be achieved. In addition, a further strength of this local/global network model is the temporal aspect in that it looks at project trajectories to focus on a project over time rather than the identification of a specific moment of translation.

4. TWO INSTITUTIONAL PROJECT TRAJECTORIES

The two institutions (A and C) described below were part of a five-university consortium looking at assessment of health students when they were out in clinical practice. The project had many strands but a significant feature was the development of an assessment application which ran on a smartphone and uploaded results back to the students' institution. Despite many issues, the project successfully proved the concept and the device was used by students but was hampered by external funding requiring all devices (>1000) to be purchased in one transaction. The consequences were that the devices gradually became less attractive to students as smartphones such as the iPhone reached the market.

The researcher had access to the project from 2008 until 2011, observing program-level meetings (which involved representation from all five universities) and interviewing key staff within each institution. Staff broadly come into four categories Executive and Management (such as Deputy Vice-Chancellors or Faculty Deans), site leads (running the project for that institution), tutors using the technology with students and IT staff at various levels who were either faculty/project based or central institutionally based. Over forty interviews were conducted and that information was triangulated with meeting observations and access to numerous project documents.

Law and Callon developed a model which represented in diagrammatic form, the 'translation trajectory' (Law and Callon, 1992, p. 47) of a project. The relative position of a project in the trajectory is a combination of the strengths of the two main factors – capacity to build and maintain a global network and the ability to build a local network. If both factors are high then the project is likely to succeed and establish itself as a point of passage and thus become an embedded solution. The next diagram (Figure 1) is a graphical representation of their model (Law and Callon, 1992, p. 49). Note that a projects position on the graph is based on a relative judgment derived from interview and observation data i.e. no scale or measurement is involved.

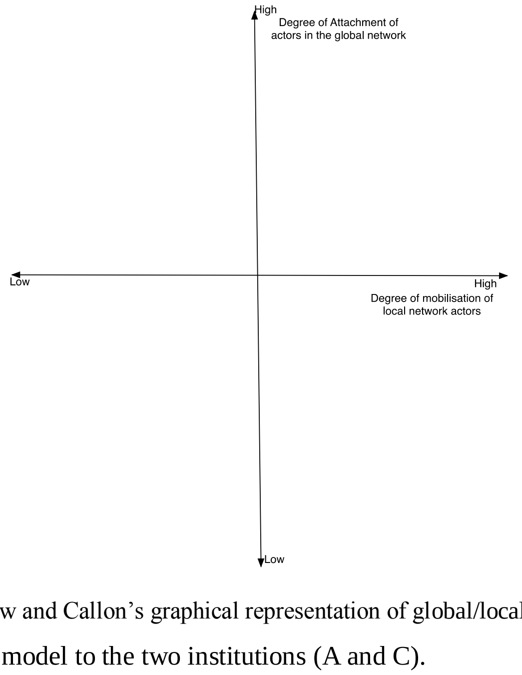

Figure 1. Law and Callon's graphical representation of global/local strength

The next sections apply this model to the two institutions (A and C).

4.1 University A

University A was the lead partner in a five university collaborative project which was trialling a mobile assessment tool. The IT structure within the institution was distributed in that it had elements of being centralised: the network, the VLE, email etc., were provided centrally, but faculties had differing levels of autonomy in how they ran their own IT. Faculty IT managers reported into the Deans or Heads of

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Department although they also had connections with central IT services. Some faculties ran their own servers giving them considerable autonomy in their decision making, whereas others bought in server support from the central IT department.

4.1.1 University A Mobile Strategy

Prior to the project starting, there was no real mobile strategy in evidence apart from the use of BlackBerry devices by staff in senior and executive roles, and it is unclear how far that situation had moved during the project lifetime. The project clearly felt that it needed to break new ground and its support from central IT services was only in helping with issues such as authentication of devices. Expertise on m-learning came primarily from the sub-contractors who developed the mobile application and the rest was developed by trial and error over the project where the team became skilled in finding solutions to a whole range of technical and administrative issues. The priorities of the institution were supporting student laptops and introducing a new VLE and quite reasonably m-learning was seen as a niche:

> “ There’s a certain wariness and reluctance to go into the mobile learning world or just the world of mobile devices at all” ***Faculty IT support***

> “It feels to me like mobile technology in terms of enterprise adaptation is where PCs were twenty years ago with people thinking, PCs they are toys, they’re personal things, and then corporate IT departments spent the next ten years trying to bring them under control ” ***Faculty IT Manager***.

Lack of the ability to integrate with other systems was also cited as a major disappointment within the project. It is clear from all five institutions that just having an assessment tool on a mobile will not engage the students fully as it is a once-a-term experience: systems are required which create multiple modes of usage and thus regular interaction. The absence of the ability to access the VLE from the mobile devices was a big disappointment to many tutors and local IT staff:

> “The VLE which was bought by the university but it doesn’t have a mobile interface and I think they acknowledge that they missed a trick by not including it in the VLE ITT document” ***Deputy Site Lead***

4.1.2 Points of Passage

In Actor-Network terms, there is clear local network that can exist mostly independently of the global network. It needs occasional support from the institution in areas such as procurement but in terms of resources and expertise is largely independent. There appeared to be no mechanism to capture the experiences of the project in a way that would inform a longer-term mobile strategy, no visible capacity-building link that captures the local network experience into the global network IT strategy:

> “Well we were sad when they came up with an IT strategy and when we read it our Project did not figure into it at all and wouldn’t you have thought they’ve got a very big project which is gaining experience?” ***Deputy Site Lead***

And when interviewed, representatives from central services conveyed the fact they felt the project was not mainstream:

> “I’ve had discussions about the project purely in the context of we’re looking at some sort of handheld device and to understand what the project is and see if there are any synergies with that, so its really peripheral to us.” ***IT User Services Manage***r

4.1.3 Embedding

The evidence would suggest that embedding at an institutional level was weakened perhaps because there wasn’t a clear and strong point of passage between the project and the overall institution global network. In effect the faculty had the IT staff and resources (provided through the project) to continue without much support from any central function. Even though the central function is at risk of losing some of the project’s work within the longer–term strategy, the local network could maintain the project work as long as it could finance it. And indeed this is what transpired as one part of the project (Medicine) was able to get a grant (from healthcare funding sources) to equip medical students with iPhones and continue the online assessment software for those students. In addition a number of other resources (apps) were to be placed on the iPhone to give the students access to electronic versions of drug and anatomical information. Having learnt the lessons from having to support out-of-date devices and perhaps more importantly, providing students with multiple reasons to use the device, they embarked on a process where all medical students will have the devices. But despite this effort, the link to the overall institution strategy is still somewhat tenuous –the iPhone work can progress without support from central IT services.

There was a persistent concern that the lessons of the project could be potentially lost or could be duplicated in different faculties:

> "Early on in the project, agreements may have been put in place with someone in central IT services and that person then moves on and so you find that a year later you are suddenly having to explain it all again to somebody new" ***Project Manager Mobile***

> "And I think the danger is that you will end up with people doing things with mobile technology in an uncontrolled, maybe slightly inefficient way and if you had some sort of central policies in place and services in place you could actually make better implementations. But, that's the way it is" ***Faculty IT Manager***.

This last quote predicts what Latour (2005) referred to as competing translations, several solutions to a similar problem existing in parallel leading to duplication of effort.

4.1.4 ANT Analysis- University A

The project trajectory is represented by the following diagram (Figure 2):

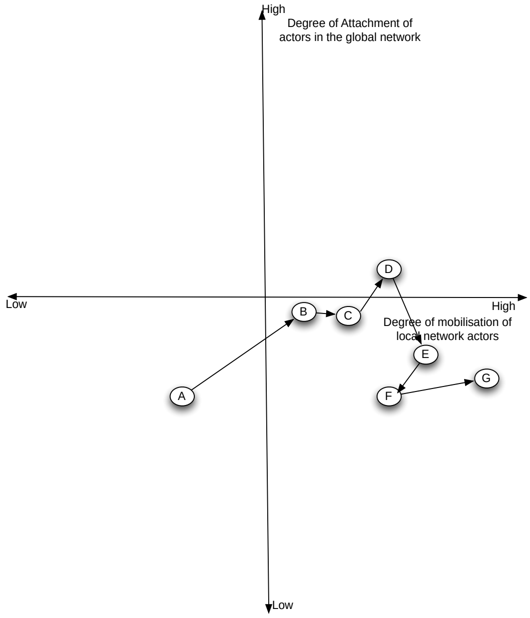

Figure 2. Project Trajectory University A

At point A, the project commenced with little involvement from the global network. At point B, technology choice, the local network asked the global network in the form of IT Services but centrally there was little knowledge to help. Pilots took place in all five institutions (point C) and choices over technology were made. At point D (procurement), the global network offered considerable help in procuring devices and negotiating agreements with suppliers. Implementation (E) and Final Project service (F) occurred as the local network tried to get students to engage with the devices, Some interaction with the global network occurred as presentations were made to IT Services representatives but no formal mechanism to share the project

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results was established. Embedding did not occur in most subjects apart from Medicine due to funding shortages and the poor student experience with the system. Embedding (at least in the area of Medicine) occurred because the mobilisation and independent capability of the local network was strong and did not require much if any support from the global network. The degree of attachment of global network remained weak reflecting the fact that capacity-building links between the project and future strategy did not appear strong and the concept of m-learning is very much seen as a niche rather than a core service.

4.2 University C

University C was a long established medium-sized university with a strong reputation for technology and innovation. The institutional IT structure was centralised with some faculties having their own local support team but the majority of services provided centrally. Central IT Services were closely involved with the project and provided the institution's IT representative to the joint IT steering group which the five institutions set up to oversee the device selection and application development process. In addition to supporting the work of the project within University C, IT Services also supplied a help-desk which was first-line support for all the students with mobile devices issued through the project, across the five universities. This was a service that the other four institutions made a financial contribution to and a good example of the capacity-building strategy that characterised University C's approach to the project.

4.2.1 University C Mobile Strategy

Consistent with other institutions, no m-learning strategy existed at the start of the project and Central IT Services saw the project as an opportunity to learn about m-learning and the problems involved. The same team already ran more than 300 corporate mobile devices used by executives, managers and senior academics and supported a facility to send text messages to students. IT Services were concerned about the proliferation of mobile solutions and applications so wanted to create a position for someone who would oversee the implementation and try to bring some order to the situation:

> "The post was the role of mobile technology advisor for we had various corporate users, a variety of mobiles, there wasn't any centralised support and people were starting to do things for teaching and learning so the job itself was an open remit, just support this E strategy vision of a wireless enabled campus" ***User Services Manager, IT***.

In this university it is interesting to note that the team were driven by both business needs and learning and teaching needs and the same team oversaw all mobile-related technology within the institution. In many institutions, these two aspects are often divided with m-learning seen as part of learning technologies and corporate phones usually associated with the telephony support team. And University C also felt that with corporate smartphones increasing there was synergy with m-learning applications:

> "People were constantly complaining about new phones, so really the role of the job was to try and smooth the introduction of smartphones and put in place better business applications and systems" ***Mobile Technology Advisor***.

The department also placed mobile as part of its customer support services rather than as part of its technology group:

> "And most people would have put mobile technology in with the techie lot. And I was quite keen that it didn't go in with technology because I think the problem was with the customer facing issues" ***User Services Manager, IT.***

IT Services saw that m-learning was something they would eventually have to support and viewed the project as a great opportunity to learn about the technology and its associated issues and build future capacity.

4.2.2 Points of Passage

In terms of IT Strategy, there was a clear point of passage between the project and the institution. The individual who provided mobile technology support to the project also provided it for the institution and reported to a manager who had a seat on the IT strategy board. So expertise flowed from IT services into the faculties that were trialling the project software and results were fed back giving the opportunity to influence the institution IT strategy. An example of the benefits of this approach is that University C was amongst the first UK institutions to implement CampusM, a student portal accessible via smartphones. The same individual was also a prominent member of the five institution IT steering group and also managed the first-line helpdesk system, which was provided to all the five partner institutions. The IT department thought advantages had arisen from hosting the help desk for the five institutions:

> "And it definitely has worked out. By hosting it I think we got a much better understanding about it all when it's together, device and learning application." ***User Services Manager IT***.

University C's site lead saw their objective was to disseminate the m-learning experience into other faculties:

> "The objective was taking mobile learning across the institution, which I haven't had that much success with, largely because of the problems with the project technology" ***Site Lead***.

Thus the impact of the mobile assessment application on other departments per se was minimal. However the site lead also had a seat on the teaching and learning committee for the university so rather than abandon any push because of the project difficulties, they looked for other opportunities:

> "What I did was I looked at what we were doing that was successful with mobile technology that the rest of the University could do. We did lots of work around audio reflection, student self-assessment and audio feedback which has been distributed across the university" ***Site Lead***.

This shows that there is a point of passage into the overall university teaching and learning strategy and where projects have successes there is an opportunity to spread and embed new practice, complementing the point of passage that exists in the IT department.

4.2.3 Embedding

Embedding did not occur in terms of the mobile assessment application due to device limitations. However, there was evidence to suggest that the project had a lasting influence on the institution, notably in the use of audio feedback, the CampusM student portal, a blog site for mobile aimed at students and also some positive experience with the project devices that helped reinforce the benefit of using mobiles for both IT and academic staff:

> "We need to start implementing it for teaching and learning here. The main benefit is just seeing how all the systems, the architecture and stuff tie in together so that we can then decide what works and what doesn't" ***Mobile Technology Advisor***

Despite the lack of embedding of the mobile assessment tool, evidence of a stronger mobile computing strategy following the project is apparent with perhaps the greatest range of mobile access to university systems amongst the five project partner institutions. The presence of an influential point of passage in terms of the mobile technology advisor has brought this about, marrying the project experience with wider institutional needs.

4.2.4 ANT Analysis University C

This is represented by the following diagram (Figure 3):

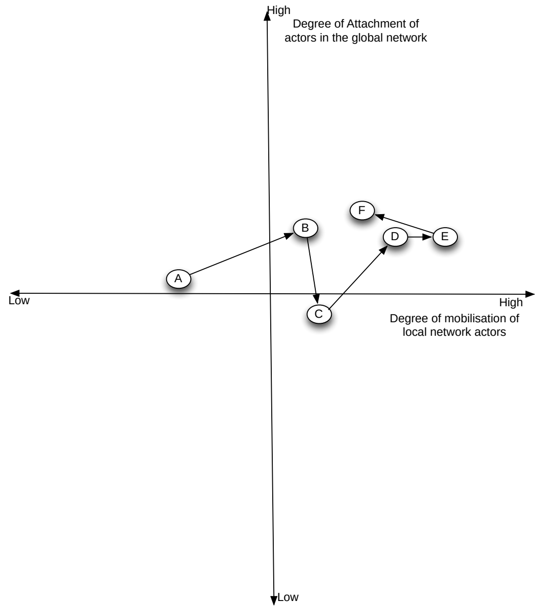

Figure 3. Law/Callon Trajectory University C

When the project started (A), both the global and local networks had a high degree of attachment to the project, the global network seeing it as an opportunity to develop mobile technology strategy for the institution. The pilot service (B) was successful, the global network offered support by developing a simple assessment application on which students gave positive feedback. At point C (technology choice) both the local and global networks were disappointed that the software technology choice wa incompatible with the institutional E-portfolio but nevertheless accepted the decision and prepared to deploy the project devices to students. Indeed the global network offered to provide a project-wide helpdesk for the five institutions, seeing this as a further opportunity to learn from the project. The initial attempts to use the devices were largely unsuccessful as many students saw the installation process as too complex. Through phase E, devices were re-called and re-launched to students with pre-installed software but by then, students were unwilling to engage with the devices, not helped by the growing obsolescence of the technology. When it came to stage F, embedding, the Health subjects did not see it as viable to continue with the existing application and there was no budget to procure new devices for students. The local network's enthusiasm for mobile technology was placed on-hold but the global network used the project experience to increase mobile access to institutional systems, a strategy that continues.

5. EMBEDDING ISSUES IN M-LEARNING

The key m-learning issues that have arisen from the field research are:

The business model. At the time of the research, it appeared that mobile service providers and Education had not produced a business model which will support students. If m-learning is mandated for assessment purposes, or is a necessary aid to field research tasks, then no model existed to support this. The institution is not able to demand that students all have smartphones with certain minimum capabilities and cannot assume that data charges will be bundled into the students' contract arrangements. Perhaps the institution could cover some of these student data costs (where it forms part of a mandatory assessment), but the mobile service providers do not have a billing system that can cope with this. The students could perhaps claim a contribution back from the institution, but expense systems would most likely creak under the weight of large numbers of small claims. Recently there may be signs that industry is starting to respond to some of these needs with the provision of data-only contracts with tablets such as the iPad and that could alleviate some of the problems experienced.

The mobile industry has not tended to value long-term customer loyalty in its business model, with customers frequently having to threaten contract termination to get a competitive deal (Ofcom, 2012). This issue of education-friendly charging plans needs to be tackled probably at least at the sector level so that affordable and flexible models can be offered, rather like the bulk discounted software licensing deals that are offered into the education sector. Network operators would have to sacrifice some shorter-term profitability in return for the opportunity to increase product loyalty and revenues in the longer term (Venkatesh et al., 2012), a model which seems to have influenced companies such as Microsoft and Google to develop education-friendly email and cloud storage offers, (e.g. Office 365 and Google Apps for Education).

Multiple Service Offerings. All institutions that were investigated highlighted the need to provide a mobile environment that students can engage with in a number of ways. Access to other services such as student portals, VLEs and university email accounts were all features that both students and tutors felt should be present. Most institutions did not produce a strategy or policy which stated what students could expect to be able to access from their phone handsets, i.e. what a minimum level of service would be. It was also not clear if institutions were considering mobile access when they procured new IT systems.

The Disruptive Nature of Mobile computing. Even before this research commenced, it was clear that many in an Education setting view mobile devices suspiciously (Sharples, 2002). Students have brought laptops into lectures for many years but tutors will be more suspicious to see students using handheld devices. Handheld devices are often regarded as something used for personal and social activities whereas laptops may be seen as business or education tools. Yet either laptops or mobile devices are equally capable of entering both worlds. With the five-institution mobile assessment project, the challenges of taking a handheld device into the healthcare world are only too apparent. Not only do the healthcare providers view the devices suspiciously and see them as an added security risk but also the service users will react to them in different ways. Future strategies are likely to be based on using students' own devices, and that was the majority view from the field research, then institutions would not be able to control the features of the device. Hence students would have to be accepted in healthcare with devices that could take pictures, make movies and record sound. Institutions saw applications for mobile assessment technology in teacher education but education providers are already engaged in a struggle with students using their devices in inappropriate ways (Cook et al., 2011).

Fragmented IT Strategy. In 2010/2011 there was evidence that some IT departments viewed m-learning and mobile technology as non-core. Subsequently there has been a significant uptake of smartphone and 3G technology by the general population (Ofcom, 2012) fuelled in particular by social networking applications such as Facebook and Twitter. Growth in HE students' ownership of smartphones has been exponential (Dixit et al., 2011) and perhaps now almost ubiquitous with many institutions responding by offering some form of mobile access to systems and enhancing Wi-Fi coverage to cope with much greater access on campus by students through various forms of mobile devices. Despite a much more open and strategic view of m-learning, the fragmented structure of some HE IT departments remains a barrier to overcome, an ever stronger reason to create effective points of passage that can enable joined-up thinking. The evidence from the five institutions examined in this research shows that IT functions are often sub-divided across the institution by functions. Any new technology that is introduced faces the challenge of this functional split but arguably m-learning is the most challenging as it can touch all areas. Adding to this functional distribution complexity, there is also the additional challenge within some institutions where IT provision is neither centralized or distributed creating a random hybrid structure where some faculties retain much greater IT independence based on historically strong 'local' networks. The distribution and organization of IT Services is a barrier to transfer of knowledge that will not be easily overcome. Innovation theories also tell us that independence of departments and faculties acts as a barrier to embedding, as it prevents a coordinated strategy being developed (Christensen and Eyring, 2011). 'Fragmented responsibility' is a major barrier that must be overcome to achieve a consistent student experience in a world where faculties and departments can develop their own mobile applications or Web 2.0 services.

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6. SUMMARY

This paper has presented a number of issues that were experienced with larger-scale m-learning projects, notably the issue of how to support student-owned devices financially, provide integrated access to university systems and handle the ethical challenges of students using devices in sensitive areas such as hospitals and schools. However the major focus of the work was embedding and the Law/Callon model puts a sharp focus on the problems of developing coordinated m-learning strategy when institutions fragment their IT responsibilities. The Law/Callon model described above has been extended to give a third dimension that places the fragmented nature of IT strategy in sharp focus (Bird, 2014). This model has applications in any institutional IS scenario and the authors now plan to apply it a to a whole institution curriculum change project which was underpinned by major restructuring of corporate and learning technology systems.

The field research was carried out prior to 2011 and thus it would be interesting to see this repeated in today's context where institutions have clearly recognised the significance of mobile access to their systems. At the end of 2014, we can reliably say that smartphones are now ubiquitous within the UK HE landscape. Recent data from Manchester Metropolitan University shows over 31,000 active users with VLE and timetable access the most popular applications. Both University A and C could report similar experiences and a recent CampusM user group meeting demonstrates widespread adoption (see www.youtube.com/watch?v=sSBX-ch4eDM). However it remains unclear whether institutions have longer-term strategies to develop mobile access and whether their fragmented IT structure can learn from future localised experiments with new mobile technologies and applications.

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MOBILE LEARNING AND TEACHER EDUCATION: RESEARCHING MLEARN PILOT DEVELOPMENT

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ABSTRACT

MLEARN, a European Union (EU)-funded project, is exploring and promoting teacher development of mobile learning practices in four member states – the Netherlands, the United Kingdom (UK) (England), Greece and Italy. This paper details the ways research findings have both fed into and been elicited from this pilot, supporting development and implementation of a teacher education programme for in-service teachers, focusing on mobile learning through appropriate pedagogic uses of mobile or handheld technologies. The research has focused on three dimensions to date: how contextual backgrounds for the programme can be considered and provided; a training needs analysis of trainers and teachers involved in the pilot; and gathering initial outcomes from teachers and learners after involvement in teacher education events and some one to two months of pilot uses in classrooms. The paper considers implementation outcomes to date, and what the next steps will be.

KEYWORDS

Mobile learning, teacher training, research roles, teachers, schools, using mobile devices.

1. INTRODUCTION

A range of mobile learning projects have already been run across Europe and outside Europe (see Dykes and Knight, 2012; Shohel and Power, 2010), and lessons learned and limitations arising have been identified across these projects. A review of research literature indicates that mobile learning practices can be developed and focused to support: behaviouralist; constructivist; situated; collaborative; informal and lifelong; and learning and teaching support (Naismith et al., 2004; Ting, 2013). Greater accessibility to information and the provision of information in context are recognised as key benefits associated with mobile learning. These contexts may be spatial/location, temporal, social, or access/technical in nature (Koshmann, 2011). Mobility, face-to-face social interactions, uses of authentic teaching and learning materials, constant alertness, the focus gained from mobile 'learning moments', and learning and time convenience are important features associated with activities in these different contexts (Economides and Nikolaou, 2008). Developing practices concerned with the concept of 'interwoven learning interactions' has been highlighted as being possible when using handheld devices in learning activities and in series of these activities (Ting, 2013). Informality and ownership are factors that influence uses of mobile technologies and the ways that activities can interweave and be interwoven (Kukulska-Hulme and Traxler, 2005; Wu and Zhang, 2010). Benefits that can arise from uses of handheld devices include alertness, choice of student preferences, saving time, broadening assessment tasks, supporting special educational needs, language learning support, all enhancing pedagogical value (Economides and Nikolaou, 2008; Wu and Zhang, 2010).

Access to and numbers of courses that focus specifically on uses of handheld devices in initial and in-service teacher education are limited, and information about these opportunities is not necessarily widely accessible to teachers in the four countries participating in the MLEARN project (Passey and Zozimo, 2014a). This report (ibid, 2014a) found that mention of handheld devices in the four national curriculum and school guidance documents is currently minimal. Although the curriculum and its intentions in Italy support practices that lend themselves to uses of handheld devices, the penetration of information and communication technologies (ICT) in schools is reported to be generally low, and teachers may not be trained in the use of these or other related ICT facilities. While uses of ICT are supported and encouraged in schools in Greece, the use of mobile telephones is not allowed. Devices for uses in schools in Greece, therefore, need to conform to handheld computer specifications, while facilities for the capture and editing of sounds or images may need to be disabled. Many teachers in schools across the Netherlands use ICT to support teaching and learning. There are agencies in place that support ICT developments and the promotion and dissemination of ICT practices, including those with handheld devices. In England, ICT and computing are specified in curriculum documents that are statutory. Teachers are asked to adopt pedagogies to match the needs of their classes and pupils, using appropriate ICT and handheld technologies.

Research reviews indicate that teacher education should provide, in as fully a contextualised and integrated way as possible, a focus on three interconnected elements (Mishra and Koehler, 2006): technological knowledge (what the device can do and how to use it); content knowledge (what subjects and topics can be addressed using the devices and their applications); and pedagogical knowledge (how this is done through the development and deployment of appropriate teaching and learning activities). When using handheld devices there is a need for teachers to consider how the learning environment might be expanded beyond the classroom, due to the portability features of the devices. Similarly, features of these devices strongly support aspects of communication and their links to teaching and learning. Already, some schools and agencies have explored the ways handheld devices can support learners with special communication needs. Teachers have used mobile devices in curriculum activities that involve and support practices concerned with research, capturing and using imagery and video clips, presenting to teachers and peers, discussing captured and presented work with teachers and peers, recording and sharing ideas with peers, providing anonymous feedback, pupils creating their own notes and books in multimodal formats, discussing strengths and weaknesses in presented work shared by pupils, creating videos for presentation to wider audiences, presenting perfect models or techniques, organising notes and work, and pupils recording video clips of lessons for later playback. Teacher education events need to identify the many applications (Apps) that can meet specific subject and topic needs. Teachers also need to be aware of both the benefits and limitations of handheld devices for teaching and learning. Activities highlighted as being worthy of exploration in teacher education events are (Passey, 2010: 69):

- “Review and reflect”, where pupils capture audio, imagery and video during lessons, use these in plenary sessions to reflect on what has been covered, consider the key elements learned, how these fit into wider subject or topic pictures, and how ideas might be used or taken further outside the classroom.
- “Think forward”, where pupils access future topic material via the Internet and capture relevant thoughts or ideas to contribute to discussions or presentations in class or through on-line discussions. Pupils can be encouraged to use the handheld devices at home to research topics for themselves.
- “Listen to my explanations”, where pupils record audio when they are completing homework assignments and these verbal explanations are listened to and marked by teachers.
- “Snap and show”, where pupils capture imagery, which is downloaded to a server and accessed through a computer or interactive whiteboard screen, for wider pupil discussion, perhaps made accessible to parents so that they can see and discuss events that have happened in school.
- “This is what I’ve done and how I’ve done it”, where pupils create presentations of how they have used mobile technologies to tackle particular activities, which are recorded and made accessible on appropriate web-sites for teachers and parents to see. Observing other pupils’ stories and reports, pupils can include sound recordings of their own voice as well as text and pictures to form multi-modal ‘texts’.
- “Tell me how I could improve this”, where pupils can share their work in multimedia formats with peers, mentors, teachers or trusted adults in order to seek comments, evaluative feedback, assessments of their work, and ideas to improve their work.

The challenge for this MLEARN project was to identify ways to integrate details of practice and teacher education needs identified through these previous research studies, and to develop a teacher education programme that could be used to stimulate and support practice within the four national pilot groups of teachers, across schools, from nursery and special, to vocational and high schools. The following step in this process was to consider how a training needs analysis could be undertaken, and how research details could then be fed into a teacher education programme. Subsequently, the research endeavour would then focus on how the practices and experiences of teachers and learners in each of the countries were developing over time.

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2. TRAINING NEEDS ANALYSIS

Training needs assessment can be considered an ongoing process, gathering data to determine what training needs exist, so that training programmes can be developed to help an individual, institution, or organisation accomplish its objectives. The importance of training needs assessment and analysis is well established (see, for example, the United States (US) Office of Personnel Management, n.d.), where it is argued that these needs should be concerned as much with identifying what is known and are strengths of individuals and organisations, as it is with what is not known and can be gained from training interventions. It is argued that training needs assessment should be considered in the context in which it is set; the context determines not only a width of what might be considered as fundamental needs, but also the values that are ascribed to these and how they might be used or deployed (and national contexts had already been identified as a part of the previous research focus, Passey and Zozimo, 2014a).

Training needs analysis can serve as a basis for evaluating the effectiveness of a teacher education programme as well as determining the costs and benefits of the same programme. Indeed, a training needs analysis can be important in identifying problems that may not be solved by teacher education itself. If policies, practices and procedures need to be corrected or adjusted, this is clearly potentially a concern for those in senior management positions, rather than it being a teacher education concern (Brown, 2002). It was recognised that this aspect might be particularly relevant when considering the outcomes of a needs assessment survey conducted in the four different countries (with their own specific policies, practices and procedures, as indicated in the initial MLEARN research report).

For this training needs analysis, two target groups were involved: 1) trainers and partners in each country; and 2) teachers to be involved in the teacher education. Four countries were involved, where there were known to be substantial differences in terms of handheld devices' acceptance within teaching practices, and resources in place to implement mobile learning initiatives and other activities. The survey was devised using findings from the previous background report (Passey and Zozimo, 2014a). Two forms of a questionnaire were developed to gather details, one for partners and trainers and one for teachers. For both groups, the surveys comprised a mixture of open and closed questions. Findings were reported at both an overall and individual country levels, for teachers and for trainers (Passey and Zozimo, 2014b).

In total, 27 teachers responded from across the four countries. The age range taught was 4 to 19 years, with most teaching across the 6 to 14 year age range. Subjects taught were wide, but most taught either all subjects or science and technology. There were 21 teachers out of the 27 who reported they had learners with special educational needs, 11 out of 27 who reported they had learners with communication needs in their classes, and 22 out of 27 who reported they had classes with special support teachers. Prior use of digital technologies for teaching was high, 25 out of 27 reporting this, with main prior digital technologies used for teaching being personal computers (PCs), laptops, internet, robots, and interactive whiteboards. Handheld devices used previously in teaching were lower, with 9 out of 27 reporting their main prior handheld devices used for teaching being iPads, tablets, and laptops. Prior use of digital technologies by learners for learning purposes was quite high, with 20 out of 27 teachers indicating main prior digital technologies used by learners for learning being PCs, laptops, internet, robots, and interactive whiteboards. Prior handheld devices used by learners for learning was lower, with 6 out of 27 reporting main prior handheld devices used by learners for learning being smartphones, iPods, Android devices, iPads, tablets, and laptops. Many teachers knew of benefits of using handheld devices for teaching and learning, with 16 out of 27 indicating main benefits concerned with handhelds being enhanced attractiveness and engagement for learners, and improving the management of courses. Fewer teachers knew of issues arising when handheld devices are used in teaching and learning, with 11 out of 27 identifying main issues as technological. Main forms of support requested from teacher education sessions were technological and content knowledge. Main features or benefits requested from the teacher education sessions were enhanced focus gained from mobile 'learning moments', the provision of constant alertness, and the use of authentic teaching and learning materials. Main pedagogical approaches requested from the teacher education sessions were collaborative, situated and constructivist. Existing knowledge of Apps or software were mainly 'a few' or 'none', with 38 items identified in total. Main practices requested from teacher education sessions were capturing and using imagery and video, research, and pupils creating their own notes and books in multimedia formats. Main examples of practices requested from teacher education sessions were 'think forward', 'snap and show', 'this is what I've done and how I've done it', and 'tell me how I could improve this'. Main formats of teacher education sessions requested were hands-on trials of practice, and demonstrations.

In total, 4 partners and trainers responded to the survey. Their responses were similar to those from the teachers, but they differed in some important ways. Main prior digital technologies used for teaching were reported to be interactive whiteboards, netbooks, visualisers, PCs, and laptops. So their background in terms of digital technology uses was not likely to be entirely the same as those of the teachers. Main prior digital technologies used by their learners for learning were PCs, laptops, iPads, and tablets; so their experiences might not be identical to teachers in that respect. Main forms of support requested from teacher education sessions were issues and challenges, technological and pedagogical knowledge. Main features or benefits requested from the teacher education were mobility, developing face-to-face social interactions, supporting special educational needs, and language learning support. Again, this difference was highlighted as being potentially significant for the design of a teacher education programme. Main approaches requested from the teacher education sessions were collaborative, constructivist, situated, informal and lifelong learning; the latter categories might have arisen because of this group's wider or longer experience. Main practices requested from teacher education sessions were capturing and using imagery and video, creating videos for presentation to wider audiences, pupils recording video clips of lessons for later playback, and pupils creating their own notes and books in multimedia formats. These were highlighted as important differences to be considered if the focus of the teacher education programme was to support both trainers and teachers equally. Main examples of practices requested from teacher education sessions were 'review and reflect', and 'this is what I've done and how I've done it'. The first of these examples was unique to the trainers and partners, and this distinction was also highlighted.

From the details gathered from the needs analysis, a 5-day teacher education programme was devised by the key trainer and MLEARN partner group. During each day, technological knowledge (operating the devices, Apps and peripherals), content knowledge (considering Apps that supported specific subject and topic areas), and pedagogical knowledge (examples of practice and a focus on one of the five activities highlighted by Passey, 2010), were integrated into demonstration and hands-on sessions. The teacher education programme was initially run to support trainers in each partner country, and these trainers then developed their own teacher education programmes to support teachers within their individual countries. The intention was to support trainers in 4 countries, who could then train a minimum of 10 teachers in each of their countries.

3. EARLY OUTCOMES FOR TEACHERS

Early outcomes were identified through online surveys that teachers and learners completed. Teacher surveys used open questions, while learner surveys used closed questions to gather evidence from the two populations. By 20th December 2014, following one or two months of pilot uses of mobile devices (depending on the start dates of each teacher), survey responses were received from teachers in 3 countries, from Italy (18 valid responses out of 19 total), the UK (26 valid responses out of 27 total), and Greece (8 valid responses). The teachers taught in kindergarten, primary, secondary and vocational schools. Many had used the devices 1 to 5 times, but some used them more often than this. Some teachers did not find the devices easy to use, for logistical or legislative reasons, or because of lack of familiarity or understanding (which suggested that the teacher education programme was not always fully effective for all teachers). However, most enjoyed using them, but working with learners with severe disabilities was clearly not easy or not possible. Most found the devices offered greater flexibility and mobility. Most reported benefits concerned with engagement and independent learning, but teachers in Italy additionally reported enhanced motivation and opportunities for working in 'an adult world'.

In Italy, responses were received from teachers in 6 schools. About one-quarter of the teachers were from primary schools and three-quarters from secondary schools. About half used the devices 1 to 5 times, but about one-quarter used them more than this. About half found the devices easy to use, but about one-quarter did not (for technical or contextual reasons), and most enjoyed using them.

In the UK, responses were received from teachers in 4 schools. About half of the teachers were from primary schools and half from secondary schools. About half used the devices 1 to 5 times, but about one-quarter used them more than this. About one-quarter found the devices easy to use, but about half did not (for

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technical and contextual reasons, and because of lack of familiarity and understanding). However, most enjoyed using them.

In Greece, responses were received from teachers in 2 schools. Most teachers were from a secondary vocational school. About one-third used the devices 1 to 5 times, but about two-thirds used them more than this. Some found the devices easy to use, but others did not (for logistical or legislative reasons). Most enjoyed using them.

4. EARLY OUTCOMES FOR LEARNERS

In terms of learner reports of outcomes following one or two months of pilot uses of mobile devices, survey responses were received from learners in 3 countries, from Italy (147 valid responses out of 148 total), the UK (61 valid responses out of 61 total), and Greece (39 individual responses and 1 group response). Learners were from kindergarten, primary, secondary and vocational schools, representing a balance of boys and girls. About 1 in 10 learners did not find the devices easy to use. For the majority, the size was reported to be 'right' and text and pictures could be seen easily; but for some, they were not sure how to use them. Most liked the devices, but a few said they did not like them. Uses were varied, with use in classrooms, with groups of learners, on their own, writing text, taking pictures, recording video, and looking at websites. Most learners felt they were benefiting – technically, cognitively, socially, widening how they were learning, but learners in Italy additionally reported motivational benefits more than learners did in other countries. Responses from learners in each of the 3 countries are shown in Table 1. It should be noted that in Table 1 numerical values are absolute, but in the case of the rows showing 'Top 6 uses', the numerical values are proportions of positive responses compared to the total numbers of responses.

To place these outcomes into a context, from the needs analysis, participants from Italy indicated that handheld devices had been used previously in teaching by 5 out of the 9 teachers, so these experiences might have particularly supported learner outcomes. Main issues identified by the teachers were concerned with overall learning issues, and teaching issues, while main features or benefits requested from the teacher education were supporting special educational needs, enhanced focus gained from mobile 'learning moments', the concept of 'interweaving learning interactions', and language learning support. These requests suggested that while some teachers had used handheld devices, they may have felt that their practices could be developed more. This view was also supported by the fact that the main teaching practices requested from teacher education sessions were research, pupils creating their own notes and books in multimedia formats, and creating videos for presentation to wider audiences. Teachers involved in this teacher education were generally already aware of issues and ways of using digital technologies in teaching and were active in using them within their schools.

From the teacher needs analysis from England (and the low number of respondents should be noted, as this might lead to a narrow picture), the age range taught was 11 to 18 years, an older age range than that for many teachers in other countries. Main prior digital technologies used for teaching were PCs, laptops, netbooks, visualisers, a variety of handheld devices, and iPads and tablets. This suggested that these teachers might have had a different technological background from those in other countries. Handheld devices used previously in teaching were reported by the teachers, so the proportion of those with experience was high. Main prior handheld devices used for teaching were interactive games, and a variety of handheld devices including projectors, microphones, iPads and tablets. Main prior digital technologies used by learners for learning were PCs, laptops, netbooks and visualisers. This suggested a different background for these learners from those in other countries. Main prior handheld devices used by learners for learning were interactive games, handheld projectors and microphones, iPads and tablets, which again suggested a different technological background for these learners. Main benefits identified were adaptability to the learner, attractiveness and engagement, improving the management of courses, and facilitating the process of learning. This width of benefits suggested a wider interest and perhaps a wider background experience with technologies. Main issues identified were technological, and teacher learning issues. The latter was different from those in other countries, and suggested a different balance of teacher concerns. Main forms of support requested from teacher education sessions were pedagogical knowledge, which again was different from those in other countries, and suggested a different focus of their concerns. Main features or benefits requested from the teacher education were use of authentic teaching and learning materials, the concept of 'interweaving learning interactions', the benefit of informality, the influence of ownership, how learners could choose or make preferences, broadening of assessment tasks, and language learning support. This width of requests suggested a different balance in this respect too. Main approaches requested from teacher education sessions were wide, again suggesting a different balance.

Table 1. Learner responses after one to two months of use in three participating countries.

Learner responses	Italy	UK	Greece
Number of valid responses	147	61	39 and 1 group response
Number of schools involved	5	6	2
Types of schools involved	Half from primary and half from secondary	Two-thirds primary and one-third secondary	More than half from kindergarten and others from vocational school
Gender balance	Half boys and half girls	Three-fifths boys and two-fifths girls	Two-thirds girls and one-third boys
Ease of use	1 in 10 did not find them easy	1 in 10 did not find them easy	1 in 100 did not find them easy
Size	For most the size was 'right'	For many the size was 'right'	For the majority the size was 'right'
Seeing text and pictures	Most could see them easily	Some could not see them easily	Could be seen easily
Knowing how to use them	Some did not know	Some did not know	-
Liking the devices	Most liked them and none did not like them	About half liked them, and some did not like them	Most liked them but a few did not like them
Top 6 uses: Working in the classroom	0.75	0.52	0.41
Top 6 uses: Working in a group with other children	0.68	0.36	-
Top 6 uses: Writing my own text	0.63	-	-
Top 6 uses: Taking pictures	0.45	0.39	0.79
Top 6 uses: Reading text online	0.44	-	0.38
Top 6 uses: Working on my own	0.41	0.33	-
Top 6 uses: Looking at websites	-	0.46	0.54
Top 6 uses: Recording video	-	0.43	0.62
Top 6 uses: Making notes somewhere	-	-	0.36
Reported benefits	Technical, motivational, cognitive, social	Technical, cognitive, social	Technical, cognitive, social
Ways they were benefiting	Widening their learning	Widening their learning	Widening their learning

From the teacher needs analysis in Greece, the teacher participants indicated that the age range taught was 6 to 16 years, with most covering the 13 to 15 year age range. So, more teachers in this group taught older learners than in other countries. Main prior digital technologies used for teaching were hardware, projectors, and multimedia. So the teachers' backgrounds with previous technologies were likely to be different from other countries. Main prior handheld devices used for teaching were experimental instruments in physics and chemistry. Again, this highlighted a difference in technological experience. Main prior handheld devices used by learners for learning were experimental instruments, and Android mobile telephones. This highlighted a further difference in terms of experience of their learners from the picture provided by the wider teacher group. Main benefits identified were facilitating the process of learning, which was a different main benefit identified. Knowing of issues arising when handheld devices were used in teaching and learning were highlighted by 1 out of 5 teachers, which was lower than that for other countries. Main forms of support requested from teacher education sessions were technological, content and pedagogical knowledge, the learning environment, aspects of communication, issues and challenges. Main approaches requested from the teacher education sessions were constructivist, situated, collaborative, informal and lifelong learning, the latter approaches suggesting the teachers would again benefit from a very wide range of approaches. Main practices requested from teacher education sessions were organising notes and work, research, discussing strengths and weaknesses of work presented and shared by pupils, and creating videos for presentation to wider audiences. This rather different profile suggested that these teachers had different concerns in terms of practice.

When the evidence from the learner responses presented in Table 1 is considered, it is clear that there are differences across countries. Considering this evidence in terms of the initial concerns for the teacher education programme, using the Mishra and Koehler (2006) categories, the responses suggest that technical knowledge has been gained and used (for example, writing their own text, and taking pictures), content knowledge has been a focus (for example, cognitive gains are reported widely), but pedagogical knowledge has varied more in terms of responses (for example, making notes outside the classroom is reported in the top 6 uses in Greece but not in Italy or the UK, while working in a group with other children and working on their own is noted in the top 6 uses in Italy and the UK but not in Greece). Similarly, if forms of pedagogy are considered from a learning concept perspective, then behaviouralist, constructivist, situated, collaborative, informal and lifelong, and learning and teaching support outcomes are not all similarly suggested by learner responses. For example, collaborative learning (if arising from group work with other children) is highlighted most in Italy, while situated learning (if arising from making notes outside the classroom) is highlighted most in Greece, and learning and teaching support (if arising from working in the classroom) is highlighted most in the UK and Italy.

Similarly, there are differences noted in terms of the ways that the evidence suggests focus on wider learning environments, and on communication. For example, wider learning environments are suggested by the evidence of making notes outside the classroom in reports from learners in Greece, but these are not highlighted by reports in the UK or in Italy. In terms of communication, however, working in a group with other children is highlighted in Italy, particularly, and less so in the UK, while recording video is noted more in Greece and in the UK.

It is interesting to speculate at this point about the reasons for these differences. It is quite possible that differences are arising both because of the restrictions that national curricula and guidelines play, but, in balance, this might be offset by the ways that mobile devices are opening up opportunities for teachers and learners to add variety to their approaches for teaching and learning. Further future research evidence gathered may enable stronger conclusions to be drawn in terms of reasons for differences arising.

5. CONCLUSIONS

This paper has indicated how research has been involved in supporting a cross-national EU-funded project focusing on developing a teacher education programme to support teachers in effectively using mobile devices in classrooms. Background details highlighted how different national contexts needed to be considered; a training needs analysis indicated how a wide teacher education programme could be designed and developed, but that important national differences needed to be considered; and an early survey has indicated positive outcomes for many teachers and learners, with some important exceptions.

It should be noted that the number of teachers and trainers involved in this initiative is clearly not representative of the entire population of teachers or trainers in each of the four partner countries. It is also clear that national pilot teacher groups are not necessarily a representative population of teachers (from across Italy, for example), and the needs of these teacher cohorts, therefore, may not be representative of a wider population. However, the means to consider these issues further has been developed within the project; it has been shown that the needs analysis instrument can identify these variations within and across different populations. While the level of research evidence gathered is low in quantitative terms, the qualitative evidence being gained is certainly pertinent at an individual teacher level.

Although from a small and selected trainer, teacher and (perhaps less so) learner group, the initial research findings indicate that uses of mobile devices are being developed in many classrooms as well as outside classrooms, and benefits are identified by both teachers and learners. The research will continue, to identify in more detail how teacher education has supported individual teachers and how this support has been translated through specific pedagogies and learning activities to enhance learning.

This paper reports on implementation of mobile practices arising from a teacher education programme. It shows that the degree of implementation following the training programme can happen quickly (within one to two months). However, as this research is ongoing, evidence will be gathered over a period of a further 8 months to identify whether and to what extent practices are sustained, developed, shaped or altered. These later elements of evidence might then provide more in-depth and valuable insights into how more innovative approaches and more detailed teacher education programmes might be constructed to support teachers more effectively in the future.

This study has shown that a needs analysis for teacher professional development in using mobile technologies can be constructed and used to help define a professional teacher education programme. This is potentially important if teacher education is one of the important obstacles that is preventing current wider uptake and adoption of mobile learning practices. Further study results may indicate how far a wider programme endeavour could be developed.

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MOBILE-ASSISTED LANGUAGE LEARNING: STUDENT ATTITUDES TO USING SMARTPHONES TO LEARN ENGLISH VOCABULARY

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ABSTRACT

This project examines mobile-assisted language learning (MALL) and in particular the attitudes of undergraduate engineering students at the South Westphalia University of Applied Sciences towards the use of the smartphone app Quizlet to learn English vocabulary. Initial data on attitudes to learning languages and to the use of mobile devices to do so was gathered by questionnaire from a convenience sample of 68 students. The results indicated that almost all of the participants had a smartphone and were interested in using it in language learning. The vocabulary for the Professional English: Engineering exam was then made available to the students in the Quizlet app. At the end of the semester ten students took part in follow-up interviews. The vocabulary scores from the exams from the two latest semesters were compared and showed no significant difference in the student performance. The interviews however revealed that the students found the use of mobile-learning flashcards to be a very efficient, convenient and enjoyable learning method. This research concludes that the use of smartphones in language learning is beneficial in terms of student motivation and may have additional long-term benefits which have yet to be seen. Continued study on a larger scale over a longer period is therefore recommended to provide more insight into the optimal use of mobile-assisted language learning.

KEYWORDS

Mobile-assisted language learning, attitudes, vocabulary, flashcards, apps, quizlet.

1. INTRODUCTION

Computer-assisted language learning has been present in schools and universities for many years. With the development of new, powerful mobile phones more and more tasks which were previously confined to desktop PCs can be carried out on mobile devices. This includes functions relating to language learning, a field which has now become known as mobile-assisted language learning (or MALL).

1.1 Mobile-learning in Meschede

Mobile phones and smartphones have become ubiquitous amongst students of business and engineering degrees at South Westphalia University of Applied Sciences in Meschede (Davie, 2012). All of the sixty students surveyed in 2012 confirmed that they had at least one mobile phone or smartphone. Half of the surveyed group said they had already used their mobile devices to aid them in their learning despite the fact that the university did not officially offer any mobile learning opportunities. Furthermore, two-thirds of the students interviewed expressed a desire for the availability of official university mobile learning tools. These responses formed a basis to further explore the area of mobile learning and conduct a small-scale development project and study on the use of mobile devices in language learning.

2. BODY OF PAPER

Research by Saran et al. (2008), Lu (2008) and Kukulska-Hulme & Shield (2008) has shown that students are favourable to the use of mobile devices for learning vocabulary and studies have also shown positive results. However, Chinnery (2006) states that there is no decisive evidence that newer technologies are any better than existing ones and Beatty (2003) confirms that teachers have to think very carefully before investing time and money in new (and unproven) technologies. The rationale of this study is therefore an attempt to reconcile the fact that students seem keen to make use of mobile learning technologies whilst at the same time there is a lack of conclusive evidence about its value for learners. This study will attempt to discover whether mobile-assisted language learning techniques do indeed offer a benefit to learners. Particular attention will be given to the mastery of vocabulary as an area which students often label as monotonous to learn and which seems to lend itself to the opportunities and restrictions offered by mobile learning.

For the purposes of this paper a clear definition of mobile-assisted language learning is required. Valarmathi (2011) defines it simply as the use of a mobile device in support of the (language) learning experience. The devices involved could therefore be a personal digital assistant (PDA), a normal mobile phone (now also known as a "dumbphone"), a smartphone, a tablet computer or an mp3 player. Each of these devices offers a combination of unique affordances which all influence the way in which it can be used as an educational tool.

For Ally & Prieto-Blázquez (2014) it is important to emphasize the mobility of the learner who should remain at the centre of the learning, rather than the technology. The role of the technology is simply to allow the learner to learn, regardless of context. Kukulska-Hulme & Shield (2008) share this sentiment. For them, mobile-assisted language learning is "formal or informal learning mediated via handheld devices which are potentially available for use anytime, anywhere".

Wagner (2005) confirms that mobile phones are a natural choice for use in mobile learning as they have already been adopted by the majority of students. This means little training or support should be required. Studies have also shown that using a device that is owned by the student is more effective than using a borrowed device (Kukulska-Hulme, 2009). This all makes a bring-your-own-device (BYOD) approach possible, saving institutions costs in both financial and administrative terms.

Flashcards are a popular tool for learning vocabulary which also now has a smartphone equivalent. Azabdaftari & Mozaheb (2012) compared the success of using traditional, paper-based flashcards with using

a smartphone app for digital flashcards. Digital flashcards have the advantages of supporting multimedia (e.g. audio files as well as text or pictures) and can also monitor and store the learner's progress. If the learner is trying to learn a large amount of vocabulary or various different lists a flashcard app can be more manageable than a stack of several hundred paper cards. In Azabdaftari & Mozaheb's study, at the Islamic Azad University in Iran, a group of 40 students used a flashcard app combined with SMS and internet dictionaries, whereas the control group of 40 students used traditional paper-based flashcards over a seven week period. A multiple-choice test was then used to evaluate the success of both strategies. Qualitative interviews were also conducted with 10 members of each group to assess the students' attitudes to the learning methods. The results showed that the mobile learning students performed significantly better than the control group.

Nevertheless it appears difficult to provide empirical evidence of mobile technologies improving students' subject skills. Many researchers have instead focused on the learners' attitude to mobile learning as a measure of its success (Kutluk & Gülmez, 2014; Jaradat, 2014). Kutluk and Gülmez (2014) explored accounting students' attitudes to the use of mobile technologies for learning. The 343 students who participated in the study had not yet officially used mobile devices in their accounting lessons but the majority had a positive attitude towards using m-learning and believed that using mobile technology for homework or research would be easy and quick.

Jaradat (2014) examined student attitudes and perceptions of the use of m-learning to learn French and attempted to measure changes to student performance before and after the use of mobile learning technologies. The 36 female students who took part in this study over two semesters made use of m-learning both inside and outside the classroom. Survey data collected on attitudes to learning French in both formal and informal settings and the use of mobile technologies was enhanced with the data from ten interviews conducted with randomly selected members of the group. The results of the survey revealed that 76% preferred to receive their French lessons by mobile phone rather than on a PC or in class. 90% said they were

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satisfied with the use of m-learning and 91% said they wanted to continue using it to learn French. However, the pre-test, post-test analysis carried out by Jaradat did not show a large improvement in the students' learning. The students saw the use of mobile technologies as improving the communication within the class and between the class and teacher. The results suggest that in this case m-learning can be seen as an efficient tool, if not necessarily an effective one.

Lominé (2009) identified three factors which have to be considered when implementing an m-learning strategy – pedagogy, economics and technology. The pedagogy must be clear before any trials are begun. It is also paramount that this is the driving force rather than the technology. The economics is the area which seems to be neglected by many of these studies – how much will such a system cost both the lecturer and the students and is it more cost-effective than alternative technologies? As well as the financial cost, this could be a high physical and emotional cost for all involved if it is not researched thoroughly. Lastly, the technology has to be considered carefully. At our institution almost all students seem to have a mobile phone (if not a smartphone). This is however not always the case and in addition, as a very hilly area, there are some villages and areas which have very poor, or no, mobile phone reception which could greatly influence the effectiveness of such a study as well as the students' attitude to the value of the tool.

The nature of mobile learning must also not be forgotten. It is, as described by Kukulska-Hulme and Traxler (Beetham & Sharpe, 2007), spontaneous, opportunistic and informal. These factors mean that it may be difficult for the learner to concentrate on learning when surrounded by distractions which are not present in the usual classroom. It therefore seems that there are significant challenges in using mobile devices to teach aspects of English as a foreign language, such as vocabulary or grammar, but with consideration they can be overcome.

Although not all overridingly positive, the results of these studies seem to suggest that there is merit in pursuing mobile-assisted language learning to help students learn vocabulary. As well as the positive affordances offered by mobile devices, their technological limitations should also not be forgotten. The smaller screen sizes and lack of physical keyboard mean that the learning activities used in class or computer-based e-learning may not be appropriate. Learning content has to be adjusted accordingly to suit the medium. The fact that this area of Germany does not have complete mobile phone coverage also means that activities which require a constant internet connection may be not always be usable. Learning material which can be accessed partly or completely offline should therefore be given preference. Finally, the studies considered here were all relatively small-scale and short term. Conducting a similar experiment over a longer period (for example the full 15 weeks of a semester) with a larger population (150 students) may prove to be more complicated. It would however also produce more reliable results and add more to the body of knowledge in this area. Many researchers (Small, M., 2014; Ally & Prieto-Blázquez, 2014) agree that there is promising evidence about the success of mobile-assisted language learning but that more research, especially empirical research, needs to be carried out to confirm and expand upon these findings.

2.1 Quizlet and MALL

Quizlet (www.Quizlet.com) is a web-based vocabulary-learning program started by Andrew Sutherland in 2005 for a high school French class (Quizlet, undated). According to the website, the site now contains over 40 million study sets created by users, both students and teachers, from all over the world. To create a new study set, as for the Professional English: Engineering vocabulary, a user can either enter each item manually on the website or they can be uploaded from an Excel or .csv file. As an Excel document with all the vocabulary for the module already existed, this was uploaded to the site and then checked for any conversion errors. Thus the entire list of vocabulary was made available within a few minutes. It is possible to control access to a study set by making it public or private. Making a list private however means that a list of approved users has to be created and the users then have to log in to the site to gain access. Leaving the vocabulary list public meant that all students could have immediate access to it without any need to wait for approval or log in.

2.2 Research Methodology

A questionnaire consisting of 24 Likert-scale questions was distributed to a convenience sample of 26 second-semester students of Mechanical Engineering and Electrical Engineering during a Professional English: Engineering class at the beginning of the summer semester 2014. In addition, a total of 42 students of business and business with engineering-based degrees also completed the questionnaire. Although these students were not sitting the same Professional English: Engineering exam the vocabulary for their Business English: Professional exam had also been made available to learn using Quizlet.

In August 2014 interviews were conducted with a convenience sample of ten undergraduate students, 5 male and 5 female. The following five questions were asked to encourage discussion:

1. The vocabulary for all English courses can now be downloaded and studied using the Quizlet app. Have you already used the app and how did you find it?

2. How did you previously learn vocabulary? What advantages or disadvantages do you see in using Quizlet?

3. The Quizlet app has three modes: Cards, Learn and Match. Which of these have you used and how did you find them?

4. In a recent survey 73% of participants agreed or strongly agreed that mobile learning could help them learn English. Was do you think?

5. More than half of the survey participants (55%) would welcome it if tutors started to use mobile learning. What do you think?

Questions 4 and 5 refer to artefacts produced during the analysis of the student questionnaires. It was hoped that this “real-world” information would encourage students to reflect upon their own opinions on the subject.

2.3 Findings

The survey results showed that mobile phone ownership is indeed as common as thought with only one out of the 68 participants admitting to not having one. 48 of the respondents were male and only 20 female with the sample ranging in age from 19 to 37 years old with the mean age being 22.

When asked to comment on the statement “Mobile learning can help me improve my English”, 77% of the engineering students and 72% of the business students strongly agreed or agreed.

The students were then asked to comment on “Using a smartphone for learning purposes would be easy”. The majority of students were again positively inclined towards this statement: 62% of the engineering students and 52% of the business students agreed or strongly agreed. Only a minority disagreed or strongly disagreed (engineers=4%, business=10%) and a large percentage from both groups (engineers=35%, business=36%) remained unconvinced in either direction.

The third statement attempted to gauge whether the students themselves felt they were knowledgeable enough to use their smartphone as a learning tool. Here the students were very sure of their own abilities with 77% of the engineers and 62% of the business students agreeing or strongly agreeing with the statement.

The following statement could be considered the most important before investing time, money and energy in adopting a MALL approach. The students were asked to comment on whether they were interested in using their smartphones to learn English. The engineering students were clearly more interested in this proposition with 69% agreeing or strongly agreeing with the statement in comparison with only 50% of the business students. The business student group also included the most students who disagreed or strongly disagreed with the idea (17% and 7% respectively).

Statement 5 of this section explored whether support from the university would encourage students to make use of mobile learning. 57% of the business students agreed or strongly agreed with this statement as well as 50% of the engineering students. In the engineering group 35% of the students chose the neither agree nor disagree option compared to only 26 of the business students. 15% of the engineering students and 16% of the business students would not be more likely to use mobile learning if the university provided technical support. This may however not mean that these students do not want to use mobile learning. It could rather mean that they do not feel support from the university is necessary so its availability or lack of availability could have no impact on their decision to use mobile learning. A comparison with the positive responses to the second statement "Using a smartphone for learning purposes would be easy" and the third statement "I have the knowledge necessary to use a smartphone for learning" would tend to support this belief.

The sixth statement attempted to discover whether the students really wanted their teachers to make use of mobile learning. In response to this statement 69% of the engineering students agreed or strongly agreed and 45% of the business students. The remaining business students were not necessarily against the idea of using mobile learning, 36% said they neither agreed nor disagreed with the statement.

Statement seven examined the student attitudes to the costs involved in mobile learning. As almost all of the students taking part in the survey already own a smartphone the answers to this statement can be considered to be more in relation to software, bills from the mobile phone provider or backend costs for the university rather than for the students buying their own smartphone. 54% of the engineering students disagreed or strongly disagreed with this statement along with 55% of the business students. 35% of the engineers and 33% of the business students neither agreed nor disagreed, with the remaining students (12% of both engineering and business students) agreeing with the statement. No members of either group strongly agreed. It therefore seems that students do not expect high costs to be associated with the use of mobile learning.

The students were also asked how efficient they thought mobile learning could be. 38% of the engineering students agreed or strongly agreed with this statement in comparison with 43% business students. The biggest group of students was unsure and could neither agree nor disagree with the statement (46% of engineers and 45% of business students).

At the end of the semester, having spent the previous fifteen weeks learning vocabulary with Quizlet, a convenience sample of ten students (5 male and 5 female) took part in semi-structured interviews in an attempt to gather more qualitative data about their MALL experience. Looking at the individual questions posed, some common themes are present amongst the answers. As shown in table 1, the first question established that the vocabulary were available in Quizlet and asked for the students' experiences using it:

Table 1. Contextual analysis of interview question 1

When asked "Have you already used the app and how did you find it?" answers included:	
• Very helpful! • …great… • …very useful… • …more fun…	• ...really good… • …very convenient.. • I have never used a better vocabulary training tool. • …super…

All ten of the respondents had already used the app and described it as a positive experience. Four of them also mentioned the mobility of the app allowing vocabulary to be learnt anytime and anywhere.

Question two examined the students' previous experience of learning vocabulary and what good or bad points they found about using Quizlet.

Table 2. Contextual analysis of email interview question 2

When asked "How did you previously learn vocabulary? What advantages or disadvantages do you see in using Quizlet?" answers included:
• Index cards. • Printed A4 list. • ..from the book.. • ..long lists… • Phase 6.

One student mentioned using a PC program (Phase 6) to learn vocabulary and the remaining students used either index cards or a printed list. All of the students mentioned the fact that the vocabulary was already available as a time saving benefit. However two of them students did recognise that writing vocabulary by hand onto index cards is part of the learning process and that this opportunity disappears when one uses ready-made digital (or paper) flashcards.

The third question went into more detail regarding how the students made use of Quizlet.

Table 3. Contextual analysis of email interview question 3

When asked "The Quizlet app has three modes: Cards, Learn and Match. Which of these have you used and how did you find them?" answers included:
• Mostly the Learn function. • All the modes – Match was most fun. • I liked Learn mode the best. • Cards mode. • All three modes.

The playful game-based nature of the Match mode was mentioned by several students as being especially fun, rewarding and motivating. The fourth question presented the students with an artefact from the questionnaire results and asked for their opinion:

Table 4. Contextual analysis of email interview question 4

When asked "In a recent survey at the university 73% of participants agreed or strongly agreed that mobile learning could help them learn English. Was do you think?" answers included:	
• I agree. • As long as it is practical, yes! • It can definitely help. • …society shouldn't get too dependent on smartphones.	• It makes it possible to learn on the move. • Yes, mobile learning really helped me. • I am absolutely convinced. • …a good idea…

Finally, as shown in table 5, a second artefact was given to discuss whether students would like mobile learning to be implemented in the university.

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Table 5. Contextual analysis of email interview question 5

When asked "More than half of the survey participants (55%) would welcome it if tutors started to use mobile learning. What do you think?" answers included:
• Can be useful. • …for other modules too. • I would welcome it… • I would like an app for every module. • I can recommend it. • Too many outside influences distract from learning.

As can clearly be seen, the student attitudes were largely positive although one participant did mention the same concern expressed by Kulkulska-Hulme and Traxler (Beetham & Sharpe, 2007) that learning outside of a classroom has a risk of distractions that can damage the learning process.

In addition to the questionnaires and interviews, the exam results from the two most recent semesters were also examined. Both compulsory technical English exam papers are structured in the same way with part one being 15 vocabulary which had to be defined in English. The results are summarized in table 6.

Table 6. Comparison of vocabulary section words defined correctly

Exam	N (participants)	Min	Max	Mean	Mode	Median
Technical English	88	1	15	9.70	15	10
Professional English: Engineering	55	0	15	8.95	15	9

As can clearly be seen the mean and median scores were higher in the first exam where the students did not officially have access to the Quizlet app to learn the vocabulary. As the cohorts are of different sizes a chi-square analysis should be conducted to confirm if these differences are significant. To aid calculation and increase reliability the results will be grouped into three categories: Poor (0-4 words correct), OK (5-9 words correct) and Good (10-15 words correct). This analysis will test the null hypothesis "There is no relation to the use of Quizlet to learn vocabulary and the number of points achieved" (see table 7).

Table 7. Chi-square analysis of vocabulary defined correctly

	Poor (0-4 correct)	OK (5-9 correct)	Good (10-15 correct)	Row totals
Technical English	15 (17.23) [0.29]	25 (24.62) [0.00]	48 (46.15) [0.07]	88
Professional English: Engineering	13 (10.77) [0.46]	15 (15.38) [0.00]	27 (28.85) [0.12]	55
Column totals	28	40	75	143 [Grand Total]

The resulting chi-square value of 0.94 is well below the critical value of 5.99 (df=2, level of significance=0.05) indicating that there is actually no significant difference found between the vocabulary points in the two exams. This therefore confirms the null hypothesis and would suggest that the use of the Quizlet app made no difference to student performance in this section of the exam.

3. CONCLUSION

Despite the mixed results of this study it seems that the use of mobile-assisted language learning does have potential. It is therefore very worthwhile to pursue further research in this area. The literature review and results show that there is a lot of room to expand and extend this work.

The students surveyed were very keen to make use of the Quizlet app and although it did not seem to lead to an immediate improvement in exam performance, the student perception of the learning process was positive. This positive attitude may lead to a long term effect which sees students remembering the vocabulary longer and more completely. As this project has not seen the use of Quizlet cause any harm it would seem that there is no reason not to keep the vocabulary available whilst nevertheless continuing to monitor student progress.

As mobile learning and mobile-assisted language learning are relatively new fields it would be interesting to explore this area further with continued research to gain a better understanding of what works best, slowly building towards a set of guidelines for the entire university.

Lominé's (2009) three factors when implementing m-learning should however definitely be kept in mind. The pedagogy, economics and technology must all be carefully considered to ensure students and staff perceive a genuine benefit to mlearning and it is not just seen as a fad or an attempt to be trendy.

At the end of the day, a positive student attitude is one of the most important factors in successful learning and even contributes to retention on a course. If the simple use of a mobile app for learning vocabulary can contribute towards an enjoyable and rewarding learning experience then we should definitely support it.

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ACTIVE STUDENTS IN WEBINARS

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ABSTRACT

To ensure student activity in webinars we have defined 10 learning tasks focusing on production and communication e.g. collaborative writing, discussion and polling, and investigated how the technology supports the learning activities. The three project partners in the VisPed-project use different video-conferencing systems, and we analyzed how it is possible to implement different learning activities in the video-conferencing tools, alternatively using external tools in combination with video-conferencing tools.
The webinar technologies investigated (Microsoft Lync, MeetCon and Adobe Connect) mainly have features to create live polls, share screens and resources, chat and handle user roles (presenter, guests). Learning activities based on e.g. collaborative text production, collaborative work with spreadsheets, presentations and evaluations demand the use of external applications.

KEYWORDS

Webinar, synchronous e-learning, video-conferencing system, student activity.

1. INTRODUCTION

As the "flipped classroom" method spreads around classrooms worldwide, it is worthwhile to consider the adoption of some of these ideas also in online learning, focusing on active students during synchronous webinars while moving one-way teacher presentations to asynchronous learning materials (e.g. videos, which the online student can watch anytime and anywhere). In the field of online learning, there is a lot of focus on MOOCs (massive online open courses) now. MOOCs are usually based on asynchronous e-learning, but also synchronous e-learning is developing as teaching methods and technology are improved. One challenge of synchronous e-learning is boring sessions with the teacher as a "talking head" with one-way presentation (Nielsen, 2005).

Synchronous e-learning often uses video-conferencing systems, teaching lessons through so-called "webinars" (web seminars). Clay (2012) discusses the term webinar, and how the student in a seminar simply sits and watches someone present. Clay suggests the term "web workshop" to more correctly capture the sense that the student will be doing something instead of passively listening. Slåtto et al (2011) compare the webinar to a web conference, which was an "attempt to transfer the physical conference to internet and not very successful. The webinar is better adapted to the characteristics of internet; it is short, fast, supporting, fragmented and dependent on being seen in a larger perspective". Slåtto et al (2011) define a webinar to be "an online meeting where several persons gather around a topic, to listen to a lecture, work on a problem, or combinations of these. A one-way presentation is usually called a webcast". We use the term webinar based on the definition of Slåtto et al (2011), meaning live online meetings including active teachers and students.

According to de Freitas and Neumann (2009) "passive modes of delivering content and a lack of active student participation or effective interaction cause more extreme problems in distance education groups, such as high dropout rates, because of limited or no face-to-face contact between students and tutors". This is one reason why it is important to look into how to create active students in a webinar-based learning environment. Finkelstein (2006) points out "lessons are best learned from group discussion or collaboration. Few things are as rewarding as watching the exploration of a topic take flight as learners discuss, collaborate, construct knowledge and work together to solve a problem".

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Teaching activities in e-learning have to emphasize more student activity, through interaction, collaboration and communication. Video-conferencing systems support two-way communication, coordination and collaboration in the learning situations.

The structure of the article is as follows; first, the study and research methods are presented, followed by a theoretical framework focusing on interaction and collaboration, and the definition of student-active learning activities. We then present the results of our study, and finally discuss the results and conclude the article.

2. THE STUDY

The VisPed study involved three educational institutions in Norway: The Norwegian University of Science and Technology (NTNU), Folkeuniversitetet Midt-Norge (FUMN) and Nord-Trøndelag University College (HINT). The project took place in 2012-2014. The three participating institutions, Norway Opening Universities, Stiftelsen for fremtidens Nord-Trøndelag funded the project.

2.1 Research Question

The main research question for this paper is how to ensure student activity in webinars, focusing on production and communication. Next, how can those activities be implemented in three different video conference systems: Microsoft Lync, Adobe Connect and Meetcon, alternatively in external tools that can be used together with the video-conferencing systems to ensure student activity.

2.2 Research Methods

The research design of this study follows the basic guidelines for qualitative research (Askheim and Grenness, 2008) with descriptions of research questions and relevant informants, where the survey was implemented and at last, how it was performed.

The main informants of this study were six teachers who planned, lead and reflected upon the webinars in their courses. We developed a guided questionnaire online, where the teachers could reflect upon specific topics after each webinar. The topics of the questionnaire were time, pilot course, video-conferencing system, categories of planned student activity in the webinar, digital tools, problems/challenges and positive experiences. Based on 20 different evaluations of webinars, mainly from using MeetCon and Adobe Connect and reflecting notes from the teachers using Lync, in addition to a focus group meeting in the end of the project with participants from all the institutions, we analyzed the experiences of the teachers. The main purpose of the focus group meeting was to highlight opportunities, similarities and differences in tools for student-active webinars.

2.2.1 Data Collection

Data was collected through pilot courses using video conferences as a teaching platform; two Spanish language courses (NTNU), a business management course (FUMN), a chemistry course and a pharmacy course (HINT). The courses were different when it comes to content, academic methods, number of students and tradition for student activity in the classroom (Kolås, 2014). The differences were valuable to the study in order to learn from each other, as well as to discuss and compare learning activities. Table 1 gives an overview of the courses involved in this project.

Table 1. Courses and webinars in the VISPED project

Name of the course	Institution	Numbers of students	Webinars
Business management	FUMN	9	6 webinars * 4 hours. Solely online students.
Chemisty2 and 3 (24 ECTS)	HINT	26	Combination of webinars and physical gatherings.
Practical pharmacy (11 ECTS)	HINT	32	Combination of webinars and physical gatherings.
SPA0502 Spanish (7,5 ECTS)	NTNU	Few	5 webinars * two hours, mixed group with both online and classroom students.
SPA6500 Migration in the Spanish speaking world (15 ESCS)	NTNU	10	12 webinars * one hour. All the students participated at the webinars.

Through seven online workshops, the participating teachers were introduced to relevant tools for student activities, e.g. wiki tools, collaborative tools related to text editors, presentation editors, mind map editors, spreadsheets and polling tools, and how to use video. The topic of the last workshop was to discuss which tools were adequate to use in different courses. The workshops took place before the pilot courses started in the fall of 2012. The workshops provided the teachers with experiences of running webinars with high impact of involvement from everyone in the webinar. Six of the online workshops took place in Microsoft Lync video-conferencing system and one workshop used Adobe Connect as webinar platform. The webinar workshops were limited to one hour each.

The three educational institutions use different video conferencing systems: Adobe Connect (NTNU), MeetCon (FUMN) and Microsoft Lync (HINT). This was valuable in our study as the different video conferencing systems provide different possibilities of student activity features and tools, e.g. chat, private chat, web cam video stream, screen sharing, polling etc. Clay (2012) suggests to use polls to check knowledge, comprehension or experience, stimulate interest, set up discussion, provide instant feedback, allow learners to compare their responses. Finkelstein (2006) points out that “live video is the most obvious answer to conveying virtual body language and a sense of immediacy. Used well and appropriate, live video can deliver a very powerful and human experience.” Clay (2012) describes how a teacher is using the whiteboard not only to record ideas in real time but also use it for freehand drawings, and to let the students fill in information to a table, where each students gets his /her own grid.

2.2.2 Limitations

The students of the pilot courses had limited skills in using digital collaborative tools. Krokan (2012) claims that many so-called “digital natives” in reality are almost digital illiterate because they have little knowledge of how to work together using services such as wiki and Google Docs. The number of student activities and tools had to be limited according to educational benefits in the learning situation. The teachers had to choose a few digital tools for each course, as each tool had to be introduced technically and pedagogically to the students. This is time-consuming since many of the students were not tech savvy. The digital tools had to provide added value to the learning activity, in order to feel useful and not a waste of time. Therefore, each learning activity and tool are limited tested.

3. THEORETICAL FRAMEWORK

To create an environment of student participation in a synchronous webinar-based classroom, it is necessary to change the role of the student. We have to replace the traditional passive receiving student with an active participant. In turn, this approach affects the manner in which we view the role of the teacher as such.

3.1 Interaction and Collaboration

Clay (2012) defines "interaction" in a virtual classroom setting as "verbal and written synchronous (two-way) communication, usually between the facilitator and the participants". When a student is asking the teacher or a fellow student a question, and receives an answer, this is interaction, but not collaboration. Clay (2012) exemplifies "interaction" as a facilitator's use of questions or polls to check understanding, maintain interest, promote the sharing of ideas and experiences or otherwise engage participants in learning activities.

Clay (2012) refers to the term "collaboration" as the "act of working together to achieve a goal", often with participants contributing independently from the facilitator. An example of collaboration is to create a product (e.g. a presentation or a text) together. Conrad and Donaldson (2004) stated that "collaboration is a key element to the success of an online learning environment".

3.2 Learning Activities

Conole and Fill (2005) define a learning activity as consisting of three elements; the context (subject, level of difficulty, the intended learning outcomes etc); the learning / teaching approaches (theories and models); and the tasks undertaken (type of task, techniques, resources, tools etc). Examples of tasks are reading paper, discussing ideas, answering questions etc.

Finkelstein (2006, page 52-53) presents several ideal learning situations based on real-time online venues, e.g. chat rooms, virtual meeting room, virtual classroom, interactive webcasting etc. A virtual classroom is according to Finkelstein (2006) characterized by real-time voice and visual contact between all participants, a shared whiteboard, an integrated area for the projection of slides, text-based interaction, student indication means, assessment tools and the ability to gauge virtual body language. Examples of ideal learning situations in different venues:

- Game-based learning activities, role-playing activities, group problem-solving simulations and team-building activities are classified as possibilities at multi-user virtual environment.
- Group meetings, team- or group discussion and work, review sessions and "show and tell" sessions are possibilities at virtual meeting room environment.
- Interactive seminars, student-led presentations, critique sessions, facilitated labs or problem solving and organized breakout sessions are possibilities at virtual classroom.
- Remote student or expert participation, group collaboration, question submission, quizzing and polling, and synchronized note taking are possibilities at in-class online aids.
- Peer discussion on course material / technical support are other useful possibilities (Finkelstein, 2006).

Combining task types, techniques and tools/resources from the learning design toolkit (Conole & Fill, 2005) and ideal learning situations defined by Finkelstein (2006) we have identified 10 learning tasks focusing on student activity in a synchronous online learning environment. We focus on learning tasks based on production and communication:

1. Collaborative writing of text. This may be in the shape of a joint effort in taking notes from class, in problem solving sessions, brainstorming sessions, resumes of texts or written discussions regarding the topics at hand.
2. Collaborative work in spreadsheets.
3. Collaborative work in presentation tools like prezi and mind map tools.
4. Collaborative drawing.
5. Collaborative data collection and data analytics.
6. Voting / polling is a learning task where the students take part in or create a survey, e.g. an opinion poll. Voting/ polling tools usually have a variety of question types and multiple choice.

7. Student presentations means that individual students or groups of students prepare and present student work orally or using media-based presentations.
8. Discussion as a learning task involves the students in oral speaking or writing statements, debating a topic.
9. Group work in small groups, where the participants collaborate (orally and/or written).
10. Share resources, which means sharing of links, images, text, files, videos etc.

4. RESULTS

Based on the 10 defined learning tasks we first shortly present how different student activities took place in our pilot courses. Next, we examined and compared the functionality of the three chosen video conferencing system, focusing on the 10 learning tasks.

4.1 Student Activity in the Webinars

The evaluation of webinars showed several useful examples and experiences of student activities.

- Collaborative text production (1) using Google Disk Document took place in the courses Business Management and Chemistry.
- Collaborative spreadsheet production (2) using Google Disk Spreadsheet was investigated in the course of Business Management. The topics were accounting and budgeting.
- Collaborative development of a presentation (3) was a task in the Spanish language course, where the students used Prezi. No pilot course used mind map tools for student collaboration.
- Collaborative drawing (4) was a topic in the Chemistry course. The teacher and the students used an electronic pen for writing chemical formulas and derivations.
- Collaborative production of surveys (5) was a topic in the courses of Practical pharmacy, Chemistry and Spanish language. In the course of Spanish language, the students used Google Forms as a common tool.
- Voting and polling (6) were used for evaluation purposes in the Chemistry course, and they used the "One Minute Paper" technique in a Google Form to evaluate the course of Business Management.
- Oral student presentation (7) based on online group work was a method in the course of Business Management, and another group had to give feedback on the student presentation (peer assessment).
- Reflections and group discussions (8) about situations from practical tasks were used in the course of Practical pharmacy. The group work took place in smaller groups (9).
- The students also created and shared resources (10) like project plans and reports in Google Disk Document (Practical pharmacy). It was also easy to share links and resources through the chat tool in the video-conferencing systems during the webinars.

4.2 Tools for Student-Active Learning Activities in Video-Conferencing Systems

We soon realized that besides video-conferencing systems, another way to develop student-active learning activities is to use external tools in combination with video conferencing tools. The results in table 2 is based on the 10 learning tasks and shows the evaluation of three video conferencing tools focusing on synchronous learning activities where the goal is active students.

Table 2. Tools for student active learning activities in three video-conferencing systems

Student activity	Microsoft Lync	Meetcon	Adobe Connect	External tools (possible to combine with video conferencing tools)
Collaborative text production (1).	Digital whiteboard	Digital whiteboard	Digital whiteboard	OneNote/Notes, Etherpad, Google Disk ++
Collaborative production of a spreadsheet (2)	No internal system.	No internal system.	No internal system.	Google Drive Spreadsheets, or application sharing (Excel, Numbers)
Collaborative production of presentation (3)	No internal system.	No internal system.	No internal system.	Prezi, Google Drive or application sharing (Powerpoint, Keynote).
Collaborative drawing (4)	Digital blackboard	Digital blackboard	Digital blackboard	Google Drive Drawing
Collaborative production of an survey (5)	An internal tool for making a survey.	No internal system.	No internal system.	Google Drive Forms
Voting and polling (6)	Survey tool	No internal system.	No internal system.	Kahoot!, Socrative + +
Student presentation (7)	Application sharing (student has a presenter role)	Application sharing (student has a presenter role)	Application sharing (student has a presenter role)	Prezi (remote presentation), PowerPoint (Broadcast slideshow)
Discussion (8)	Oral discussion through the webinar and written discussion through the chat	Oral discussion through the webinar and written discussion through the chat	Oral discussion through the webinar and through the chat	LMS discussion forums, Facebook groups ++
Group work in small groups (9)	No breakout room function	No breakout room function	The Breakout room function.	
Share resources (10)	Oral through the webinar and posting through the chat.	Oral through the webinar and posting through the chat.	Oral through the webinar and posting through the chat.	

For group work in webinars (9) only Adobe Connect have Breakout room with random subdivision of the group or the administrator could define the subdivision. Further, the webinar administrator decides when the breakout rooms ends and with automatically transfer to the ordinary webinar room. For Microsoft Lync and Meetcon the students must leave the webinar room and enter separate group-rooms. After the group session, the students must return to the ordinary webinar room.

5. DISCUSSION

Our study shows that it is possible to make online students active in webinars, but the study also shows that the video conferencing systems have limited tools to ensure student-active learning activities. It is often necessary to use external tools, e.g. Kahoot!, Prezi, MindJet etc as the video conferencing systems lack features, which are necessary to implement student-active learning activities. One drawback of using external applications are that the teachers and the students need to learn to use several applications.

5.1 Challenges with Cloud-Based Software

The VisPed project mainly used free software for the project, e.g. Google Disk, Prezi, Etherpad, Padlet, Mind42, Socrative, Wikispaces and Kahoot! The advantages of these tools are that they are easy to learn and possible to use in a browser (no software installation) and they have collaborative functionality. However, the use of cloud-based services has some disadvantages. Cloud-based software often has its own user/password session. Teachers and students have to sign in, remember, use and maintain several logon sessions, which is time-consuming and confusing. Some free versions lack some tools compared with the more advanced versions. Changes of functionality in free software happens, and free software sometimes work in only a specific browser. This frustrates teachers and students.

5.2 Teaching the Teachers

Teacher-centric presentations have long traditions in higher education, and new ways of teaching like the flipped classroom method and more student-active learning activities challenge both teachers and students. Teachers have to learn to use a variety of tools. It is important that the teacher learn the digital tools they want to use for student activities before ahead of the course. Many tools were new to the teachers in our project, but were learned through online workshops. The goals of the workshops were to learn how to use tools for collaborative work, e.g. wiki, writing, spreadsheet, presentation and mind map. In addition, the webinar form of the workshops made the involved teachers familiar with webinar tools. The teachers got pedagogical ideas and sufficient technological skill to organize their own webinars with several elements of student activities.

5.3 Student Expectations

Many students expect a traditional teacher to teach them knowledge, skills and attitudes. Introducing several student activities into the webinar classroom indicate that the students have to be more active and visible. They have to write, speak, discuss and evaluate during the webinars, and not all of them are familiar with professional communication through video conferencing devices. Further, the students have to spend some time to learn new digital tools instead of using the same time focusing on the learning outcome of the course. New digital tools have to provide added values and be well-supported with learning materials. The VisPed project developed a toolbox for student-active learning activities. Here each software tool was introduced with a short introduction page and short "how-to" videos and written instructions. These resources were available for both teachers and students.

Webinars and collaborative tools introduce several sources for learning content and relevant student work. Collaborative tools store the learning content in different places, and mainly in cloud-based services like Google, Prezi, YouTube and other social media. This is more complex than reading the learning content from a textbook and use a LMS for messages, tasks and assignments. The students expect an uncomplicated learning environment, and complain if the learning environments are too complicate. To solve this challenge we have to teach the students how to organize their own learning environment when we introduce new learning tools. It is also important to present a common digital hub where teachers and students can post links to learning content each webinar and topic of learning outcome.

6. CONCLUSION

The main goal of the VisPed project was to investigate how to introduce student-active learning activities for webinar-based teaching. We defined 10 learning tasks focusing on active student participation in webinars. Collaborative writing of text, spreadsheets, presentation, drawing and surveys are valuable student activities in addition to discussion, voting, polling, sharing resources and student presentation.

Video conferencing systems used for webinars have limited functionality to ensure an active and participating student. Microsoft Lync, MeetCon and Adobe Connect mainly have features to create live polls, share screens and resources, chat and handle user roles (presenter, guests). In order to create learning activities based on e.g. collaborative text production, collaborative work with spreadsheet, mind map, presentations, polls and evaluations it is necessary to use external applications e.g. Kahoot!, Google drive, Etherpad and Wiki pages.

As Conole and Fill (2005) defined “learning activity” to consist of context, learning/teaching approach and task, we have in our study a learning / teaching approach focusing on student activity, a context of three different video conferencing systems and tasks based on production and communication.

Video conferencing systems allow for interaction and collaboration, using a variety of tools e.g. chat, sharing application and polling. Instead of focusing on the existing tools, we have performed a study of three video conferencing systems focusing on their abilities to ensure student activity. This study ensures that online teaching methods do not solely take software features as a starting point, but first consider what learning activities are preferable to use, and afterwards look at what software features are needed.

6.1 Further Research

After the VisPed project was ended, the use of webinars in synchronous e-learning has expanded to other courses at the institutions (Kolås, 2014). Several participants raise demand for further evaluation of the webinar area. The literature study points out some other relevant learning tasks for synchronous online learning environment, which are not evaluated in our study, e.g. brainstorming, role-playing, game-based learning, collaborative video production and peer assessment.

Even though students and teachers meet through e.g. weekly webinars, the learning materials accessible between the webinars are also important. Further research should include the investigation of how e.g. short videos can replace the one-way teacher presentations (in an “online” flipped classroom method) to ensure that even more time of the webinars can be dedicated to active student participation.

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VisPed project homepage: http://visped.wikispaces.com/

Short Papers

EXPANDING THE MEDIA MIX IN STATISTICS EDUCATION THROUGH PLATFORM-INDEPENDENT AND INTERACTIVE LEARNING OBJECTS

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ABSTRACT

The ubiquity of mobile devices demands the exploitation of their potentials in distance and face-to-face teaching, as well for complementing textbooks in printed or electronic format. There is a strong need to develop innovative resources that open up new dimensions of learning and teaching through interactive and platform-independent content.

This paper presents such a resource for statistics education and vocational training. It is about a new, award-winning web app that is already employed world-wide in different educational settings, for example at universities within traditional statistics courses or online campus systems.

KEYWORDS

Statistics education, platform-independent learning objects, interactive visualization

1. INTRODUCTION

Nowadays, education at universities is represented by a media mix embracing classical media, such as face-to-face teaching and printed textbooks, and online components, such as e-books and online material stored within e-learning management systems. Learning content operating on mobile devices is increasingly complementing the media mix. However, learning content designed for mobile devices is usually far from fully exploiting its potentials. A multitude of apps designed for tablets and smartphones provide navigation tools supporting queries or access to social networks but apps providing user-controlled and immediate visualization of theoretical concepts are still rare.

Interactive visualization is particularly useful for teaching and learning mathematics and statistics (see Günster et al, 2013). These are sciences where formulae or data, and graphs representing the formulae or data, play an important role. Today, mathematical and statistical literacy are considered in many occupational groups as key qualifications for employability. Especially, the importance of statistical literacy is more and more recognized. This is due to the fact that management decisions at the shop-floor and other areas are increasingly based on statistical arguments ("evidence-based decision-making").

Hence, these factors suggest starting with the design of an app that facilitates the understanding of basic statistical methods and models. The app presented in this paper contains a set of self-contained interactive learning objects. The set is split up into three sub-sets. Two of these are dedicated to visualizing statistical methods and models related to descriptive and inferential statistics that are part of every introductory statistics course or textbook. The user is able to "try out" basic statistical concepts through interactive visualization.

The third sub-set of learning objects is still under development and at present only contains three learning objects. It enables the user to visually explore selected data sets by applying different graphical tools without being confronted with information overload. The data are from Eurostat, the European Statistical Office (Eurostat) in Luxembourg, and refer to the EU Member States. They cover topics that are of great interest and relevance not only for specialists but also for the lay public.

The overall goal of the app was to expand the currently applied blended-learning approaches in statistics education and further education. The existing media mix is complemented by user-friendly and platform-independent environments for interactive visualization of statistical methods or models and selected data sets

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from official statistics. Hence, at last the app aims at promoting statistical literacy through providing innovative learning objects supporting the understanding of statistical theory and enabling user-controlled exploration of selected and relevant data sets from official statistics.

2. DESIGN PRINCIPLES AND EXEMPLIFICATION

2.1 Design Ideas Applied By Developing the App

The app presented in this paper is accessible for free at www.fernuni-hagen.de/jmittag/app. It is employed by students for self-study purposes, by lecturers in face-to-face teaching scenarios and as well as a supplement to introductory statistics textbooks. In order to facilitate world-wide use and to ensure usability in very different educational settings, the following design principles have been applied:

- *Stressing visualization:* All learning objects emphasize visual and interactive communication of statistical methods or data. Formulae are avoided because notation in statistics is not fully internationally uniform. The theoretical background needs to be provided by a teacher or a textbook.
- *Use of self-contained learning objects:* The learning objects are "light" and self-contained (independent "micro-learning worlds"). The granularity facilitates the embedment into different learning scenarios.
- *Use of English:* Text appearing on the screen is in English which is understood around the world. This furthers use in all continents and as well international co-operation through joint employment of innovative learning content.
- *Self-explaining navigation:* The learning objects are transparent and self-explaining. This implies that instructions for navigation are dispensable.
- *Minimizing textual information*: Text appearing on the screen is minimized in order to facilitate translation into other languages and as well the maintenance of the learning objects.
- *Platform-independence*: The app operates on all mobile devices (iOS, Android) and on all desktops. In order to avoid the access to the app via different app stores, the app is designed as a web app. After first online use of the app, it is stored in the internal cache and can also be used offline. For mobile devices, touch functionalities are incorporated whereas for desktops all functionalities of the mouse can be used.
- *Responsive web design*: The display of learning objects needs to automatically take the size of the screen into account. Hence, the size of a graph increases when switching to a device with larger screen. When using mobile devices, the learning objects can be displayed in landscape and as well in vertical format.
- *Avoiding information overload:* Learning objects presenting data do not present all data simultaneously. Instead of this, the user is enabled to select and visually present different sub-sets of the data. This makes it easier to discover messages behind the data or striking features.

2.2 Examples Illustrating the Implementation of the Design Ideas

Figure 1 exemplarily illustrates how the goals of communicating content via interactive visualization and creating self-contained and self-explaining learning objects have been achieved. The learning object exclusively deals with the binomial distribution. The binomial distribution represents one of the most employed models for discrete random variables. Nowadays, this model is already taught at secondary schools. The navigation of the object is easy and obvious. The user can change the parameters n und p of the model und as well the argument variable x of the probability density function f(x) and the cumulative distribution function F(x). The Figure shows the result for two different choices of the triple (n, p, x). For each triple, the graphs of f(x) and F(x) are shown and the value for F(x), with x as chosen by the user, is displayed in red. Introductory statistics textbooks typically contain in an appendix only tables for the values F(x), whereas the learning object also reveals the meaning of such values. The values marked in red result by summing up the length of the bars in red of the upper graphs.

Figure 1. Learning object “The binomial distribution” (in English), displayed on a smartphone

Figure 2 is dedicated to the standard normal distribution, the most used model for continuous random variables. This model can again be described by the probability density function and the cumulative density function. The latter function has a special notation Φ(x) instead of F(x), due to the paramount importance of the standard normal distribution. When employing this learning object, the user is able to determine and to change the value of the argument variable x. The Figure displays the resulting value of the cumulative distribution function for two different choices of x. The values Φ(x) are tabulated in any introductory textbook, but again, the learning object provides an interpretation of the meaning of such values. The displayed values Φ(x) correspond to the coloured area below the graph of the probability density function.

Figure 2. Learning object “The standard normal distribution” (in English and Japanese), displayed on a smartphone

The second part of Figure 2 illustrates how the minimization of text on the screen and the granularity of the learning objects facilitates translation into other languages and its embedment into different contexts. For implementing a Japanese version of the learning object dealing with the standard normal distribution, only the title of the object and the label of both vertical axis needed to be exchanged. Japanese versions of different learning project of the app are already in use within the ongoing JINSE project (*J*apanese *I*nter-University *N*etwork for *S*tatistics *E*ducation; see *Takemura et al, 2013*).

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Figure 3 shows again the interactive learning object dealing with the standard normal distribution, now retrieved from a tablet. The responsive web design ensures that the visualization of both graphs is adapted to the screen size. The simultaneous usability of all learning objects on mobile devices desktops requires the incorporation of navigation approaches that are typical for both types of hardware: availability of touch functionalities for smartphones and tablets as shown in Figure 3 and employability of the mouse for desktops.

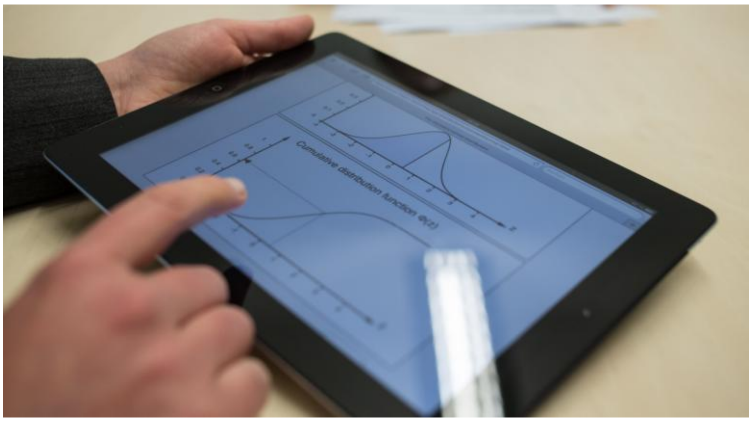

Figure 3. Learning object "The standard normal distribution" in use on a tablet (English version)

Figure 4 illustrates how information overload is avoided when interactively exploring a data set. The data in play are official data from Eurostat for the current European Member States. The data set refers to 28 countries and covers the period 1990 – 2012. The national emission levels for 1990 are defined as 100. Cutting down the relative levels by 2020 from 100 to 80 represents one of the key targets of the so-called *Europe 2020 Strategy* of the European Commission.

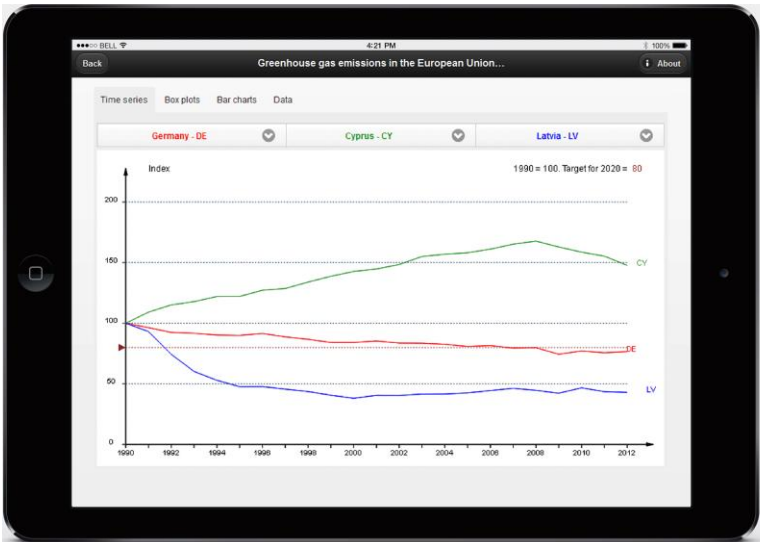

Figure 4. Learning object "Greenhouse gas emissions in the EU-28" (in English), displayed on a tablet

The learning object dealing with European data on greenhouse gas emissions enables the user to visually judge the progress made by the individual Member States so far, on the basis of all data available through Eurostat. Instead of simultaneously presenting time series graphs for all countries, the design allows the display of time series graphs for the whole period 1990 – 2012, but only for three user-selected Member States. The design also allows the comparison via bar charts for all 28 countries, but in this case only for one year that again can be chosen by the user. One immediately notices, amongst others, that Cyprus failed and Latvia succeeded hitherto in decreasing the national greenhouse gas emission level measured in 1990.

Other learning objects of the app aiming at user-controlled data exploration of relevant data from official statistics refer to life expectancy of newborn with breakdown by sex or to employment rates in the EU-28.

3. CURRENT USE OF THE APP, CONCLUSIONS AND OUTLOOK

For the time being, the app is employed at the University of Hagen, the only German State University specialized in distance teaching, within an introductory statistics course. The course is available as textbook and e-book (Mittag, 2014). The printed book version contains QR codes providing direct access to the individual learning objects of the app.

The learning objects of the app are employed as well outside Germany. Due to the functionalities of Google Analytics, it is possible to monitor world-wide how often, at which location and with which technical device the different learning objects are used. Currently, the app or its components have been implemented in about 20 countries, although the purpose and context of use is usually unknown. There are a few exceptions such as the inclusion of interactive elements translated into Japanese into the educational project JINSE. This ongoing project involves eight Japanese universities.

Since January 2015, a modified and expanded German version of the app is accessible for free via www.hamburger-fh.de/statistik-app. The German version contains short operational instructions for all learning objects. It is intended for use in Germany and German-speaking regions not only for introductory statistics education at universities, but at secondary schools and colleges as well.

A potential application of the learning objects dedicated to interactive data visualization is their use in the new field of data journalism. Here, environments for dynamic or interactive data visualization are embedded into a story referring to the data. The results are data-driven stories which are increasingly published in leading online journals. The reader of an article written in this new format is thus able to explore the data and to check and comprehend the arguments of the story around the data.

The statistics app presented in this paper is globally the first platform-independent app designed for introductory statistics education. It stresses interactive visualization of basic statistical concepts and user-controlled exploration of selected data sets from official statistics. In the months to come, the goal is to complement the learning objects developed so far by further objects, in co-operation with international partners. The information on web traffic for the app gained via Google Analytics shows a continuously increasing interest in the tool. The next step will be to systematically collect user feedback and suggestions for further improvement, for example by employing questionnaires evaluating user satisfaction.

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RESEARCH ON MOBILE LEARNING ACTIVITIES APPLYING TABLETS

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ABSTRACT

The paper aims to present current research on mobile learning activities in Lithuania while implementing flagship EU-funded CCL project on application of tablet computers in education. In the paper, the quality of modern mobile learning activities based on learning personalisation, problem solving, collaboration, and flipped class methods is compared against the quality of traditional, mostly face-to-face learning activities based mainly on knowledge transmission. Research was twofold – on the one hand, the results of online questionnaire of teachers and students participated in the first cycle of CCL pilots in Lithuania were analysed, and on the other – expert evaluation method was used. A special attention is paid to suitability of learning activities to particular students learning styles. Presented approach on learning activities quality evaluation and optimisation problems could help educational institutions to select suitable mobile activities for particular learning styles.

KEYWORDS

Mobile learning, tablet computers, learning activity, personalisation, expert evaluation.

1. INTRODUCTION

The paper aims to present current research on mobile learning activities (LA) and learning scenarios (LS) applying tablet devices for secondary education in Lithuania while implementing CCL (2014) – the flagship EU-funded project in the area. Mobile learning presents new opportunities for both the design and delivery of learning. These opportunities are enabled by the unique hardware and software capabilities of mobile devices (e.g. tablets) coupled with convenient size and portability. Among all mobile devices, tablets are mostly used for learning at the moment – 61% (Kurilovas 2014).

In the paper, the quality of modern mobile LA using tablets based on learning personalisation, problem solving, Web 2.0 enhanced collaboration, content creation, and flipped class methods are compared against the quality of traditional, mostly face-to-face LA usually based mainly on knowledge transmission currently applied at comprehensive schools in Lithuania. Currently, mobile LA and LS for primary and secondary education are deeply analysed, applied, and evaluated in EU in CCL project while LA and LS are created using methodology elaborated and applied in parallel large scale EU-funded 7FP iTEC (2014) project.

The Creative Classrooms Lab (CCL) project is developing innovative teaching and learning scenarios involving the use of tablets in and out of school. It validates these in policy experimentations involving 9 Ministries of Education in Europe and 45 classes that are already making use of tablets from different suppliers. Ministries of Education also seek to co-design action research pilots with industry partners that are project Associate Partners. CCL is one of the means to help European Ministries of Education to make proper decisions concerning large scale investments in tablet devices and related teacher training.

Systematic review of scientific literature performed in ISI Web of Science database on topics ” ’information technologies’ AND ‘personalisation’ ”, and ” ’tablet devices’ AND ‘education’ ” has shown that tablets could have a positive impact on learning personalisation and thus on learning quality, but their additive value highly depends on proper application of suitable learning scenarios and learning activities (Kurilovas 2014).

2. RESEARCH METHODOLOGY

2.1 CCL Personalised Learning Activities and its Expert Evaluation

In CCL, we have prepared a typical problem solving scenario based on personalised learning approach using Web 2.0 based group work, content creation, and flipped class methods for piloting in Lithuanian CCL schools. Problem solving scenario was implemented by the following steps: (1) Discussing the problem scenario in the groups which promotes communication skills and cooperative learning; (2) Brainstorming ideas to cross the learning boundaries which promote creative learning and knowledge integration; (3) Identifying the learning issues for research which promotes active learning and critical thinking; (4) Research to construct the action plans which promotes new knowledge development; and (5) Reporting the research findings to the groups which promotes peer-to-peer learning to complete the final products.

Personalised learning approach was implemented here by division of learners into distinct groups according to their learning styles. We used learning styles grouping method applied earlier for evaluating LS quality by Kurilovas & Zilinskiene (2012), namely, Activist, Theorist, Pragmatist, and Reflector: (1) Activists learn by doing; their preferred activities are: brainstorming, problem solving, group discussion, puzzles, competitions, and role-play. (2) Reflectors learn by observing and thinking about what happened; their preferred activities are: paired discussions, self-analysis questionnaires, personality questionnaires, time out, observing activities, feedback from others, coaching, and interviews. (3) Pragmatists need to be able to see how to put the learning into practice in the real world; their preferred activities are: time to think about how to apply learning in reality, case studies, problem solving, and discussion. (4) Theorists like to understand the theory behind the actions; their preferred activities are: models, statistics, stories, quotes, background information, and applying theories.

There are different methods to determine students' learning styles, e.g. questionnaires, learners' interviews, analysis of their e-portfolios, data mining etc. In CCL, we have developed online questionnaire and software to automatically establishing students' learning styles. Its application in Lithuanian CCL schools has shown that there are almost no 'pure' Activists, Reflectors, Pragmatists or Theorists in real life – students are mostly "mixtures" of different learning styles. Lithuanian schools involved in the project have identified their students' (128 persons) learning styles as follows: mostly Activists – 27.5 %, mostly Reflectors – 13.7%, mostly Pragmatists – 29.4 %, and mostly Theorists – 29.4 %.

After that, students' learning styles were interconnected with suitable learning activities, types of LOs, tools and tablet apps. Learners were divided into distinct groups according to their learning styles before or just after Discussion stage of the problem solving activity. This could guarantee that, in their groups, learners could learn using similar suitable LAs, LOs types, and apps. Learners were divided into groups applying TeamUp grouping tool created in iTEC. Collaboration in groups was based on face-to-face collaboration and Web 2.0 tools. Groups' internal collaboration activities were applied in Brainstorming, Identifying the research issues, and Research steps, and combined with the other groups in Discussion and Reporting steps of the problem solving LA.

In CCL, we have proposed mobile personalised LA (let us call it LA_1) on problem solving in STEM (Science, Technology, Engineering and Mathematics) subjects. Mobile LA created by the Lithuanian CCL lead teacher is named "Why ships don't sink" and conforms to 10-lessons Lithuanian Physics curriculum topic on the Archimedes' law. Other teachers' mobile LA were carried out at Biology, Computer Science, Mathematics and Physics subjects lessons are named respectively "Why Materials Change in Nature?", "How to Help a Friend Choose a New PC?", "Research on Phenomena with One Variable Properties", "Why the Clothes Become Dirty?". In these mobile LA_1, students use tablets in all stages of their problem solving activity for grouping, research, collaboration, flipping, content creation, and presenting their research results to peers and teacher. In LA_1, students use personalised learning methods, suitable content and apps while working with iOS (iPads) and Android (Samsung tablets) operating systems. There were several outdoor activities implemented in these LA_1 such as visiting sea museum, homework etc. On contrary to LA_1, we consider LA_2 as traditional "one size fits all" activity based on topic explanation in classroom and students' home works.

Typical LS could consist of LOs, LAs, and learning environment(s). In this paper, we pay special attention to LA since our aim is to analyse LS independently of its learning objects and environment(s). In this research, LA_1 and LA_2 use the same learning topics of Lithuanian curriculum.

Further, we'll use LA quality criteria that were elaborated earlier while implementing iTEC project by Kurilovas & Zilinskiene (2012) and presented in Table 1 below. In the paper, Fuzzy AHP method (Chang 1996) was applied to perform expert evaluation of LA_1 and LA_2. 3 experts (the authors of the paper) have expressed their opinion on importance (i.e. weights) of LA quality criteria, and also identified the ratings (values) of LA quality criteria.

2.2 Online Questionnaire

Online questionnaire was created by the authors and filled in from 2nd to 16th of April 2014 after implementing the first cycle of CCL pilots. In Lithuania, five secondary schools participate in CCL and filled in the questionnaire. The questionnaire for Lithuanian CCL schools consisted of 5 questions concerning different aspects of the proposed CCL LS impact on learning motivation and results. The formulation was as follows: "What characteristics of mobile CCL scenarios were helpful in terms of better students' motivation and learning results?", and the following characteristics were suggested: (1) Identification of students' learning styles using proposed online tool; (2) Suitable learning activities, methods, LOs, tools and tablet apps were identified and proposed for students according to their learning styles; (3) A proper set and sequence of learning methods was used (e.g. problem solving, flipping, collaboration, content creation); and (4) The main mobile features of tablets were used (e.g. outdoor activities, shooting etc.). The last question was the open one: "Other success factors".

3. RESEARCH RESULTS

3.1 Online Questionnaire Results

Online questionnaire results were as follows: (1) Positive (40%) and preferable (more positive than negative) (60%) impact. According to comments on the 1st question, "Students were interested to know their learning styles. Learning became more productive. Knowing students learning styles, teachers could select suitable tools, apps and methods". In some classes, "it was hard for students to answer psychological questions, and, therefore, maybe their learning styles were identified not precisely". There were students with different learning styles identified, e.g., in one class, "there were two activists groups, two theorists groups, and one reflectors and one pragmatists group". (2) Positive (40%) and preferable (60%) impact: "Students were motivated, and this improved their learning results. Students could control their learning by themselves". (3) Positive (80%) and preferable (20%) impact: "Activists and theorists were happy to learn in groups. Majority of students were satisfied with flipped classroom and mind mapping". (4) Positive (60%), preferable (20%) and more negative than positive (20%) impact: "One of the lessons took place in Sea museum, and students used shooting and monitored computer simulations". In some schools, there were legal problems to bring tablets out of school due to insurance problems. In one class, BYOD (Bring Your Own Device) principle had more negative than positive impact due to interoperability problems. (5) Other mobile LA success factors. Some schools consider that "Students created content should be placed in cloud. Tablets should be new and qualitative to allow all mobile activities (shooting, using apps etc.)". Some schools wrote about "importance of schools administration support and understanding".

93 % of all students involved in LA_1 were satisfied with such learning way, and the greatest difficulties encountered faced Reflectors as they don't like to use technologies or can't choose the suitable one however only half of them indicated it as problem. The majority of students indicated that the personalisation is very important as it gives the possibility to learn with someone who thinks in the same way thus it becomes easier to understand each other. Also, the outdoor activities were indicated as a very acceptable form of learning due to the similarity of the game that gives a sense of fun and freedom.

3.2 Expert Evaluation Results

After application of fundamental scale of absolute numbers for estimation of the weights of LA quality criteria, the criteria importance table is as follows:

Table 1. Experts' opinions on importance of LA quality criteria

LA quality criteria	Expert 1	Expert 2	Expert 3
1) Ease of use	4	7	5
2) Conformance with learning goal	3	3	4
3) Interoperability and flexibility	8	8	8
4) Feedback and appropriate assessment	7	6	7
5) Active engagement of learners in learning	5	2	2
6) Facilitation of interaction and collaboration	6	5	6
7) Employment of multiple teaching methods	2	4	3
8) Incorporation of learners backgrounds, experiences and expectations	1	1	1

Based on Table 1, criteria weights obtained while evaluating importance of the quality criteria by the experts are presented in Table 2:

Table 2. Weights of LA_1 and LA_2 quality criteria

a_i	a_1	a_2	a_3	a_4	a_5	a_6	a_7	a_8
Weights	0.012	0.165	0.001	0.001	0.227	0.022	0.201	0.371

According to (Kurilovas et al. 2011), in the case of using average Trapezoidal Fuzzy Numbers (TFNs), linguistic variables conversion into non-fuzzy values of the evaluation criteria should be as follows: "excellent" – 1.000, "Good" – 0.800, Fair – 0.500, "Poor" – 0.200, and "Bad" – 0.000.

The TFN ratings (values) of the analysed LA quality criteria by the experts are as follows:

Table 3. Ratings of LA_1 and LA_2 quality criteria

Learning activity	Ratings							
LA_1	0.500	1.000	1.000	1.000	1.000	1.000	1.000	1.000
LA_2	1.000	1.000	0.500	0.500	0.200	0.200	0.500	0.200

After using the TFN application method, the experts' additive utility function (Kurilovas et al. 2011) should be applied to calculate the sum of the weights multiplied by the ratings (values) of the quality criteria for each of the explored LA alternatives.

The results of experimental evaluation of the analysed LA quality using weights (Table 2) and ratings / values (Table 3) are presented in the experts' additive utility function as follows:

$$a_i \cdot f(X_j) = (0{,}9940 \quad 0{,}4025)$$

The obtained evaluation results mean that LA_1 meets 99.40% quality in comparison with the ideal, and LA_2 – only 40.25%. Therefore, LA_1 is much better alternative for students in comparison with LA_2.

LA_1 advantages are better feedback, more actively engagement of students in learning, facilitation of interaction and collaboration, employment of multiple teaching methods, and incorporation of learners' backgrounds, personal experiences and expectations. The experts believe that LA_1 has more possibilities for feedback, more actively engages students in learning, facilitates interaction and collaboration, employs multiple teaching methods, and incorporates learners' backgrounds, experiences and expectations in comparison with LA_2. LA_2, in its turn, is more easy to use in schools at the moment. On the experts' opinion, LA_1 based mobile learning using tablets could have a noticeable additive value for Activists and Pragmatists, and they could be also useful for Reflectors, but they have only minor additive value for Theorists.

4. CONCLUSION

Research results have shown that modern mobile learning activities applying tablets based on problem solving, personalisation, collaboration, and flipped class are more flexible than traditional ones, they have more possibilities for feedback, more actively engage students in learning, facilitate interaction and collaboration, employ multiple teaching methods, and incorporate learners' backgrounds, experiences and expectations. Students were motivated while applying personalised learning approach, suitable activities, tools, LOs, apps, and proper sets of learning methods. On Lithuanian teachers' opinion, one of the main success factors in CCL was personalisation by interconnecting students' learning styles with suitable activities, tools, LOs, apps and proper sets of learning methods and thus creating personalised learning scenarios for their students.

Research results have also shown that the proposed quality evaluation approach: (1) is applicable in real life situations when educational institutions have to decide on use of particular learning activities for their education needs, and (2) could significantly improve the quality of expert evaluation of learning activities by noticeably reduce of the expert evaluation subjectivity level.

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LEARNER CENTERED EXPERIENCES WITH FLIPPED CLASSROOM AND MOBILE ONLINE WEBINARS IN DISTANCE HIGHER EDUCATION PROGRAM

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ABSTRACT

The aim of this study is to describe and analyse students' learning activities in distance higher education program with online webinars (WEB-based semINAR) by computer, laptop or mobile app for phones and tablets directly face-to-face (F2F) with other students and teachers introduced by "flipped classroom". The data collection consists of qualitative research interviews with students and observations of F2F webinars and parallel chat communications with problem solving, discussing theoretical concepts and literature, and engaging in various collaborative group works, as well as examinations. Theoretically, the study joins the research tradition of sociocultural theories and Computer Supported Collaborative Learning, CSCL, as well the theoretical approach of self-efficacy and Computer Self-Efficacy (CSE) concerned with individuals' media and information literacy. Important conclusions from the results of the learning activities with flipped classroom, online synchronous webinars and chat communications are that these learning activities gives the students more learner-centered experiences and are important for them in order to continue the education and be able to be a part of the reciprocal learning processes, as well as to understand the academic way of reading and writing.

KEYWORDS

Computer-Supported Collaborative Learning; Computer Self-efficacy; Distance Education; Distance Learning; Flipped classroom; Higher Education; Mobile app; Webinar

1. INTRODUCTION

The purpose of this article is to describe and analyse students' learning activities in distance higher education program with online webinars (WEB-based semINAR) by computer, laptop or mobile app for phones and tablets, directly face-to-face (F2F) with other students and teachers introduced by"flipped classroom". The core ide of "the flipped classroom" is to flip the common instructional approach with recorded teacher-created videos with various briefings and interactive instructions that can be accessed at home before the ordinary class learning activities, as in this study before follow-up online webinars F2F. Therefore, the flipped classroom consists of two parts: interactive group learning activities inside the online webinars F2F and direct computer-based individual instruction outside the classroom, which remove the outline lectures from the webinars in order to allow better use of the in-class time during the webinars, as well as help and scaffold the students to be prepared for the learning activities during the in-class time (Bishop & Verleger, 2013; Long et al., 2014). "Class" becomes the room / place of the online webinars at distance to deal with problem solving, discussing theoretical concepts and literature, and engaging in various collaborative group works, as well as examinations. A webinar in this study is defined as mobile online meeting at distance for direct / synchronous discussions F2F, with a predefined aim, during real-time and a specific time period, guidance of a teacher. The potential of online synchronous webinars is that everyone can see and hear each other and at the same time communicate via textual chat. Furthermore, the synchronous online webinars can be recorded for later asynchronous viewing online in the learning management system (LMS) in order to provide students the opportunity to take a step back, reflect, self-assess and compare various contributions. Several activities can be part of the course structure with online synchronous webinars in order to mediate meaning and learning on a higher level. Such activities are:

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- Tutoring and scaffolding, as well as peer learning processes;
- Group discussions regarding theoretical concepts, literature, experiences and problem solving, as well as course assignments;
- Receiving and providing peer feedback and self-assessment;
- Collaborate with common notes, documents and whiteboards;
- Sharing screens and software with others;
- Examinations of course assignments and critical peer review.

In this context it is important that research focus is on how new educational techniques can support students learning and collaboration in a more digitalised mobile education, instead of merely focusing on how such new media techniques can make education more effective or detrimental (e.g. Amhag, 20011; 2013; Lee & Salman, 2012; Rockinson-Szapkiw et al., 2013; Sana et al., 2013).

1.1 Previous Research

Recent researches on emergent pedagogy of the flipped classroom in higher education are based on articles and conference proceedings. Bishop and Verleger (2013) provide a comprehensive survey of these prior and ongoing researches of the flipped classroom to avoid considerable amount of buzz in academic circles at all levels. Most of the studies explore student perceptions and work in single-groups, someone is mixed. But the students are overall generally positive. However, there is little research investigating students learning outcomes objectively. A literature review by Roehl et al. (2013) shows that flipped classroom is easy-to-use with readily accessible technology in order to give prepared pre-class time from planned in-class time. This design allows an expanded range of learning activities during class time for active learning and provides opportunities for greater teacher-to-student tutoring, peer-to-peer collaboration and cross-disciplinary engagement.

Likewise, the trial of flipped classroom by Wagner et al. (2013) indicate that flipped classroom materials can offer a unique, yet challenging opportunity for universities to collaborate on maximizing the effectiveness of higher education. Some observations by Wallace (2014) are made regarding evident in the way in which video, text and instruction are balanced both synchronously and asynchronously according to need and practicality. The roles of the teacher and the student, and how these relationships become more complex and complementary in online spaces, are also changing. The essences of flipped classroom, according to Long et al. (2014), show that more opportunities can be provided to the students in the in-class time. The teachers can prepare for their course implementing, both the pre-class phase and the in-class phase, and their own technical literacy, and other available resources and supports. Even the faculty contact could be reduced by two-thirds demonstrate Baepler et al. (2014) if there is an active learning classroom. The students achieved learning outcomes were significantly better, in comparison with traditional classroom. Even the student perceptions of the learning environment were improved. These results suggest pedagogically dialogues and active learning classrooms.

Only a few research studies have examined the impact of online synchronous webinars. For example Nelson´s (2010) study, about the learning outcomes of online synchronous webinar versus classroom instruction among 224 nursing students showed no significance difference between the groups. An online synchronous webinar was just as effective as classroom instruction. Rich´s (2011) investigation, which measured the impact of online synchronous webinar instruction at a National Science Foundation Advanced Technology Center, showed that there was a lack of evidence about the actual outcomes of participation in synchronous webinar. Buxton et al. (2012) research evaluates pharmacists' satisfaction with and reasons for enrolling in a series of continuing education webinars. The online webinars included presentations, lectures, workshops or directly F2F-webinars. The results show both positive satisfaction for the quality of the programming efforts and the method of delivery, but also the lack of continued participation in subsequent webinars. Skype, as another online communication tool, examined by Kiriakidis (2010), contributed level of self-efficacy to school and district administrators'. The result shows that self-efficacy can be increased through opportunities for ongoing, systemic, and systematic discussions with other participants. However, these studies focused on organizing and administrating the education from an individual perspective.

2. THE AIM

The aim of this this research is to describe and analyse if and in what way the learning activity with flipped classroom and synchronous webinars or by computer, laptop or mobile app for phones and tablets would give distance higher education students greater opportunities to participate and learn with other students and teachers. Following questions will be illuminated:

- What experiences and opportunities can the mobile learning activities with flipped classroom and synchronous webinars give distance students as a tool for learning and development?

3. THEORETICAL APPROACH

This research is based on socio-cultural theory in which our understanding of language, communication, culture, and various aspects of the social context for student learning and development is central. Wenger (1998) consider sociocultural theory of learning in terms of *communities of practices* constituted by students´ negotiated engagement and joint enterprise as well as shared repertoire. There is also a question of collective appropriation of tools through language, and how students use language as a tool for learning. The concept of Wenger (1998, p. 5) is divided into four components: 1) *meaning*, as a way of talking about our abilities, individually and collectively, 2) *practice*, as a way of talking about different perspectives that can sustain mutual engagement in action, 3) *community*, as a way of talking about social arrangements and suggesting that our participation is recognizable as a capability, and 4) *identity*, as a way of talking about learning. According to this perspective, people's dialogues, interactions, and interplay constitute a determining factor for the individual's learning and knowledge development. The theoretical approach of self-efficacy is related to Computer Self-Efficacy (CSE), which has been used in research concerned with individuals' intentions to use information technology (IT), as in this study, to use flipped classroom and participate in mobile online synchronous webinars F2F, and the opportunities to challenge different efficacies and make assessments of their ability to apply knowledge, and manage and evaluate the peer learning activities, collectively as individually (Bandura, 2002). Bandura (1984) distinguishes between the component skills in practice through car driving e.g. between driving in freeway traffic and navigating twisting mountain roads. It is comparable with the individual and collective efficacy through flipped classroom and participating in online synchronous webinars F2F or the use of mobile tools as mobile phones and tablets to develop CSE, which can be seen as a level of *media and information literacy*. Methodically, CSE has been used and concretized through Compeau and Higgins (1995) three interrelated dimensions: *magnitude*, *strength*, and *generalizability*. The *magnitude* of CSE can be understood as a reflection of the student's cognitive knowledge processes, based on the abilities to analyze, communicate, manage information, and understand concepts and meta-cognitive skills, such as problem solving, interpreting, reflecting and evaluating. The *strength* of CSE refers to the self-confidence and self-esteem the student has in his or her ability to perform various tasks. *Generalizability* of CSE reflects the degree to which online studies are limited to a specific area of a learning activity, such as *media and information literacy*, and use of different software and computer systems as online synchronous webinars F2F with different mobile tools.

4. METHODOLOGY

This article is based on a study with 22 student teachers (women=16, men=6) participating at half-time study in the first three continuing web-based courses over a eighteen-month period in Vocational Teacher Education Program, VTEP, to become authorized teacher in any of the twelve upper secondary schools vocational programs. This qualitative research design involved an in-depth data collection process and analysis of open-ended interviews and observations of mobile online synchronous webinars F2F. Therefore, the researcher had the opportunity to obtain a deeper inquiry per individual in order to provide possible complete understanding. The interviews and dialogue exchanges during the webinars were transcribed and analyzed by Wengers (1998) four components; *meaning*, *practice*, *community* and *identity*, complemented by Compeau and Higgins (1995) three interrelated dimensions: *magnitude*, *strength*, and *generalizability*.

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4.1 Data Collection

The data collection consists of ten recorded online synchronous webinars F2F, of which five of them were examinations and five of them prepared with flipped classrooms during spring and fall semester 2013. The students could also have parallel textual chat communications during the webinars. All webinars were recorded and made available online in the students learning management system (LMS) after the webinars were ended in order to take a step back, reflect, evaluate and compare own and others contributions. The data collection was after the two courses were ended complemented by semi-structured research interviews with six students about their participations and uses of the flipped classroom and the meanings content and dialogue exchanges during the mobile online synchronous webinars F2F and textual chat communications. Each recorded interview lasted for approximately half an hour and was transcribed verbatim.

4.2 Context and Implementation

The e-meeting system with mobile app for phones and tablets which was used in this study has three interfaces with chat: 1) sharing desktop, program and whiteboard, 2) F2F discussion via webcam and microphone/headset, and 3) collaboration by using whiteboard PowerPoint, pdf-files, pictures and video. The students worked during the web-based courses both individually and group wise with problem-based course assignments with deadlines. They were divided into five groups of four to five students in each. A summary of the design is given in Table 1.

Table 1. Summary of the design with flipped classroom and online webinars in VTEP.

Fall semester 2012 (half-time study)		**Course 1 VTEP** - Three introductions of online webinars about social relations, conflict management and educational leadership.
Academic year 2013		(half-time study)
Date	**Length**	**Course 2 VTEP** - Learning outcome about syllabus, vocational didactics and assessment
02/15/2013	00:27:46	Flipped classroom: Theory of Pedagogy & Didactic, follow-up of course start
02/25/2013	01:16:27	Webinar: Teaching & Education, five groups, drop-in
03/15/2013	00:19:13	Flipped classroom: Theory of Formative assessment
03/21/2013	00:19:51	Flipped classroom: Theory of Assessment & Grading
03/21/2013	01:14:01	Webinar: Assessment & Grading, three groups, 25 min / group
03/25/2013	01:00:59	Webinar: Assessment & Grading, two groups, 30 min / group
05/07/2013	00:55:06	Webinar: Tutoring of the two last course assignments, five groups, drop-in
Date	**Length**	**Course 3 VTEP** - Learning outcome about development, learning and special education
09/09/2013	00:28:05	Flipped classroom: Theory of Read & writing disabilities, follow-up course start
10/14/2013	00:47:49	Webinar: Literature of Read & writing disabilities, five groups, drop-in
10/29/2013	01:04:57	Webinar: Examination of Read & writing disabilities, two groups, 32 min / group
10/31/2013	00:46:22	Webinar: Examination of Read & writing disabilities, one group
10/31/2013	00:42:36	Webinar: Examination of Read & writing disabilities, one group
10/31/2013	00:56:22	Webinar: Examination of Read & writing disabilities, one group
12/10/2013	00:34:24	Flipped classroom: Theory of Teaching & Education of vocational students
12/19/2013	00:39:50	Webinar: Tutoring of the last course assignments, five groups, drop-in

5. FINDINGS

Important conclusions from the results of the learning activities with flipped classroom, mobile online synchronous webinars, and chat communications are that the time and space for learning expands. The flipped classroom gave the students more learner-centered experiences when they had the ability to prepare and negotiate new meanings before and during the online webinars by computer, laptop or mobile app for phones and tablets for further learning and collaboration The result shows that the peer learning activities gives the students (N=22) more *meaning* and learner-centered experiences. Also to prevent drop off, as well as to help and scaffold students' peer learning processes to get ideas and define roles in the processes that contribute theoretical refinement and constructive criticism (Amhag, 2011; 2013). The preparations in the flipped classroom lectures, before the follow-up webinars, gave the students more time to managing the content from the literature. Online webinar is a kind of *community of practice* (Wenger, 1998, p. 226) which involve the whole person in a dynamic interplay of participation and reflections on learning. This is possible when the students directly meet other fellow-students and teachers F2F online and can discuss how they shall deal with literature, theoretical concepts, course assignments and examinations. The *magnitude* of CSE might be gauged in terms of support levels required to be a part of the reciprocal learning processes that take place at distance (Compeau & Higgins, 1995). Moreover, their *strength* of self-confidence and self-esteem to perform various tasks has also developed, as well as to understand the academic way of reading and writing. The *meaning* of meta-cognitive ability is related to a wide range of skills, such as identity, problem solving, interpreting, communicating, reflecting and evaluating (Wenger, 1998). In practicing peer-to-peer collaboration and cross-disciplinary engagement in various professional fields (Roehl et al., 2013), the students can identify their professional *identity*, as well as strengths and weaknesses in own and others work.

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WALK LIKE AN EGYPTIAN: A SERIOUS, PERVASIVE MOBILE GAME FOR TOURISM

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ABSTRACT

Walk like An Egyptian is a location-based, mobile native game developed for tourists. The game provides information for tourists about the touristic places, motivates nationals to visit their historical sights and increase their cultural heritage awareness enabling them to explore the past and connect with it. At the same time, the game allows to gather information and data about the visited places as a side effect of playing. The data could be in a form of annotated photos, comments and reviews. This paper also provides some quantitative and qualitative analysis of the game.

KEYWORDS

Crowdsourcing, decision tree, location-based mobile games, serious games, tourism.

1. INTRODUCTION

Every country has plenty of fantastic attractions and unique sights to offer. Egypt, for instance, is full of landmarks in almost all of its cities. Unfortunately, some of these attractions, which are worth visiting, are not well-known and deserted, even by many Egyptians. This could be due to the lack of on-site tour guides, activities and advertisements and due to the political circumstances that Egypt has been going through for the last few years. This has largely contributed to the collapse of the tourism industry. Accordingly, other amendments are needed and new approaches should be developed to boost tourism. Walk Like An Egyptian is a serious, mobile game with a purpose (GWAP) that has a twofold purpose. It provides tourists with information about historical places, while connecting them to the place's history and discovering their ancestors' glories. At the same time it gathers information about places through tasks that should be accomplished while playing the game. Thus, it is a multi-purpose game that encourages players to explore their cities and contribute to historical records through providing their experience and knowledge for visited places. Being mobile, the game is not restricted to a specific area, city or even country and can easily accommodate other countries other than Egypt. Therefore, it is a more generic game that could be played at anytime and at different places; ranging from different neighborhoods to different countries through the use of mobile devices. Thus, this game can be considered to be a pervasive game as the game is taken to the streets and players experience games that are interlaced with the real world while not being attached to the console (Benford et al. 2005). The game also exploits human computation to collect and annotate data. Human computation refers to the humans' interaction and contribution to solve problems that are better solved by humans. The problems might be also solved by computers but not with the needed processing speed and correctness level that could be achieved through humans' interaction (Law and Von Ahn 2009).

Thus, Walk Like An Egyptian leverages the addiction and power of games, the many-in-one characteristics found in the mobile devices, human computation and crowdsourcing to connect the players with their past and gather information to increase the cultural heritage awareness. Consequently, contributing and sharing their experience with others to have mutual benefit. This is done by developing a motivating and engaging location-based mobile game prototype that enriches visitors' knowledge while maintaining the required game elements.

Some other approaches have been developed to encourage people to visit touristic places and boost tourism. **REXplorer** is a mobile, pervasive, location-based game designed for tourists of Regensburg, Germany. It is a spell-casting game that allows the player to awaken and communicate with spirits to reveal their 'cliff hanger' stories related to important events and periods in the city's history (Ballagas et al. 2008). **The Castle Route** is a project aimed to develop a historical geo-referenced route for a castle in Portugal to increase students' knowledge in cultural heritage. Walking through the route, information in the form of audio, text and photos appears to the users. The users were asked to add and tag photos and to answer specific questions about the castle. The route was then displayed on Google Earth **(**Magro 2014**)**. **Intrigue At The Museum** is a location-based game aimed to make children explore and provide them with information about a museum in Italy and orientate them through the museum in an enjoyable manner. The children are told about a theft that happened in the museum and the probable suspects. Children get to know information about the place and master-pieces through solving riddles (Xhembulla 2014). **History Unwired** is a project made to take visitors to less-known neighbourhoods in Venice, Italy. The work provided a narrated walking tour via the use of location-aware mobile devices. The information was gathered and brought to visitors through visual characters describing the neighbourhood (Epstein and Vergani 2006).

This paper is structured as follows: Section 2 describes the game. Section 3 shows the game evaluation and results. The conclusion and future work are presented in Section 4.

2. GAME DESCRIPTION

Walk like An Egyptian applies the concepts and rules of the games which were studied carefully to come up with the game design and prototype to keep the objective of the game clear for the players. Thus, the prototype includes features like: receiving information from multimedia sources, learning 'just-in-time', instant gratification and instant rewards and learning that is relevant, instantly useful and fun (Derryberry 2007). Also, Facebook was integrated in the prototype to gain the benefits of social networks (SNs) (Murphy and Moulaison 2009). To be able to test the game, the game database was loaded with some information related to touristic places in Cairo to seed the database. This information was gathered from historical books, recommended by an Antiquities inspector, pamphlets of the places and trusted Internet sites. Afterwards, the information about various places was compiled from the players' entries after validating them.

After the signup and login view, the game consists of four rounds. Based on the player's location, a list of 'nearby places' is shown. These places are returned from the Google Places API. A map view for the nearby places is also available to get an insight of the proximity of the places. This is useful to eliminate the ping-pong effect; to leave and return to the same place as an effect of not knowing the place location. The map view consists of all the places including the player's location; the places are marked with blue and the player's location is marked with red. Figure 1 shows the welcome view and Figure 2 shows the map view.

In round one, information about a selected place is shown to the players through a call to Wikipedia and Google Images. From the Wikipedia page, we only extract the first paragraph to give a quick overview of the place. The players have the option to 'check-in' to a place; the check-ins are further used during the game play. Thus, in round one the players take a quick overview of any of the selected nearby places.

Round two takes the players back to the past through quick facts related to the places, questions and answers. After clicking on a certain place, the players can choose to take quizzes for that place. A place's information is stored in the database in a sort of question/answer and quick facts. The players learn the information by answering questions and getting notified with their result. For some questions, the stored answers consist of the correct answer and wrong answers that are wrong in a way that the player should not choose them as they cannot be related to the questions. However, not all questions have direct straight forward answers. This is to keep the game challenging and encourage the players to explore the place. If a question has a quick fact then it will be shown first till the player clicks a 'Got it!' button to start answering the question (shown in figure 3). The players are notified with the result. If the answer is wrong, they get notified with the correct answer; to inform them about the place. Figure 4 shows the notification shown to the player. The player's score is incremented for each correct answer he/she makes.

In round three, it is the player's turn to contribute to the social good and make other people benefit from his/her experience. Players are encouraged to add comments, upload and annotate photos. Their score gets incremented for sharing the comments and uploading the images. A capturing feature was added within the game to make it easier for players to capture images whenever they need. The players cannot upload an image until they add a title, tags and the place that the image belongs to. Consequently, the player selects the name from a check-list consisting of the player's checked-in places. Figure 5 shows a screenshot of the image

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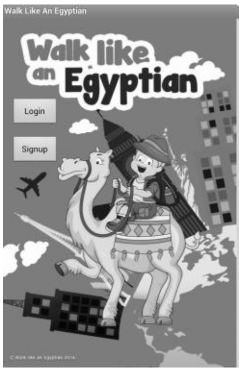
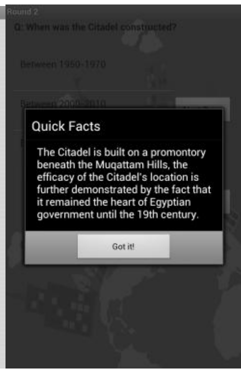
uploads. Moreover, the players know a priori that their entries will be used in the game database and are considered added values to the game. Accordingly, they are motivated to be information suppliers to engage others and introduce them to the historical places. The incentives are offered in terms of score keeping, instant gratification, leader board, badges and sharing wealth on SN. The player's score is recorded and whenever the player reaches certain scores, he/she gets notified with the new badge he/she won.





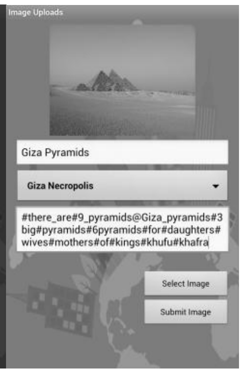


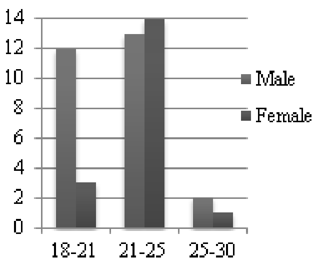
Figure 1. Welcome View Figure 2. Map View Figure 3. Quick Fact Figure 4. Q&A Figure 5. User-Upload

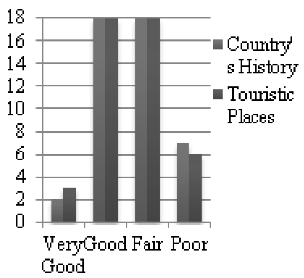
To make the cultural heritage awareness more pleasant, the game ends with a fourth round called 'Guess the place!'. In this feature, the player should think of a place (not only the ones they visited) and the game would guess it, by asking the players some questions. They are basic and simple questions which classify the place. The answers have two forms: yes/no and actual answers that describe the place. The WEKA tool was used to make the classification and decision tree (Bhargava et al. 2013). The tool is fed with a file containing a list of questions along with their possible answers and a data training set. All questions have 'Do not know' and 'irrelevant' answers. The questions and the answers were structured based on 'tourism attractions classification' that relies on 'folksonomy' of tourism attractions. This is to match the players' common knowledge and responses to the questions, compared to taxonomies (Tweed 2005; Kusen 2010). If the algorithm could not guess the place (whether because it is not stored in the database or the player's answers do not match any of the data), the player is asked to add the place he/she was thinking of. This feature adds knowledge about unknown places to the game database.

3. EVALUATION

3.1 Pre-Evaluation

In the first phase of the work, a survey was conducted to measure how far the individuals know their city history and cultural heritage. The survey also included a section for game features that players would like to have which helped in designing the game. The surveys were distributed offline and 45 were completed and all the participants were Egyptians. The participants' demographics, knowledge for their country's history and the knowledge of touristic places are shown in Figures 6.a, 6.b, respectively. Figure 6.c shows the game features.





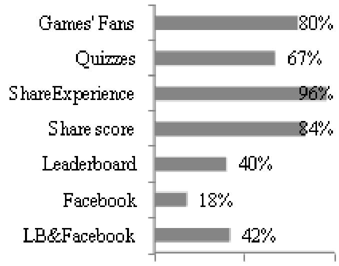


Figure 6.a Players' Demographics Figure 6.b Historical Info Figure 6.c Game Features

3.2 Post-Evaluation

This section describes the game evaluation and measures various game features that assess players' contribution and analyze the results of interviews conducted after testing. The game marketing was done through Facebook as well as promoting the game on campus by giving a short description of the game and its goal. The promotion on Facebook was done by sharing the application fan page which was created to inform Facebook users about the game and to act as an advert to the game thus leveraging the advantages of SN. Testing on random and diverse types of testers of different nationalities was needed to measure and evaluate the game prototype from different perspectives and get a wider range of feedback on the prototype.

3.2.1 Quantitative Analysis

The number of users who played the game reached 44 over 11 days of testing. The Facebook application fan page received 84 likes. The prototype was tested on both males and females and 70% of the participants were female users. The biggest age group was between 20 and 30 years while the biggest testers group was the random group. Four testers were American, two Australian, two Chinese and the rest were Egyptians.

By the end of the testing phase, eight historical touristic places were visited and explored. The places' selection was done based on the most famous touristic places in Cairo and Egypt. The places are of different types and historical eras. For example, the game was played at the Giza Pyramids, Salah-ElDin Citadel in Cairo, famous mosques, a church and a synagogue. The game was tested over several days with different participants to get a wide range of feedback and contribution and to be able to evaluate the game prototype. The database was loaded with 45 questions, 43 quick facts and 105 answers. By the end of the testing phase, 96 comments; given either as sentences or one-word phrases, having a total of 633 collected words. Out of the 96 comments, 75 sentences were useful comments that can be generated as 'Quick Facts'. The useful comments had variable lengths, reaching up to 34 words per sentence. 68 images and 866 tags were collected with an average of 12 comments, 9 images per place respectively and 13 tags per image.

3.2.2 Qualitative Analysis

The gathered comments, photos and tags were manually examined and analyzed. 95% of the words used in the useful comments were correctly spelled words in English. 96% were English words, 0.32% were misspelled in English, 4% were spelled in Franco Arabic (e.g. 'Ma'zana'), 0% written in pure Arabic, 2% were Arabic given names that were written as pronounced (e.g. 'Hassan'), 92% of the photos were unique and descriptive images, 26% related to places that did not appear in the near-by places list, but they were in the proximity area, 93% of the tags were single English words, 100% of the English tags were spelled correctly, 8% were spelled in Franco Arabic, 0.8% were considered bad quality words (e.g. '..').

The players' feedback about the game and its features was gathered through interviews. The choice of conducting interviews rather than surveys was to get more feedback as the interview flow goes and to ensure that we get the test points answered. The players were asked whether the answers were predictable, game was beneficial and if they liked the game. This is shown in Figures 7.a, 7.b and 7.c, respectively.

We show here some of the distinguishable players' comments: *"I am really happy with this experience! I have visited three new places in one day and knew about them through the game"*, *"I believe we need a game like that as that we could not find any tour guides!"*. The Australians commented: *"It is really nice, useful and interactive. I think it will work at my country. I would rather play it instead of listening to the audio records!"*. One player was more excited to have a narrated story: "*I would have got more engaged through listening!*". One player wanted to have the options whether to read the quick facts or not. For the time limit, one player commented: *"I like not being limited by time. We are not in an exam! We play for fun and knowledge, why the rush!"*. On the other hand, one player wanted to have the option to enable/disable the time. The players liked the fourth round, one player commented: *"That was exactly what I am thinking of!"*

4. CONCLUSION

This paper introduced a serious location-based mobile game prototype for the tourism domain. The game motivates players to visit their touristic places, get connected to their past and collect related information about such places. In eleven days of testing, 8 new places were visited and 96 comments having a total of 633

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words were collected. Moreover, 68 images having a total of 866 annotations were gathered. After analyzing the gathered data, 28 new questions were formed and 72 quick facts were generated. The results' analysis showed that the game mechanics provided visitors with a fruitful, engaging history learning environment, increasing their cultural heritage awareness. Moreover, it showed how the use of mobile devices facilitates and encourages users to interact, learn, make good use of time, share experience and contribute to the social good. It is important to mention that the testing was done only in Egypt, but there is no restriction to use it in other countries. In our future work we want to validate the gathered data and determine its correctness level. Also, we plan to make a generic quick facts and questions/answers generators based on the gathered validated data. In addition, we want to add a story-telling part in the game.

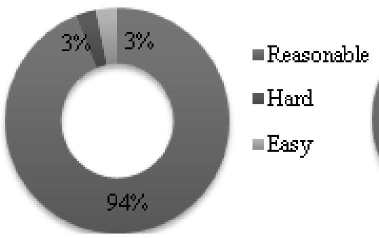

Figure 7. a Answers Predictability

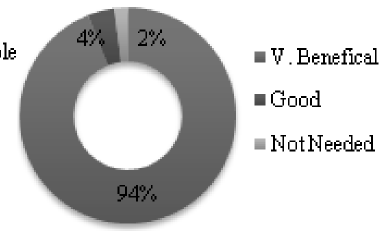

Figure 7. b Benefit

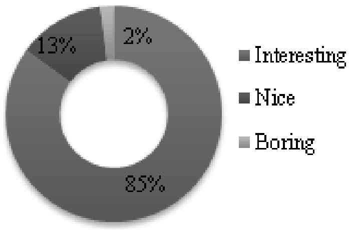

Figure 7. c Players feedback about the game

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EDUCATIONAL MATERIALS FOR MOBILE LEARNING

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ABSTRACT

This paper introduces several educational materials developed by ICER (Innovation Center for Educational Resource) of Kyushu University Library and considers about what are better designs for mobile educational materials through their development experiences and their investigations about its learning effectiveness. The introduced materials are various types and have several ICT(Information and Communication Technology), e.g. serious games for medical fields, web application-based educational materials using HTML5-based technologies, online educational courses such as OCW (Open Course Ware) and MOOC (Massive Open Online Course), etc.

KEYWORDS

Educational Materials, Mobile Learning, Serious Game, Open Course Ware, Massive Open Online Course.

1. INTRODUCTION

With the rapid advancements of ICT (Information and Communication Technology), our education environments also have rapidly changed. Many researches using mobile educational materials in their education program have introduced year after year (e.g. Hwang et al.; Yordanova et al.). These mobile technologies and Internet technologies enable us to easily access online educational resources anytime and anywhere. Therefore, we can learn using them without any spatial and temporal restrictions. The World Wide Web supports an effective study environment to learn various knowledge by following its links and jumping from a web page to a web page. On-demand courses using online environments such as OCW (Open Course Ware) and MOOC (Massive Open Online Course) receive massive leaners from all over the world and spread their knowledge in their class and compensate learners' understanding by online discussion. 3DCG (3D Computer Graphics) technology shows stereoscopic structures of things and we can watch it from various angles by taking interactive operations. These technologies allow us to develop effective educational materials which are difficult to achieve with *Paper* educational materials and also support *Active Learner* who can make their goal for their learning stage and proactively learn by themselves. As Kyushu University Library supports these educational environments with novel ICT and cultivates *Active Learner* by utilizing them, ICER (Innovation Center for Educational Resource) was established in 2011 (Online Reference: ICER) for supporting the development of such educational materials using ICT and investigating its learning effectiveness. This paper introduces several educational materials developed by ICER's projects.

The remainder of this paper is organized as follows. First of all, we focus on designs of game-based educational materials through several development experiences of serious games and investigation of their learning effectiveness. In section 3, as another educational design, we consider about an availabilities of web-based application as educational materials. Section 4 introduces on-demand education courses such as OCW and MOOC, and consider about availabilities of the educational designs. Finally, we conclude and discuss about better designs for mobile educational materials.

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2. GAME-BASED EDUCATIONAL MATERIALS

Game-based educational materials such as serious game have a possibility to engage learner's motivation to provide an effective method for amusingly learning. The motivation is necessary not only to make a learner interested in at his/her first study stage but also to maintain his/her willingness for the study.

The left side images in Figure 1 are screenshots of a serious game for learning utilizations of library services, e.g. book lending period, internet search service and so on. The target leaner is university freshmen. In this serious game, 12 questions about library services are shown to a learner. The question styles are quiz, crossword puzzle and QR (Quick Response) code matching, etc. A learner has to move around library to answer these questions. By answering questions with moving around library, they can understand not only knowledge about questions but also gradually learn places of book shelves and several service counters. Some university freshmen are boring to a seminar style lecture and the knowledge learning in such kind of situation becomes forgettable. On the other hand, game-based educational materials like this educational material have a possibility to engage learner's motivation. The serious game which runs on iOS and Android OS as one of the mobile applications can communicates to a data analysis server logging learner's activity data such as answer data and tracking data. Librarians checks these log data and use those for the improvements of their library services.

The center images in Figure 1 are screenshots of a serious game for Bacteriology (Sugimura et al.). The target leaner is university students in the school of medicine. The genre is an adventure game. This game has its story that a bacterial accident occurred and several bacteria are spread all over the university hospital. As the result, almost people in the hospital are infected by the bacteria. In this game, a Bacteriology leaner must help people to pinpoint bacteria causing their bad symptom by hearing their health condition e.g. having fever and stomach ache, and to administer most effective medicine to the person. In the administration phase, the game transitions to a command-based battle scene in which a leaner can select several medicine and throw it to bacteria. Incorrect medicines give a little damage to the bacteria but the correct medicines give a big damage to them. By playing this serious game, a learner can understand knowledge to pinpoint bacteria causing the symptom and to administer most effective medicine against the bacteria. This serious game runs on Android OS.

Figure 1. Screenshots of serious games developed by ICER; left are the serious game for library services, center are the serious game for Bacteriology, and right is the serious game for Anatomy.

The right side image in Figure 1 is a screenshot of the serious game for Anatomy. The target learner is university students in the school of medicine. The genre is a board game similar to *MONOPOLY* in which several player battle simultaneously with occupying their regions. In this game, at first, a leaner throw dice and move on the field according to a number of the dice. The field has several types of grids: quiz grids, item grids, organ grids which are occupation possible location. If a learner stay on a quiz grid, the game shows a quiz about Anatomy. These quizzes are various styles: true-false quiz, four selection quiz, text input style quiz and sorting type quiz. If a leaner select a correct answer, they get money for purchasing locations. One of the advantage points of this serious game is to learn about Anatomy with face-to-face communication. In this game, as several learners study simultaneously, they can see a playstyle of another learner. Therefore, learners enjoy to study with their friends together than they are alone. The platform of this serious game is Android OS.

In our investigation for leaning effectiveness about these serious games, we could not find significant differences of learners' test scores between the two study styles: learning with serious game and without it. But we found that there is a difference about their study period between them. The game-based studies have the result that learners study for longer time than non-game-based study. This result shows that a game-based study can continuously maintain leaners' motivation for their study.

3. WEB-BASED EDUCATIONAL MATERIALS

As one of the available tools for supporting mobile educational environments, ICER focus on educational materials as web applications. Web applications have an advantage to execute without minding about OS platforms and devices because we can run them on a web browser. HTML5 supports multimedia contents: videos, 3D graphics, sounds and so on. Therefore, it is very useful to develop educational materials containing these contents as web applications. The following introduces web-based educational materials run on a mobile device.

The left side images in Figure 2 are screenshots of the educational material for learning multiple languages. In this material, a leaner can hear conversations of several languages and read text of the conversations comparing other languages. The material supports seven languages: Japanese, German, French, Spanish, Esperanto, Chinese and Korea. In the hearing phase, an image appears to compensate its conversation situation.

The right side images in Figure 2 shows screenshots of the educational material for leaning Osteology. In this material, a leaner can study names of bones with interactive operations to watch them from various angles. The target of the material is university students in the school of medicine. They must remember over than 200 bone’s names. This material helps their hard study with 2D and 3D graphics images.

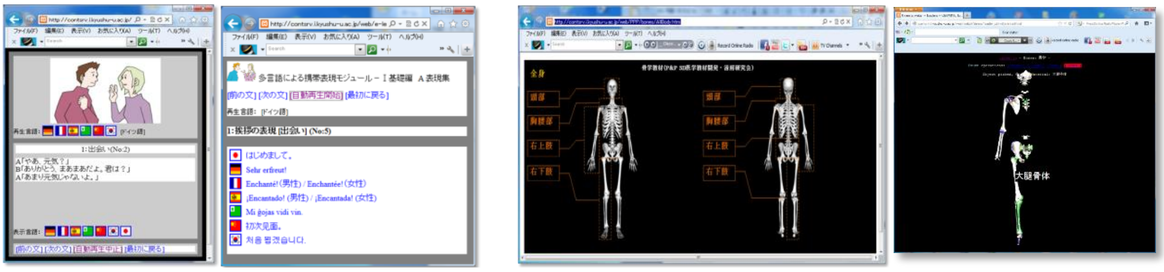

Figure 2. Web-based educational materials developed by ICER; left are educational materials for learning multiple languages and right are ones for learning Osteology.

A web-based educational material has advantage to execute it without worrying about OS on their computer and mobile devices. One of disadvantages is that the performance of its execution speed is not so good especially using very heavily 3DCG on a mobile device. Another disadvantage of the web-based educational materials is that a leaner can’t watch it without the Internet.

4. ON-DEMAND EDUCATIONAL COURSES

On-demand educational courses using the Internet such as online e-learning service provides helpful educational environments in which a leaner can take a course they want to learn without minding about learning pace and physical spaces. Another advantage of the course is that a lecturer can teach to massive people from all over the world.

ICER organizes OCW in Kyushu University (Online Reference: OCW). One of the screenshots of OCW pages appears on the left side in Figure3. In this course, a learner can experience a lecture of our university by watching the lecture videos and reading its educational materials. The courses are open on the Web so that a learner can study anytime and anywhere. Additionally, a learner does not need to worry about their platform, OS and devices because they can watch the online contents by their web browser. We also broadcast lecture videos through YouTube and iTunes U. Several courses are provided as iTunes U Course which is OCW platform in iTunes U. The center image of Fig. 3 is a screenshot of educational materials about historical resources in Kyushu University on iTunes U Course.

ICER has a film studio for taking a lecture movie. The studio is used for making MOOC contents. MOOC has become a hot topic in recent online e-learning fields. ICER developed MOOC contents for Archaeology titled “Global Social Archaeology” broadcasted from JMOOC platform (Online Reference: MOOC). The right side image of Figure 3 is a screenshot of the MOOC. 799 people from 53 countries attended the course and got 27.8% completion rate which is the current best rate in JMOOC.

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On-demand educational services are very useful to teach their knowledge to massive people. The disadvantage, which is the same problem as web-based educational materials mentioned above, is that a learner cannot take the course in offline environments.

Figure 3. On-demand educational courses developed by ICER. The left image is a screenshot of OCW in Kyushu University. The center image is a screenshot of the educational material on iTunes U course. The right image is a screenshot of MOOC on JMOOC platform.

5. CONCLUSION

In this paper, we introduced mobile educational materials developed by ICER and considered their designs from several viewpoints of their styles. Each design has its advantage and disadvantage points. Therefore, we have to consider about what kind of situation we provide our educational materials to and select the best choice for a leaner to study. ICER continues to develop various mobile educational materials and investigate its leaning effectiveness.

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BOOSTING UP JSL LEARNERS' OUTSIDE-CLASS LEARNING TIME WITH LEARNING LOG SYSTEM

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ABSTRACT

This paper tackles enhancing outside-class learning of JSL (Japanese as a Second Language) learners. The objective of this study is to examine the effectiveness of our developed learning log system called SCROLL (System for Capturing and Reminding Of Learning Log) in terms of boosting up outside-class learning time of JSL learners in Japan. In our evaluation, there was a statistically significant increase of outside-class learning time during the phase with SCROLL. However the number of uploading words did not contribute to boosting up outside-class learning time but it seemed taking quizzes that contributed to the increase. The questionnaire survey shows that no advanced learners gave positive comments about SCROLL, while there was only one negative comment from the beginners. It implies that the system might more fit beginner learners.

KEYWORDS

JSL (Japanese as a Second Language), learning log system, mobile language learning, outside-class learning time

1. INTRODUCTION

According to Japan Student Services Organization (JASSO), as of May 1, 2013, 135,519 international students are now studying in Japan. Learning Japanese is a necessity for them. Besides, Japanese Government put forward a "Plan for 300,000 Exchange Students" as a policy measure to create A Japan that is Open to the World in 2008. Since then, Japanese language education for international students has become an emergent issue. But learning a new language is a time consuming process as the Foreign Service Institute (FSI) of the US Department of State has pointed out. According to their investigation, 2,200 hours is necessary for English speakers to achieve general professional proficiency level of Japanese language.

A questionnaire was conducted to examine how many Japanese language classes per week international students are taking at university in Japan (46 participants). The result shows that the average number of Japanese language class was 1.3 class per week (SD: 2.49). Lack of in-class learning time is obvious. If it is not possible to increase in-class learning time, the only choice left is to boost up students' outside-class learning time.

What could be a real contributor to boosting up outside-class learning time? In order to find the answer, we explored effectiveness of Learning Log System called SCROLL. The objective of this study is to find out an answer to our hypothetical question; whether SCROLL could be a contributor to boosting up outclass learning time for JSL learners in Japan.

2. BACKGROUNDS

2.1 Boosting Up Outside Class Learning

It takes a substantial amount of time to master a new language, but time spent in-class is far from sufficient. However, there are very few studies in which they challenged to boost up outside-class learning. Shirono

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(2009) reported that by letting their students keep their learning reports and submit them to their teacher, it helped them get more committed to outside-class learning. Tan (2012) explored the pedagogy of blended language learning to promote learner autonomy. But no research studies were found where they challenged it with mobile and web language learning application even though there are countless tools at present.

2.2 Mobile Learning Environment

Mobile learning has generally been defined as learning with its use of mobile and wireless technologies. It is often depicted as "learning anytime anywhere". It has been recognized as one of the natural directions toward which CALL (Computer Assisted Language Learning) is heading (Chinnery, 2006; Stockwell, 2007). Thornton & Houser (2005) reported that the learners preferred mobile platform rather than PCs. We believe its mobility aspect will be able to contribute to boosting up outside class learning.

3. SCROLL

Learning takes place in variety of situations. How can we record our learning experiences? Taking notes is a traditional way. When we come across new vocabularies, we may take notes. However, the notes will not remind us of what we have learned. SCROLL has been developed in order to support learners to record new information, to remind them, to share and reuse them in future learning. The system is designed to support every aspect of a learner's activity model called LORE (Log-Organize-Recall-Evaluate) (Ogata et al. 2011).

3.1 Design of the System

In this paper, we define the term, ubiquitous learning log (ULL) as record of what a learner has learned in the daily life using ubiquitous technologies. Each recorded object is called ubiquitous learning log object (ULLO). SCROLL is a client-server application. The server side runs on Linux OS. It runs on different platforms such as smart phones, tablets, and PCs. SCROLL interfaces that support the learners to record, share and reuse ULLOs with smartphones are as follows.

3.1.1 ULLO Recorder (Log)

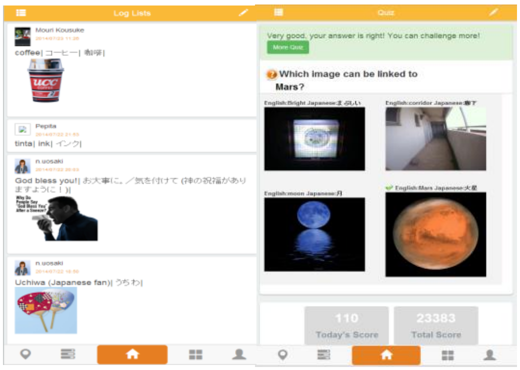
This component facilitates the way learners upload their ULLOs to the server whenever and wherever they learn. In order to add a ULLO, a learner can take a photo, ask questions about it and attach different kinds of meta-data with it. Figure 1(1) shows the android interface of adding a ULLO.

3.1.2 ULLO Finder (Organize)

If a learner registers a new ULLO, the system checks whether the same object has been already stored or not. Also, the learner can search ULLOs by name, location, text tag and time. Using this function, a learner can understand what, where and when he learned before. Besides, it allows him to be aware of others' learning objects and to relog them if he regards it as useful. This means that he can make a copy of another learner's learning object into his own log. Therefore, learners can obtain a considerable amount of knowledge from others even though they have not experienced that knowledge themselves. By sharing ULLOs with others and relogging other learners' ULLOs, the acquisition of knowledge is enhanced.

3.1.3 ULLO Reminder (Recall)

Figure 1(2) shows multiple-choice quizzes generated automatically by the system. The system immediately checks whether the answer is correct or not. These quizzes are generated according to the learner's profile, location, time and the results of past quizzes. The quiz function is designed not only to help learners to reinforce what they have learned, but also to recommend other learners' ULLOs according to their current location in their preferred time.



(1) Add ULLO (2) Multiple-choice quiz

Figure 1. SCROLL Interface of Android mobile phone

Figure 2. SCROLL TimeMap

3.1.4 ULLO Review and Evaluation (Evaluate)

The system shows the users TimeMap (cf. Figure 2). They can evaluate and review when and where they learn their logs. They can also review how actively they use the system and how many correct and wrong answers they give by looking at the dashboard on top page and Quiz Logs.

4. EVALUATION

Seventeen international students (3 German, 2 Chinese, 2 Taiwanese, 2 Thais, 1 American, 1 Canadian, 1 Brazilian, 1 Danish, 1 Korean, 1 Vietnamese, 1 Spanish, 1 Hong Kongese) of CALL class which was held weekly at Osaka University participated in the evaluation. They all reported they had Internet-connected PCs at home and were mobile phone owners.

The evaluation was carried out over 6 weeks. Each participant experienced each of the two outside-class learning modes 1) without SCROLL for the first 3 weeks (Phase 1) and 2) with SCROLL for the second 3 weeks (Phase 2). Therefore the only parameter for comparison was WITH and WITHOUT SCROLL. Other conditions remained the same. Since our main objective is to examine SCROLL contribution in terms of boosting up outside-class learning time, the participants were asked to report their outside-class learning time to the teacher every class. Time aspect was emphasized because as mentioned, outside-class learning time is pivotal to learn a foreign language. On the day that Phase 2 started, they created an account of SCROLL and received a briefing about how to use the system such as how to upload newly learned words, how to take quizzes, how to practice pronunciation, how to review their past logs, and how to relog other users' logs during the class. They were encouraged to use the system outside-class for their target language learning.

4.1 Results and Discussions

Table 1 shows the outside-class learning time for the target language learning during Phase 1 and Phase 2, its difference (Phase 2 – Phase 1), the number of SCROLL uploads, times of quiz taking and the number of correct answers of quizzes. The average learning time was 8.3 hours during Phase 1 and 12.2 hours during Phase 2 per week. It shows the statistically significant increase (t = 3.20, p= 0.00028). Totally 435 learning logs (Mean = 25.6/person Max. = 107 Min. = 2) were uploaded to the system. There were no reclogged objects. We examined correlation between each student's number of uploads and learning time increase (Phase 2 – Phase 1). The correlation coefficient between the two factors was -0.12. No statistically significant correlation was detected.

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Table 1. Outside-class learning time (per week), SCROLL uploads, and Quizzes

Student	Phase 1 Without SCROLL (hrs)	Phase 2 With SCROLL (hrs)	Phase 2 – Phase 1	Number of SCROLL uploads during Phase 2	Times of quiz taking during Phase 2	Number of correct answers during Phase 2
#1	20.5	35	14.5	10	63	60
#2	4	18.6	14.6	26	53	49
#3	3.3	4	0.7	11	10	9
#4	5.1	3.7	-1.4	107	48	36
#5	12	15	3	3	7	7
#6	3.9	6.9	3	59	9	8
#7	5.7	10.7	5	11	8	5
#8	3	6.7	3.7	8	24	23
#9	5	11.7	6.7	10	37	31
#10	14	12	-2	24	0	0
#11	5.6	8	2.4	10	20	12
#12	15.7	12.2	-3.5	29	43	41
#13	17.3	24	6.7	107	32	25
#14	7.5	15	7.5	2	0	0
#15	7.5	10	2.5	3	22	21
#16	2	2	0	2	0	0
#17	9	12	3	13	13	9
Mean (SD)	**8.3 (5.41)**	**12.2 (7.83)**	**3.9 (4.90)**	**25.6 (32.67)**	**22.9 (19.32)**	**19.8 (17.71)**
t-value	**3.20 (*p*= 0.00028)**		***r*** (correlation)	**-0.12**	**0.45**	**0.49**

The average times of quiz-taking was 22.9 times (SD = 19.32 Max. = 63 Min. = 0). We examined correlation between each student's times of quiz-taking and time increase (Phase 2 – Phase 1). The coefficient of correlation between the two was 0.45. Statistically significant correlation was detected as the following formula indicates: $r^2 = 0.2113 > 0.2105$ {4/(n+2)}

The average number of correct answers was 19.8 times (SD = 17.71 Max.= 60 Min.= 0). We examined correlation between each student's times of quiz-taking and time increase (Phase 2 – Phase 1). The coefficient of correlation between the two was 0.49. More statistically significant correlation was detected as the following formula indicates: $r^2 = 0.2416 > 0.2105$ {4/(n+2)}

Outside-class learning time significantly increased in Phase 2. Therefore the use of SCROLL could be one of the contributors to the students' more involvement in outside-class learning. However the number of uploading words did not contribute to boosting up learning time. It was found that taking quizzes could be one of the contributors. Table 1 shows that it was significantly correlated between learning time and times of giving right answers to the quizzes. Why did they enjoy the quiz but not the uploading activity? In our previous study, SCROLL group uploaded less words but learned more words than the control group (Uosaki et al. 2012). It took more time to upload new words than taking notes. Unlike uploading, quiz taking is an easy operation. In fact, our previous studies show that the subjects gave good impressions on the quiz function (Li et al., 2013; Uosaki et al. 2013). Therefore taking quizzes might have triggered their outside-class learning.

Student # 14 showed 7.5 hour increase, even though he did not seem to use the system a lot. A personal inquiry was made about his outside class learning activities and it was found out that he in fact used the system quite often and viewed other learners' logs, which, we believe might be one of the reasons why his outside-class learning time increased during Phase 2.

Table 2. What is your impression of using SCROLL?

Student	level	comments
#1	advanced	It`s a great idea, and it`s set up well, but it seems underdeveloped. It also relies on the accuracy of the words posted by contributors, which can be risky
#2	advanced	time consuming and when the network is not stable it is so difficult to use
#3	advanced	none
#4	beginner	none
#5	advanced	It takes time to get used to it.
#6	advanced	It has interesting features, like attaching pictures and/or sharing your location when uploading a new card. The translator gets most of the words correctly, but sometimes fail to translate longer expressions.
#7	beginner	good
#8	intermediate	It seems very useful for learning foreign language
#9	intermediate	its good
#10	intermediate	It is a nice system but I don't think that it is very useful for me personally.
#11	beginner	I can see and study from my friend activities.
#12	advanced	I think it's a very nice idea to learn vocabulary with the opportunity to include pictures. It's way easier to learn them. But on the other side it's complicated to input pictures which should show verbs.
#13	intermediate	I don`t find it really useful.
#14	beginner	none
#15	intermediate	Doesn`t seem all that great, there are much more professional websites for learning languages
#16	beginner	interesting
#17	beginner	very unorganized, not very polished

A questionnaire survey was conducted to ask their impression of using SCROLL (cf. Table 2). Five gave positive comments, 5 gave negative ones, and 4 gave both positive and negative ones. No advanced learners gave positive comments, while there was only one negative comment from the beginners. It implies the more they get advanced, they are likely to get unsatisfied. It suggests that the system might more fit beginner learners.

5. CONCLUSION AND FUTURE WORKS

This paper explicated our research study using SCROLL for boosting up JSL learners' outside-class learning time. The result of the evaluation showed that there was a statistically significant increase of outside-class learning time during the phase with SCROLL. The correlation coefficient value implies that it was taking quizzes that contributed to the increase. The user comments imply that the system might more fit beginner learners. Since more than half of the participants had negative comments, SCROLL is needed to be more sophisticated. As our future work, we are going to introduce game elements in our system. We expect that such game elements will be able to add some fun factor so that they can enjoy and get more involved in learning outside-class. We believe it will be one of strong contributors to boost up outside-class learning time.

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AN INTEGRATED LEARNING MANAGEMENT SYSTEM FOR LOCATION-BASED MOBILE LEARNING

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ABSTRACT

This paper discusses the relevance and challenges of a location-based learning platform that supports mobile learning in education. We present the design of an integrated management system for location-based mobile learning. Independent of the taught subject, the objective of the system is an easy-to-understand user interface for both - teachers and students.

KEYWORDS

Location-based mobile learning, learning platform, Geographic Information System, GIS

1. INTRODUCTION

With the rapid development of mobile telecommunication technologies, learning content can be accessed virtually anywhere and anytime. Learning on mobile devices is typically referred to as *mobile learning* (Murphy, Castillo et al. 2014), or as wireless, ubiquitous, seamless, nomadic, or pervasive learning (Frohberg et al., 2009). *Location-based mobile learning* (LBML) can be seen as a sub class of mobile learning, which accounts for the learner's location in the learning concept, allowing her to interact with the environment during contextualized learning activities (Patten et al., 2006). This offers opportunities to support formal, nonformal, and informal learning (Tan, Liu et al. 2013) as experience (learning in the environment), or from the perspective of the natural environment and its affordances it offers to educate visitors (learning about the environment) (Brown, 2010). Even though the potential of LBML has been recognized in research, a large-scale adoption of LBML in education is still missing. One reason can be found in the high effort required for setting up and customizing LBML.

In this paper, we argue that LBML requires specialized learning management systems for geographically referenced content (Geo-LMS). We describe an architecture for a Geo-LMS consisting of a web-based client for creating content that can be attached to geo-spatial coordinates (teacher interface), an LBML app providing the content to the student on a mobile device based on the location, and a server component for managing the data. One key design goal for a Geo-LMS is the high usability for non-IT experts, decreasing the barriers for teachers and enabling them to integrate LBML modules in their regular teaching with acceptable effort. An evaluation study for our envisioned Geo-LMS with lecturers and students at the university level is outlined.

2. RELATED WORK

As we enter a new world of global digital communication, it is no surprise that there is a growing interest in the relations between mobile technology and learning. Sharples et al. pointed already in 2010 to the well-publicised convergence of mobile technologies, as market mobile computer-communicators, combining into a single device the functions of phone, camera, media player and multimedia wireless computer. Based on a variety of previous research studies Sharples et al. observe another equally important convergence between the new personal and mobile technologies, and the new conceptions of learning as a personally-managed lifelong activity. The criteria for a theory of mobile learning are presented in Table 1.

Table 1. Convergence between learning and technology

New Learning	New Technology
Personalised	Personal
Learner centred	User centred
Situated	Mobile
Collaborative	Networked
Ubiquitous	Ubiquitous
Lifelong	Durable

Both aspects of mobile learning (learning with portable devices and learning while mobile) are starting to converge, as handheld and wearable devices interact with their surroundings and static objects respond to people on the move as shown in the Caerus project (Naismith et al., 2005) where visitors to the University of Birmingham's botanic gardens were given handheld location (GPS) devices that automatically offered audio commentary on the flowers and shrubs as they walked around the gardens.

A specifically promising type of mobile learning is LBML. From research on LBML it is known that the placement of learning content locally with digital mobile and multimedia technologies may constitute a useful addition to traditional didactic methods. Learning with location-based environments can be achieved through arranged field trips, outdoor education, environmental studies, and field-worker training. It is important to know that in this framework, learning is still guided by a curriculum, and it is conducted by the instructor or teacher to fulfill the course learning objectives (Tan et al., 2013).

There are several research projects which have proposed to utilize location for mediating knowledge about the outdoor environment. For example, in a field trip study based on curricula in the natural and social sciences, two positive effects were identified: students were engaging in "mobile-technology-supported" observation as well as "mobile-technology-supported" manipulation during their scientific inquiry (Liu et al., 2009).

In contrast to formal learning, location-based environments for informal learning usually take the form of casual and self-motivated learning. Students can learn with location-based environments without waiting to receive instructions from the teacher or course guide. Informal learning with location-based environments could happen in the context of experience, and even if it is spontaneous, it is still intentional (Clough, 2010).

A number of case studies with location-based learning applications have been performed. One recent study analyzed iCollaborator, an iPhone application developed at the Athabasca University which provides multimedia mobile meetings and interactive virtual whiteboards in which participants can communicate and exchange ideas in real time with location-aware aspects (Tan et al., 2010). Another study describes the design and development of a system that facilitates location-based, situated and collaborative language learning incorporating the potential of Internet-based television and mobile phone (Fallahkhair, 2011).

To handle all aspects of the mentioned learning process, e-learning must be organized and managed within an integrated system which is the common idea behind learning management systems (LMS). An LMS serves as the infrastructure that delivers and manages instructional content, identifies and assesses individual and organizational learning or training goals, tracks the progress towards meeting these goals, and collects and presents data for supervising the learning process of the organization as a whole (Szabo, 2002).

Different tools are integrated into a single system as learning activities, which offers all necessary tools to run and manage an e-learning course. Typical tools contained in an LMS include syllabi, discussion forums, file sharing, management of assignments, lesson plans, chat, etc.

As early as in 2006, the emergence of social software has questioned the use of integrated LMS. The integration of educational social software tools in LMS was an important topic in LMS and pedagogy research. Dalsgaard (2006) argued that it is necessary to move e-learning beyond LMS in social software and networks to support self-governed learning activities of students.

Geographic Information Systems (GIS) have a long tradition as software tools for handling and processing geographic information for spatial decision-making (Goodchild, 2011). With the rapid development of mobile technology a broad range of Internet-based GIS-platforms have become available. Using Global Positioning System (GPS) data to pinpoint geographical location together with the rapidly evolving Web 2.0 technologies supporting the creation and consumption of content suggest a potential for collaborative informal learning linked to location (Clough 2010).

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Nowadays the progress of technology has again speeded up significantly. Web resources are operated by service-oriented architectures and web services. Why not integrating GIS and social network technologies in mobile devices by means of an integrated LMS?

3. A MANAGEMENT SYSTEM FOR LOCATION-BASED MOBILE LEARNING

Many of the aforementioned examples, which have a strong teaching and learning context, focus on the advantages of mobile technology to engage students in a particular subject-based learning activity. This paper takes a more technology-oriented perspective by suggesting an approach which integrates GIS technologies into an LMS in order to close the gap between the theoretical study of place-related teaching content, and students' direct experiences at the respective location. As an add-on to existing didactical concepts, the platform allows for creating location-based learning modules, which can be used in a mobile app.

Geographic Information (GI) can relate unrelated information by using location as the key index variable. Locations or spatial extents on Earth may be recorded with dates/times of occurrence, and x, y, and z coordinates representing longitude, latitude, and elevation, respectively. Integrating GI in a LMS focuses learning activities within a defined spatial context.

The purpose of the proposed Geo-LMS is that the system allows assigning learning contents to places in an intuitive map interface. The primary goal is testing the efficiency and effectiveness of Geo-LMS for mediating current didactic concepts in a spatial environment using GIS technology. A second goal is the development of an intuitive map interface which strives for high usability for both, the lecturer and the student, leading to low technical, administrative, and cognitive barriers for usage in actual education scenarios. The Geo-LMS further features an interdisciplinary conception, long-term maintainability, and adaptability to new technologies.

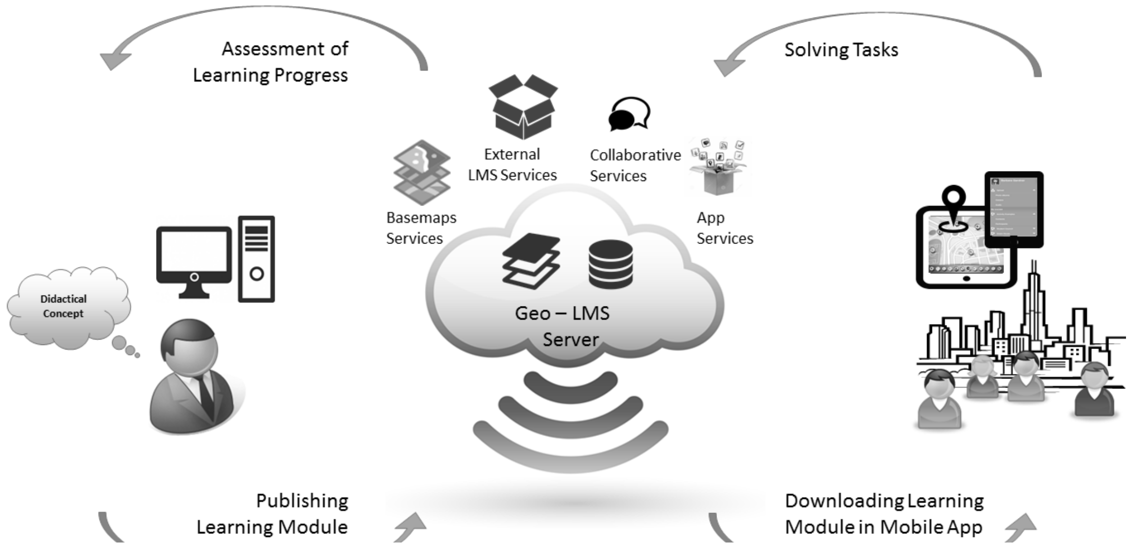

Figure 1. System Architecture of the Geo-LMS

Figure 1 provides a schematic overview of the proposed Geo-LMS platform. The interface for the creation of learning units is a web application, which can be accessed with conventional browsers by the user group of lecturers (*producers*). A web application has the advantage of being independent of an operating system. The learning units are stored with their geographical footprint, i.e., a trigger polygon in geographic coordinates, in a spatial database. The Geo-LMS offers a number of learning unit types which can be combined flexibly, depending on the didactical and educational approach. Examples include: context-information by text or photo; task solving by text, multiple choice, picture, voice or video recording; seeking and documenting real-world objects in collaboration with other students. Some information is stored directly in the Geo-LMS database, other information for learning units can be stored in linked external LMS or third party applications or services (multimedia, social networks or specialized applications). All the service units are seamlessly integrated in the creation interface for the editor (lecturer).

With mobile devices, the learning units can be executed by the students (*consumers*). When learning takes place, the learning contents associated with spatial information will be retrieved from the Geo-LMS as soon as the mobile device's current location intersects the footprint of the content. The content then appears automatically on the learner's mobile device and, if applicable, the learner is asked to solve a task.

The Geo-LMS server works as the connecting element between the web application for the creation of the learning units and the mobile devices for consuming the learning units. The learning contents are stored in learning repository databases with identification attributes tagged with the location information.

4. CONCLUSION AND OUTLOOK

In this paper we have argued that LMS can be enhanced by GIS technology to support mobile learning in location-based environments. The spatialization of learning may influence learning theories by modifying existing ones or creating new ones.

Sharples et al. (2010) postulate different criteria on their theory of Mobile Learning that is supported by portable devices, wireless networks and universal as well as subject-specific applications. Mobile Learning at school means that computer technology is no longer locked away in separate computer rooms, but flexibly and readily available for both learners and teachers in their everyday activities. The integration of location-based environments into the context-aware mobile learning systems opens up great opportunities for teaching, learning, learning content management and delivery, and educational administration.

At the same time it is apparent that there are many challenges for those who seek to employ Geo-LMS. How do we design such system effectively in considering the learning technologies, the pedagogy and learning administration, such as educational and social criticism, financial and personal reasons, school policy, legal issues and privacy, and very important technical reasons and technical skills of the users (Döring and Kleeberg, 2006, Tan et al., 2013, Lude et al., 2013)? Even the limited capabilities for teacher-student dialogue enabling influence and feedback during learning are an important challenge and an open research topic (Sharples et al., 2010).

The first study on the impact of LBML technology for teaching will be performed in a course for one semester at university level at ETH Zurich by the Institute of Cartography and Geoinformation in collaboration with the Institute for the History and Theory of Architecture. The project targets the development and evaluation of location-based mobile learning modules about Architecture and Urban Design in Zurich with the goal of closing the gap between the theoretical study of place-related teaching content in the classroom, and students' direct experiences at the respective location. Thanks to the mobile app of the Geo-LMS, the required documentation, such text or images, is always available at the right location. In the same way methods such as performing tasks (take a picture/video, answer a multiple choice question) or comparing one's own observations of the real environment with the data model of the app (display/hide geoinformation on 2d or 3d maps, or display objects in augmented or virtual reality) will be part of the toolset.

With its experience of spatial methods and algorithms, GIS can contribute to the progress of education. Similar concepts in social, collaboration and continuous learning in the environment context are known from GeoGames (Lude et al., 2013, Kiefer et al., 2006). However, these GeoGames are not developed for educational formal purposes, which means that a directed effort is necessary to develop educational collaborative learning elements to support learning activities.

Plenty of computer game-based learning exists, which fortifies the positive aspects of merging the motivational effects of playing games with the intellectually demanding aspects of learning. As in the case of pure mobile learning, stationary computer games do not inherit spatial and temporal grounding of the educational content (Kiefer et al., 2006).

In fact, there are these components, spatial and temporal, which we suggest produce the desired value propositions for a Geo-LMS. The effectiveness still needs to be evaluated. First, the results of the students learning tasks get checked and evaluated in a "quantitative" way and compared with students doing the same tasks in the traditional way of classroom-learning. The performance is evaluated through real examinations at the end of the learning period.

A second, equally important evaluation tool for education we will use, is the student's reflection journal which has become very popular for the evaluation of learning progress. Likewise the teaching progress, creating the app and executing it with the students and evaluating their results have to be reflected in journals and surveys. These records help evaluating the design, structure and also popularity of Geo-LMS and return essential insights for future work.

Based on the concepts, implementation and evaluation of the existing prototype of OMLETH, future work includes finding existing and new didactical concepts for LBML. Another question is whether the proposed location-based mobile platform and workflow generates long-term learning effects.

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THE INFLUENCE OF AFFORDANCES ON LEARNER PREFERENCES IN MOBILE LANGUAGE LEARNING

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ABSTRACT

This study investigates the influence of sensory and cognitive affordances on the usability of mobile devices for multimedia language learning applications. An audio-based learning application – the 'Vowel Trainer' (audio-based speech app), developed by University College London was chosen, against a comparison, text and picture-based language learning application – 'Learn English for Taxi Drivers' from the British Academy (app based on vocabulary, grammar). Impressions of the two applications were assessed on two different devices that have virtually the same interface, but differ in physical size: the iPhone and the iPad. A mixed design was chosen, with device type (iPad vs. iPhone) as between groups factor and language application type (audio vs. video) as a within groups factor. Assessments of sensory and cognitive affordances were made, along with measurement of learner preferences of each application and their suitability for each device. A preliminary (N=22) dataset was analysed using a mixed design MANOVA and the implications of the results for developing design guidelines for spoken language learning applications are discussed.

KEYWORDS

Mobile language learning, affordances

1. INTRODUCTION

There use of mobile technologies for language learning is not new and there is an abundance of research on learning outcomes of these newer language-learning technologies incorporating multimedia (e.g. Guerrero, Ochoa, & Collazos, 2010). However concerted efforts to incorporate usability principles into designing language-learning software for mobile devices have been relative scant. A large body of research so far has been done with visually-based applications in mind (e.g. Chinnery, 2006; Fisher et al., 2009; Kukulska-Hulme, 2005; Kukulska-Hulme & Shield, 2008), but the generalisability to audio-based applications has not been directly empirically tested. Given the suggestion that some of these devices might actually have a better suitability for audio and speech applications (Uther, 2002; Uther et al., 2007; Uther, Zipitria, Uther, & Singh, 2005), and the possibility that mobile devices may offer a more portable and personalised learning solution (Kukulska-Hulme & Shield, 2008), it is vital that these new technologies are considered and evaluated appropriately for their effectiveness in relation to language learning applications and the requirements that those kinds of applications might have.

A useful and interesting line of investigation is the use of 'affordances' to guide what might make a usable application. In the usability field, the development (and popularisation) of the term 'affordances' came with the work of Norman (1988). Norman suggests that there are both perceived and actual properties of an object that can lend itself to affordances (e.g. a chair can afford the act of sitting, but the chair can also be carried (McGrenere & Ho, 2000)). In more recent years, distinction between perceived and 'real' affordance has resulted in a useful further development in what could be termed a 'multiple abstractions' view of affordance. A framework developed by Hartson (2003) is useful, which specifies kinds of affordances: physical, sensory, cognitive and functional. This study focuses on the influence of sensory and cognitive affordances. A sensory affordance, Hartson argues, is having a font size that is large enough to read the label clearly. One could also specify further that sensory affordances could be a product of the software (as in the font size of the actual label), but these may also be influenced by the user's *perception* of the quality. Cognitive affordances on the other hand are design features that assist the user in identifying how a particular object could be used. For example, smart phones have buttons and physical interfaces that signify that this is a device that is for speaking and listening into. Hartson's framework is a useful one for evaluating affordances of mobile language learning applications, particularly as for example audio quality might obviously affect spoken language learning outcomes.

Of course, affordances are generally speaking very difficult to test within controlled experiments because hardware design often determines a priori whether the affordance is there or not (for example, a very small screen will simply not afford to the task of reading as well as a large screen, despite the best attempts of a software designer). As engineers embark on design of hardware, consideration is generally restricted to the physical affordance level, with consideration of cognitive or sensory affordance left to the task of software designers. The difficulty in investigating the role of cognitive or sensory affordances for applications such as language learning technology is that there are a myriad of different kinds of devices that may be used for language learning (iPods, iPads, smartphones, PCs, tablets, etc.). Each have different physical constraints and it is difficult to match these in a controlled way to inform good practice in user design. However, with the development of the iPad and iPhone, there is a unique opportunity to study affordances for use of multimedia in language learning. With both types of devices, there are similar if not identical video and audio capabilities (audio quality is identical, although video quality is superior). Physical interaction styles – screen layout and the physical interface (navigation button and swipe) are also identical in both cases.

Studying cognitive and sensory affordances can provide useful information that would inform future design of spoken language learning technologies. As it has been hypothesised (Uther, 2002; Uther et al., 2005) that mobile phones have an affordance for spoken language, it would be useful to compare spoken language learning applications in a mobile phone that has a virtually identical counterpart in a larger device. From the 'cognitive affordance' point of view, one could argue that the very nature of a phone signals functions for speaking and listening to. Such a comparison would also provide a useful framework for evaluation of these technologies that can assist practitioners conducting usability studies for industry. In this study, two software applications with two different kinds of multimedia (audio-rich vs. graphics-rich) are compared: an audio-intensive language learning program (UCL Vowel Trainer) and a more text- and picture-rich language learning program, focused on grammar ('Learn English for Taxi Drivers' by the British Academy). Both software applications are tested on both types of devices (iPhone and iPad). In terms of sensory affordances, it would be predicted that both devices fare equally well in terms of audio quality. However, video content may be rated more highly on the iPad due to its superior video bit rate and larger screen size. In terms of cognitive affordances, it could be predicted that iPads might afford better for the video-based application as it has a larger screen and iPhones may afford for the audio language learning application as it is seen as better for listening. Equally, one could also plausibly predict that both types of applications might afford equally well to the iPad because the iPad might be seen by users as a better 'educational' tool.

2. EXPERIMENT

A small-scale study (N=22) was conducted on 12 native speakers of English and 10 non-native speakers of English. Methods and preliminary results are briefly described below.

2.1 Method

2.1.1 Participants

Participants were aged 18-26 years old (mean=19, SD=18) and were recruited from the University of Surrey. Participants were studying Psychology, with the exception of two students studying Engineering. Psychology students received course credit for their participation. None suffered hearing or visual impairments.

2.1.2 Procedure

Participants were given informed consent, and filled questions relating to their demographic and language background. They were then given a selection of standard music, audio book and video samples (approx. 15 seconds each) to listen to on both iPad v.2 and iPhone v.4. They listened to the samples in a quiet room, using a standard pair of Sennheiser headphones set to a comfortable hearing level. They completed a set of questionnaires throughout the testing asking them to rate the sound and picture (where applicable) quality of the samples as they listened to each. The participants then were given a demonstration and opportunity to have a short trial of the two language learning software applications. They were asked to rate the software on both devices for sound and picture quality. They were also asked to rate the suitability of each software for each device and how likely it would be that they would procure such an application if they were a non-native speaker. The participants also rated usability of software applications using the Questionnaire for User Interface Satisfaction (QUIS). Preliminary results of the affordance and suitability data are only presented in this paper due to time and space constraints.

2.2 Results

2.2.1 Sensory Affordance Questions

A comparison of participant-rated sound quality showed no significant differences between the iPad and iPhone devices. For the video sample, participants rated both picture and sound quality as higher in the iPad compared to the iPhone ($F_{1,20}$ = 8.391, $p<0.05$ and $F_{1,20}$=20.792, $p<0.05$ respectively), see Figure 1 below. There were no differences in ratings between native and non-native speakers.

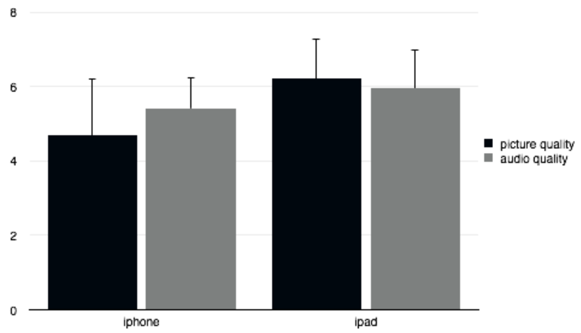

Figure 1. Mean quality ratings of video clip sample on iphone and ipad. Error bars show standard deviation.

2.2.2 Cognitive Affordance Questions

Analysis of sound quality for the Vowel Trainer across devices showed that participants rated sound quality as better on the iPad compared to the iPhone ($F_{1,20}$=4.611, $p<0.05$, see Table 1 below). Analysis of the sound and picture quality of the Learn English application showed that there were no significant differences between the rated sound quality on the iPad vs. iPhone. However, participants did rate the picture quality as superior on the iPad for the Learn English application ($F_{1,20}$=4.638, $p<0.05$, see Table 1).

Table 1. Comparison of participant ratings of sound and picture quality on the two software applications on both devices. Mean values are given, with standard deviations in brackets.

	iphone		***Ipad***	
	Vowel Trainer	***Learn English***	***Vowel Trainer***	***Learn English***
Sound quality	4.81 (1.53)	5.77 (1.19)	5.23 (1.54)	5.91 (1.15)
Picture quality	-	4.90 (1.15)	-	5.54 (1.26)

Analysis of rated suitability and likelihood of future use showed similar patterns of results. There were no overall main effects of device nor software. However, there was a significant interaction between software and device ($F_{1,20}$=7.580, $p<0.05$ for suitability and $F_{1,20}$=5.649, $p<0.05$ for likelihood), with participants rating that they felt the suitability and likelihood of future use was rated more positive for the iPhone compared with the iPad for the vowel trainer, whereas the converse was true for the Learn English software, see Figure 2 below.

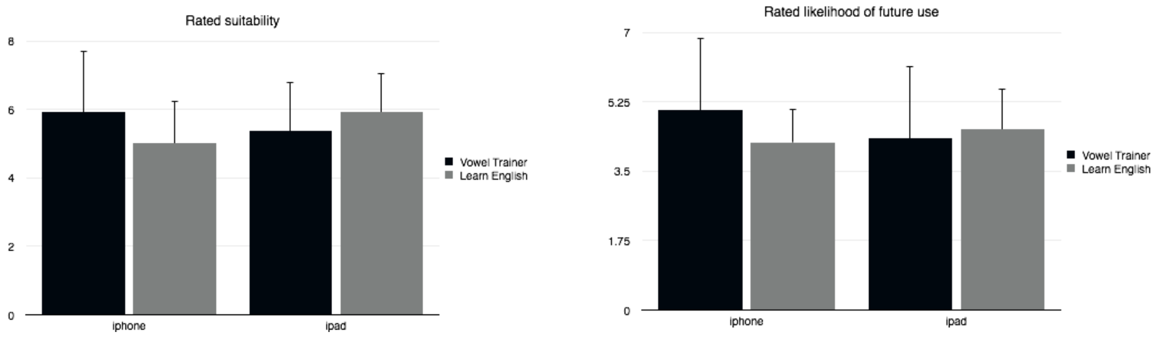

Figure 2. Participant-rated suitability of different language learning applications on ipad and iphone.

3. CONCLUSION

The preliminary results of the study show that there appears to be little difference in the subjective perception of sound quality between the two devices for audio content. When evaluating video content, picture quality was perceived to be superior on the iPad, which mirrors the physical differences between the devices. However, for video samples, audio quality was also perceived to be superior in the iPad, despite there being no differences in audio quality. At a user level, it appears the iPad has more of a superior rating for both picture and audio quality. Interesting, when looking at whether these sensory affordances affect cognitive perceptions of suitability of the language learning applications, users appear to disregard these sensory perceptions when it comes to audio-based applications when assessing suitability and likelihood of future use. Further research and analysis needs to focus on whether there are differences in perceptions between the two types of language learning software or other contextual factors that underpin these cognitive perceptions.

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MICROLEARNING AS INNOVATIVE PEDAGOGY FOR MOBILE LEARNING IN MOOCS

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ABSTRACT

MOOCs are open online courses offered by major universities, free to everyone, anywhere in the world. Hundreds or tens of thousands of learners enrollee in MOOCs but completion rate is extremely low, sometimes less than 10%. There is a need to explore new and more engaging forms of pedagogy to improve retention. Focusing on this need, this paper, proposes the combined use of Microlearning and Mobile Learning in MOOCs, for a new educational approach. The benefits of this new educational approach might be the development of innovative short in time learning activities in MOOCs, enabling anytime - anywhere learning, like small steps that over the day are together forming a continuous learning path.

KEYWORDS

Microlearning, Mobile Learning, MOOCs.

1. INTRODUCTION

MOOCs opened the doors of higher education to anyone with an internet connection and spread so rapidly that 2012 was declared by NY Times "The year of the MOOCs". Teaching to thousands and creating scalability challenges MOOCs provide a new context for the study of Open and Distance Education.

The aim of this paper is: a) To present MOOCs and their need to explore new and more engaging forms of pedagogy to improve retention. b) To present Mobile Learning and its use in Massive Open Online Courses. c) To present Microlearning and its two components, microcontent and microlearning activities, as pedagogy that can utilize mobile learning. d) To propose the combined use of Microlearning and Mobile Learning in MOOCs.

2. MOOCS

'MOOC' stands for 'Massive Open Online Course'. The acronym highlights the key components; i.e. that they are online courses which use open practices to educate massive numbers of students.

The innovative about MOOCs is not their online nature: 'it is the 'M' in MOOCs that underlies and influences the unique nature of the design space' (Bayne and Ross, 2014). When elite universities offer online courses for free, thousands of learners register to grab the chance to get a first-rate education creating scalability challenges. The massive nature of MOOCs harnesses the potential for learning in a large-scale (Conole, 2013). However, we are still trying to learn how to handle the scalability issues for teaching, learning, and assessment models (Kay et al., 2013).

There are many different pedagogical approaches in MOOCs, even between MOOCs in the same platform. Some are emphasizing individual learning through interactive materials while others are focusing more on social learning (Conole, 2013). On one end of the MOOC spectrum is the connectivist cMOOCs and on the other end is the cognitive-behaviorist xMOOCs offered by MITx, Coursera, and Udacity (Reilly, 2013).

The instructional design of the connectivist MOOCs consisted of multiple digital spaces with choices of tools for the learner to use built into the design of the course. Based on principles of connectivism (autonomy, connectedness, diversity, and openness), there are four types of activities: aggregation, remixing, repurposing, and feeding forward of resources and learning (Reilly, 2013).

In Coursera MOOCs, which are based on the effectiveness of online learning and Mastery Learning, learners watch short video lectures, take interactive quizzes, complete peer graded assessments, and connect with classmates and teachers. Mastery Learning helps students fully understand a topic before moving onto a more advanced topic (Coursera, 2014). In FutureLearn MOOCs: ‘every course has been designed according to principles of effective learning, through storytelling, discussion, visible learning, and using community support to celebrate progress’ (Futurelearn, 2014). In iversity MOOCs learners can watch videos, discuss with their peers and take quizzes and exams (iversity, 2014).

Key elements of MOOC pedagogy are peer communication, support and assessment, because of large numbers of learners and few instructors. Forums play a central role in most platforms, with diverse expectations including increasing engagement, promoting deep learning, maintaining motivation and decreasing risk of drop-out (Boyatt et al., 2014).

2.1 Dropout Rates: Need for Innovation

Many criticize MOOCs, pointing to high dropout rates and learner confusion and frustration, despite the potential of new technologies to support learning (Conole, 2013).

In 2012, the typical Coursera massive open online course (MOOC) enrolled between 40,000 and 60,000 students. In total, roughly 5 percent of students who signed up for a Coursera MOOC earned a credential signifying official completion of the course. Among students who intended to finish, roughly 24 percent successfully completed the course, compared to fewer than 2 percent in the remaining population of registered students (Koller, 2013).

The first of the working papers, which was written jointly by researchers at both universities Harvard and MIT, provides an overview of the data from 17 MOOCs: a) 841,687 people registered for the 17 MOOCs from Harvard and MIT. b) 5 % of all registrants earned a certificate of completion. c) 35 % never viewed any of the course materials. d) 54 % of those who “explored” at least half of the course content earned a certificate of completion. e) 66 % of all registrants already held a bachelor’s degree or higher. f) 74 % of those who earned a certificate of completion held a bachelor’s degree or higher. g) 29 % of all registrants were female. e) 3 % of all registrants were from underdeveloped countries (Kolowich, 2014).

Although high dropout rates in MOOCs can be explained in some way, it remains a challenge to improve the educational process through new innovative educational approaches in order to increase learners’ satisfaction and develop a more efficient massive education. Technology can find solutions for scalability issues in MOOCs but we also need innovative pedagogies to boost human interactivity and connectivity in order to engage learners in a massive learning process.

MOOCs represent a sign of the times and there is a need to take them seriously and to make more informed pedagogically effective design decisions, leading to an enhanced learner experience and ensuring quality assurance (Conole, 2013). It is important to strive always to improve retention among highly committed learners, by exploring new and more engaging forms of pedagogy, or by adapting existing MOOCs to better fit the needs of the working adult online learner (Koller, 2013). The challenge in MOOCs is to find ways to effectively teach thousands of students simultaneously and this requires pedagogical innovation. This innovation makes MOOCs important, more than their massive enrollments (Stacey, 2013).

3. MOBILE LEARNING

Mobile Learning has been defined as: ‘learning across multiple contexts, through social and content interactions, using personal electronic devices’ (Crompton, 2014). It is certainly concerned with learner mobility, learning outside a classroom or in various locations. It requires nothing more than the motivation to do so wherever the opportunity arises – from books, electronic resources, places and people (Kukulska – Hulme et al., 2005).

Shrinking eLearning content to make it accessible on mobile devices might be the most intuitive approach to mLearning. Such efforts can certainly have their merits, in particular to reach distant and mobile employees. Woodill (2012), argues that the "full potential of mobile communications for learning will not be realized until we stop producing learning apps or mobile websites that simple repackage classroom materials to be read or played with on a smaller screen" (Pimmer and Pachler, 2014).

3.1 Mobile Learning & MOOCs

Coursera's free iOS and Android app is perhaps the very best way to take part in a MOOC through a phone or tablet. The app gives limited access to Coursera's list of available courses as well as any you have already signed up for. When you're already enrolled in a course, you can view its lecture videos through Coursera's app. These can be streamed or, if you plan ahead, downloaded in advance so that you don't burn through your mobile data allowance while traveling. The app is limited, though, and doesn't let you take some of the multiple-choice tests or perform peer-review assignments (Eaton, 2014).

MobiMOOC, a MOOC on mobile learning (14 mLearning topics) with 1250 learners, 17 facilitators, held in April – May 2011 and September 2012. Researchers found that mobile users engaged more frequently in learner interactions than the non-mobile users. Additionally mobile users engage more in follow-up messages leading to increased understanding. 90% of active participants said the MOOC format was appropriate for their learning communities and 77.5% accessed MobiMOOC via mobile (Waard, 2013).

4. MICROLEARNING

Microlearning is an emerging theory of learning that utilizes web content, with activities of short duration. It offers a new way of designing and organizing learning, like learning in small steps and small units of content, with structure and classification created by the learner. It is a new theory and a precise and comprehensive definition has not been given yet. New dimensions and new perspectives of the term are continually added (Kamilali and Sofianopoulou, 2013).

Microlearning is related to relatively short efforts and low degrees of time consumption. It deals with small or very small content units and rather narrow topics (Hug, T. and Friesen 2009). The focus of Microlearning is not in hierarchical classification and sequence of courses and modules but to encourage learners to become active co-producers of content through active social participation (Kerres, 2007).

Microlearning consists of Microcontent and Microlearning Activities. Microcontent is information published in short form. It may be an article on a blog, a post on Facebook or Twitter. Its length dictated by the constraints of a single main topic and the physical and technical limitations of software and devices (Dash, 2002 in Lindner, 2006). Microlearning activities are short learning experiences for learners while they are working on microcontent. Microlearning activities should be designed as to be driven by learners or created by them (Kerres, 2007).

Microlearning may vary depending on the pedagogies and media involved. It can be utilized with a range of pedagogies, including, reflective, pragmatist, conceptionalist, constructivist, connectivist, or behaviourist learning, or action-, task-, exercise-, goal- or problem-oriented learning. It can be designed for classroom learning as well as for corporate learning or continuing education, entailing processes that may be separate or concurrent, situated or integrated into other activities. It may follow iterative methods, networked patterns or certain modes of attention management entailing different degrees of awareness (Hug, T. and Friesen 2009).

4.1 Microlearning & Mobile Learning

The nature of Microlearning fits to the nature of mobile phone. Microlearning applications have to feel peripherous and casual, for being usable in a state of "Discontinuous Partial Attention" (Lindner, 2007).

Some microlearning and mobile learning research projects:

a) Researchers from MIT and Intel, demonstrated software for mobile devices designed to help users learn via "microlearning" events. The application domain is rehearsing names and faces of people in one's field or social network (Beaudin et al., 2006).

b) Researchers evaluated the flashcard system MemReflex across three user studies. Overall, the work suggests new directions for mobile microlearning and "micro activities" in general (Edge et al., 2012).

c) KnowledgePulse is a new and pioneering learning technology developed by Research Studios Austria FG. The KnowledgePulse supports knowledge acquisition by a smart system of repetition, using intelligent learning cards (Research Studios Austria FG, 2014).

d) Researchers explore the use of ubiquitous sensing in the home for context-sensitive microlearning. This work was supported by Intel Corporation. The sensors used were developed with support from National Science Foundation grant. The PlaceLab stay was funded by Microsoft Research (Beaudin et al., 2007).

4.2 Need for Research

In our rapid moving connected world we only have small 'windows' of time to devote to lifelong learning. Microlearning fits to our world and to our needs with its microcontent and microlearning activities. Although there is plenty of microcontent everywhere in the Web, there is a lack of research in microlearning activities that can utilize it in a Microlearning educational context. There is a need for research to develop and apply new innovative Microlearning strategies and study their efficiency in education.

Microlearning raises new questions of didactical design of learning activities based on microcontent and resulting in microcontent (Lindner, 2006). The small format of Microlearning does not imply simplified pedagogical strategies. On the contrary, designing microlearning scenarios becomes even more complex, as it integrates various didactical approaches (Kerres, 2007).

5. CONCLUSION

Massive open online courses need new innovative engaging forms of pedagogy in order to handle the scalability issues for teaching and learning. New pedagogical approaches need to be tested to improve retention and adapt existing MOOCs to better fit the needs of the working adult online learner.

Focus on this need, this paper presented two innovative pedagogies, mobile leaning and microlearning, in order to propose their combined use in MOOCs, for a new educational approach.

Mobile learning: a) Is method for learning on the move and has limitations in time and device use. b) Is learning across multiple contexts, through social and content interactions. c) **Is not s**hrinking eLearning content to make it accessible on mobile devices. There is a need to design learning differently: linking people in real and virtual worlds, creating learning communities between people on the move, providing expertise on demand, and supporting a lifetime of learning.

Microlearning: a) In terms of time, is related to relatively short efforts and low degrees of time consumption and in terms of content, deals with small or very small units and rather narrow topics, so fits to mobile learning limitations. b) Encourage learners to work on microcontent with individual and social activities, so fits to the social character of mobile learning. c) Have to feel peripherous and casual, for being usable in a state of "Discontinuous Partial Attention".

Mobile learning and Microlearning: They can be used together for the development of short online activities in MOOCs that can be embodied to everyday life.

As it was shown, it seems that the combined use of Microlearning and Mobile Learning in MOOCs is possible. The benefits of this new educational approach might be the development of innovative short in time learning activities in MOOCs, enabling anytime - anywhere learning, like small particles that over the day are together forming some continuous structure in the learner's mind.

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Reflection Papers

CROSS-PLATFORM USER INTERFACE OF E-LEARNING APPLICATIONS

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ABSTRACT

The paper discusses the development of Web educational services for specific groups. A key feature is to allow the display and use of educational materials and training services to the widest possible set of different devices, especially in the browser classic desktop computers, notebooks, tablets, mobile phones and also on different readers for visually impaired users. The Web service will be created according to the rules WCAG (Web Content Accessibility Guidelines).
The article also focuses on the accessibility of educational services and the selection of appropriate tools for effortless and effective implementation.
The Department of Information Technologies of the Czech University of Life Sciences Prague has extensive experience with electronic online education of specific groups (e.g . seniors, women at maternity leave).
The solution will be used in the development of educational services "Labyrinth". Software will be developed in collaboration the Department of Information Technologies of the Czech University of Life Sciences Prague and nongovernment organization Czech Society for Information Technology in Agriculture.

KEYWORDS

Responsive design, online study materials, website usability, lifelong learning, bootstrap, Sass

1. INTRODUCTION

At Czech University of Life Sciences Prague (CULS), we teach regular university students and we also provide lifelong learning to various groups of people. Among our most successful lifelong learning educational activities belong learning of women at maternity leave, the virtual university of the third age, courses for young new entrepreneurs, help to handicapped people and education of farmers and people living in rural areas. We have employed information and communication technologies (ICT) in all mentioned cases to a certain extent starting from an online study material distribution to a full-scale online learning. According to our experience, there are differences in the acceptation of diverse teaching methods among different groups of people. The selected topic covers many aspects where among the most significant belong: lifelong learning, social impacts of digital divide, influence of technologies and their usability in the educational process.

Our contemporary society has been characterized not only by a permanently growing number of information sources but also by an access to these sources from various client devices and platforms. An enormous growth has been recorded especially in the area of single-purpose or multi-purpose mobile devices. There exists an inexhaustible number of mobile devices using several platforms from which users connect to the server sources of information. (Palmieri, 2012) The most frequently used platforms are Android a iOS even though they are rather different. (Šimek, 2014) Display units of various devices vary greatly, mainly because of its size and resolution; display density pixels per inch (PPI). (Xanthopoulos, 2013).

The Department of Information Technologies (DIT) of the CULS has extensive experience with electronic online education of specific groups (e.g. seniors, women at maternity leave). For each group was used individual eLearning web application. It was mainly used modified version of the LMS (Learning Management System) Moodle. (Moodle) The development of information and communication technology

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was creating a requirement to create the cloud applications (Sultan, 2010). Application will provide a learning environment for different specific groups as a service.

The paper discusses the development of Web educational services for specific groups. A key feature is to allow the display and use of educational materials and training services to the widest possible set of different devices, especially in the browser classic desktop computers, notebooks, tablets, mobile phones and also on different readers for visually impaired users. The article also focuses on the accessibility of educational services and the selection of appropriate tools for effortless and effective implementation.

2. MATERIAL AND METHODS

2.1 Requirements

Based on the requirements of the target groups, project managers and technical staff of the Department has been defined by the following requirements for educational services:

- Online running application (access via the Internet).
- Access to the application via different devices on different platforms and different web browsers. (Nathan, 2011)
- Fast and efficient development allowing effortless upgrade.
- Accessibility according to WCAG 2.0 (Web Content Accessibility Guidelines). (W3C)

2.2 Web Mobile Application

The major advantage of the mobile web application is an easy and very fast implementation with the help of an intelligent distribution of cascading style sheets for a web browser. Even though the result could be an effective responsive design (Figure 1. Responsive web design), of classic web application users mostly use the permanent Internet connection for their work with a mobile application. (Šimek, 2014)

2.3 Responsive Web Design

Media Queries is a Cascading Style Sheets 3 (CSS3) module enables adaptive rendering web pages according to various factors such as screen resolution and screen size (i.e. Screen smartphone vs. PC display). They were first used in 2001 and became a World Wide Web Consortium (W3C) recommended standard in June 2012. It is the basic building block for responsive web design. This makes it possible simply edit the styles and significantly improve user experience (UX). Media queries are considered to be the last level of responsive web design. These are rules that make it varied styling document depending on the available width of the screen display device. (W3C) (Kulkarni, 2011)

Figure 1. Responsive web design
Source: http://blog.dobryweb.cz/mejte-web-prizpusobeny-pro-jakekoliv-zarizeni

Responsive Design Tools:
There are a variety of tools and frameworks for the development of applications using responsive design, the most common are:

- **Bootstrap** is a toolkit for creating websites and web applications. Includes design templates based on HTML and CSS, used for adjusting typography, forms, buttons, navigation and other interface components, as well as other optional extensions JavaScript. Bootstrap is compatible with the latest versions of all major browsers and smartly adapts to using older browsers such as Internet Explorer

(IE) 8. Since version 2.0 also supports responsive design. Bootstrap is released under the MIT license and is copyright 2014 Twitter. (Bootstrap)

- **jQuery Mobile** is a web framework written in JavaScript and optimized for touch devices. It develops jQuery project, creator of jQuery and jQuery UI. jQuery Mobile released under the MIT license.(jQuery mobile)
- Other tools and frameworks: Kickstrap, YUI (Ivanovs, 2014)

CSS pre-processor:
CSS pre-processors are dynamic style sheet languages that after compilation create CSS files. Tools enable efficient, faster managing large and complicate CSS files. Among the most significant CSS pre-processors are mainly Sass, LESS and Stylus. (Firdaus, 2014)

2.4 Accessibility

WCAG (Web Content Accessibility Guidelines) create firs rules dealing with the accessibility of a web site. Created by group WAI (Web Accessibility Initiative) under the W3C (World Wide Web Consortium). Present version is from 11. 12., 2008. Version WCAG 2.0 was published as W3C recommendation.

The guidelines and Success Criteria are organized around the following four principles, which lay the foundation necessary for anyone to access and use Web content. Anyone who wants to use the Web must have content that is:

- ***Perceivable*** *- Information and user interface components must be presentable to users in ways they can perceive.*
- ***Operable*** *- User interface components and navigation must be operable.*
- ***Understandable*** *- Information and the operation of user interface must be understandable.*
- ***Robust*** *- Content must be robust enough that it can be interpreted reliably by a wide variety of user agents, including assistive technologies*.

If any of these are not true, users with disabilities will not be able to use the Web. (W3C) The accessibility of the website can be checked for example by using online tools Achecker (achecker.ca).

2.5 Application Evaluation

Firstly were analysed the available tools and frameworks to improve the efficiency of creating and managing the appearance of web services.

It was decided to be used for the development of multiplatform Web Services Framework Bootstrap. To manage CSS styles will be used the CSS pre-processor Sass.

There were experimentally created a sample prototype of eLearning website. The prototype was evaluated according to the following parameters:

- Application performance on different devices.
- Correct rendering on different devices (evaluation was attended by representatives of the target groups).
- User friendliness from the perspective of developers (especially clarity of code, technical support, and other subjective parameters).

3. CONCLUSION

The KIT staffs were analysed requirements and it was found that the best and most effective solution is to use *CSS3* module *Media Queries* to create the design of an educational portal.

There were developing a testing the prototype of eLearning applications. The conclusions of the testing of prototype are.

- Prototype run on various devices and is suitable for target group as a learning platform.
- Design and user inteface shoud be simmilar on each device (tablet, mobile, destop) So the user is not confused when switching between them.

- Based on the analysis developers desidet to use thises techlogies for developing of final application (Saas, CSS3, bootstrap).

Based on these results further development will be done. The Education Service "Labyrinth" will be developed in collaboration of the Department of Information Technologies of the Czech University of Life Sciences Prague and nongovernment organization Czech Society for Information Technology in Agriculture. The development of cloud applications will run in the first half of 2015.

The final solution will represent universal solution for creating cross-platform educational services.

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TECHNOLOGY TRENDS IN MOBILE COMPUTER SUPPORTED COLLABORATIVE LEARNING IN ELEMENTARY EDUCATION FROM 2009 TO 2014

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ABSTRACT

This paper analyses mobile computer supported collaborative learning in elementary education worldwide focusing on technology trends for the period from 2009 to 2014. The results present representation of device types used to support collaborative activities, their distribution per users (1:1 or 1:m) and if students are learning through or around the technology. The major findings show that in the last five years tablet computers and small handheld devices are used nearly with equal frequency as mobile learning devices, mostly in 1:1 distribution simultaneously being an instrument through which collaborative activities are performed.

KEYWORDS

Mobile learning, collaborative learning, elementary education

1. INTRODUCTION

The purpose of this analysis was to point out the recent trends in mobile computer supported collaborative learning (mCSCL) as well as the role of technology in mCSCL throughout the last five years, from 2009 to 2014, focusing on elementary education worldwide. Although there are several different definitions of mCSCL depending on the context in which it is used, the authors of the paper adopted definition in which mCSCL includes usage of mobile devices as tools for in-classroom and out-of-classroom teaching and collaborative learning (Zurita & Nussbaum, 2004) where, as defined by Dillenbourg (Dillenbourg, 1999), collaborative learning is "a situation in which two or more people learn or attempt to learn something together".

The paper is organised as follows: Section 2 presents research methodology carried out in order to gather data relevant for the analysis. Section 3 discusses the results, while Section 4 points out the major findings.

2. RESEARCH METHODOLOGY

Three research questions were defined in order to analyse recent technology trends in mobile computer supported collaborative learning in elementary education worldwide: 1) What types of mobile devices are used in collaborative activities?, 2) What is the distribution of devices per users (1:1 or 1:m)?, and 3) Do students collaborate around the devices or through them?.

23 papers in total were selected as relevant for this research as a result of online databases search carried out in October and November 2014. The databases searched were: ACM Digital Library, ERIC, IEEE Xplore and Science Direct. The summary of selected papers is presented in the Table 1.

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Table 1. Summary of selected papers

Authors	Paper description	Devices used
(Lan, Sung, & Chang, 2009)	This study attempts to implement a cooperative reading environment for EFL early reading using a mobile-device-supported computer-assisted reciprocal early English reading (CAREER) system.	Tablet computer
(Nussbaum et al., 2009)	This paper reports on the design of a digital system that aims to support the practice of face-to-face collaboration on open ended tasks.	Handheld device
(W. Chen, Looi, & Tan, 2009)	This paper analyses the role of different communication modes in students' collaborative learning.	Tablet computer
(Hung, Young, & Lin, 2009)	This study is aimed to develop a face-to-face collaborative English vocabulary acquisition game system on portable devices, called Wireless Crossword Fan-Tan Game (WiCFG).	Tablet computer
(Lin, Wong, Shao, Niramitranon, & Tong, 2010)	The paper investigates the effects of collaborative concept mapping of a 1:1 digital learning environment, comparing with a 1:m environment in terms of students' overall learning gains, knowledge retention and quality of the concept maps.	Tablet computer
(W. Chen, Looi, & Tan, 2010)	This exploratory study analyses how students use different communication modes to share information, negotiate meaning and construct knowledge in the process of doing a group learning activity.	Tablet computer
(Looi, Chen, & Ng, 2010)	This paper describes the findings of an exploratory cycle of a design-based research project and examines the learning effectiveness of collaborative activities that are supported by the GroupScribbles.	Tablet computer
(Guerrero, Ochoa, & Collazos, 2010)	This paper presents the design of a Collaborative Learning activity and the corresponding mobile software tool developed to support teaching grammar to primary education students.	Handheld device Personal computer
(Roschelle, Rafanan, Estrella, Nussbaum, & Claro, 2010)	The paper investigates whether an existing face-to-face CSCL tool from Chile called Eduinnova might serve as the basis of an effective CSCL practice in U.S. primary school classrooms.	Handheld device
(Sánchez & Olivares, 2011)	The paper presents the results obtained with the implementation of a series of learning activities based on Mobile Serious Games (MSGs) for the development of problem solving and collaborative skills.	Tablet computer
(Chang, Chen, & Hsu, 2011)	This paper demonstrates the impact of different teaching strategies on the learning performance of environmental education. The major contribution of this study is the introduction of WebQuest into the outdoor instruction.	Handheld device Personal computer
(Hwang, Chu, Lin, & Tsai, 2011)	In this study, a grid-based knowledge acquisition approach is proposed and a Mindtool is developed to help students organize and share knowledge for differentiating a set of learning targets based on what they have observed in the field.	Handheld device
(Wong, Boticki, Sun, & Looi, 2011)	This paper narrates researchers' journey of conceptualizing, prototyping, implementing trials, reflecting, refining, and doing the design formalization of Chinese-PP – a mCSCL solution for Chinese character learning.	Handheld device
(Pemberton & Winter, 2011)	The paper reports the results of an empirical evaluation of the learning experience with Invisible Buildings, a mobile collaborative game-based activity for schoolchildren.	Handheld device
(Lin, Shao, Wong, Li, & Niramitranon, 2011)	This study aimed to develop a collaborative and manipulative virtual Tangram puzzle to facilitate children to learn geometry in the computer-supported collaborative learning environment with Tablet PCs.	Tablet computer
(Lu et al., 2011)	The paper proposes a hybrid approach to combine the key elements and appeals of traditional arts with the convenience and immediacy of interactive technologies.	Tablet computer Multimedia environment and other
(Nordmark & Milrad, 2012)	The paper explores indicators for creative collaboration, of learning supported by mobile technologies, and of awareness of multimodal approaches for self-expression and meaning making for further DBR.	Handheld device
(Y.-H. Chen, Lin, Looi, Shao, & Chan, 2012)	The paper provides an account of learning arithmetic skills in an interesting way through the collaborative playing of a puzzle game.	Tablet computer

(Bollen, Gijlers, & van Joolingen, 2012)	This paper reports on the results of research efforts in investigating conditions that are advantageous in collaborative drawing activities in learning scenarios for young students.	Tablet computer
(Boticki, Wong, & Looi, 2013)	The paper describes the design of a technology platform for supporting content-independent collaborative mobile learning in the classroom.	Handheld device
(Furió, González-Gancedo, Juan, Seguí, & Rando, 2013)	The study determines whether the AR iPhone game has better learning outcomes than a traditional game.	Handheld device
(Chiang, Yang, & Hwang, 2014)	In this study, a location-based augmented reality (AR) environment with a five-step guiding mechanism is developed to guide students to share knowledge in inquiry learning activities.	Handheld device
(Falloon & Khoo, 2014)	This paper explores young students' talk in iPad-supported collaborative learning environments.	Tablet computer

3. RESULTS

The gathered data from the selected papers was analysed on the bases of the research questions. The results are presented hereafter.

Three different groups of devices used for mobile learning were identified by the authors: 1) small handheld devices, being devices that one can hold in his/hers hand and are pocket-sized, 2) tablet computers, essentially being bigger handheld computers, and 3) other devices which are not mobile devices but are used to support the activity in combination with the mobiles. The analysed data from selected papers showed moderately higher representation of tablet computers (44%) compared to handheld devices (41%). The other devices, for example personal computers or projector screens, were used 15% of the time in combination with handhelds and tablet computers.

Secondly, the distribution of devices per activity was observed and classified into one of three categories: 1) one-per-one or 1:1, 2) one-per-many or 1:m, and 3) combined usage of these two per activity. The 1:1 distribution refers to one device per user usage, while 1:m indicates one device per more than one user usage. Also, a collaborative activity can be carried out in combination of these two, for example if every student has its own device but shares the work on common screen. The devices are mostly used in 1:1 distribution (76%), followed by 1:m distribution (20%) and in combination (4%).

And third, the purpose of devices was explored and was determined that the activity can be carried out in three ways: 1) through and 2) around the device or 3) in combination of these two. The activity in which collaboration is facilitated and carried out by the device as infrastructure through which students communicate and collaborate is referred to as "through", whereas the situation in which students are gathered around the device in order to collaborate is referred to as "around". Also, the activity can be a combination of these two when, for example, a group of students is working together around technology, but with another group through technology. The activities are most frequently organized through devices (70%), while minority is held around (26%) or in combination of these two (4%).

4. CONCLUSION

This paper analysed the context of collaborative mobile learning activities that took place in the elementary education worldwide from 2009 to 2014 focusing on technology trends. From the gathered data it can be concluded that the tablet computers and small handheld devices are used almost equally throughout this period. The most common distribution of devices for the last five years was 1:1. The devices mostly serve as instruments through which the collaborative activity is performed.

According to the gathered data it is to be expected that in the near future the research in mCSCL will continue on 1:1 distribution of devices per users spawning the development of software and frameworks which use mobile devices as tools for collaboration.

ACKNOWLEDGMENT

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Posters

CHALLENGES OF USING LEARNING ANALYTICS TECHNIQUES TO SUPPORT MOBILE LEARNING

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ABSTRACT

Evaluation of Mobile Learning remains an open research issue, especially as regards the activities that take place outside the classroom. In this context, Learning Analytics can provide answers, and offer the appropriate tools to enhance Mobile Learning experiences. In this poster we introduce a task-interaction framework, using learning analytics techniques to support educational decision making, that has been designed by extending the results of well-established studies in this field with the aim of dealing with the complexity of Mobile Learning.

KEYWORDS

Mobile Learning, Learning Analytics, Semantic Web, Linked Open Data, Educational Decision Making

1. INTRODUCTION

In the last few years, Mobile Learning has been increasingly used to support learning experiences both in formal and informal contexts (Ahmed & Parsons, 2013; Jones, Scanlon & Clough, 2013). People using mobile and ubiquitous technologies for learning produce abundance of data as a result of their activities and interactions with the context; consequently, datasets built on these data are different both in size and type from the ones stored in VLEs (Merino et al. 2013; Ferguson, 2012). Moreover, according to Traxler (2007), the evaluation of a Mobile Learning experience has to consider a number of independent variables that influence the learning process; it is necessary to analyze a large amount of data and find relationships amongst data, in order to improve the learning experience, as well as to personalize contents and teaching methodology. Learning Analytics applied to Mobile Learning offers a promising framework to evaluate a "noisy phenomenon where context is everything" (p. 6, Traxler, 2007). In fact, Learning Analytics in Mobile Learning is a challenging research topic, due to the distinguishing features of Mobile Learning related to the technologies used, learners' mobility, the possibility of having localized data and information, the large amount of data that can be collected during a learning session, and the social dynamics that characterize the context in which learning takes place.

2. THE TASK-INTERACTION FRAMEWORK

In this poster, we introduce a framework based on the relationships between the different types of interactions occurring in a Mobile Learning activity and the tasks which are pedagogically relevant for the learning activity. In particular, the task-interaction framework deeply described in Fulantelli et al. (2014) is rooted in the task model for mobile learners introduced by Taylor et al. (2006) and Sharples et al. (2007), in the work on classification for Mobile Learning projects done by Frohberg et al. (2009) and in the classification of interactions for learning analytics proposed by Agudo-Peregrina et a. (2014).

Specifically, while we have designed the task-interaction framework with the aim of dealing with the complexity of Mobile Learning, the framework extends the Frohberg' results, by introducing an interaction layer to activate learning analytics processes and support educational decision making strategies. In fact, Frohberg and colleagues introduce a classification for Mobile Learning projects, based on Taylor and

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Sharples' model, by defining specific scale values for each of the six factors in the model: context, tools, control, communication, subject and object. The same factors, which have proved extremely effective in describing Mobile Learning projects in a structured way, were used in our study to guide the interpretation of the learning processes in a Mobile Learning experience. For this to happen, at first glance we have identified practical activities performed by students which characterize their behavior according to each of the six categories described by the factors. Then, we have considered the students' interactions in a Mobile Learning experience, by identifying which types of interactions, amongst those described by Agudo-Peregrina et al. (2014), can best characterize the students' behavior, and consequently, should be considered important in the activation of learning analytics techniques to support educational decision making strategies.

In table 1 we give an overview about the links between each of the six factors proposed by Sharples and Taylor, the corresponding scale range identified by Frohberg et al., and the types of interactions identified in our framework. Furthermore, examples of indicators are also provided for each factor. Considering the factors in detail, for the Context factor, which reflects the importance of the environment for the learner, Frohberg identifies four categories: independent, formalized, physical and socializing. These labels represent the environment where learning takes place. The values for the context factor range from independent, where the learner's environment and his/her learning subject are in no way connected, to socializing, where learners exchange everyday experiences and support each other in a learning experience. The analysis of activities related to the context factor refers to the student-context interaction. In fact, as stated above, this type of interaction represents the relationships between the student and the context in which the learning activities take place. The difficulties in identifying context boundaries in Mobile Learning experiences constitute an obstacle to the definition of the relevant indicators for measuring and capturing information about this type of interaction.

Table 1. Overview of types of interactions combined with Mobile Learning factors

Factor	Issue	Values/Scale range	Interactions	Examples of indicators
Context	Relevancy of environment and learning issue	independent, formalized, physical and socializing	Students / Context	Position of a student in relation to the other students.
Tool	Pedagogic role of tools	From: content delivery To: content construction	Students / Content	# access to content, # creation of new content
Control	Responsibility for learning process and goal	From: full teacher control To: full learner control	Students / Teacher	# messages between students and teachers (Note: the direction is highly relevant)
Communication	Social setting	From: isolated learners To: cooperation	Students / Student Students / Teacher	# message between students and between students and teacher
Subject	Previous knowledge	From: novice To: expert	Students / Content Students / Teacher	# access to content , # request for teacher intervention
Object	Level	From: know To: synthesize and evaluate	Students / Context Students / Content	indicators strictly related to the type of learning experience

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EFFECTIVENESS AND UTILITY OF TERMINAL TABLET AS ELECTRIC TEXTBOOKS FOR NURSING PRACTICUM

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ABSTRACT

Based on the Nursing Learning Support System, which was developed and tested by our university, this study developed the "Digital Nursing Dictionary (ver. 2)," a terminal tablet with a new function of an electronic books, by taking advantage of the developed ICT. This paper describes an interim report of the results of those assessments.

KEYWORDS

Mobile learning, Terminal tablet, Nursing education, Nursing practicum

1. INTRODUCTION

The system development and operational model construction of e-learning have advanced in the educational engineering field. However, even given high needs for e-learning, the nursing field is confronting important problems of the deficiency of educational materials and wide gaps in informational technological literacy. Now, we have developed the Digital Nursing Dictionary (Ver.2), with educational material contents and electric textbooks loaded on a terminal tablet. This study was undertaken as a performance assessment using the terminal tablet in nursing practicum to verify its effectiveness and utility.

2. RESEARCH METHODS

The method is as follows: (1) Subjects are 76 of 137 4th grade nursing students. (2) The period of performance assessment: October 2012 – July 2013. (3)The main research contents of self-completed questionnaire survey: The status, time, and place of terminal tablet's use, the status of the internet connection, the usefulness of the contents, and the evaluation of functions, etc. (4) The data were analyzed using statistical methods with basic descriptive statistics and analysis of free description response contents. (5) We obtained permission to conduct the study from this university's ethical commission.

Regarding the terminal tablet development: (1) Electronic textbooks: We created electronic books using PDF data of the text and index provided by the publishers. (2) Educational material contents for the nursing support system: The system include 132 scenes of nursing simulated examples, nursing skill video images with 100 titles, 1,000 pages of knowledge cards, and 180 questions from the national examination. (3) The terminal tablet: We used (RW-T110; Sharp Corp.), which weighed about 640 gram had a 10.1 inch TFT liquid crystal screen. The platform was Android™ 2.3. Wireless LAN communication was used. Functions of the terminal tablet is 1) Handwriting (marker), bookmark function 2) Text input 3) Dictionary search function.

3. RESULTS

Basic information of participants, 73 (96.1%) were female and 67 (88.2%) were 20–22 years old. Also, 71 (93.4%) used a smart phone, 42 (55.3%) used WiFi by wireless LAN, and 53 (69.7%) used wireless LAN at home. Regarding the use frequency by practicum subjects, the percentage of answers “often used it” and “used it” were the highest in child care nursing (83.5%), followed by maternity nursing (62.9%), Critical nursing (36.9%), and chronic nursing (34.1%)(Fig.1). Regarding places of use, the devices were most frequently used at home and in dormitories (93.9%), but less at college (31.8%) and practicum facilities (21.2%). Regarding times of use, they were most frequently used during 21:00–24:00 (80.6%) and 16:00–21:00 (53.2%), but less during practicum. The use frequency of educational material contents on the terminal tablet shows that the percentage responding that they “often used it” and “used it” were the highest (84.8%) for the electronic textbook, followed by nursing skill videos (42.3%), knowledge cards (19.7%), and example educational materials (22.7%)(Fig.2).

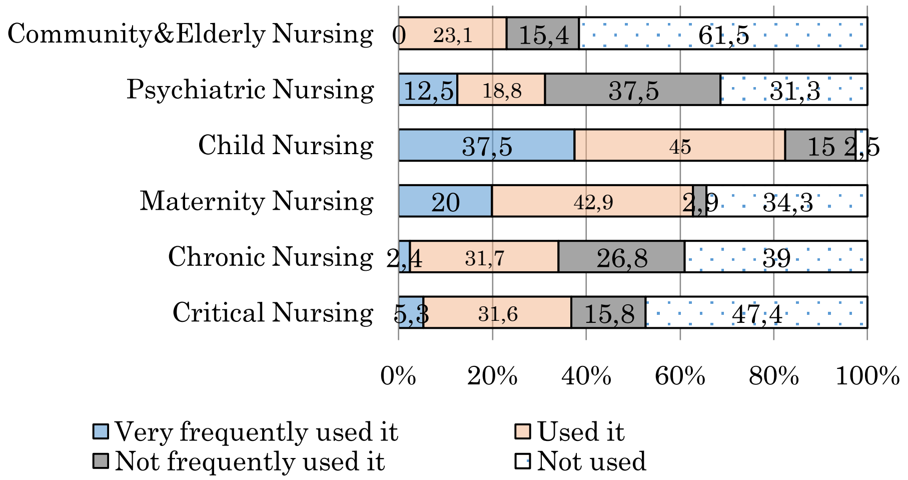

Figure 1. Use frequency for using the terminal tablet by practice subjects

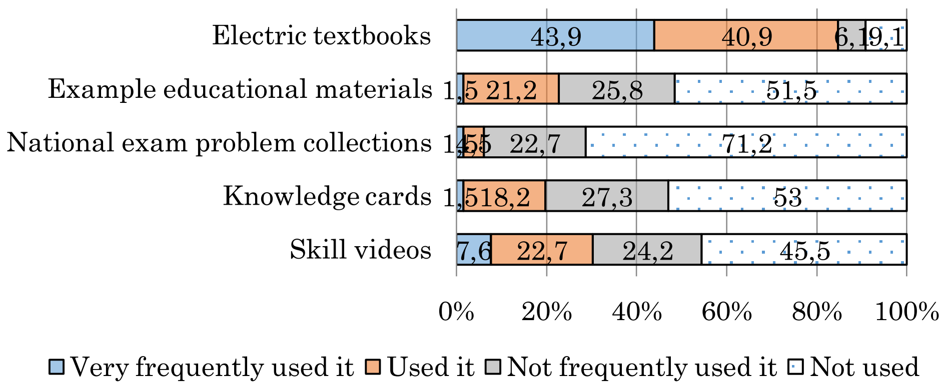

Figure 2. Use frequency of contents for using the terminal tablet

Regarding the usefulness of the terminal tablet’s educational material contents, the percentage of those who answered “very useful” and “useful” were the highest for electronic textbooks (76.6%), followed by skill videos (43.6%), knowledge cards (29.5%), and example educational materials (13.6%).

As to the usefulness of the terminal tablet’s functions, the percentage of those who answered “very useful” and “useful” were the highest in the dictionary search function (76.6%), followed by the Web search function (66.1%), hand writing (marker) function (62.9%) and bookmark function (58.8%).

In terms of the practical utility of the terminal tablet, the percentage of those who responded “very easy to use it” and “easy to use it” were the highest in the basic operation (78.8%), followed by dictionary search function (76.6%), Web search function (66.1%), hand writing (marker) function (62.9%), and bookmark function (58.8%).

4. DISCUSSION

The use status of the terminal tablet varied depending on the subject of practicum. It was more frequently used in child nursing and maternity nursing; it was less commonly used in chronic nursing and psychiatric nursing. As to frequently used contents, the electric textbooks were frequently used. Furthermore, the high use frequency of utilization of the search function and bookmark function shows that participants often used the electronic textbooks. Among the electronic contents, nursing skill videos were frequently used. Because nursing students need to confirm the nursing skills in advance before helping nurse patients in nursing practicum, it is very useful to see the videos of nursing skills anytime, which are expected to contribute to achieving their learning effects.

In addition, the terminal tablet, even if mobile, was used more frequently at home. It was necessary to encourage the participants to use practicum facilities and ask the staff of the practicum facilities for their cooperation. Furthermore, although the web search function was often used, because the penetration of wireless LAN at home is about 50%, if penetration expands, the web search function’s use rate can be expected to grow. In terms of practical utility, even given the tablet’s basic operation, dictionary search, and web search functions were evaluated to be easy to use, note-making functions were not frequently used and availability was also not good, which suggest room for improvement. Additionally, because the participants used the terminal tablet with paper textbooks for learning and because they felt the importance of the paper textbooks, the terminal tablet is expected to serve as an important teaching aid.

5. CONCLUSION

The “Digital Nursing Dictionary (Ver.2)” with the terminal tablet developed this time had electronic contents and electronic textbooks provided by a web system. Because it allows the users to use electric educational material contents and electronic text-books in a unified manner, it is expected that these books will contribute to achieving the users’ learning effects. Among them, the utilization rate of the electronic text-books was high. Their availability would be improved if users became accustomed to using them, making them an effective educational material for use in future studies. The use frequencies of the terminal tablet’s functions vary. Therefore, we must make improvements by narrowing down the necessary functions and by making actions easily accessible for anyone to use it.

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A STUDY ON THE PROCESS DEVELOPMENT OF COLLECTIVE INTELLIGENCE FOR UTILIZATION OF UNUSED SPACE OF ABANDONED SCHOOLS

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ABSTRACT

Living conditions and social environment are changing through time, and recently schooling population is diminishing in Korea. Thus the number of abandoned schools has increased. In order to utilize unused space a mechanism is required for the exchange of various ideas. However, there is little effort to provide a platform for this purpose. This study aims at developing a process and a systemic method to collect intelligence of utilizing unused space.

KEYWORDS

Abandoned school, collective intelligence, unutilized area data, decision making process.

1. INTRODUCTION : BACKGROUND AND RESEARCH GOAL

Living environments change depending on national policy, culture and its inhabitants much like a living organism. Some cities and facilities that could not adapt themselves to such changes miss their chance to be fully utilized and instead fall behind. In the case of school facilities, finding the proper flexibility to change and adapt to its environment has remained a challenge due to its characteristically sensitive nature to the population distribution of inhabitants. Those school facilities that have fallen behind from adapting and changing are easy to spot as most of them eventually become abandoned spaces. As the world enters an aging society, an upwards trend is evident in the return to farm and rural living styles in elderly people in Korea, while cultural and educational facilities seem to be neglected as they often do not meet new demands. To solve such phenomena, consistent ideas regarding the educational environment must be developed through on-going discussions of various concepts.

The supportive environment, however, is relatively weak in reality but can be highly effective when the collective intelligence is constructed on a specific topic through multiple mediums due to the advancement of the internet and mobile devices. For example, Wikipedia is one of the most influential encyclopedias based on the concept, ‘Encyclopedia written by everyone’. The development of mobile devices has helped boost ‘digital data’ environmental conditions in various physical spaces.

This research looks into methods to data unutilized areas by observing possibilities possessed by collective intelligence and by using mobile devices. It also suggests the process by which people can provide educational knowledge by utilizing ideas based on this. Nevertheless, as the category of unutilized spaces is very broad, the research has limited the space to abandoned schools as mentioned above.

2. PROCESS, TEMPLATE AND PLATFORM

2.1 Definition of Collective Intelligence

Collective intelligence means collective intellectual ability obtained through cooperation or competition of multiple unities. Such ability shows strength that exceeds the intellectual ability of a single unity. It was first

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proposed in《Ants : Their Structure, Development, and Behavior》published by William Morton Wheeler, American entomologist in the year of 1910. Wheeler explained the high intellectual ability of colonies that exceeds a single unity with the example of ant colonies. In the case of human beings, such concepts are being realized through a vast network called the internet, and its related case is as follows.

2.2 Related Cases and Shared Features

Table 1. Related cases

Case name	Content	Verification method
Wikipedia	It is an internet technology-based website where people make an encyclopedia together. It does not simply create intellectual content, but also organizationally generates the expansion, confirmation and connection of contents through mutual interaction. Users are independent from one another and the order of rank is not apparent like in the existing society as it has various backgrounds. Therefore, it is much more autonomous and it updates new knowledge which is reflected without limitation.	Changed recently, various editors find errors or wrong expressions as it is consistently exposed through Observation Document Queue function.
Innovation Jam	It is one of the driving forces of IBM for consistent innovation. It provides a large-scale forum of discussion through its website every year since 2001. Approximately more than ninety thousand people scattered all over the world write ideas related to a few topics. In 2006, IBM produced 10 innovation businesses for the next generation and invested one hundred million dollars for 2 years.	Verification made through complementation and modification from focused discussion over the course of several days, 24 hours

Common features of two cases are as follow. Firstly, they provided an environment where various people can gather. Secondly, they have consistent and focused verification systems for a specific period of time. Thirdly, the necessary feedback is provided. To reflect such characteristics positively, web or mobile environments ar e essential.

2.3 Space Utilization Element Abstraction of Abandoned School

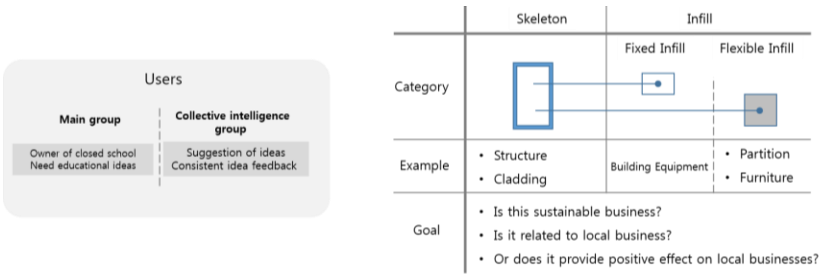

Figure 1. User and elements of abandoned school

To utilize abandoned schools educationally, two groups need to be formed. Firstly, a main group which owns abandoned school while requesting ideas. Secondly, unspecified persons called the collective intelligence group, which suggests ideas and provides feedback. In prior research, utilization methods were largely divided into Skeleton and Infill, and the above figure can be seen excluding those conditions subordinated in South Korea. To meet the suggested requirement, the main group must collect preliminary information about the provided area among the elements of Skeleton and Infill, while also providing a clearly defined goal to the collective intelligence group. Also, the collective intelligence group suggests ideas based on suggested preliminary information and goals. There must be consistent feedback for a specific period of time between the two groups based on such suggested ideas.

2.4 Sharing space Utilization Element Using Mobile Device

Skeleton and Infill elements which will be suggested by the main group can be concretized as follows.

Table 2. How to utilization elements using mobile device

List	Utilization of mobile device	Content
Location	GPS Data input	International standard coordinates provision that shows real location
Characteristics of site	Input after taking pictures by using camera	Report site area and characteristics. Ex) garden, play-ground
Facility area	Enter the written data through the measurement of preliminary information or floor formation	Area suggestion of composing facilities
Floor formation	Utilize mobile application that creates floor plan based on image processing and AR distant shooting technique	Suggest approximate structure of floor formation
Note	Enter text and image	Major businesses of neighborhoods and cities, or population related data Suggest short-term, medium-and-long-term goals Other necessary data

2.5 Sharing Unutilized Area Data and Decision Making Process

Suggestion of sharing unutilized area data and idea decision making process by using the above conditions is as follows.

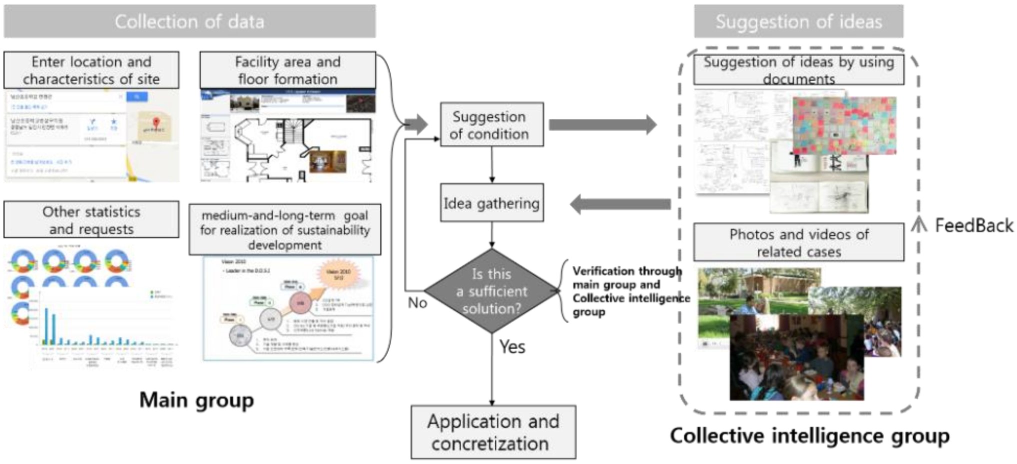

Figure 2. Decision making process

Firstly, main group collects information on the location, characteristics of the site, facility area, floor formation and other requests. Secondly, main group uploads the collected data in a website where sharing of ideas will be performed. Thirdly, main group enters ideas about expected application on facilities and input, and inquires medium-and-long-term goals and other conditions based on the collected data. Fourthly, the collective intelligence group confirms, enters, and shares ideas through various methods. At this moment, an environment is provided where they can input not only text, but also related case URL, images, or video links. Fifthly, two groups constantly give feedback for collected data during a specific period of time. Lastly, abstracted ideas are implemented on unutilized spaces.

2.6 Process Implementation Example

With the contents above, it can be imaginarily implemented on real abandoned schools in South Korea as the following. Firstly, main group suggests the following data by using mobile devices and basic information. Secondly, the collective intelligence group suggests the following idea by using the data proposed above. Thirdly, the final idea will be drawn through feedback of two groups during a specific period of time.

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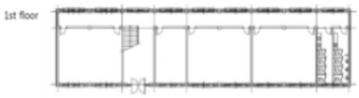
Table 3. Sharing unutilized area data and suggestion of idea

List	Contents (Example)
Location	37°08'14.4"N 127°18'29.3"E / Hupyungro 6, Wonsammyun, Yonginsi, Kyungkido, South Korea
Characteristics of site	   Secure space where outdoor activities can be performed Site area : 9,788㎡
Floor formation	  
Note	Environment near farming area as it is separated from cities Low accessibility Nonexistence of convenient facilities around Number of households/Number of population : 3,287/7,654
Traditional drink experience Realization of educational space	  Suggests educational program which can be performed without frequent visit as it has low accessibility. Even though it is adult-oriented program with high mobility, it provides educational enviro nment where youth and children can observe production and fermentation processes. Possible to have the program 3 times per year with total 4 groups in 4 months as one unit. Continue with farming producible traditional food such as Kimchi, soybean paste if expan sion is possible in the future.
Feedback	 Provide additional successful cases in other countries, example) Heineken factory, Domin us Winery etc. To reinforce the possibility of expansion, medium-and-long-term goal needs to be consider ed so that it can be performed by focusing on Korean fermenting food such as Kimchi and Soybean paste

3. CONCLUSION

The research determined how in abandoned school, unutilized space can be educationally reused through the means of collective intelligence. It was identified that collective intelligence can be used to draw and concretize ideas regarding utilization of unutilized space through this research. However, to reuse the unutilized space educationally, various conditions such as the selection of investors and operators need to be considered. Therefore, additional researches about other additional conditions must be performed with the suggested processes mentioned in this thesis.

ACKNOWLEDGEMENT

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IMPLEMENTATION OF AN ADAPTIVE LEARNING SYSTEM USING A BAYESIAN NETWORK

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ABSTRACT

An adaptive learning system is proposed that incorporates a Bayesian network to efficiently gauge learners' understanding at the course-unit level. Also, learners receive content that is adapted to their measured level of understanding. The system works on an iPad via the Edmodo platform. A field experiment using the system in an elementary school begins in September, 2014. In addition to the contents of this paper, reports on the field experiments and a demonstration will be given at the conference poster presentation.

KEYWORDS

Adaptive testing, Adaptive learning, Bayesian net, Edmodo

1. INTRODUCTION

Smart phones and tablet devices are now widely used. According to Cabinet Office research in 2013, the family unit penetration rate in Japan reached 54.7% for smartphones and 20.9% for tablet devices. Looking at the educational situation in Japan, the Ministry of Education, Culture, Sports, Science and Technology (MEXST) has set a goal of reaching a 100% penetration rate among students in elementary, junior high and high schools by 2020.

In this situation, the first task is to digitize the learning material. After simple digitization, we should address the challenge to use learners' learning logs to create tailor-made learning material that promotes efficient and motivated learning. In this paper, we propose an adaptive learning system that constructively uses learners' logs as part of its implementation scheme. Section 2 explains the basic theory and implemented system. Section 3 deals with the ongoing field experiments. Section 4 concludes the paper.

2. NETWORK-BASED ADAPTIVE TESTING

The system has 2 modes: testing mode and learning mode. The testing mode gauges learners' understanding in each course unit using the Expected Value of Network Information (EVINI)-based adaptive testing scheme (Ueno *et al.*, 1994). EVINI was inspired by the Expected Value of Sample Information (EVSI) (Raiffa 1961) concept from decision theory. In the proposed system, the learning mode assigns each learner drills on course units that the learner is not good at. Compared to the adaptive test using conventional item response theory (Birndaum 1968), this network-based adaptive testing method enables more detailed modeling of the relationship of the course units. The Bayesian net framework (Pearl 1989) is used to calculate EVINI. The details are explained in 2.2.

2.1 System Configuration

Figure 1 shows the configuration of the proposed system. The WEB application server runs HTML5-based drill contents for both modes. In the testing mode, the system automatically sets testing units for each learner. The unit selection is based on EVINI, which is computed using the learner's previous answers. To calculate

EVINI, a Bayesian net server infers the probability that the learner has understood each of the not-yet-set units, by examining the accuracy of previous answers. Details of EVINI are explained in 2.2. The database server stores learners' logs, which contain each learner's drill answers.

Table 1. Schedule of the field experiments

Phase type	Period
Data collection phase	September, 2014 to October, 2014
Adaptive learning phase	October, 2014 to February 2015
System Evaluation phase	March, 2015

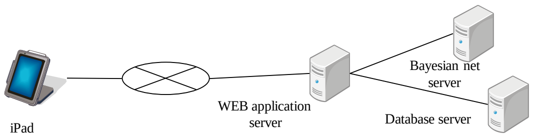

Figure 1. System configuration

2.2 Basic Theory

A Bayesian network framework is used to build an inference model of learners' understanding. The model structure and conditional probability table (CPT) are trained on preliminarily collected learners' logs. Each node of the Bayesian network relates to a course unit of content, and each node has 2 values, "understanding" and "not understanding," denoted by "1" and "0". In the testing mode, at the conclusion of questioning for each unit, the system uses the Bayesian network to infer the probability that the learner understands the units that they have not yet worked through. We denote the set of the units as "***N***". Using the conditional probability given by the inference, the system selects the most informative units ($\hat{j}$) calculated by Eq. 1 as the next testing units.

$$\hat{j} = \arg\max_{j \in N} EVINI_j \qquad (1)$$

$EVINI_j$ is given by the following formula.

$$EVINI_j == \sum_{x_j=0,1} P(x_j) \sum_{X_l \in X_L} P(X_l \mid x_j) \log P(X_l \mid x_j) - \sum_{X_l \in X_L} P(X_l) \log P(X_l)$$

Where X_l is a pattern vector (understanding pattern) in a set of nodes that consists of the j-th node and its child and parent nodes. Thus, $P(X_l)$ is a joint probability. X_L is the set of pattern vectors for the j-th node and its child and parent nodes.

The testing mode continues until forward testing is no longer expected to provide a preselected level of network information gain, i.e., the maximum value of $EVINI_j$ in Eq.1 becomes smaller than a threshold.

3. ONGOING FIELD EXPERIMENTS

We started field experiments with the system in a real-world classroom in September, 2014. The goal of the field experiments is to evaluate the proposed system, which uses learners' logs to guide adaptive learning.

The participants are 89 students in the 5th grade. The course material covers 4th to 6th grade math drills consisting of 43 course units. The implemented system works on an iPad via the Edmodo platform (https://www.edmodo.com/) .

Table 1 shows the schedule of the field experiments at a public elementary school in Japan. We collect students' logs in the data collection phase. Using the data, the Bayesian network structure and CPT are trained. The adaptive learning phase is the central focus of the actual field experiments, using the system explained in Section 2. We plan to evaluate the system in terms of learning outcomes and usability with an achievement test and questionnaire.

4. CONCLUSIONS

In this paper, we explained the implementation of a Bayesian network based adaptive learning system. The system will provide a way to use the learners' logs to facilitate efficient learning.

We also provided information on ongoing field experiments with the system at an elementary school in Japan. We plan to evaluate the system from the viewpoint of learning effectiveness and usability in the near future.

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MATHEMATICS AND MOBILE LEARNING

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ABSTRACT

The wide range of Mathematical Apps targeting different mathematical concepts and the various types of mobile devices available present a demanding and challenging problem to the teaching and learning in the field of mathematics. In an attempt to address this issue, few Apps where selected, implemented and tested in this work.

KEYWORDS

Mobile Devices, Mathematical Apps, functions

1. INTRODUCTION

The aim of this activity is to is to test three selected Apps, namely MyMath, EigenMath and PhotoMath, for capability, friendliness and impact on learning and applying mathematical concepts. The three Apps were chosen from a previously collected and categorized list. A randomly selected class of 24 students, split into 6 groups was presented with the task of solving algebraic equations and calculus problems using the given Apps on mobile devices.

2. BODY OF PAPER

<u>Challenge:</u>

The wide range of Mathematical Apps and the various types of mobile devices available present a demanding and challenging problem to learners.

<u>Methodology:</u>

Collect a number of popular Apps, test them and classify them according to their math capability, friendliness and impact on learning.

<u>Authentic Environment:</u>

- Classrooms, students are the main party in this investigation.
- Learners are presented with a list of selected apps alongside a set of typical mathematical problems.

<u>Learning Outcomes:</u>

By the end of this Activity, participants will be able to:
- Apply problem-solving techniques using mobile devices.
- Use these apps skillfully to solve given algebraic and calculus equations.
- Store and share their work with other participants.

<u>Activity:</u>

1. Sketch the following function $f(x) = x^3 + 2x^2 + 3x - 1$
2. Differentiate this function
3. Find the zeros of the derivative function
4. Sketch a graph of the derivative function

Recommended Apps: PhotoMath, Mymath and Eigenmath.
You can use other online Apps/websites

<u>Discussion:</u>
Samples of participants feed back on capability and friendliness of Apps:

PhotoMath: this App solves equations by scanning the camera over it however,

- Does not support handwritten text.
- Solves easy math questions only

Mymath:

- Recognizes handwritten text but limited to solving and graphing algebraic functions.
- was kind of helpful, but the scanning hand written equations was not accurate most of the time.

Derivative calculator website for windows users:
http://www.freemathhelp.com/derivative-calculator.php

- Excellent website that find the derivative of any algebraic expression.

EigenMath:

- This App tackles various mathematical tasks such as differentiating, integrating and sketching functions however, needs more practice.

2.1 Figures and Tables

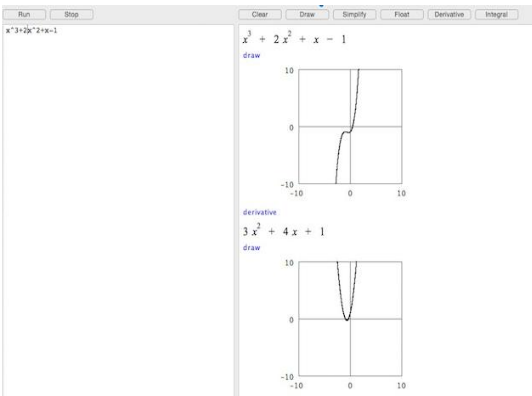

Figure 1. Algebraic solution using EigenMath

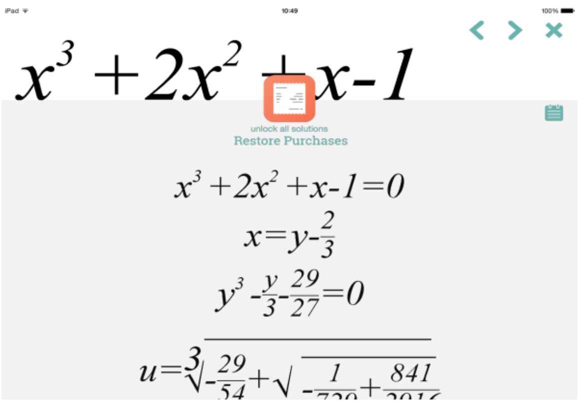

Figure 2. Derivatives and sketches using EigenMath

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Table 1. A list of various Math Apps

Apps	iPhone	iPad	Android	Mac Laptop	Descriptions
MyScript Calculator	√	√			Solves hand written calculations
Mathway	√	√		√	Solves general math problems
Fraction Calculator Plus	√	√			Fractions Calculator
Quick Graph	√	√		√	Graphic calculator
yHomework- Math solver	√	√			Solves step by step
FX Math Solver	√	√			Solving step by step
FX Algebra Solver	√	√			Solving step by step
FX Calculus solver	√	√			Solving step by step
MathRef	√	√	√		Math Education App (Formulas)
PhotoMath	√	-		-	Scan and Solve Equations using iPhone
Geogebra		√	√	√	Geometry, Algebra and Statistics

3. CONCLUSION

Clearly indicate advantages, limitations and possible applications.

- Students enriched the activity with additional Apps they found themselves which generated a bigger list of Apps.
- Faster way of finding solutions in comparison to the classic approach, as participants were not hindered by tedious algebraic and calculus calculations. This lead to more time devoted to analysing results.
- Students with challenged algebraic skills worked well with the advanced concepts of calculus.
- This work is limited to three Apps and a specific topic of maths.
- More Apps should be studied and linked to relevant math concepts, an initial attempt is presented in Table-1.

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Doctoral Consortium

A FRAMEWORK TO SUPPORT GLOBAL CORPORATE M-LEARNING: LEARNER INITIATIVE AND TECHNOLOGY ACCEPTANCE ACROSS CULTURES

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ABSTRACT

Corporations are growing more and more international and accordingly need to train and develop an increasingly diverse and dispersed employee based. M-learning seems like it may be the solution if it can cross cultures. Learner initiative has been shown to be a disadvantage of distant learning environments, which would include m-learning. Consequently this study will look at the influence of Hofstede's cultural dimensions on Learner Initiative (LI) and how LI influences technology acceptance of m-learning. A prototype will be designed and shown to representatives of various cultures along the cultural dimension who will then answer a questionnaire. Responses will be evaluated in two phases with the first phase focusing on the cultural influence on LI and the second phase focusing on how LI influences technology acceptance.

KEYWORDS

Learner Initiative, M-learning, Technology Acceptance

1. INTRODUCTION

Similar to other forms of e-learning, one of the benefits of mobile learning is the ability to offer concepts in various formats, ranging from static text to interactive modules, to meet the needs of different learners. But if the learner will not attempt to access the information or cannot incorporate the information due to cultural differences, there is little chance of achieving the desired learning outcome.

Corporate Training and Development departments are often tasked with training a globally dispersed, multi-cultural employee population in a cost effective and consistent manner (Holmes 2009). In an attempt to reach a greater percentage of these employees, many companies are turning to m-learning. According to a 2013 mobile learning survey "…73% of organizations are actively engaging in mobile learning in some form and 87% plan to increase usage over the next 12 months"(Brandon Hall Group 2013). While some m-learning may be created as multi-platform web-based learning, others take a more native approach attempting to take advantage of the contextual features inherent in smart phones and phablets. These contextual features can allow learning to happen when and where it is needed.

M-learning has its roots in distant learning. The correspondence courses of the 1990s are now web based courses accessible via the internet and increasingly in mobile friendly formats. Tuckman (2007) noted that the reliance on learner initiative was a major disadvantage of web-based distance learning. In this case, initiative would be the ability to independently assess a need to for learning, find value in using a mobile learning app to satisfy that need, and thus begin the mobile learning process. Given that m-learning is ubiquitous in nature and is being designed to be used as needed, it will be up to the learner to assess a need and initiate the learning process. A learner will need to feel it is within his or her power and interest to initiate m-learning. Accordingly Lerner Initiative (LI) is an important aspect of m-learning that must be accounted for. When looked at it from a cross cultural perspective, differences in cultures could affect what is perceived as being within ones control and thus the ability to assess the need for and take action to initiate m-learning could be very different.

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This paper will propose research as part of a Ph.D. candidacy that will look at LI as part of technology acceptance across cultures research. Initially the paper will look at the research that has focused on cross cultural technology acceptance. The following section will look at the research objective and discuss LI with regards to Hofstede's cultural dimensions and LI as a construct of the technology acceptance model. Finally the paper will concluded by looking at the study where it is now and where it can grow.

2. RESEARCH BACKGROUND

Technology acceptance has been the topic of numerous studies since the 1980s. Some of these studies, such as DeSanctis et al (1994) and Orlikowski (2000), propose taking a holistic approach which incorporates actual everyday technology usage. Other studies suggest a structured technology focused approach. One such structured approach is the Technology Acceptance Model (TAM). It is one of the most widely used and accepted theories in Information Sciences for understanding and predicting technology acceptance. The TAM was the result of Davis' doctoral research where he showed, as seen in Figure 1, that the Perceived Usefulness (PU) and the Perceived Ease of Use (PEOU) of a system directly impact the Attitude Toward Usage (A) which then impacts the Behavioral Intent (BI). Since the introduction of the model, it has been validated and extended.

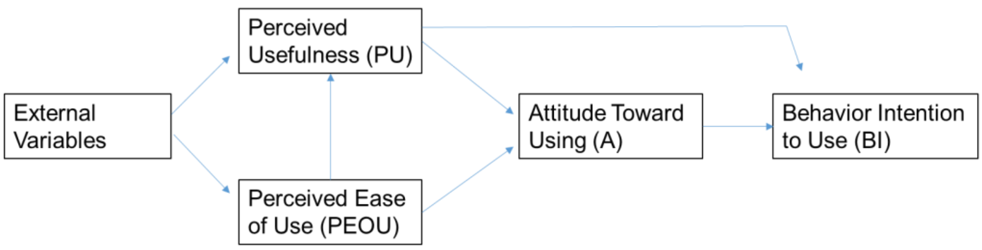

Figure 1. Technology Acceptance Model (Davis et al. 1989)

The Unified Theory of Acceptance and Use of Technology (UTAUT) by Venkatesh et al. (2003) endeavored to combine the TAM with elements of seven other acceptance models. The UTAUT looks at four factors: performance expectancy, effort expectancy, social influence, and facilitating conditions. While it has been used to research the cross cultural acceptance of technology, it has not been used to the extent that the TAM has.

Given the focus on LI as an element of initial attitude and intention, the use of a model such as the TAM, will not only allow for that initial perspective, but also for the incorporation of cultural elements in a manner consistent with past research. That being said, as the TAM itself does not include a cultural element, a corresponding model will need to be accounted for.

One such cultural model has been developed by Hofstede, a leading researcher of cross cultural values orientation. His work has been sighted in the majority of IT related cross cultural studies. He defines culture as the "software of the mind," as it is something that is "programmed." It is something that is learned and experienced from childhood on and becomes more ingrained as time passes. Between 1967 and 1979, Hofstede surveyed IBM employees in over 70 countries to find out how values in the workplace are influenced by culture. The findings of his study should not be interpreted as saying that every individual holds the same values dear, but rather a culture in general tends to identify with certain values over others. His study allows people working and communicating across cultures to have an understanding of how the unwritten and unspoken rules of engagement change when working with a new culture. He was able to statistically categorize these value orientations into dimensions of national culture. These dimensions are Power Distance (PDI), Individualism versus Collectivism (IDV), Masculinity versus Femininity (MAS), and Uncertainty Avoidance (UAI). Table 1 looks at what these dimensions are as well as general implications of how those dimensions correlate with technology acceptance according to a comprehensive literature of IT research conducted by Gaspay et al (2008).

Table 1. Dimensions of Hofstede's Cultural Values Orientation and implication for technology acceptance

Dimension	Explanation
Power Distance (PDI)	A culture's preference for hierarchy vs. equality. The lower the power distance, the more equality is valued.
Individualism versus Collectivism (IDV)	The cultural preference either toward the individual or the group. In other words, is the individual responsible for him or herself or is the extended network responsible for the group
Masculinity versus Femininity (MAS)	A culture's prefers competition and achievement vs. collaboration and compassion
Uncertainty Avoidance (UAI)	A culture's comfort level with uncertainty and ambiguity

With regards to how these dimensions affect the acceptance of technology, a comprehensive 2008 IT literature review was conducted by Gaspay et al. (2008). For all for dimensions a relationship was shown between a culture's values orientation and that cultures inclination toward technology acceptance. High PDI was shown to inhibit adoption, diffusion, and innovation of new technology while cultures tending toward Collectivism in the IDV dimension were more inclined to adopt technologies that facilitate group and interpersonal relationship building. It was also shown that both MAS and UAI negatively correlate with technology acceptance.

In 1991, based on research by Bond and supported by Hofstede, the dimension of Long-Term Orientation (LTO) was added. Long Term Orientation looks at how much a culture is interested in indulgence today as opposed to investing for a time in the future. In 2010 two more dimensions were added. As a result of research by Minkov, a fifth dimension of Pragmatic versus Normative (PRA) was added. This dimension, however, corresponds at least in part with the already existing LTO dimension. The 6th dimension was a result of Minkov's analysis of the World Values Survey data and was title Indulgence versus Restraint (IND). Indulgence versus Restraint (IND) looks at the preference of society toward gratification vs. strict social regulations (The Hofstede Centre 2014). No research was found tying the latter two dimensions to IT usage.

Table 2 looks at past research which incorporated Hofstede's model with technology acceptance. After a literature review, focusing on how m-learning research analyzed cultural dimensions in combination with technology acceptance, was conducted and few sources were found, the scope of the research was extended to also include studies of technology acceptance outside the realm of e-learning and m-learning.

Table 2. Comparison of Models used to determine Technology Acceptance

Paper	IS Model	Cultures	Hofstede Dimensions
Im et al. 2011	UTAUT	Korea v. US	PDI, IDV, UAI, MAS
Straub et al. 1997	TAM: PU & PEOU	Switzerland, Japan, and the USA	PDI, IDV, UAI, MAS
Zhao, Tan 2010	TAM: PU, PEOU, IM (Intrinsic Motivation), BI	China & Canada	PDI, IDV, UAI, MAS
Terzis et al. 2013	Computer Based Assessment Acceptance Model (CBAAM)	Greece & Mexico	PDI, IDV, UAI, MAS
AL-Jaafreh 2011	TAM: PU & Cultural Dimensions yield BI	Jordan v. Western	PDI, IDV, UAI, MAS
McCoy et al. 2007	TAM: PU PEOU, BI		PDI, IDV, UAI, MAS

These studies show that the TAM has proven to be not only a viable model but also the most commonly used model when incorporating the Hofstede dimensions to research technology acceptance across cultures. In each of the studies, the technology acceptance results were compared on a country by country basis with the expectations set forth by the cultural dimensions. In each case, the results positively correlated with expectation indicating that culture does have an impact on technology acceptance. As Li (2010) showed, it can even impact how and why we access information when looking for answers in the workplace. M-learning offers the ability to personalize training to a person's style, needs, and schedule but we need to make sure that we understand the cultural implications that lead the learner to initiate the learning process.

3. RESEARCH OBJECTIVE

The proposed research will study the need to consider LI as a part of m-learning technology acceptance across cultures. Tuckman (2007) discussed the disadvantages of distant web based learning which includes the reliance on learner initiative. Mobile Learning is being designed to be flexible and personal, when, how, and where the learner needs to learn. This necessitates however that the learner is able to assess a need and feels sufficiently in control of his or her own learning to initiate m-learning. Given the impact LI is believed to have on m-learning, this research proposes first looking at the correlation of the cultural dimensions with LI and then as a construct with the TAM to test for acceptance of m-learning. As in previous research, the construct will be calculated on a country by country basis then compared with the expectations set forth by the cultural dimensions. In order to remain consistent with this previous research the study will only calculate for the first four Hofstede cultural dimensions. The first step in the two step approach will be to look at the impact of the four dimensions on Learner Initiative (LI).

H1 - Power Distance (PDI) will have an impact on LI

H2 - Uncertainty Avoidance (UAI) will have an impact on LI

H3 - Individualism versus Collectivism (IDV) will have an impact on LI

H4 - Masculinity v. Femininity (MAS) will have an impact on LI

The second step will be to look at LI with respect to the TAM. As seen below in Figure 2, the hypothesis is that LI will impact PU and it will impact A.

H5 - LI will impact PU and A of mobile

H6 - LI will impact PU and A of mobile

Hypotheses H7 – H10 will remain consistent with the TAM in that PEOU will continue to impact PU and A which will impact BI.

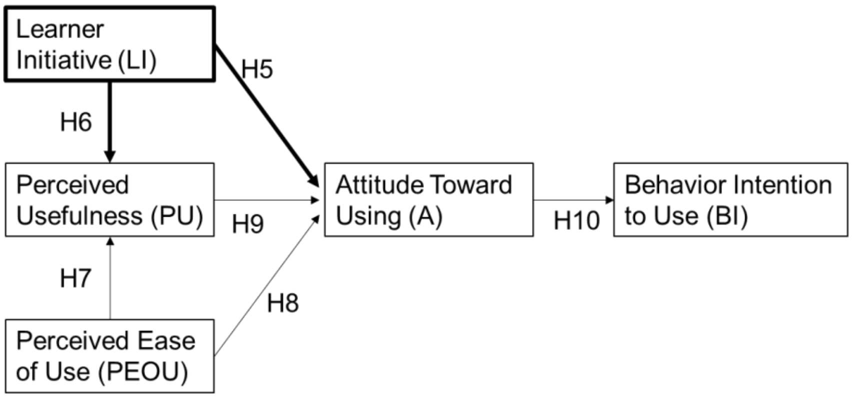

Figure 2. Technology Acceptance Model including Learner Initiative

To conduct the study, a prototype will need to be designed and created in order to make sure questionnaire participants have the same concept of what aspects of m-learning the questions refer to. A web based questionnaire will be devised of questions related to the hypothesis. The participant base will represent different cultures along the spectrum of Hofstede's cultural dimensions. Prior to the questionnaire, participants will be exposed to the prototype and then answer questions about m-learning applications. As indicated above, LI will first be considered with regards to the Hofstede dimensions followed by tabulations for fit with the Technology Acceptance Model. Partial Least Squares Structural Equation Modeling (PLS-SEM) will be used as the statistical modeling technique.

4. CONCLUSION

Learner Initiative is a needed construct in assessing technology acceptance of m-learning across cultures. This research will focus primarily on the relationships using Hofstede's cultural dimensions to investigate the effects of culture on Learner Initiative followed by the impact of Learner Initiative as a construct of the Technology Acceptance Model. The usage of an m-learning prototype will give questionnaire respondents a base line concept of the m-learning applications being questioned. Although this research is still in the very early stages, it is expected that future research can investigate how contextual elements inherent in mobile devices can address differences in LI through processes and application functionality so that learners in different cultures can achieve the desired learning outcome.

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