Editorial

Sabine Graf and Charalampos Karagiannidis, Co-Editors

Welcome to the Bulletin of the IEEE Technical Committee on Learning Technology, Volume 16, Number 2/3, July/October 2014 issue. This issue includes five articles on diverse topics on learning technologies.

The first two papers are on the topic of sensor-based learning support and technologies. The first paper, written by Marcus Specht, introduces the area of sensor-based learning support and technologies, discusses examples and structures of typical learning technologies using sensor-based learning and point out key challenges and open research questions. In the second article, Schneider, Börner, van Rosmalen and Specht present a system, Presentation Trainer, that uses sensors to analyse body language and voice for providing immediate feedback to learners to improve their presentation skills. A user test has been performed with 6 participants, showing that the Presentation Trainer is robust enough for comprehensive evaluation studies and that participants were enthusiastic about the tool.

The third paper, written by Eom, investigates learners' satisfaction with learning management systems. In particular, learner satisfaction was analysed in context of information quality, self-regulated learning, self-efficiency and readiness for online learning. A study with 633 participants was conducted. As a results, authors found that only information quality and readiness for online learning impact learner satisfaction.

In the fourth paper, Ebner and Schön present their research on open educational resources. The authors introduce the Open Textbook project "L3T" where an open access textbook on Technology Enhanced Learning was written with about 200 people contributing to the textbook. In order to facilitate this process, Open Journal Systems was used and a plugin for Open Journal Systems was created to support access of the textbook through mobile devices. The paper discusses the process of creating such textbook as open educational resource as well as the technical challenges faced in this project.

In the fifth paper, Molnar investigates the use of mobile devices for learning. A survey study has been performed with 83 participants, aiming at better understanding the use of mobile phones for educational purposes. In particular, four aspects have been investigated: (1) the use of Internet via mobile phones, (2) the ability of functionality to use different media type, (3) the preferred media types used, and (4) the use of mobile phones for learning. Interesting results were found from this survey. For example, it was found that 30% of the participants already use their mobile phones for learning.

We sincerely hope that the issue will help in keeping you abreast of the current research and developments in Learning Technology. We also would like to take the opportunity to invite you to contribute your own work in this Bulletin, if you are involved in research and/or implementation of any aspect of advanced learning technology. For more details, please refer to the author guidelines at http://www.ieeetclt.org/content/authors-guidelines .

Special theme of the next issue:
eLearning and Linked Open Data

Guest editors:
Salvador Sanchez-Alonso and Enayat Rajabi
Information Engineering research unit
University of Alcalá, Spain

Deadline for submission of articles:
December 15, 2014

Articles that are not in the area of the special theme are most welcome as well and will be published in the regular article section.

Sensor Technology for Learning Support

Marcus Specht, *Member, IEEE*

***Abstract*— One major technology revolution of the last 2-3 years is the broad integration of sensor technology into every day environments and end user products. This article explores the potential and possibilities of sensor technology for learning support. The author gives several examples and structures the potential implications according to different typical applications of learning technology.**

***Index Terms*—Immediate Feedback, sensor-based learning support, non-verbal communication**

I. Introduction

Tracking information about learners and their learning progress is at the core of computer based educational systems. Especially adaptive educational systems used learner tracking for personalization of interaction or assessment of learner skills. Learner modeling based on either student provided problem solutions or tracking of learning activities has been one main topic in the domain of Intelligent Tutoring Systems. Adaptive feedback, navigation support, and tutoring of computer-based systems was in most cases based on the assessment of performance of learners inferred from tracking information on tasks or usage information [1], [2]. In the field of learner modeling a variety of information was used to analyze the learners progress ranging from the learner's interaction history, analysis and data mining of footprints, to highly sophisticated assessment processes integrating a variety of methods [3]. In the field of competence assessment multi-method approaches have shown to be more accurate, these can include multiple-choice assessment, face-to-face assessment, as also social assessment procedures as 360º feedback. In general the more data is available about learner activities the more accurate adaptive systems can adapt to learners and support personalized learning. With the growth of ubiquitous computing facilities adaptive interactive system more and more took into account user tracking in physical space [4], [5] in modeling the user characteristics as also the relevant information in the learners environment. This has led to a variety of applications in the field of context-aware computing [6]–[9] ranging from new forms of intelligent objects to new user interfaces as also educational applications in cultural domains. In the field of mobile learning mostly location tracking technology was used to filter information to the location and context specific need of learners [10], [11].

In the last years sensor technology has become a cheap and efficient method to collect data and give direct feedback to system users [12] and more and more sensor components are integrated into every day environments and the collected data can easily be aggregated and used for system adaptation. While the idea of using sensors in body area networks has been used already quite some time in physical education and advanced sports training, life logging and sensor tracking applications nowadays are used in a wide range of applications fields as health, nutrition, life-style, fitness, sleep, or productivity. The quantified-self[1] movement has brought awareness to the multiple use of sensors in everyday activities for creating personal awareness and possibilities for reflection for behavior change. The following article structures the potential of sensor technology according to the application for learning support on three levels, i.e. direct feedback, support for reflection, strategic coaching and long term analysis.

II. Sensor technology for learning support

The range of sensors being available for learning support in the last years has increased and broadened steadily. As the most popular example GPS location tracking technology has been used already in the late 90's for supporting field trips and location based city hunts [11], [13]. In the field of context-aware computing this has been extended to a variety of other sensors including sound, light, accelerometer, gyroscope, and others. Examples for creating context-aware artifacts and learning support can be seen in [9], [14]. Another line of developments of sensor-based information systems focused on the detailed tracking of human activities based on movement data. Beside the direct usage of accelerometer data also the algorithms for analyzing and segmenting the data streams have become more in the focus of research projects. In some cases already the detailed analysis of a single sensor as the water usage in a household allows for inferences on individual users in a household and their daily patterns and preferred devices [12]. Based on single sensor types or the combination of different low level sensors higher level sensor technologies for the detection of different movement patterns, the classification of activities, posture detection [15] and other have been developed [16].

A variety of sensor components has been used for different purposes and educational applications. Examples for recognizing and making use of different gestures are given in

The underlying research project is partly funded by the METALOGUE project. METALOGUE is a Seventh Framework Programme collaborative project funded by the European Commission, grant agreement number: 611073 (http://www.metalogue.eu).

[1] http://quantifiedself.com/

[17]. The educational potential of tangible user interfaces is analysed in [18]. Seen from the perspective of educational applications the level of granularity with which sensors can analyze the learner's environment and the relation to the educational objectives is often relevant. Therefore we would like to classify the sensor components here according to the level of granularity of the environment or physical context they can be used to identify. In general the following sensors are currently used in educational contexts:

- Object identification sensors: basically all types of technologies to identify objects as infrared, RFID, barcodes, QRcodes and visual tags can be used in educational applications to identify the learners focus of attention in an easy way. Learners just need to scan a tag and this automatically either gives filtered information for the identified object or enables special services associated [19].
- Location sensors: All kinds of location tracking sensors enable the identification of the learners physical environment, location in relation to relevant other Points of Interest or relevant learning activities. The technologies used for location detection are broad and range from GPS based solutions to triangulation approaches.
- Audio sensors can either be used to identify and recognize the users audio environment. Basically all kinds of analysis are possible based on audio sensors directly connected to the learner's environment via the users smartphone or audio installations.
- Visual sensors are most prominently used in video analysis either for face recognition or analysis but also for activity recognition and movement analysis.
- Accelerometers either directly integrated in wearable computing devices as snarphones or in Smartphones. This allows for movement analysis, activity or agility analysis.
- Magnetometer enable measurement of orientation, magnetic field, shaking, as also absolute orientation these are highly relevant in mobile augmented reality applications for linking augmentations to the user's visual field [20].

Based on the combination of these low level sensors high level "sensors" can be defined that enable the definition of complex adaption logics to the learner. For example [21] describes diverse new interaction scenarios for using wearable systems with sensor and indicator components to train experts, novices and even develop virtual models based on expert movements in different sports.

To be able to abstract from the specific technologies and to identify higher level characteristics of a user movement or the current environment the AICHE framework has been developed [22]. Basically the framework defines a basic sensor layer, which collects and aggregates sensor data that is used on a higher level in an instructional logic. In that sense also the position/location of a user has to be determined with a GPS sensor, an electronic compass, and probably even with an indoor location tracking solution to be able to continuously track the position of the user in relation to the relevant objects of instruction. An analysis of making use of sensors to detect different aspects of the users context and use them in mobile augmented reality applications for learning is given in [23].

III. How to Make Use of Sensor Data for Learning

Sensor data can be used for different purposes considering the learner support.

- Data Collection in inquiry-based learning approaches: collecting evidence for evaluating hypotheses is at the core of inquiry-based learning models. In most cases evidence is collected in a collaborative way and the collected data is also annotated with meta-data as in [13] or just used for collaborative reflection [24]. Different applications use distributed crowd-sensing approaches for noise measuring with mobile phone audio sensors [25] or measuring of specific pollution [26].
- Context-aware adaptation of information selection: In this case sensor data is used to filter information selection or the user interaction with a software system. Classical applications are location-based information systems, or object-based information systems in a museum or on field trips [27][28].
- Real-time feedback and reflection in action support: In this case the information from sensors is directly used for feedback to learners. Most popular applications come from the domain of sports [29]–[33], rehabilitation [15] and health training [34], [35].
- Assessment, analytics, and reflection about action support: Cheap and efficient collection and aggregation of sensor data makes it possible to do more long term assessment [36] or a comparison of different activities and analysis post-hoc [37].
- Notification for triggering user action. Users can either be notified of relevant changes in their current learning context or cues can be given for stimulating self-reflection or experience sampling [38], [39].
- Awareness support: Several applications use ambient and ubiquitous sensor technologies in combination with situated displays to foster user awareness and reflection in action [40], [41].

In general terms sensor-data can be used for different educational functions ranging from evidence collection, to monitoring, assessment, or filtering functions, it supports reflection and notification of environmental changes relevant for the learning objectives.

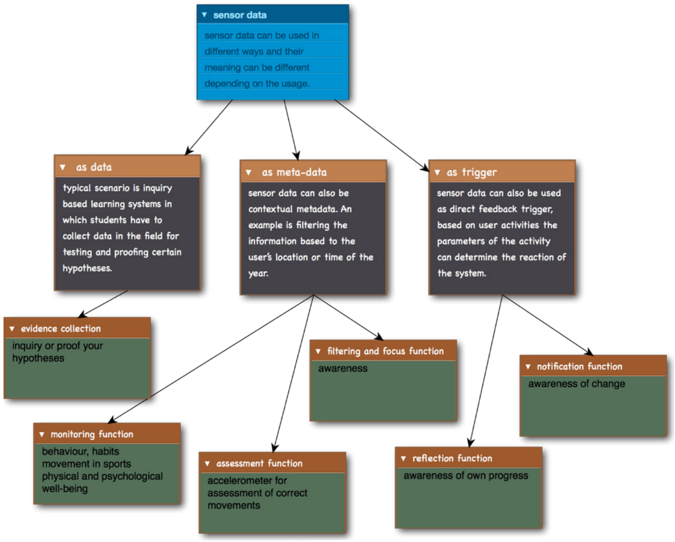

Figure 1: Functions of sensor data in educational settings

IV. Key Challenges and Research Questions

The research on designing efficient and effective personalized as also collaborative technology-enhanced learning is confronted with new challenges based on the rapid development of sensor technology. On the one hand this enables the integration of learning support in every day environment and takes learning into the actual learning and performance environments. On the other hand this allows for an analysis of learner behavior sometimes not even possible by a human coach either based on the high granularity of analysis as in wearable computing devices or connected to the cheap long-term data collection as also the integration of multiple data-sources in distributed sensor systems.

Already some forms of new user-interfaces and physical learning objects have been developed linked to natural learning environments and interactions of learners. While most of the current developments are linked to physical activities and the monitoring of body movements in sport or health, the development of algorithms for audio and video sensor data analysis already now enable much more fine-grained analysis of human gestures, facial or tonal expressions. Examples already now support the analysis of emotions [42] in human computer dialogue. Tangible objects and Internet of Things making use of sensor technology enable the implicit tracking of user activities and recording for analysis and reflection.

Real-time data applications can extend current learning support into different directions. One key question is how the integration of feedback and learning support in real-world environments can be implemented in a way to be efficient and distracting. Embedding and integrating ambient and personal displays into learning and performance support systems while not reducing the user performance or avoiding attention split. Without doubt the analysis and integration of multiple sensor components and the trend towards wearable and implanted sensor technology definitely will show an unforeseen level of information about single users as also their environment for supporting personalized learning.

The integration of distributed sensor systems and their relevance for learning support is another key question in which the distributed support of learning activities as also the analysis of learning activities based on multiple sources of data and crowd-sensing applications is another relevant research area.

The authors hope to demonstrate the remarkable potential sensor technology can give to instructional designers and technology experts to develop systems that can embed learning support in real world interactions and develop technology enhanced learning solutions that are effective, efficient, enjoyful, relevant, personal, and engaging.

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Presentation Trainer: a Study on Immediate Feedback for Developing Non-Verbal Public Speaking Skills

Jan Schneider, Dirk Börner, Peter van Rosmalen and Marcus Specht, *Member, IEEE*

Abstract— **The increasing accessibility of sensors has made it possible to create instructional tools able to present immediate feedback to the learners. To study how this type of instruction is able to support learning, we developed the Presentation Trainer, a tool whose purpose is to train the non-verbal communication skills for public presentations. In this paper we present our findings about studying immediate feedback based on a first round of user tests with the Presentation Trainer.**

***Index Terms*—Immediate Feedback, sensor-based learning support, non-verbal communication**

I. Introduction

FEEDBACK is one of the most influential learning tools, thus learners' achievements either positive and negative vastly depend on it [1]. The means to present feedback vary greatly and several dimensions of feedback have been identified. One of these dimensions refers to the timing of feedback, which can be delayed or immediate [2]. Most of the studies conducted comparing both types of feedback, concluded that for most learning situations the impact of immediate feedback is more positive, since delayed impact tends to delay the acquisition of needed information [2]. A challenge for immediate feedback relies on the implementation of it, as it requires personal tutors to be constantly evaluating the learner. However, the currently increasing accessibility to sensors [3] has lead to a vast research of tutoring systems able to proportionate this type of feedback.

In this paper we present the first evaluation done of the *Presentation Trainer*, a prototype whose objective is to train the non-verbal communication skills for public presentations. This prototype gives feedback about the posture, body movements, voice volume, and voice cadence of the public speaking trainee. The purpose of the paper is to present our findings conducting a first round of user tests on the Presentation Trainer.

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II. Background

The technique of using sensors to track the learner's current state or behavior in order to provide them with immediate feedback has already been used since the late 1970s. In 1978 sensor-learning support was used to treat Idiopathic Bladder Instability. The changes of bladder pressure were translated into auditory and visual stimuli, making patience aware of them [4]. In those early stages biofeedback has also been used for different things such as teaching people how to relax [5] and how to reduce migraine [6]. An early finding about these type of tutor systems, is that feedback should be consistent, it should either always be presented or not presented at all, partial feedback just increases the confusion in learners [7].

Lately, the pursue of studying new automatic tracking recognition techniques using sensors, has lead to an exploration of different learning fields, which can be supported by immediate feedback tutoring applications. The field of learning sports is one that has received vast amount of support by these applications. Research for immediate feedback application has already been conducted in sports such as cross-country running [8], Karate [9], rowing [10], snowboarding [11] and Taekwondo [12]. In these cases the immediate feedback is presented letting learners know about their current performance. Besides sports, immediate feedback sensor-systems have also been studied for physical rehabilitation [13], treatment of Parkinson disease [14], and treatment of attention deficit disorder [15].

Since presentation skills are fairly important in education and in order to acquire those skills students need sufficient practice and feedback [16], for our study on sensor-support for immediate feedback, we developed the *Presentation Trainer*. A prototype able to analyze aspects of the learner's body language such as amount of movement and posture, and aspects of its voice such as volume and cadence.

III. Presentation Trainer Prototype

A. Software Architecture

The software framework used to develop the *Presentation Trainer* prototype has a layered architecture, composed of 3 layers: the *Sensor Layer*, *Output Layer* and *Integration Layer*. The purpose of the *Sensor Layer* is to use sensors to track the learner while training for a presentation. This layer is constituted of a set of objects all of them derived from the

SensorObject class. Each of these objects is bound to a specific sensor, and is responsible for the analysis of the sensor data according to predefined public speaking rules. The *Output Layer* is responsible to exhibit the immediate feedback about the learner's current performance. It consists of a set of objects derived from the *FeedbackObject* class, which are bound to their corresponding set of *SensorObjects*. The output of these *FeedbackObjects* can be toggled on and off at run time, allowing the study of different feedback representations. The *integration layer* contains the main class of the application. It instantiates the different *SensorObjects* and *FeedbackObjects,* and bounds them together. It is also responsible for logging the state of all the instantiated objects allowing for a post analysis of the learner's presentation. This software architecture allows the exploration of different sensors and feedback representation forms, making it suitable for our study.

B. *Body Tracking*

In order to track the learner's body, the *Presentation Trainer* has used the Microsoft Kinect sensor [16] in conjunction with the OpenNI SDK [17]. This fusion has allowed us to create a skeleton representation of the learner's body, which has been used for the analysis of its posture and movements. For the analysis of the body posture, we predefined some postures that should be avoided while giving a public presentation. These postures are: arms crossed, legs crossed, hands below the hips, hands behind the body and hunchback position. The skeleton representation of the learner's body is compared against those postures and when a match is presented, the posture mistake is fired.

To calculate the movement, the *Presentation Trainer* compares the current position of the different limbs of the skeleton representation against their previous position in order to find the distance between them and hence the movement of the learner. When the amount of movement after some predefined time falls outside the thresholds, a movement mistake is fired.

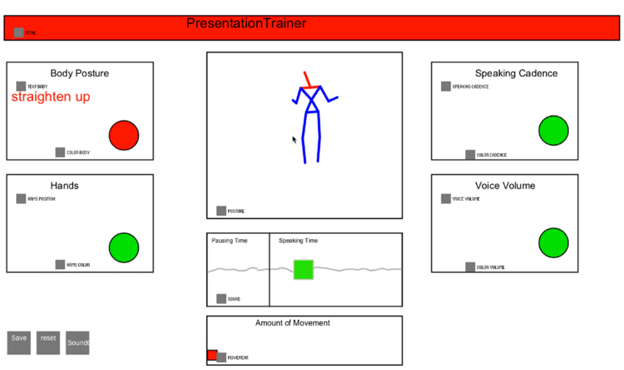

Figure 1: The Presentation Trainer interface indicating the learner to straighten up. Shown up left in the Body Posture module and up center shown in the Skeleton Feedback module.

C. *Voice tracking*

To analyze the voice the *Presentation Trainer* has used the integrated microphone of the computer together with the Minim audio library [18]. For this analysis we have predefined different thresholds regarding the volume value received by the microphone. Values below the low threshold are considered as silence. Once silence is detected the pausing timer starts its tick. Whenever the pausing timer reaches certain time the long pause mistake is fired. The other volume thresholds defined are the low volume and high volume threshold. In case these volume levels are reached, their corresponding timers start ticking. Once these timers pass certain amount of time the *speaking too loud*, or *speaking too low* mistakes are fired. The voice modulation mistake is fired when the volume difference captured by the microphone stays below a predefined threshold for a predefined time.

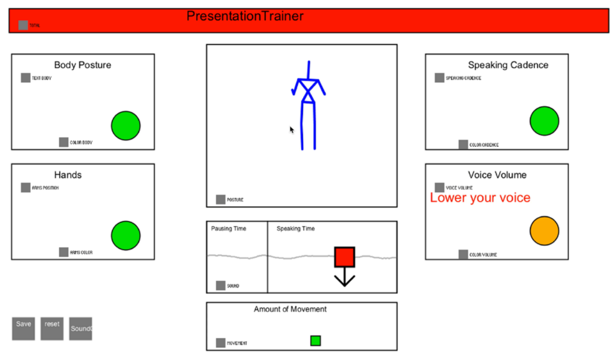

Figure 2: The Presentation Trainer interface indicating the learner to Lower its voice volume. Shown middle center in the Voice Feedback module and bottom right on the Voice Volume Module.

D. *Output Interface*

The output interface that has been used for the first user tests of the *Presentation Trainer* contains 8 different feedback modules. The modules of Body Posture and Hands, are located in the left side of the interface; the modules of Speaking Cadence and Voice Volume, are located in the right side of the interface. Each of these modules presents two different types of feedback representation. A written text instruction on how to correct the learner's mistakes; and a circle, whose color fades from green to red indicating whether the learner is performing correctly or not.

The center of the interface displays 3 feedback modules: *Skeleton Feedback, Voice Feedback, and Movement Feedback*. The feedback given these modules, continuously reflects the learner's actions, and highlights the learner's mistakes. The *Skeleton Feedback* shows the skeleton representation of the user and highlights the limbs situated in a wrong posture. The *Voice Feedback* shows a square, which moves to the right while speaking and to the left while pausing, showing the student's how they are approaching to the long pause or long speaking time. It shows an arrow pointing up indicating to raise the voice volume, an arrow pointing down indicating to lower the voice volume and both of the arrows indicating to module the voice tone. Furthermore, the square fades its color from green to red according to the mistakes performed by the trainee. The *Movement Feedback* module shows a square that moves to the right when the learner is moving and to the left when is standing still. As the square approaches to the edges of the module its color fades from green to red, indicating the user to move more or to stand still.

The last feedback module is located in the title bar of the interface, which fades its color from green to red indicating whether mistakes are being performed or not.

IV. User Tests Set-Up

A. Preparation

Before doing the user test, we introduced the prototype to all of the participants during a presentation, where we explained the tool and its purposes. At the end of the presentation we let the audience give their feedback and impressions about the tool. After the questions and comments session, we asked for volunteers for the user tests.

B. User Test

The test consisted on giving a short presentation while using the Presentation Trainer as an immediate feedback tool. The people inside of the room during the test were the participant and the examiners. The test started by showing the participants a comic story containing 6 pictures and asking them to give a short presentation about it while using the Presentation Trainer as an instructor.

In front of the participant there were two computer screens one displaying the Presentation Trainer and the other displaying the comic slides of the presentation. Shown as a sketch in figure 3.

After the presentation, participants were asked to fill in a System Usability Score (SUS) test followed by an interview. During the interview we showed the user interface of the *Presentation Trainer* to the participants and asked them questions to find out which components of the interface were the most used, helpful and interesting. We also asked questions on their general opinion about the *Presentation Trainer* and what they would like to get from it in the future.

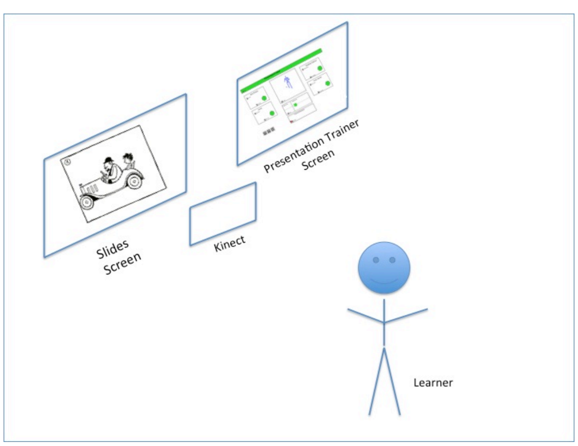

Figure 3: User Test Set-Up.

V. Results

In total we had 6 participants, for the user tests. The background of the participants was either in learning or computer sciences. The average scores for the SUS questionnaire were: 67.5 for SUS, 65.1 for usability, and 77.1 for learnability.

All participants concluded that the most observed element of the interface during the presentation was the *Skeleton Feedback* module and the second most observed was the *Voice Feedback* module. The colored circles were observed but participants did not know how to change their behavior based on them. "I wanted to turn it back to green but I did not know how" was a remark letting us know about this issue. The users have not observed the displayed texts with instructions. Some participants have suggested using icons instead of text to give the instructions.

Participants remarked the overload of information when giving a presentation and being aware of all the feedback at the same time. Therefore it was suggested to use a learning strategy focusing on giving feedback only about one aspect of the trained skills at the time.

Most participants show skepticism about the immediate feedback during the public demonstration of the *Presentation Trainer*. Thus, suggested to use the tracking capabilities of the *Presentation Trainer* to show the learners' performance and mistakes after the presentation, with the purpose of supporting their learning more effectively and allowing them to reflect about their performance. Nevertheless, after using the tool they all stated their enthusiasm towards the immediate feedback. One of the participants gave us the following commentary stating this point during the interview: "It is funny, I was one of the persons suggesting to focus on giving feedback after the presentation and now I would like to be able see that skeleton while presenting."

VI. Discussion And Future Work

Participants in the user tests show great enthusiasm towards the *Presentation Trainer*. The remarks about the immediate feedback received were positive and participants liked the idea of using a similar tool to train for their presentations. However, observations executed during the user tests showed that the purpose of the *Presentation Trainer* has only been partially accomplished. Participants did not always adapt their behavior, even when the *Presentation Trainer* was suggesting on doing so. Two variables have been identified for this partial adaptation and learning impact; therefore requiring a special attention for further studies on the effectiveness of the *Presentation Trainer's* immediate feedback. The first variable is the cognitive load. Not being prepared for giving a presentation, regardless of its simplicity proved to be a fairly complex task, consuming most of the participants' attention; hence a small percentage of their focus was paid on the *Presentation Trainer*. In order to deal with this problem it is important to determine whether this is an experimental set-up or an immediate feedback issue. For that we plan to do some new user tests, asking participants to prepare for the presentation before using the *Presentation Trainer* for the first time. In case the cognitive load continues to be fairly demanding to focus on the feedback given by the system, strategies to shift the learner's attention towards the *Presentation Trainer* will be explored.

The second variable identified having an influence on the *Presentation Trainer's* immediate feedback effectiveness and therefore requiring further studies, is the feedback representation. By examining the different feedback representations used during the tests, we identified that the ones continuously reflecting the actions of the participants', were the easiest ones to be understood and followed during the presentation. Semaphores captivated the users' attention but its information was not enough to let them know how to adapt their behavior. Finally participants did not perceive the instructional text. Before arriving to conclusions, we first need to make sure, whether these results have been obtained because of the feedback representation and not because of the experimental set-up. Therefore in the next user tests a big screen is going to be used, ensuring that participants are able to easily read the instructional feedback texts.

In the short-term future work we pretend to continue conducting small trials changing the experimental set-up, with the intention to identify the right setting allowing us to later investigate the learning support provided by the *Presentation Trainer.* For these following trials we plan to experiment with different set-ups such as: having participants prepare their own presentation before doing the test. Changing the size of the displayed feedback. Allowing participants to explore the tool before doing the presentation. Lastly we want to study a set-up where first participants will do a presentation having their performance logged and without feedback. Then they will be asked to explore the tool. Furthermore on the last step participants will repeat the presentation, this time receiving feedback.

Summarizing, this study has shown that the *Presentation Trainer* is robust enough to be used in experiments. The user tests revealed that before continuing with our empirical studies on the educational impact of the *Presentation Trainer*, in order to obtain conclusive results, we first need to explore the experimental set-up. Finally the enthusiasm shown from the participants towards the tool ratified us the relevance of our study.

Acknowledgment

We will like to give a special acknowledgment to all of the participants who willingly took part on the user tests, their valuable insights and feedback made this study possible.

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Understanding e-Learners' Satisfaction with Learning Management Systems

Sean B. Eom

Abstract—**Our university has recently transitioned from a home-grown learning management system (LMS), online instructor suite (OIS), to an open-source LMS, Moodle. Reactions of students to the new LMS range from "extremely dislike" to "extremely like." This study tested a model for determining e-learner satisfaction with LMS using WarpPLS. Of the four antecedent constructs hypothesized to affect user satisfaction with LMS, only two (information quality and readiness for online learning) are significant, while both learners' psychological variables (self-efficacy) and psychological learning process (self-regulated learning management) failed to show significant and positive relationships with e-learner satisfaction with LMS.**

Index Terms— ***Learning management systems, satisfaction, self-efficacy, self-regulated learning, readiness for online learning, warpPLS***

I. Introduction

Our university has recently transitioned from a home grown learning management system (LMS), online instructor suite (OIS), to an open-source LMS, Moodle. Reactions of students to this transition range from "extremely dislike" to "extremely like" as shown below.

"I like the new Moodle system even though it was difficult at the beginning."

"This course was one of the fall courses that switched to the Moodle interface and it was so much better than the old LMS."

"I like the websites like they are now with Moodle so much better."

"Moodle was very difficult to use in this class. I think this had a strong impact on not only my grade, but also my feelings towards online classes in general."

"Get rid of Moodle!"

"Moodle is absolutely terrible and does not help students learn."

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A possible theoretical model that can be applied to explain these differing perceptions on-line students on the identical LMS is the DeLone and McLean (DM) model, which is one of the widely recognized information system (IS) success models. The DM model has explanatory power and therefore it has merit for explaining IS success [1] and perceived system quality and information quality are significant predictors of user satisfaction. The crucial component of the DM model is the "use" construct. A large number of empirical studies in mandatory, quasi-voluntary contexts failed to provide the link between "use" and "satisfaction". A series of research tested the DM model in an university e-learning context [3]. It was found that three constructs (system quality, information quality, and system use) may not be sufficient enough to fully explain the success of e-learning systems. The DM model, despite its huge success in many different settings, may have a very limited explanatory power to understand learner satisfaction with LMS and LMS's effectiveness [3]. This paper investigates determinants of e-learner satisfaction with LMS to better understand and explain why some e-learners view the new LMS was so much better than the old LMS, while others think it was absolutely terrible.

II. User Satisfaction

This research used the definition of user satisfaction by Ives et al. [4] and Larker and Lessig [5]. The former defined it as "the extent to which users believe the information system available to them meets their information requirements." The latter defined it as "perceived usefulness" of many features of information systems.

LMS help e-learners (a) access instructional information in the form of assignment pages, hyperlinked supplementary documents and multi-media files, (b) actively interact with the instructor and fellow students, (c) complete assignments and upload them to the dropbox, (d) take exams and quizzes. Any LMS provide a wide range of features in support of students' activities (a) through (d) such as communication/collaboration, contents, and assessment. Communication/ collaboration features include mobile messaging, blogs, wikis, chat, discussion forums, calendars, etc. Content features of an LMS include file types supported and file uploading capabilities, and ease of integrating media. Finally, Assessment features include quizzes, surveys, discussions, and assignment dropbox.

Satisfaction from students' activity (a) may be directly linked to information quality (IQ), while the remaining activities (b) through (d) are more influenced by students' perception of usefulness" of communication/collaboration, contents, and assessment features of an LMS.

III. Research Model and hypotheses

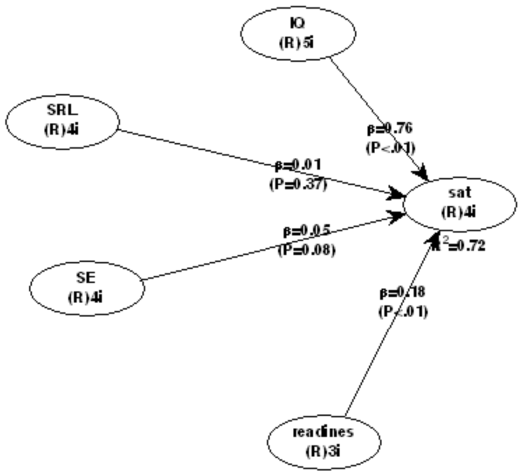

Fig. 1 Research model and results

The model in Figure 1 represents the relationships among five constructs. The four independent constructs are information quality (IQ), self-regulated learning (SRL), self-efficacy (SE), and readiness for online learning (Readiness). The dependent construct is the satisfaction with LMS (sat). Due to space limitation, figure 1 contains both the research model and results.

A. *Information quality*

Information quality is the measure of distinctive characteristics of the quality of information produced by LMS. Information quality consists of a range of attributes including accuracy, timeliness, reliability, relevance, format, perceived usefulness, and understandability [6, 7].

We hypothesize the following.

H_1: Information quality will be positively related to e-learner satisfaction with LMS.

B. *Self-regulated learning*

Self-regulation refers to self-managing behavior, motivation, and cognition [8]. Self-regulation in distance learning may be more important than in traditional face-to-face learning because of the changing role of students from passive learners to active learners [9, 10]. Education psychologists found that the essential qualities that discriminate a self-regulated learner from others are the individual's conscious choice of cognitive learning strategy, and continuous monitoring and self-assessment of learning effectiveness and progress toward the learning outcome [11, 12]. Self-regulated learners possess three self-regulatory attributes (self-efficacy, self-awareness, and resourcefulness), which drive learners' self-regulatory processes (attributions, goal setting, and self-monitoring). Self-regulatory attributes, especially self-efficacy, are positively related to task persistence, effective study activities, and learning outcomes [12]. A self-regulated learner is an active and persistent seeker of information.

A self-regulated learner, as an active seeker of information, presumably interacts with the instructor and fellow students more than other students via ccommunication and collaboration features of LMS. Therefore, we hypothesize the following:

H_2: Self-regulated learning will be positively related to e-learner satisfaction with LMS.

C. *Self-efficacy*

Self-efficacy is an individual's belief in his or her ability to accomplish a certain task and to produce designated levels of performance with the skills he or she has [13]. Self-efficacy beliefs determine how people motivate themselves and behave [14]. Computer self-efficacy was positively linked to e-learning outcomes measured by average test scores in e-learning [15], perceived content value, course satisfaction, and course performance [16], individuals' intentions to continue using LMS [17], and e-learner satisfaction [18]. Therefore, we hypothesize the following.

H_3: Computer self-efficacy will be positively related to e-learner satisfaction with LMS.

D. *Readiness for Online Learning*

One of the different natures of on-line and face-to-face learning environments is using the Internet and many other information and telecommunication technologies with no direct contact with the instructor and students. Consequently, a determinant of e-learners' satisfaction with LMS is the internet and technology readiness. Online Learner Self-Assessment was developed to provide potential e-learners with a comprehensive analysis of their readiness for success in an online learning environment prior to enrolling in e-learning courses [19, 20]. Readiness constructs of Parnell and Carraher [20] include information and internet technology skills, course flexibility, Quality. Therefore, we hypothesize the following:

H_4: Readiness for online learning will be positively related to e-learner satisfaction with LMS.

IV. Survey Instrument and sample

The survey questionnaire is selected from a multi-dimensional model for assessing e-learning systems success (ELSS) from the perspective of the e-learner developed by Wang, Wang, and Shee [21]. The ELSS model conceptualized the construct of e-learning systems success and provided empirical validation of the construct and its underlying dimensionality. The survey instrument consisted of 35 items using a seven point Likert scale ranging from "strongly disagree" to "strongly agree." In this study, all constructs are reflective constructs. The population was undergraduate and graduate students that were enrolled in an online course at a large university located in the Midwest United States. Invitations to reply to the survey were sent to 2,156 unique students. Of those students invited, 809 students volunteered responses with 633 surveys being complete and usable for a response rate of 29.35%.

V. Measurement Model Estimation and Validation

The research model (figure 1) is tested using WarpPLS, which is the structural equation modeling (SEM)-based Partial Least Squares (PLS) methodology. The test of the measurement model includes an estimation of the internal consistency and the convergent, discriminant, and factorial validity of the instrument items, as suggested by Straub et al. [22]. Construct validity is assessed through establishing both convergent and discriminant validities. Convergent validity refers to the extent to which a set of indicator variables load together and they load highly (loading >0.50) on their associated factors. Individual reflective measures are considered to be reliable if they correlate more than 0.7 with the construct they intend to measure. Most of the loadings were above 0.8 for the five constructs, higher than the threshold value .7. When indicator variables do not cross-load on two or more constructs, each construct is said to be demonstrating discriminant validity. Indicator variables in each construct do not cross-load on two or more constructs. All constructs in the estimated model fulfilled the condition of discriminant validity.

All reliability measures were above the recommended level of 0.70., thus indicating adequate internal consistency [27, 28]. The average variance extracted scores (AVE) were also above the minimum threshold of 0.5 [24, 25] and ranged from 0.743 to 0.920. When AVE is greater than .50, the variance shared with a construct and its measures is greater than error. This level was achieved for all of the model constructs.

VI. STRUCTURAL MODEL RESULTS

A. *Information quality*

This study found a strong positive relationship between information quality and user-satisfaction with e-LMS. Our findings strongly support the previous works of Rai, et al [1], Livari [2], and freeze, et al. [29]. These three studies found strong positive relationships between information quality and user-satisfaction in a voluntary or mandatory use context. This research solidifies their findings that information quality is a significant predictor of the satisfaction of e-learners with LMS, regardless of the nature of systems use.

B. *Readiness for online learning*

A key element of e-learning success factors is the active role of students who are ready to engage in e-learning activities. A significant positive relationship was found between students' satisfaction with e-LMS and readiness for e-learning. This result confirms that the determinants of e-learning success [30] differ from those of conventional classroom.

C. *Self-efficacy*

This study failed to confirm that students with a high level of computer self-efficacy were positively related to e-learner satisfaction with LMS.

D. *Self-regulated learning*

No statistically significant evidence is found to suggest that the psychological learning process (e.g., self-regulated learning management) had effects on e-learners' satisfaction with LMS.

VII. CONCLUSION

This study tested a model for determining e-learner satisfaction with LMS. As can be seen from the results (figure 1), Of the four antecedent constructs hypothesized to affect user satisfaction with LMS, only two (information quality and readiness for online learning) are significant, while both learners' psychological variables (self-efficacy) and psychological learning process (self-regulated learning management) failed to show significant and positive relationships with e-learner satisfaction with e-LMS.

Our study showed that e-learner satisfaction with LMS largely depends on the information quality of LMS. Students' satisfaction will increase if LMS provide information which is relevant to learning, easy to understand, and up-to-date. The quality of information is largely determined by the instructor who designs the course structure and delivers the course contents. Another key Determinants of e-Learners' Satisfaction with LMS students readiness for e-learning measured by basic skills of using computers, the Internet, e-mails, etc.

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Open Education Systems – the challenge of up-dating when republishing is allowed

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Sandra Schön, *Salzburg Research, Austria*

***Abstract*—Open Access and Open Educational Resources are important issues for the future of education even or especially in Higher Education. This contribution introduces a project on a textbook done collaboratively by more than 200 participants. From a technical background the Open Journal Systems is used to assist and manage the whole scientific publishing process. Furthermore a plugin for the system has been developed to open the access to the content to any other third party application like mobile applications. In spite of a fully Open Education System numerous chapters appeared on different platforms because of the nature of openness and the possibility of republishing. This research study aims to address the problem of unnecessary multiplication of learning objects. The report concluded that much more awareness is needed towards sustainability and reliability.**

***Index Terms*— Internet, Open Education, Information System, Web technologies**

I. Introduction

OPEN education is defined by Meisnzer [1] as *free and open access to, the usage of and the right to modify and re-use digital open educational resources and digital educational tools, and the free and open access to the related virtual educational communities, in order to learn, teach, exchange or advance knowledge in a collaborative and interactive way.* Therefore Open Educational Resources (OER) are a just a part of the whole movement, but maybe the most important one [2]. The UNESCO by means of their "Free Educational Resources" initiative firstly described OER in 2002 as the *wish to develop together a universal educational resource available for the whole of humanity* [3]. Subsequently the Massachusetts Institute of Technology (MIT) started the "MIT Open Course Ware" and offered a number of courses, videos or other learning content for free [4]. Two further publications, a questionnaire about OER of the OECD in 2007 as well as a first draft about the OER-movement by the William and Flora Hewlett Foundation [5], helped to gather further attention. Further follow up projects like the OpenLearn project of the Open University UK [6], the Wikieducator [7] or the German ZUM-Wiki help to increase the number of OER.

The big advantage of OER that there is no restriction in exchange, modification and republishing is also its most worst disadvantage. Bearing this in mind the number of similar objects will increase, doubled, tripled and so on. In this publication we would like to address exactly the problem of unnecessary multiplication of learning objects, how it might be avoided or it might be solved in future. We present our thoughts along a research project done in the German speaking area.

II. The Open Textbook Project "L3T"

L3T is a German acronym for "textbook on learning and teaching assisted by technology" [8]. The project was started in 2010 by the authors with a video call for chapters[1] for an open access textbook on Technology Enhanced Learning. The call found interest by more than 130 people – professors in the field, researchers, and educators. Within ten months 48 chapters were written and reviewed in a highly collaborative way and the book was online available since February 2011[2] with the assistance of about 200 different people [9]. From a technical point of view the world's most used open source platform for journal management and publishing the Open Journal Systems (OJS) was used. Legally, the project used the creative commons license "CC BY NC ND" for every single chapter, so it was easy to use, copy and implement them on a single chapter base.

The project got well recognized in the German speaking area and the free available chapters got downloaded more than 100.000 times in the first year. Several small follow-up projects deal with the possibility of different usage of the content. For example iPhone or Android apps were developed or a special print on demand solution. The main website was completely redone[3] and chapters also got published on other platforms like Slideshare.com.

In 2013 the book was rewritten during a further research

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[1] http://youtu.be/SM3HJ_Y3rLc?list=PLDE65680727BA9014 (last access July 2014)
[2] http://l3t.tugraz.at (last access July 2014)
[3] http://l3t.eu (last access July 2014)

project [10]. The authors initiated a so called book sprint and proposed that they would like to write the new version of the book in just seven days collaboratively and online. Therefore eight camps were organized with the idea to synchronize different kind of people during the whole week and to support online workers in an appropriate way. Afterwards different roles were defined from authors of chapters to designers as well as editors. With the help of numerous online available tools the whole process was operated, monitored and realized online. In summary, more than 250 people worked simultaneously on the project within seven hard days. The final result was a lecture book fully available online with 60 chapters on the issue of technology enhanced learning. Additionally the whole content is now licensed with the creative commons license “CC BY SA” and each single picture, too. This makes it now an fully “open educational resource” in the sense of current definitions, as it now allowed to copy, modify, re-publish the texts or single pictures under the same license (“share alike” component).

III. The Open Journal Systems

In the very first beginning of the project it was decided to use the open source software Open Journal Systems (OJS) as publishing tool [11]. The software has been developed since 1998 following the idea to be able to manage, to publish, and finally to index online journals. OJS is for sure a milestone for the open access movement. Today more than 24.000 known installations are in use[4] and the map-visualization[5] displays a dramatically increase all over the world.

Due to the fact that the whole process of doing a scientific journal is highly complex the system assists the major steps – submission of a proposal, review of the proposal, decision of acceptance, compilation of the issue and finally the publication.

The software is written in the object-oriented language PHP using Smarty template framework for the user interface abstraction. The backend supports the free SQL database management system. OJS offers a huge variety of features due to its extendable architecture and the possibility of additional plugins. Consequently, different plugins has been programmed for example to integrate social media, to print the journal via a Print on Demand Service [12] or to recommend articles to the readers [13].

IV. Open up the OJS with an API

Our research interest was not only to provide the textbook as Open Educational Resource but also to offer each chapter in as many as possible different ways. So from a technical point of view it should not matter which devices are used or which browser or software.

The OJS itself just allow publishing different file formats. Therefore till the second version of the book each chapter is available as PDF format, HMTL format or even EPUB format

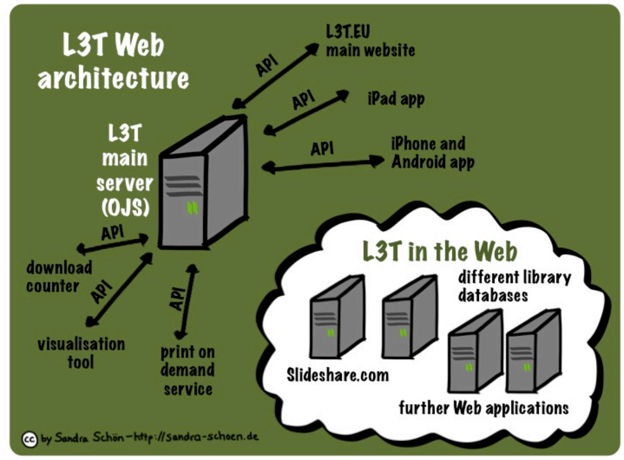

Fig. 1. The architecture of the textbook L3T in the World Wide Web

for e-readers. For that purpose a special edition was developed to export different file formats from just one source.

To allow mobile access a further plugin has been programmed. This plugin provides an API (Application Programming Interface) allowing other applications to download the chapters directly or even to get more detailed information (such as title, authors, number of downloads). This follows the main idea to allow third party applications to use the original documents without duplicating them on the World Wide Web. Fig. 1 points out the architecture of the textbook. All chapters (files) are physically on the L3T web server within the OJS and are used from different applications:

- L3T main website: The official main website of the book is completely separated from the OJS due to mainly design reasons.
- Three mobile applications for the iPhone, for the iPad as well as for numerous Android devices are available in the corresponding Stores. Each of them is downloading the chapters via the API [14].
- There are a further special site[6], which acts as download counter and displays in real time how often different chapters got downloaded.
- A visualization tool[7] points out how often each chapter got downloaded with the help of a bar chart and from where readers are coming from using additionally the Google map API.
- With the help of a developed Print on Demand Plugin chapters can freely chosen and sent to a print service [12].

At this point it can be stated that the OJS combined with the API- plugin greatly opened up the system to allow third party application dealing with the content.

V. External Copies and Modifications

After running the system for some time interesting aspects popped up. Despite our idea to deal with central stored files,

[4] https://pkp.sfu.ca/ojs/ojs-usage/ (last acess July 2014)
[5] https://pkp.sfu.ca/ojs/ojs-usage/ojs-map/ (last access July 2014)
[6] http://l3t.tugraz.at/analytics/ (last access July 2014)
[7] http://l3t.eu/visualization/ (last access July 2014)

which may be used via an API for several services, we were more or less forced to use external copies as well.

- In the very first time authors and experts wanted to embed articles in their personal websites, blogs or e-portfolios. Therefore all chapters have been uploaded to slideshare.com (see Fig. 1). We did this with a special L3T account and for every single chapter. The aim was to be at least able to up-date these files and to be able to monitor the usage.
- Additionally, we asked the German archive service within our domain, the "FIS bildung" database, to archive our chapters from issue 2 (2013). Technically, as archive service, they deal with copies that cannot be updated by us.
- Furthermore, the Austria Wiki, the Austrian open-access platform for Austria-related content with diverse content, asked to integrate the L3T chapter within their system. Again, their system allows smart scrolling through the pages, but is not able to deal with our API.

Additionally, open educational resources respectively liberally creative commons licensed content means that others cannot only download the content, but also modify and upload it to different websites:

- Several libraries of universities archives L3T chapters. Of course, not all of them also archived the newer issue by now or brings the archived issues together.
- Additionally, several contributors, but also other users, upload chapters on their website, in their learning management systems, as part of the online literature of a seminar and so on.
- Certainly, there are materials (for example slides, videos, podcasts, single Weblog postings, course materials) where L3T material is (modified and) re-published.
- Last, but not least, the copies of L3T make it obligatory, that our main server still is at the top rank of search machines. If big and important (other) university servers have a higher page rank, this would additionally limit the visibility and usage of the central and current chapters.

Legally, this is a wished and welcomed usage. Nevertheless, practice shows the challenges of this practice.

- Citations of the L3T projects shows, that a lot of current citations use the first issue (2011) and not the current one (2013). This might not only a problem for a lack of literature research literacy, but also a consequence of several L3T copies from 2011 in the Web.
- Even worse, there are already citations existing, that do not link the central L3T system or URL, but to a copy.
- Following these observations, we are sure that a lot of people use and deal with L3T articles from the first issue and do not get aware of the newer version or current version.

Last, but not least, finally we wanted to provide our authors the compensation of the German copyright collector VG Wort. We thought that it might be able that they use our API to get directly the correct number of downloads. But the collecting society treated us to provide a website with a hidden pixel to count the numbers. We refused it due to the fact that each chapter is not available through only one webpage (especially if we think about the two versions) and therefore the number of downloads are to low to get considered.

VI. Discussion

In our particular case the OJS turns into an Open Education System due to the fact that the content itself is intended for lecturing as well as learning. The advantages of this technical solution are:

- The content is stored once and no further resources are wasted.
- The content can be updated easily – it will be automatically appear in the third party application.
- From a user perspective it means that he/she get for sure the latest version.

Nevertheless, L3T chapters and figures are licensed and developed as fully open educational resources. They are meant to get copied, modified, re-used. As we pointed out, the goal to centralize the data and make it accessible from just one point, which make sense concerning currency and quality issues, is not possible due to many practical reasons.

VII. Conclusion

Our practical example points out that Open Education System does not only mean to offer the content for free but also to offer APIs to allow the usage by different third party applications. On the other site openness means also that any user can republish the content him/herself on any other website ignoring aspects of sustainability, reliability and version control. In times of information abundance the idea of Open Education Systems needs awareness of how technology is working in the background otherwise an information dilemma can be predicted.

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On Better Understanding the Usage of Mobile Phones for Learning Purposes

Andreea Molnar

Abstract—**Mobile devices are omnipresent in one's life leaping developed and developing worlds and leading to interest among researchers on how to use them for learning purposes. This article presents the results of a survey that aims to better understand the use of mobile phones for educational purposes. The results show that 54% of the participants use mobile Internet from their phone the most cited reason being the cost. A total of 30% use their mobile phone for learning purposes and 69% have mobile devices that would allow them to watch video content. The results of people's preferences for specific types of educational media are also presented.**

Index Terms—**Mobile Internet, Mobile Learning, Mobile Phones, Media Usage, Technology-Enhanced Learning.**

I. Introduction

Mobile device ownership has increased both in developed and in developing countries, being the fastest growing technology in industry [1]. Increasing ownership and the ability to provide access to educational content "anytime, anywhere" have made them an attractive platform for different services, including education [2]. Previous research has shown mixed findings regarding the usage of mobile devices as a means of facilitating the delivery of learning outcome [3]. Some studies suggest that since a mobile phone is primarily used for entertainment, it is unlikely that people will use them consistently for learning [4], [5]. Faculty resistance to using mobile technology in the classroom is also presented as an impediment [6], [7]. The effectiveness of using mobile devices for educational purposes in terms of learning achievements is still an open question [8]. However, a literature review from 2008-2011 on mobile learning have shown that positive results were reported on improving the learning achievements, student motivation and interest [9].

On the other side, different media types and formats that could be more suitable for mobile learning in an experimental setting have been studied by Macdonald & Chiu [10]. Their results show that video is the preferred multimedia content for mobile devices. As this study has been performed in an experimental setting and there is a lack of research on what media students preferred when using mobile phones for learning purposes in their day to day life. In order to be able to better assess and integrate at a large scale mobile devices in the classroom, an overview of the usage of mobile devices and whether or how they are used for learning purposes in real life rather than in an experimental setting is also important. This study is planning to address this gap by showing the results of a self-disclose usage of mobile devices.

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II. Surveys Exploring the Use of Mobile Phones in Education

Several recent surveys have been performed to assess the state of usage of mobile devices among students [11-14]. Chen & Denoyelles [11] look at the ownership of mobile devices among university students. The results show that the ownership is high and tablets are the most used devices for learning purposes. Johri et al. [12] survey first year engineering students in 2009. The results show that the students use more mobile devices (understood as in previous studies in the broad term, including laptops, tablets etc) than desktop computers. Dahlstrom et al. [13] show that it is common for students to own more than one Internet capable device. The laptop was found to be the most owned device by students followed by the smartphone and desktop computer. The study identifies several barriers that keep the students from using their smartphones as a learning tool, the top five reasons being: low battery life, slow Internet connection, usability issues, cost of Internet connection and limited access to the network. Gidion et al. [14] look into how often students use different devices for studying (including mobile devices) and how satisfied they are with their usage for educational purposes. The study presented below focuses on mobile phones and assesses what media type (i.e. text, image, audio and video) people prefer to use when learning for mobile devices and how people use Internet from mobile phones.

III. Research Study

A. Research Questions

The following questions guided the design of the survey instruction and subsequent data collection:

Research Question 1: Do students use mobile Internet from their mobile phones?

Research Question 2: Do students have a mobile phone that allows them to watch different types of media content?

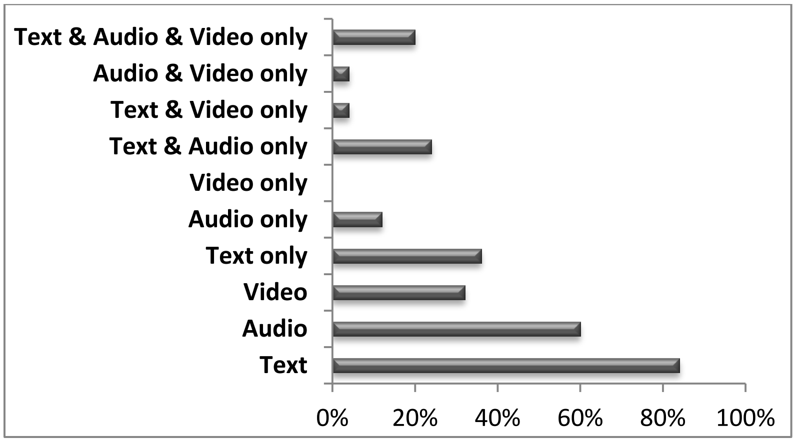

Fig. 1. Preferences towards mobile learning content.

Research Question 3: What kind of media content do students access over the Internet and what is their preferred media content?

Research Question 4: Do students use their own devices for learning?

B. Data collection

A survey was conducted in order to address the research questions. The survey was completed voluntarily and anonymously. The survey was based on a non-probable and convenient sampling. Due to a lack of a sample frame for the population it would have been difficult to reach out a large population using a random approach.

C. Demographics

The survey was administered online and as a result participants from different countries participated in the study. A total of 83 participants fully answered the survey and were considered for the analysis. Their age ranged from 19 to 46, with an average of 26 years old. A total of 41% of the subjects were female and 59% male. Among those 17 were full time students and the rest they were either graduate students or students who were also working. Their job varied (e.g. software developer, pharmacist, sales etc).

D. Findings and Discussions

The results of the survey that were quantitative are presented using descriptive statistics, whereas for the open ended questions a thematic analysis process [15] was used to analyze the responses.

Usage of Internet

The results showed that 54% of the respondents used mobile Internet from their mobile phones. Most cited reason for not using mobile Internet was the cost and lack of transparency in the pricing. Different types of mobile data billing plans have been shown as hard for people to understand especially when they are capped or people pay based on the amount of data they consume [16]. Capped billing plans could either: (a) lead to bandwidth throttling when the data included in the bundle is exceeded or (b) the need to pay more for the data that exceeds the bundle quota [17]. In the first case, the learner, even if s/he uses the mobile data will not be able to access heavy multimedia content (e.g. video) as the bandwidth is limited [18]. In the second case the pricing for the data acquired over the capping could lead to higher than expected bills. It has been shown that in this case, some of the learners preferred to have the video content adapted to a lower quality if this means that they will have more data left in the bundle or they will need to pay less [19]. Moreover this adaptation has been shown to reduce cost [20] and not necessarily affect the learning outcome [21], therefore could be used as a solution for these situations.

Most of the respondents (69%) have devices that would allow them to watch different types of multimedia content including video. However, among those who use the Internet from their mobile devices only 33% use the Internet to watch video online. Participants selected choices are presented in Fig. 1. When the respondents selected only the presented media files they are marked with only in the figure. For *text and audio only* show the percentage of the respondents that selected both text and audio as their preferred option but they did not select *video* or *text + image*. When the respondents selected a certain media type as their option but they may have selected also other options *only* is missing in the figure. For example *video* shows the percentage of the respondents who selected video as one of their option but they may have selected also other media types. Based on these results it may be concluded that if mobile devices are to be used for learning purposes, they should allow for both online and offline content. Moreover, consideration should be taken for the users that do not have mobile devices that support this type of content. Otherwise there is the danger of creating two classes of users, those who can afford the technology and mobile Internet cost and those who do not. Therefore personalized content delivery is necessary. These findings are similar to the current trends that show that among mobile users only 30% own a smartphone [22]. Although some of the feature phones will allow playing video content this type of content is mostly accessible through smartphones.

The participants were asked also to select among text, audio and video content, or they could choose other multimedia types, and they were asked to expand upon their choices. They were allowed to choose multiple options. Most users selected one among several options: text (84%), only 36% preferring video content and none preferring only video content. Text is overall the most preferred multimedia content followed by audio. These results are different from Macdonald & Chiu [10]. However it should be considered that in those studies the participants were in a controlled environment and given devices that support different types of content, including video, while the participants in this survey did not necessarily have access to a device that has video capability. Therefore, the study design might have had an effect over the results.

Usage of Mobile Devices for Learning

Only 30% of the respondents reported using their mobile device for learning purposes. Although data was not collected to why these participants do not use mobile phones for there are various barriers that could have impeded the participants in using them for learning such as the usability issues with mobile devices, not always having Internet connection due to price or network coverage, battery lifetime [13]. As mobile phones are mostly seen as being used in places where the user would not have access to a laptop, tablet desktop or other connection means, intermittent Internet connection and not having the ability to access educational content from them "on the move" could be an impediment. Another reason may be that people usually do not see mobile devices as a learning device but more as a personal device [4].

IV. Concluding Remarks

Despite mobile phones being ubiquitously present in their possessors' lives, there are still open questions on how they can be used for learning purposes. This article added to the understanding of the usage of mobile phones for learning purposes, the barriers to this and preferred media types. The results have shown that 54% of the participants used mobile Internet from their phone and 69% have devices that allow them to access different types of multimedia content including video. This survey has also shown that 30% of the participants use mobile phones for learning purposes. Our findings echo some of the previous studies [13], [22]. For example we found that cost is an issue for using mobile data as Dahlstrom et al. [13] found.

It can be concluded that when designing educational content for learning purposes there is a need to consider that not all the learners have access to the latest mobile phones and not all of them could have access to mobile Internet at any time either due to cost or intermittent connectivity. As a result, the content needs to be adapted not only to the learner profile and the context in which the learner is but also to the device capabilities and user ability to access the content.

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