Tablets with Restricted Mobility: Investigating User Acceptance in a South African Mathematics Mobile Learning Project

Thanél Voigt
Department of Informatics
University of Pretoria
South Africa
voigtthanel@yahoo.com

Machdel Matthee
Department of Informatics
University of Pretoria
South Africa
machdel.matthee@up.ac.za

ABSTRACT

Ericsson initiated a project called 'Connect to Learn' (C2L), where a mobile learning solution focused on introducing creativity and interactivity into the classrooms of South Africa using various mobile technologies and applications, was developed. Ericsson has employed this solution in various schools in and around Johannesburg, South Africa. This research study focuses on investigating the user acceptance (teachers and learners) of utilizing tablets (MobiPads) in the learning of mathematics in classrooms participating in the C2L project. The tablets are not owned by the learners and are not used by learners in an informal environment outside of school boundaries. The tablets therefore have restricted mobility and the study contributes by exploring user acceptance of semi-mobile learning. It is shown that learners value the mobility feature of the devices, even though it is limited. However, what proves to be essential for acceptance of mobile mathematics learning is the content, its relevance to real-life situations, providing capability to explore and the mapping of the content to the curriculum.

Keywords

mobile learning, Android mobile tablets, MobiPad, user acceptance, mathematics education, mathematics mobile learning, restricted mobility.

INTRODUCTION

We are living in a new era of technology enabled personal mobility, which inevitably affects our education systems and offer the opportunities to design teaching and learning differently. Outside of schools, information and communication technologies (ICT) such as mobile devices are changing the way students find information, how they learn and even how they are entertained. This resulted in a new era of learning and teaching being realized that moves away from the static classroom structure of "chalk and talk, as well as desk and texts" (Roschelle, Pea, Hoadley, Gordin & Means, 2000, p.76) and moves towards dynamic learner-centric environments that facilitate more personalized, contextualised and collaborative learning (Liu, Han & Li, 2010).

In Africa, when comparing the amount of users of fixed lines with users of mobile phones, Lange (2010) reports that in early 2010 mobile users constituted more than 90% of all African telephone subscribers. This fact together with the apparent ease with which South Africans adopt mobile technology suggests a wide range of possibilities for development in South Africa using mobile technology, including mobile learning.

Education in South Africa faces many challenges of which inadequately trained teachers is but one (Matthee and Liebenberg. 2007, p.156). This results in poor performance in science and maths, those subjects on which a budding economy depends. In the 2003 TIMSS (Trends in International Maths and Science Study) tests South Africa had come last, even behind African countries such as Ghana and other developing nations whose expenditure on education is far less than that of South Africa (Mail and Guardian, 2010). South Africa pulled out from the 2007 TIMSS test.

Given these challenges, the government as well as private companies are trying to address the problems facing education, and specifically mathematics and science education, in South Africa. The case reported in this paper is part of such an initiative where Ericsson together with other partners started a mobile learning project, the so called Connect to Learn project. The next section gives more detail on the project.

CONNECT TO LEARN PROJECT

In September 2010 Ericsson launched the Connect to Learn (C2L) project with the goal to "implement ICT to connect classrooms and improve access to quality educational resources for learners and teachers around the world, even those in the most remote villages" (http://www.connecttolearn.org/). Ericsson has employed this solution in various schools in and around Johannesburg, South Africa of which the school discussed here forms a part.

IT School Innovation is a partner of Ericsson and the C2L project. IT School Innovation, an ICT education company (http://itschools.co.za), is the creator of the MOBI® project and develops products that are integrated, accredited and curriculum based. IT Schools Innovation has designed the educational applications that are found on the MobiPads such as MobiMaths. The MobiPad was introduced in 2010 by the MOBI® project. The MobiPad is a tablet mobile device with a 7 inch touch screen. It comes with a pouch with a full QWERTY keyboard (see figure 10) and runs on a Google Android platform. The MobiPad contains, among other, pre-installed MobiMaths software, which is the core feature of the MobiPad (http://www.phusionmedia.com/MobiPad/). MobiMaths is based on the South African mathematics curriculum of Grade 4 to 12 and allows the user to complete theory examples, exercises and assessments relevant to their grade. In addition, the MobiPad is supplemented with more than 3000 tutorial videos that the user can access by the press of a button. The MobiPad also contains pre-installed MobiParent software that parents can use to monitor their children's' progress in completing content on the MobiPad. Other mobile learning technology that was used to supplement the MobiPads were laptops (for teachers), projectors and screens, docking trolleys to charge the MobiPads in and interactive whiteboards. Distance learning technology included a Samsung Scopia VC220 video conferencing system.

RESEARCH OBJECTIVE

Although one of the distinctive characteristics of mobile learning is mobility (learning anywhere/anytime), mobile technologies in this project have restricted mobility. Learners do not own the technology and cannot take it home. More detail will be given on the background in the "method" section. Given the increasing interest of educational institutes to employ mobile learning, it becomes crucial to gain more understanding of the factors that influence students' satisfaction and acceptance of mobile learning (Wang, Wu & Wang, 2009; Hassanein, Head & Wang, 2010), since the acceptance of mobile technologies by itself does not guarantee the acceptance of mobile learning (Liu, Han & Li., 2010). According to Liu, Han and Li (2010), research on user acceptance of mobile learning is still in short supply. From an academic perspective it becomes interesting to investigate user acceptance of mobile learning where mobility is limited. . From a practitioner's perspective it is also important to investigate user acceptance of mobile learning in this project to enable better practice in future.

This research therefore investigates user acceptance of mobile mathematics learning where learning with the devices takes place only in a face-to-face classroom environment, i.e. the mobile device are not used by learners in an informal environment outside of school boundaries; the learners do not have ownership over the mobile learning device; and learning takes place in a developing context, namely South Africa.

RESEARCH APPROACH

This research uses a case study strategy from an interpretivist view. Interpretivism is concerned with "understanding the social context of an information system" (Oates, 2006, p. 292). All processes concerning teaching and learning with tablets occur in social settings and thus research subjects, both teachers and learners, should be studied in their natural classroom settings and not in a laboratory or other measured or controlled environments. The research on which this paper is based, investigated two different case studies: one grade ten mathematics class from a high school and one grade seven class from a primary school. Only the first case study will be discussed in this paper. Interviews were used as the data collection method for this case study. An individual interview was conducted with one mathematics teacher and two group interviews with the learners. Interviews conducted with the teacher and learners were semi-structured, which allowed the interviewees more freedom to '"speak their minds" (Oates, 2006, p. 188). The interviews were aimed at eliciting the participants' thoughts around the use of tablets in mathematics and how the tablet may have contributed to their knowledge and understanding of mathematics.

The questions of the interviews and questionnaire were structured around the elements of the proposed theoretical framework given in the next section. Once the data have been collected as explained above, it was transformed into a standard format. The researchers then identified key themes from it, aligned to the theoretical framework.

Case study

The participating public school is located in Johannesburg, South Africa. They use MobiPad to facilitate mathematics learning in grade ten both during school hours and during extra mathematics classes outside of school hours. Currently, only the grade ten mathematics learners participate in the Ericsson C2L project. The project was introduced to the school by selecting 18 learners to receive formal training. Their training included basic IT training, MobiPad training (thus training on how to operate the tablet device), training on how to use the interactive whiteboard equipment and also training on understanding the content of the device (the applications). Thereafter, it was expected from the trained learners to take the role of the trainer and transfer all the necessary skills that they have learned to their untrained learners.

The Ericsson C2L project also enabled the school to take part in distance learning via live broadcasting to various other high schools. When a Grade 10 mathematics lesson is given by an educator at another high school, the learners at the school view the lesson material on an interactive whiteboard in the their classroom. The learners are then able to answer questions in real-time on the whiteboard and feedback is given to the educator from the other school that is presenting the mathematics lesson.

The school is only utilizing the MobiPads in class for mathematics modules that learners tend to struggle with. The structure of a mathematics lesson where the MobiPads are used is as follows: the teacher presents a short lecture on the maths content in a traditional manner, after which the learners do exercises on the MobiPad and the teacher moves into the role of a facilitator. The MobiPads are handed out in each class and are collected again at the end of the class. It is the responsibility of the teacher to look after the devices, which includes keeping it in storage and charging the devices..

Figure 1: Learner at the school while interacting with the MobiPad

A MOBILE LEARNING ACCEPTANCE THEORETICAL FRAMEWORK

For the purpose of this study, 'acceptance', 'adoption' and 'satisfaction' will be used as synonyms. This is based on the fact that various researchers in the literature used it as such (Liu, Han & Li., 2010; Crescente & Lee, 2011). The objective of the study was to investigate students' and teachers' acceptance of the use of tablets in classrooms as a tool for learning mathematics. The researchers combined the following models to compose a composite theoretical framework that the researchers believe is a better fit to be utilized for evaluating m-learning acceptance in this context: Unitified Theory of Acceptance of Use of Technology (UTAUT) (Venkatesh, Morris, Davis and Daivs, 2003), an extended UTAUT model for learning with tablet PCs (El-Gayar and Moran, 2006), TAM (Davis, Bagozzi & Warshaw, 1989), an extended TAM model for m-learning (Huang, Lin & Chuang, 2007) and a two conceptual m-learning acceptance models suggested by Liu, Han and Li (2010) and Hassanein, Head and Wang (2010). Figure 2 depicts the composite theoretical framework and all the included constructs.

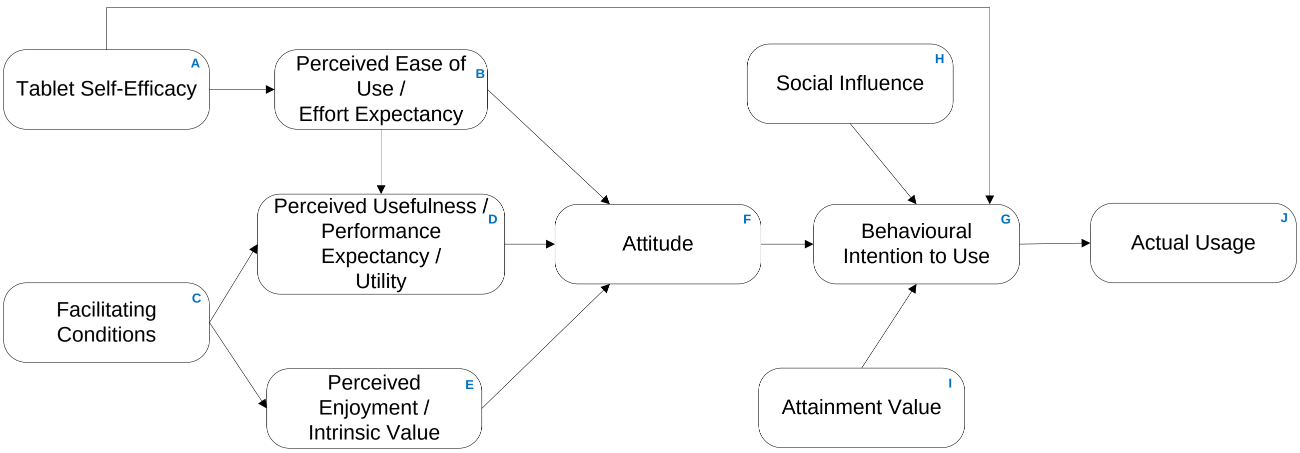

Figure 2: Composite Mobile Learning Theoretical Framework

While studying students' intention to use web-based learning, Chiu and Wang (2008) suggested an extended UTAUT model where self-efficacy was modeled as having a direct effect on effort expectancy and also suggests that self-efficacy affects intention to use the technology. While studying students' acceptance of tablet PC computers, El-Gayar and Moran (2006) and Moran (2006) suggested an extended UTAUT to include self-efficacy as affecting intent to use or behaviour intent. Tablet self-efficacy represents a person's perception of their capabilities to use the tablet to complete necessary m-learning tasks. Effort expectancy is defined as "the degree of ease associated with the use of the system" (Venkatesh *et al.*, 2003, p. 450). Perceived ease of use can be defined as the perception of the user that using the technology will not require a lot of effort (Huang, Lin & Chuang, 2007). Consequently, based on the latter two definitions, it can be said that the *effort expectancy* construct of UTAUT relates to *perceived ease of use* of TAM which refers to the student's perception of how much effort will be required to use the tablet for m-learning. The different relationships between the constructs in Figure 2 will be explained below.

A → B and A → G: if a student believes that they are capable of using the tablet for m-learning, they will perceive it as easier to use and similarly, they will also be more likely to intend to use the tablet.

B →D: In TAM, Davis (1986) modelled perceived ease of use (similar to effort expectancy as previously mentioned) to have a direct influence on perceived usefulness. Perceived usefulness can be described as the degree to which the user believes that the use of the technology will enhance or positively affect their performance (Huang, Lin & Chuang, 2007). Venkatesh et al. (2003, p.447) defines performance expectancy as "the degree to which an individual believes that using the system will help him or her to attain gain in job performance". Utility value refers to how the learner sees m-learning as valuable in contributing to their short term and long term goals (Liu, Han & Li, 2010). Consequently, based on the latter three definitions, it can be said that *perceived usefulness* from TAM is related to *performance expectancy* from UTAUT, and also to *utility* extracted from the conceptual model suggested by Liu, Han and Li (2010). The relationship between perceive ease of use/effort expectancy and perceived usefulness/performance expectancy/utility can be understood with an example where increasing ease of use of a technology would cause an increase in the performance level that is expected, or otherwise stated, if a technology or application is easier to use, meaning it requires less effort to operate, it will be perceived as more useful and a learner might see m-learning as valuable in contributing to their future goals (utility).

C → D and C → E: When constructing a conceptual model using literature from IS and also from education and psychology to evaluate user satisfaction of m-learning, Hassanein, Head and Wang, (2010) showed that *facilitating conditions* (a construct extracted from UTAUT) have an effect on both *perceived usefulness* similar to performance expectancy and utility as stated before) as well as *enjoyment*. According to Liu, Han and Li (2010) *intrinsic value* is associated with enjoyment, as it refers to how much a learner views m-learning as enjoyable by itself. Facilitating conditions can be seen as any resources, support structures and other factors in place to assist students in using the tablets. According to Hassanein, Head and Wang, (2010, p. 291), "facilitating conditions imply circumstances that enhance the pleasure associated with using the information system". In the context of this study, this refers to the circumstances that increase the enjoyment associated with using tablets for learning.

B → F, D → F and E →F: According to TAM developed by Davis (1986), *attitude* towards the technology is directly affected by *perceived ease of use* (similar to *effort expectancy* as previously mentioned) and *perceived usefulness* (similar to performance expectancy and utility as stated before). If a learner does not perceive the tablet as easy to use and/or useful, they are likely to have a negative attitude towards using the tablets for learning. Huang, Lin and Chuang (2007) applied an extended TAM to an environment where their goal was to explain and predict user acceptance of m-learning and found that perceived usefulness and perceived ease of use are critical in determining students' attitudes towards m-learning. As previously mentioned, Hassanein, Head and Wang (2010) included *enjoyment* as a construct to evaluate user satisfaction of m-learning. Huang, Lin and Chuang (2007) also included *perceived enjoyment* and suggested that it affects attitude toward m-learning and described it as a "causal relationship" (Huang, Lin & Chuang, 2007, p. 589). If users perceive using tablets for learning as enjoyable, it positively affects their attitude towards learning with tablets.

F → G: Several models, including TAM and other conceptual models in the literature include *attitude* towards using m-learning as one of the constructs used to evaluate acceptance of m-learning (Davis, 1986; Chiu & Wang, 2008; El-Gayar & Moran, 2006; Moran, 2006; Huang, Lin & Chuang, 2007; Hassanein, Head & Wang, 2010). All of the above mentioned models suggested prove that there is a relationship between attitude and *behavioural intention to use* the relevant technology. El-Gayar and Moran (2006) even found *attitude* to be the strongest predictor of user acceptance of tablet PCs. *Behavioural intention to use* is where the student decides whether or not they want to use the tablet for learning. If a student has a negative attitude towards m-learning or tablets, they are unlikely to intend to engage in m-learning activities on tablets.

I → G: *Attainment value* refers to the "personal importance of doing well on a task" (Chiu & Wang, 2008, p. 195) with regards to personal values, achievement goals, etc. Chiu and Wang (2008) suggest that *behavioural intention to use* the technology is also effected by *attainment value*. If a student values it to do well in learning on a tablet, they are more likely to intend taking part in m-learning activities on tablets. In the context of this study, mathematical content are provided on the tablets, so if a student values it to do well in mathematics, they will probably engage in m-learning mathematics activities on tablets.

H →G: *Social influence* refers to the degree to which students care about how others will view them after they have used the tablet for learning. This construct is included in UTAUT and modeled to have a direct effect on *behavioural intention*. Moran (2006) and El-Gayar and Moran (2006) also included *social influences* in their extended UTAUT model as a construct to evaluate user's acceptance of tablet PC technologies and as having an influence on behavioural intention. If a student perceives that using the tablets for learning might make them, for example, seem smarter to his fellow students, it will likely positively influence their behavioural intention to use the tablet PCs for learning.

G → J: *Actual usage* is included in TAM as actual system usage and in UTAUT as use behaviour. Moran (2006) and El-Gayar and Moran (2006) also included use behaviour in an extended UTAUT model for the purpose of predicting user acceptance of tablet PCs. In all above mentioned models the actual usage of the system is directly affected by *behavioural intention to use*. Thus, if students do not intend to use the tablets as a m-learning tool for practicing mathematics, they will not actually use the tablets.

Due to the fear of damage or loss of the tablet devices, the students were not allowed to take the devices home with them. Thus, the devices were used only in the classroom environment and students did not really get to experience the mobility feature of these tablets. Therefore, the *perceived mobility value* construct from the model suggested by Huang, Lin and Chuang, (2007), was excluded from this theoretical framework.

FINDINGS

In this section the data gathered through the above mentioned interviews are analysed at the hand of the proposed theoretical framework developed by the researchers in the section above. In numerous instances the perspectives of the learners correlated with those of the teacher but in some instances it differed radically.

Tablet Self-Efficacy

Tablet self-efficacy represents the teachers' perception of their capabilities to use the tablet to complete necessary mobile learning tasks. Responses to the concept of self-efficacy differed between learners and teacher. Although the learners had no prior knowledge of tablets, or MobiPads, the majority of the learners had confidence in their technology skills and capabilities to use the tablets or confidence in their capability to easily pick up on any skills that they lack. Furthermore, the learners had complete confidence in their technical skills and knowledge that they learned through formal training to properly transfer the knowledge and skills to their fellow classmates. After being introduced to the MobiPad, and seeing that it is easy to use, those learners that questioned their self-efficacy, felt re-assured that they had the necessary technology skills to use the MobiPad. One learner stated that "we didn't need to learn new technology skills, because it was not hard to use the MobiPad, it was basic steps".

On the other hand, the teacher responded by saying "it was a new technology that I was not familiar with". He felt that he surely needed training to familiarize himself with the new device. However, the teacher was confident that he will be able to quickly learn the required technology skills once he receives training. It is important to note that the interviewed teacher was of a young age, which partly explains his tablet self-efficacy.

The teacher and some learners who did not have high initial tablet self-efficacy before receiving training, stated that after being trained, they had also then acquired confidence in their capabilities to use the MobiPads to learn mathematics. This suggests a relationship between facilitating conditions (training is a facilitating condition as explained before) and tablet self-efficacy.

Perceived Ease of Use / Effort Expectancy

Both learners and teacher found the tablet device as well as the applications on the device easy to use. The teacher explained that "after introducing the devices into the mathematics class, all the learners in the class knew how to use the device after only two days". Some compared the device to a laptop and said it is even easier to use and easier to carry. When learners got stuck on a specific sum or mathematical problem, the device provided them with several help functions that gave further explanation.

When asked to comment on the technical features of the MobiPad, the teacher and learners did not have much criticism. The minority of the learners found the small screen size sometimes limiting when a mathematical sum stretches across two pages, but also added that it happens rarely and is not a big concern. The majority of the learners were not bothered by the screen size and added that "no extensive scrolling is needed to read the exercises". The satisfaction of the learners with the technical features of the MobiPad can be attributed to the fact that the applications and learning content of the device were designed with the relevant mobile device in mind, for instance the size of the screen. Furthermore, the device itself were designed for educational use.

The extra keyboard served as an extra option that the teacher and learners can use to input data but some learners commented by saying that "the touch screen was actually enough because we only had to answer multiple choice questions". As previously mentioned, it is the responsibility of the teacher to charge the battery of the MobiPads and this can pose to be a challenge. The docking trolley proved to be ideal for this purpose. The teacher commented saying "this makes it very easy for me to charge the devices and I also know that it is safe inside the trolley". He also expressed that he thinks the device has a good battery life as it generally lasts a week.

Perceived Usefulness / Performance Expectancy / Utility

Through the data gathered in the interviews, it is apparent that the teacher and learners perceive the use of the MobiPads in mathematics learning as very useful. Both teacher and learners identified opportunities that the tablet offers them that they did not previously have. The learners recognised that the worth of the tablets providing them with extra maths practice and explanation, in addition to those provided by their teacher. They describe the tablet as a "very successful and helpful thing" that extends their usual method of learning maths with a lot more exercises. Occasionally the MobiPads technologies were used in distance learning where they were given a mathematics class by another maths teacher from another school. Although the learners view the MobiPad as valuable in contributing to their knowledge, they have however not yet associated the use of the MobiPad with improved mathematics grades. When asked the question of whether their grades improved due to the use of the MobiPads, the following response was the norm: "No, we did not actually use the MobiPad that much". Although the learners did state that, for those chapters that they did use the MobiPad, they understood the maths better. Nevertheless, when looking at the big picture, they do not yet feel that their grades improved due to the MobiPad.

As identified in the literature, mathematics is generally a 'problem' subject that learners underachieve in, struggle to understand and have little interest in. Several researchers have asked themselves the question of how can mobile learning be useful in teaching and learning mathematics. (Tangney *et al*., 2010; Swan, van 't Hooft & Kratcoski, 2005). Tangney *et al*. (2010) theorizes that three things need to occur to make mathematics education 'closer to the learner': (a) getting rid of the didactic teaching methods; (b) allowing learners to explore various ways of finding solutions to problems; (c) and teaching maths on the context of real life situations and examples. The teacher and learners recognize how useful the tablets are in addressing all three of these factors. While lecturing to learners did not completely disappear from the classroom lessons, as in these case studies the teachers still spend some time at the beginning of the lesson explaining the content of the maths lesson, the majority of the time is spent as a facilitator to learners while they do mathematical exercises and further explanations on the tablets. This way, learners are also exposed to different methods and processes of finding solutions. Also, receiving lessons from external teachers via video conference just further expose them to knowledge and stimulation. One of the most valued aspects of the tablets expressed by the teachers is how it provided for teaching mathematics in a contextualised manner by integrating abstract mathematical concepts with real life examples and situations.

Bringing technology devices into the classrooms can potentially be more of a distraction as the learners can use these devices for other purposes than that it was intended for as the learners have access to the internet through the MobiPad. During the interview, the teacher expressed that he realises this and therefore enforces a lot of discipline and is very strict with the learners on using the device only for mathematics learning purposes.

Facilitating Conditions

Facilitating conditions are those conditions that the user believes to exist in support of using the technology (Venkatesh *et al*., 2003), such as training, technical support, instructor or peer support and any additional resources. The interviewed teacher explained that, before starting to facilitate classes to learners, he received extensive training on how to operate the device, as well as how to deal with various problems and situations that he might come across. The teacher in this study is the only teacher at his school involved in the C2L project, thus he does not have peer support at the school but stated that "there is a lot of people I can phone when I have any problems with regards to the MobiPads that I do not know how to handle" but then again pointed out "but they trained me very well to deal with all sorts of issues, so it happens rarely". This covers the technology support that the literature points out as often overlooked when introducing technology into classrooms.

As previously explained, 18 of the learners who are currently involved in the C2L project have received formal training for a duration of 2 weeks. Thereafter, those learners trained their peers by transferring those skills and knowledge that they acquired at the formal training sessions. A learner pointed out that "we appreciated the training, because we want to be careful with the device and look after it well, so after training we knew exactly what to do with it and how to work with it and therefore could enjoy it more from the moment we started doing maths on the device". When asked to explain what support systems exist in terms of using the MobiPads, the interviewed learners explained that they have complete confidence in their teacher's ability to provide them with technical support as well as help them with any issues relating to the MobiPad and the mathematical content. One learner further mentioned that "we also help each other with any issues relating to MobiPad as a device, since the majority of us also received formal training". This confirms a relationship between facilitating conditions and perceived enjoyment as modelled in the theoretical framework of this study.

Another factor pointed out in the literature that can 'make-or-break' an mobile learning project is the manner in which the mobile devices are integrated into the curricula. This needs to be done in a suitable way so that the learners find it usable and attractive, while still making pedagogical sense. The teacher described in the interview that he works in conjunction with the people who created the Mobi project to design, develop and structure lesson plans to integrate the MobiPads in a suitable way into the mathematics curricula. This confirms a relationship between facilitating conditions and perceived usefulness as proposed in the proposed theoretical framework of this study.

Perceived Enjoyment / Intrinsic Value

As stated in the literature, intrinsic value is associated with enjoyment, as it refers to how much a learner views mobile learning as enjoyable by itself (Liu, Han & Li, 2010). Learners expressed that they thoroughly enjoy learning mathematics with the MobiPad. One learner stated that "the MobiPad makes maths fun and interesting". The teacher confirms this by stating that "I can definitely see that the learners enjoy learning with the MobiPad and that makes it also enjoyable for me to facilitate the classes with the MobiPads".

Attitude

The teacher valued the tablets as an extra tool in supporting them as teachers in terms of providing learners with mathematics practice. One of the aspects of the MobiPad that the teacher valued the most was how the exercises on the MobiPad connected mathematical concepts to real-life situations and thus allowed the learners to see and realize how they can and will use maths in the outside world. He continued by saying that "this naturally created more positive attitudes towards mathematics as a subject." The learners repeatedly expressed how glad they are to be moving away from the boring 'chalk and talk' classroom structure where they have to write down everything from a board that is explained by their teacher and how much they *enjoyed* using the MobiPad instead. Throughout the interview, learners expressed how *easy* the MobiPad is *to use* as one learner stated that "if we don't understand something, there is a button we can press on the MobiPad and then we receive a step-by-step explanation of how to solve the problem". Features like repeat, explain, pause, etc. on the applications on the MobiPad makes the learners feel that they have total control over their maths learning.

Social Influence

Social influence refers to the degree to which learners care about how others will view them after they have used the tablet for learning. Some learners view the use of the MobiPads as some sort of a status symbol when one learner replies that "it does make us feel cooler because we are the only class in the school who is using the MobiPads". However the majority of the learners indicated that their family does not even know about the C2L project and that they do not associate the MobiPad with status. Social influences seem to play a bigger role for the teacher. The teacher explained that since the start of the project, the other teachers have shown more interest in speaking to him. In some instances, their interest displayed jealousy towards him being part of the Ericsson Connect to Learn project, and in other instances their interest displayed respect towards him having knowledge about this new type of technology. Some teachers have even requested the interviewed teacher to train them on using the MobiPad.

DISCUSSION

As explained elsewhere, the researchers decided to exclude the construct *perceived mobility value* from the proposed theoretical framework. The reason for this was the limited mobility of tablets in the context of the case study. *Perceived mobility value* refers to how much value an individual places on the mobility feature of mobile learning (Huang & Lin, 2007). In a sense, the restricted mobility of the MobiPads in the classroom makes it comparable to a computer lab with maths educational software. Do these tablets have any mobility features valued by the users? It emerged from the interviews that learners compared the MobiPads to laptops and spoke about how easy it is to carry – implying mobility within the classroom. That is, learners are not stuck to a PC station but can move between peers with their tablets while learning and collaborating. Also, safekeeping of the devices is easier than that of a computer lab since the devices can be locked in the docking trolley and put away in the school' safe at the end of a school day. It seems that the mobility of the tablets, albeit restricted, still positively influences user acceptance of mobile learning. The teacher pointed out that he would have preferred full mobility of the tablet devices such that learners could take it home with them to further exercise mathematics outside of school boundaries. It is suggested that the full mobility characteristic of the tablet device would have had an even greater effect on the acceptance of learning mathematics with a tablet.

CONCLUSIONS

This paper investigates user acceptance of mobile mathematics learning in a context where the mobile devices has limited mobility and where the learning environment is situated in a developing context. It seems that learners valued the mobility feature of the devices, even though it was limited. The value of mobility in a classroom or group setting as well as the easy safekeeping of the devices was highlighted as factors contributing to acceptance. The teacher pointed out that full mobility would have influenced acceptance even more.

This study was undertaken by a fourth year student in Information Systems with research focus user acceptance of mobile learning. The fact that the content was mathematics was not considered as important. However, what became clear in this study was that the mobile device is a necessary but not sufficient condition for successful acceptance of mobile mathematics learning. Instead, the content, its relevance to real-life situations, providing capability to explore and the mapping of the content to the curriculum prove to be essential. What these results imply is that current acceptance theories (e.g. TAM) do not provide enough explanatory or predictive power for subject specific mobile learning acceptance studies. The model proposed by Liu, Han and Li (2010) should be of more value since it classifies the mobile learning user as technology user, consumer and learner. Under the category learner, the construct *subjective task value* might be of value in explaining the importance of the mathematics content and software in successful acceptance.

REFERENCES

Chen, M.-P. & Yen, J.-C. (2007). An Evalutation of Learners' Satisfaction toward Mobile Learning. *In Proceedings of the 6th WSEAS International Conference on Applied Computer Science*. Hangzhou, China, 15 – 17 April, 382 – 388.

Chiu, C.-M. & Wang, E.T.G. (2008). Understanding web-based learning continuance intention: The role of subjective task value. *Information & Management*, 45(3), 194-201.

Crescente, M.L. & Lee, D. (2011). Critical issues of m-learning: design models, adoption processes and future trends. *Journal of the Chinese Institute of Industrial Engineers*, 28(2), 111-23.

Davis, F.D., Bagozzi, R.P. & Warshaw, P.R. (1989). User Acceptance of Computer Technology: A Comparison of Two Theoretical Models. *Management Science*, 35(8), 982-1003.

El-Gayar, O.F. & Moran, M. (2006). College Students' Acceptance of Tablet PCs: An Application of the UTAUT Model. Dakota State University, 820 N. Washington Avenue, Madison.

Hassanein, K., Head, M. & Wang, F. (2010). Understanding Student Satisfaction in a Mobile Learning Environment: The Role of Internal and External Facilitators. *In Proceedings of Ninth International Conference on Mobile Business*, Athens, 13 – 15 April 2010, 289 – 296. doi = http://doi.ieeecomputersociety.org/10.1109/ICMB-GMR.2010.38

Huang, J.-H., Lin, Y.-R. & Chuang, S.-T. (2007). Elucidating user behavior of mobile learning. *The Electronic Library*, 25(5), 585-98.

Lange, P. (2010). 2010 Africa - Fixed-line Telecommunications and Infrastructure Statistics. Retrieved from http://www.budde.com.au/Research/2010-Africa-Fixed-line-Telecommunications-and-Infrastructure-Statistics-tables-only.htm

Liaw, S.-S., Hatala, M. & Huang, H.-M. (2010). Investigating acceptance toward mobile learning to assist individual knowledge management: Based on activity theory approach. *Computer & Education*, 54, 446-54.

Liu, Y., Han, S. & Li, H. (2010). Understanding the factors driving m-learning adoption: a literature review. *Campus-Wide Information Systems*, 27(4), 210-26.

Matthee, M.C. & Liebenberg, J. (2007). Mathematics on the Move: Supporting Mathematics Learners through Mobile Technology in South Africa. *In proceedings of MLearn2007*, 16- 19 October, Melbourne, Australia, 156 – 161.

Mail and Guardian, (2010). SA ready to take the TIMSS test again. Retrieved from http://mg.co.za/article/2010-08-03-sa-ready-to-take-the-timss-test-again

Moran, M.J. (2006). *College Student's Acceptance of Tablet Personal Computers: a Modification of the Unified Theory of Acceptance and Use of Technology*. Unpublished doctoral dissertation. Capella University. Minneapolis, Minnesota, USA.

Oates, B.J. (2006). *Researching Information Systems and Computing*. First Edition ed. London: SAGE Publications.

Roschelle, J. M., Pea, R. D., Hoadley, C. M., Gordin, D. N., & Means, B. M. (2000). Changing How and What Children Learn in School with Computer-Based Technologies. *The Future of Children*, 10(2), 76-101.

Swan, K., van 't Hooft, M. & Kratcoski, A. (2005). Uses and Effects of Mobile Computing Devices in the K-8 Classrooms. *Journal of Research on Technology in Educations*, 38(1), 99-112.

Tangney, B., Weber, S., O'Hanlon, P., Knowles, D., Munnelly, J., Salkham, A., Watson, R. and Jennings, K. (2010). MobiMaths: An approach to utilising smartphones in teaching mathematics. *In Proceedings of MLearn2010*, 20 – 22 October 2010, Valletta, Malta, 9 – 16.

Ting, Y.-L.R. (2005). Mobile Learning: Current Trend and Future Challenges. *In Proceedings of the 5th IEEE International Conference on Advanced Learning Technologies*, ICALT 2005, 05-08 July 2005, Kaohsiung, Taiwan, 603 – 607.

Venkatesh, V., Morris, M.G., Davis, G.B. & Davis, F.D. (2003). User Acceptance of Information Technology: Towards a Unified View. *MIS Quarterly*, 27(3), 425-78.

Wang, Y.-S., Wu, M.-C. & Wang, H.-Y. (2009). Investigating the determinants and age and gender differences in the acceptance of mobile learning. *British Journal of Educational Technology*, 40(1), 92-118.