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A Model for Using Mobile Phones in Teaching and Learning Mathematics

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ABSTRACT:- The use of mobile learning, or M-learning, has become more and more popular in education; however, it may not be effective in all situations. This paper examines the opportunity of using mobile phones for teaching and learning mathematics, specifically for supporting students' self-study. A pedagogical model was designed to integrate an interactive mobile website in order to investigate mobile phones as a learning tool in the mathematics classrooms. We found that the use of the mobile phones environment encourage students to learn at their own pace and preferences. Furthermore, the research findings indicate that students have positive attitudes towards self-study guide system on the website.

Keywords: *M-learning, mathematics, high school students, Self-study*

I. INTRODUCTION

In recent years, there have been considerable interests in exploiting the potentials of mobile phones for their pedagogical uses because mobile devices are becoming a part of the daily life of almost every student and teacher. Most of students had low access to computers but high access to mobile phones. Moreover, a large number of mobile phones are able to run software applications and access to Internet. Therefore, mobile phones will allow students to learn anytime, anywhere and with any media. Therefore, many educators have attempted to make good use of these devices for improving students' learning experience, creating a new trend in education called mobile learning or M-learning. According to Mcconatha, Praul, and Lynch (2008), M-learning is employed through the use of small computing mobile devices such as smartphones and small handheld devices. Others simply consider M-learning ad an extension of distance learning (Mirski and Abfalter, 2004 as cited in Al-Emran, Elsherif, and Shaalan (2016)) or e-learning (Alzaza & Yaakub, 2011). More broadly, Matias and Wolf (2013) see that M-learning not only includes learning that is based on the use mobile devices but also the learning that is mediated across multiple contexts using portable mobile devices (1.5.9).

There have been a number of examples of successful mobile learning interventions all over the world. Tatar, Roschelle, Vahey and Penuel (2003) examined the use of mobile phones in mathematics learning by organizing several interactive activities such as: (i) distribution: sending the same learning resources to all students; (ii) differentiation: sending different tasks and assignments to each student; (iii) contribution: forwarding an exercise or real- life data investigation done by a student to a classmate; and (iv) harvesting: following the collaborative work of several students. Wei and Chen (2006) designed e-book interface on mobile phones that allowed students to enter queries on the text that were transferred to a discussion forum. Genossar, Botzer and Yerushalmy (2008) found that apart from making the dynamic mathematical applications more accessible, the mobile phone enabled students to engage in authentic tasks. The students were able to construct useful mathematical knowledge in real situations. Kinsella (2009) built a mobile application which allowed students to anonymously post questions to the teacher, who was then able to give summarized feedback to all participating students in real time. More recently, Kearney, Schuck, Burden and Aubusson (2012) espoused a pedagogical framework of mobile learning informed by a sociocultural perspective, comprising three features: personalization, authenticity and collaboration (5,9,12).

Mobile phones are available and are part of the daily culture of almost every student. However, students have limited access to mobile phones and Internet because schools and teachers do not encourage their students using mobile phone during the class. For that reason, the aim of this research was to gain an understanding of the way mobile learning approaches can enhance mathematics teaching and learning as well as how mobile phones support students' self-study at home.

II. METHODOLOGY

Firstly, we conducted a large-scale survey in eight public high schools in Thai Nguyen province. Five schools were located in urban areas and three other schools were located in rural and mountainous areas. The survey was conducted to analyze the initial ideas of the potentials of using mobile phones in the context of school mathematics education and how students use these devices to support their learning.

Secondly, we designed an interactive mobile website for teaching and learning K- 12 mathematics. This website integrated a sequences of modules in each e-lesson. These e-lessons were constructed based on the national curriculum as well as school knowledge and skill standards. They can be accessed from mobile phones at the website: www.mlearningvn.com.

Every e-lesson on the website for K-12 students contained three modules, including
(1) Theoretical review: the content of this *module presented basic knowledge and a series of typical examples (See Figure 1);*
(2) Instructional exercises: this module included the exercises that were designed based on differentiated system. The solution of an exercise was divided into "dose". In order to complete one "dose" and move on the next "dose", students must correctly replied all of the questions. During solving the problem in each "dose", students were given some suggestions or hints if they met difficulty in finding the answer. In this case, students spent much more time and even took different steps to reach a detailed solution;
(3) drilling exercises: this module was designed for knowledge reinforcing as well as differentiated purposes (See Figure 2). These exercises only contained the final answer excluding a detailed solution. The levels of difficulty of each exercise were change based on the students' response of the preceding exercises.

Figure 1. Theoretical Review Module

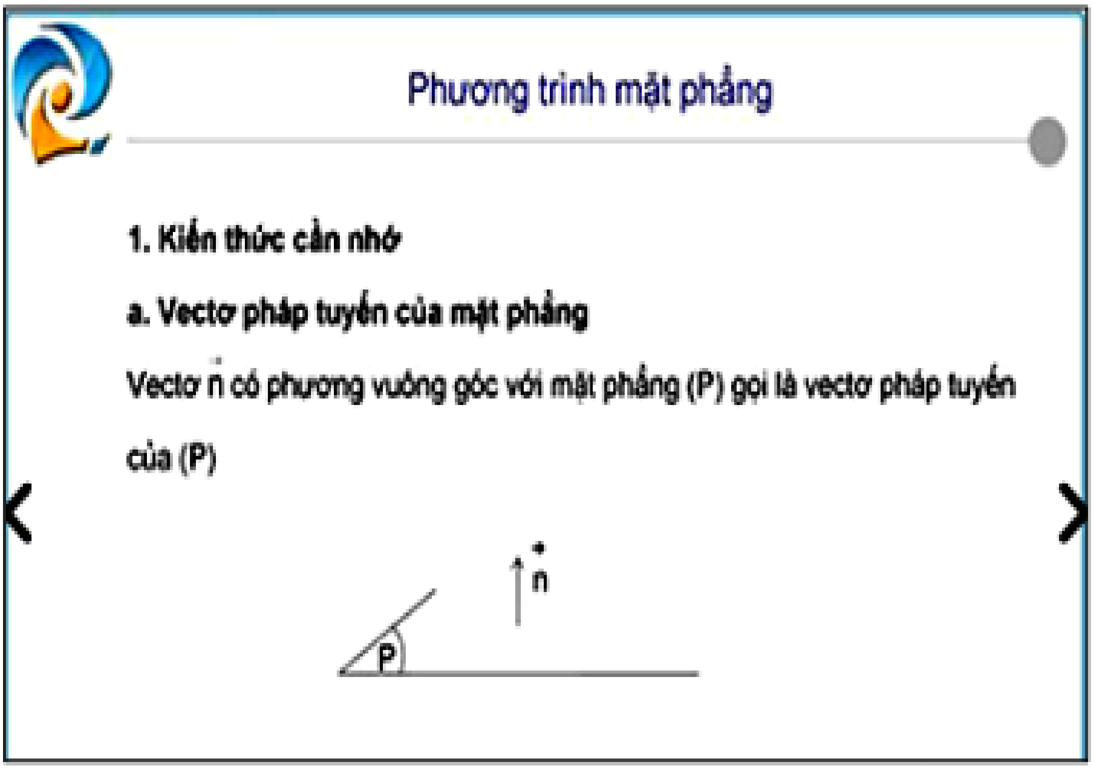

Figure 2. Drilling Exercises Module

Thirdly, we conducted a pilot study with 474 students in two high schools in Thai Nguyen City. They were allowed to access Internet using mobile phones and exploit provided resources on the website throughout their school day. Moreover, teachers encouraged them to self-study at home by doing individual homework and assignments. Finally, we conducted a small- scale survey to examine the attitudes of students towards this model and to explore how mobile phones support their mathematics learning.

III. RESULTS

Results from the first survey indicated that mobile phones were highly popular in Thai Nguyen province. Although we expected a higher usage of mobile phones than access to computers, the actual numbers were still surprising: 86.47 % of students have their own mobile phone (see Table 1 below). This is accordance with the nationwide trend of mobile application development. More importantly, about 71.71 % of students posed mobile phones that could access to Internet and other mobile applications. In other words, a considerable percentage of students had access to modern mobile phones that included multimedia and networking features, such as integrated audio player, integrated camera, Internet access and interactive learning applications.

Table 1. K-12 Students' Possession of Mobile Phones

Name of High School	Numbers of Students	Numbers of Mobile phones	Percentage (%)	Mobile phones with Internet Accessibility	Percentage (%)
Dong Hy	142	116	81.69	95	66.90
Khanh Hoa	133	107	80.45	97	72.93
Thai Nguyen	250	236	94.40	198	79.20
Luong Ngoc Quyen	150	138	92.00	121	80.67
Chuyen	292	290	99.32	276	94.52
Chu Van An	150	124	82.67	114	76.00
Phu Binh	136	102	75.00	64	47.06
Dinh Hoa	129	82	63.57	26	20.16
Total	1382	1195	86.47	991	71.71

Table 1 also makes it clear that students from rural areas had significantly lower access to Internet than their urban peers. Hence, we chose two urban high schools to investigate how students used the mobile phones and Internet supported their study. We found that entertainment, reading newspapers and accessing social networking services were the top functions that students used on the mobile phones. About 30.8 % of the students had access to mobile phones to exploit math websites and only 10.6 % of the students enrolled in online math course (see Table 2 below). In particular, there were only a few students in a class who accessed the Internet to look for learning resources because of low quality content websites as well as high cost for using mobile services. In order to find a suitable solution for this situation, we designed the interactive mobile website to support students learning mathematics at home. This pedagogical model would encourage individual learning by providing a 1:1 student: device ratio and students could access the website on the mobile phones every time throughout their personal life. During the course on the website, students were offered opportunities to gain access to learning experiences by using some popular functions of mobile phones such as messaging, imaging, games, sharing, and media.

Table 2. Some K-12 Students' Popular Activities on Mobile Phones

Activity	**Thai Nguyen**	**Percentage**	**Chuyen High**	**Percent a**
	High School	(%)	School	(%) '
Listening to online music	183	92.4	242	87.7
Watching online movies	183	92.4	193	69.9
Reading newspapers for latest news	154	77.8	182	65.9
Accessing school's website	163	82.3	276	100.0
Using SMS to discuss about math problems	32	16.2	95	34.4
Using social networking to discuss about math problems	131	66.2	244	88.4
Taking online tests or quizzes	140	70.7	257	93.1
Exploiting math websites	61	30.8	105	38.0
Participating online math courses	21	10.6	9	3.3
Total	198	100.0	276	100.0

Results from the research shown that most students felt positive about using mobile phone for communication purposes (phone calls, SMS, MMS and emails). In particular, they were interested in group work, forum discussion, help offered to and from classmates, receipt of personalized information, communication with the teacher, issuing of spot quizzes and so on. From this research, we recognized that mobile phones were also used successfully by some of the teachers for personal support with timetabling, records of meetings, lesson observations, graphing, information gathering, students' attendance and grades, and just-in-time information from the Internet.

Table 3. Levels of Students' Satisfaction with the Interactive Mobile Website

Level of satisfaction	**Excellent students**	**Good students**	**Average students**	**Bad students**
Very satisfied	12 %	27 %	19 %	7 %
Satisfied	21 %	41 %	52 %	28 %
Neutral	23 %	22 %	13 %	32 %
Dissatisfied	30 %	3 %	11 %	23 %
Very dissatisfied	14 %	7 %	5 %	10 %

The second survey on students' attitudes towards their satisfaction with the interactive mobile website shown a surprising result. There was a different evaluation among four groups of students (see Table 3 below). About 71% average students and 68% good students satisfied with the content on the website, which helped them to effectively learn mathematics. We observed that they only focused on two modules during their learning (theoretical review and instructional exercises). Conversely, only 33% excellent students and 35% bad students satisfied with modules and "dose" on each module. These percentages show that we need to design "dose" in each module so that it can support all of students. In other words, the content of each "dose" requires a higher level of differentiation that allows students selfstudy at home with their own pace and preferences.

To sum up, there are a lot of benefits of using mobile phones to support students in learning mathematics because they can facilitate students learning anytime, anywhere, from any source, and at any pace. In other words, mobile phones can support students in learning mathematics with high flexibility and personalizing: each “dose” on each module is suitable for a group of students; online forum allows students to communicate, argue with other members and learn from the others; integrate testing modules which allows students to self- evaluate and make a plan for their progress; and SMS services help students get instant feedbacks from the teachers.

IV. CONCLUSION

This paper provides an overview of large potentials for using mobile phones to support students learning mathematics. Students can access to the Internet on mobile phones to review theories, do differentiated exercises, post comments on a forum, take online quizzes and chose the way of learning on their own. The results of this research would contribute to further investigation of the benefits of mobile phones in educational setting. Although most of the schools in Vietnam banned or limited the usage of mobile phones, we proposed a model of using mobile phones aimed at providing a rich opportunity for students to learn mathematics at home. Teachers can also use different “dose” on the website to facilitate students’ self-study in a differentiated approach.

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