



Attitudes towards Using Mobile Applications in Teaching Mathematics in Open Learning Systems

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Abstract: This study investigated attitudes towards teaching mathematics via mobile learning in open learning systems. The sample of the study consisted of 57 male and female students enrolled in the mathematics course in the department of educational studies at the Arab Open University/ Jordan for the academic year 2016/2017.

Results of the study showed that positive student attitudes toward using mobile applications reached 80%. Each of the following scores is ranked as ascending: mathematical thinking (75%), achievement motivation (76%), developing social and emotional skills (77%), and application technology (96%).

There was no statistical significance difference ($\alpha \leq 0.01$) between the variable type of general secondary certificate (scientific / arts stream) as well as the nature of employment in terms of whether the learner was either an employee or non-employee. In light of results of the study, the researcher recommends using mobile applications in teaching courses of mathematics in open learning systems.

Keywords: open learning, mobile learning, mathematics.

Résumé : Cette étude interroge les réactions suscitées par l'enseignement des mathématiques par apprentissage mobile dans des dispositifs d'apprentissage ouverts. L'échantillon de cette étude est constitué de 57 étudiant(e)s suivant le cours de mathématiques du département de sciences de l'éducation à l'université ouverte arabe de Jordanie pour l'année académique 2016/2017.

Les résultats de l'étude ont montré que 80% des étudiants perçoivent positivement l'usage des applications mobiles. Les thèmes suivants sont classés de façon ascendante : pensées mathématiques (75%), motivation à réussir (76%), développement de compétences sociales et émotionnelles (77%), technologie d'application (96%).

Aucune différence statistiquement significative ($\alpha \leq 0.01$) n'a été observée entre les différents types de certificat d'enseignement secondaire (filiales scientifique / artistique) pas plus que selon le statut d'emploi, c'est-à-dire le fait que l'apprenant était employé ou non. A la lumière des résultats, le



chercheur recommande l'usage des applications mobiles pour l'enseignement des mathématiques dans les dispositifs d'apprentissage ouverts.

Mots-clés : Apprentissage ouvert, apprentissage mobile, mathématiques

Introduction

Today's educational systems seek to integrate technology in education through computerized programs, and increase teachers' awareness of the proliferation of computerized and mobile applications in teaching.

One of the most important challenges facing pre-service teachers is lack of training to use technology in teaching, specifically in the domain of mobile applications in terms of their diverse applications that provide immediately accessible learning opportunities, shortening temporal and spatial distances between the learner and the institution, and saving time, effort and money for both learners and teachers.

The systems of educational institutions adopting open learning combine traditional and distance learning in terms of providing sources of learning and an educational environment that keeps abreast of developments, as well as the traditional obstacles to pre-service teachers' ability to directly and indirectly communicate with trainers.

Mathematics is one of the most important topics in the field of education, where students develop the ability to think, solve problems, and develop the skills of arithmetic and engineering principles, analysis, induction, and the use of mathematical rules in various areas of knowledge, such as trade, technology, engineering and other natural sciences.

Therefore, it is necessary to provide learning environments that help pre-service teachers to learn mathematics and teaching strategies in an interesting and skillful way, such that teachers acquires an understanding of the concepts of mathematics and master related skills and the ability to extrapolate and apply principles in a creative new ways.

The National Council of Teachers of Mathematics in the United States emphasizes the importance of using technology in mathematics education (NCTM, 2000). Technology can support effective mathematics teaching and learning, help use various sensibilities, approximate abstract concepts through simulations, and link mathematical information with students, providing direct sensory experiences (NCTM, 2000).

The development of Information and Communication Technologies (ICT) and the spread of digital tools and skills among schools and university has led to the emergence of new forms of education

delivery. Today, the proliferation of wireless technologies is leading to growth in Mobile Learning Systems or Mobile Learning (Al-Hamami, 2006).

Abdul Ghafoor (2012) points out that mobile technology can facilitate learning environments and create opportunities for learners, enabling them to access knowledge and learning, as if they were on the campus, and the aims can be achieved easily and rapidly.

Mobile learning is a real and practical translation of the philosophy of distance learning, based on expanding educational opportunities for learners by achieving flexibility of learning and interaction with the teacher at anytime and anywhere. The learners are able to follow their learning according to their abilities and speed of learning. Self-learning, and mobile learning is a pattern of e-learning. It is based on interactive communication between teachers and learners (Bader, 2012).

The main difference between e-learning and mobile learning is that in e-learning study is done by using the computer in the classroom, or the lab or even at home, but in mobile learning, the study occurs in any place and any time where the learner under the guidance of the teacher (Al-Hadi, 2011). In this regard, institutions of higher education have been interested in the capacity of mobile learning to provide access to various educational services anywhere, regardless of time or location.

There are two basic types of learning through mobile applications: educational services (pedagogical services) such as teaching and learning materials and activities, and administrative services such as registration (Zaza, 2013).

Mobile learning approaches are based on a social constructivist theory of technological learning. This theory emphasizes the importance of learning as a dialogue within a social cultural context that is largely shaped by the learner's behavior and skillful use of knowledge, tools, and resources to acquire more knowledge, solve problems through dialogue, and contemplative thinking to link current experience with previous knowledge that constructs new interpretations (Khadri, 2008). Jeng et al. (2010) studied the relationship between mobile learning, traditional educational learning strategies, existing environments, and the need for integration between all these dimensions.

Mobile devices can be used in several ways (Sampson & Panagiotis, 2013): to involve students in learning and education without being restricted by place or time, to enable students to continue learning activities within or outside classes through continuous interaction, communication, continuous support, and to provide follow-up.

Before the era of unlimited informational flow, courses were based on an educational form through which the math teacher communicated the mathematical content through available print or other media technology, which means that, opportunities were very poor for a learner to ask questions, or

to think independently, or to interact among students and engage in learning mathematics. In the context of mobile learning, there is a major shift in building a learner-centered learning environment that is based on the fact that the learner builds knowledge and organizes new experiences with the existing knowledge structure (Al-Qassas, 2008).

Al-Sawai & Khashan (2005) point out that effective learning of mathematics comes through the active integration of learners in learning concepts and objective mathematical generalizations, not only through the preservation of formulas and concepts, and that technology can enhance this aspect through learners' ready access to mathematical and scientific concepts. This process requires learning environments that enable learners to develop skills of networked communication via social media with peers and faculty. In this regard, Kearney & Maher (2013) emphasized the need to pay attention to the professional development of pre-service teachers of mathematics by employing modern technologies such as mobile learning and tablets. The study concluded that the use of mobile devices by pre-service teachers of mathematics let them learn trigonometric content, concepts of fractions, develop their higher thinking skills, and help them learn mathematics via social media.

The study of Ismail & Others (2013) showed the need for effective use of mobile services in the domain of education. In this regard, Matthew & Damian (2013) found that the use of mobile learning for pre-service teachers of mathematics improved the actual practice of teaching mathematics, helping them develop their mathematical ideas through discussions, ideas exchange, saving information, and informal retrieval of information.

Dahiru & Biya (2010) noted that mobile use in learning mathematics has many advantages, because it includes tools that allow students learn and communicate through text and voice communication, instant messaging, and multimedia to display mathematical content. The study found that students in the preparatory stage used the mobile technology tool to learn mathematics.

Gupta (2012) conducted a study aimed at using of mobile in the field of mathematics education which was found to help students understand graphs, and discover new, unfamiliar mathematical concepts compared with the traditional learning environment.

Ford (2009) noted that the use of modern technology can help engage in learning mathematics through e-mail, online training, Internet databases and video conferencing training. These tools can be used to increase the ease of engagement among students. Electronic learning helps to support and engage students at different levels of education. Also Aljorisi & Alomari (2015) points out the importance of mobile in teaching, the results of the study showed the effectiveness of mobile applications in teaching students of the Faculty of Education at the University of Taiba in Saudi Arabia and changing the attitudes of students towards mobile learning.

The rapid development of the Internet and wireless technologies resulted in the growth of educational institutions connected electronically. Communication between those institutions interested in the educational process and rapid access to the courses of electronic mathematics is now possible. Mobile learning has become one of the modern methods of mathematics teaching and learning for its multiple advantages. It has provided the opportunity for lifelong learning without being associated with a specific place or time. The productions of electronic courses, which include a huge number of educational objects, are represented in: texts, PowerPoint lectures, illustrations, and animation, sound files, video, virtual labs, electronic tests and other media (Taleb& Abu Saud, 2007). Content is a designed educational learning in the form of learning objects or small learning units of knowledge and skills can be learned in a time of usually two to fifteen minutes each section represents a stand-alone idea and each section is called Learning Object or educational section (Zaytoon, 2005).

There are abundant reasons for educational institutions to develop mathematics content for mobile delivery, such as: the ability to provide content to large numbers of learners, the speed of providing feedback, the number of learners who can interact with the content of mobile mathematics, as well as the availability of mobile devices in very large numbers, including the community as a whole. In comparison, the number of computers is much more limited and unassociated with the learner all the time compared to mobile, and this shows the importance and speed of the content of mathematics and interaction (Bader, 2012).

Training pre-service math teachers in a digital or e-learning platform through mobile includes many positive aspects, most notably the mastery of learning and integration, and building mathematical knowledge on their own, thus helping them to innovate and follow up on the subject.

Graham & Fennel (2001) believe that effective teaching of mathematics requires a well-prepared teacher to have the ability to make appropriate decisions in the educational situation about mathematical knowledge, curriculum objectives, classroom environment, student needs, and the duration of their involvement in various mathematics activities. The school mathematics principles and standards document emphasizes the need for teachers of mathematics to understand what their students know, what they need to learn, and then to create opportunities for effective teaching and learning mathematics (NCTM, 2000).

This importance of the teachers of mathematics dictates the need to prepare and develop the preparation program to ensure that qualified teachers are able to perform their roles successfully. Effective teaching experiences are acquired during pre-service preparation and in-service career growth program (Graham& Fennel, 2001). The professional standards document for teaching

mathematics state that teachers' experiences during the preparation period affect the way they students (NCTM, 2000).

Therefore, attitude as an element of the affective domain has been of growing interest in the teaching of mathematics; these studies have emphasized the importance of measuring learners' attitudes as they help them adapt in their complex world, during their positive interaction with the environment in which they live, which may change their negative attitudes towards mathematics.

By studying the characteristics of the students of the faculty of education in universities that adopt open learning systems, it is noted that they are from different age groups (18 - 50 years), their scientific backgrounds vary, and most of them affirm their poor achievement in mathematics at various school levels and their negative attitudes toward mathematics.

Problem of the Study

There is a decline of interest in mathematics teaching among university institutions and public education institutions in preserving the main aspects of mathematics education in terms of concepts, generalizations and mathematical skills without promoting understanding these aspects. This may be due to many factors, the most prominent of which are: content of mathematics delivered by abstraction and reduction. The students' lack of awareness of the importance of the material in their practical life, the weakness of the learner's involvement in the content, the various activities of mathematics, the lack of follow-up and employment of technological innovations in the education process all contribute to this problem.

Enhancing a positive environment for teaching mathematics requires change in some of characteristics of education, such as following a curriculum that promotes analytical and critical thinking, creativity and the ability to solve mathematical problems rather than indoctrination, practiced in most Arab countries. To solve problems in mathematics, to memorize formulas and procedures, and not to encourage engagement in the learning process to build a real understanding of the principles of mathematics impede interest in and understanding of mathematics (Faor, 2012).

Mansour & Salman (2011) points to the fact that one of the main reasons for reluctance of university students to study mathematics is that the introduction and methods of teaching do not use modern technologies, as well as to students' lack of interest in the quantitative cumulative employment of mathematical knowledge.

The study of Halverson (2009) and others suggests that the design of learning objects in mathematics has helped students and seniors understand and improve their mathematical performance in terms of

general concepts, generalizations, and mathematical skills. With regards to mathematics on the design of these objects. Buteau & Mgombelo (2012) have pointed out that the development of mathematics education and learning requires the design of high-quality educational objects to bridge the knowledge and mathematics gap among high school students before entering the university. Learning objects in mathematics play a great role in remedial teaching and taking into account individual differences among learners. Cotton (2008) focused on how teachers of mathematics used e-learning objects for design, development and evaluation. Their results showed that teachers had weak skills in designing digital learning objects, which influenced the use of these objects in learning.

From the above, the problem of the current study is determined in an attempt to investigate the attitudes of the students of the Faculty of Education in the field of primary education towards the use of mobile applications in the teaching of mathematics courses.

Research Questions

1. What are the attitudes of the students of the faculty of education towards the use of mobile phone applications in open learning systems?
2. Are the attitudes of the students of the Faculty of Education different from the use of mobile phone applications, depending on the type of secondary certificate (scientific / arts stream)?
3. Are the attitudes of the students of the Faculty of Education different from the use of mobile phone applications by type of general secondary certificate (employee / non-employee)?

Importance of the Study

The intent of this study is to support pre-service learning programs for teachers, develop their ability to learn mathematics, train pre-service teachers on the use of modern technologies, increase motivation for students to learn through the use of technology in education, increase students' academic achievement in mathematics and achieve success, and increase their knowledge in modern teaching methods.

The technology used in the study was the mobile application specified by WhatsApp, which is one of the social media that allows people to communicate and cooperate with each other and enable them transfer the experiences and knowledge around the world.

In this study, the application was used by creating a group to send different worksheets, videos, photos, sounds, links, and tasks to the members.

Terminology of the Study

M-learning (in mathematics): is a form of distance learning and an extension of e-learning, with the use of mobile devices, where the teacher can provide the content of mathematics and follow-up students anywhere and anytime by designing educational sites in the field of mathematics, integration into learning mathematical content according to their circumstances and needs.

Mobile applications: these applications are available on smart phones, and in this study the tool was the WhatsApp application which is one of the most widely used mobile apps.

Orientation: a state of mental readiness (emotional) in the individual relating to a specific behavior directed in a certain way regarding that thing and measured by the degrees of the sample of the study on the questionnaire that consists of the following domains: mathematical thinking, achievement motivation, developing social and emotional skills, application technology.

Determinants of the Study

- The study is limited to a sample of students of the Faculty of Education in primary education in the mathematics course of the second semester 2016/2017 in the Arab League.
- The study is limited to mobile applications (What's App).

Sample of the Study

The sample of study consisted of students enrolled in the ED360 mathematics course for the second semester of the academic year 2016-2017 at the Arab Open University /Jordan branch. The following table shows the distribution of the sample of the study.

Table 1: Distribution of the sample of study due to the variables of the type of general secondary school certificate and the nature of the work (employee/ non-employee)

(Scientific, Arts Stream)	(Employee, Non-employee)	No.
Scientific	Employee	12
	Non-employee	11
Arts Stream	Employee	16
	Non-employee	18
Total		57

Tool of the Study

The mobile application was used to teach the mathematics course for a sample of the Arab Open University students in the following areas: Mathematical thinking field, achievement motivation field, social and emotional field, and application technology field.

To verify the validity of the tool, it was submitted to a group of arbitrators in the field of teaching mathematics and psychology, leading to revisions. To verify the stability of the tools, their consistency was verified using the internal consistency coefficient of their verbs by applying them to a survey sample. The following table shows the stability coefficients of the sub-operas and the scale as a whole.

Table 2: Cronbach Alpha's internal consistency coefficients for the attitude scale towards mobile applications

Domain	No. of Items	Reliability Coefficient
Mathematical thinking	10 (paragraphs)	0.81
Achievement motivation	10 (points)	0.84
Developing Social and emotional skills	10 (paragraphs)	0.79
Application technology	8 (paragraphs)	0.82
Total	38	0.83

Procedures of the Study

- The theoretical framework of education technology, open learning and mobile applications that can benefit from teaching mathematics was studied.
- Using the application of the WhatsApp in teaching mathematics courses.
- Worksheets, videos, links and audio recordings were created to teach the concepts, skills, generalizations and issues of the course. They were sent to students, which they discussed with each other and answered the questions.
- The preparation of a tool to measure the attitudes of students towards the use of mobile applications in the teaching of mathematics was verified for validity and stability.

- Apply the tool of study which is a questionnaire to determine the student’s levels of their attitudes towards the using of mobile application.
- Achieving results through the integration of data into statistical packages, the use of arithmetical means, standard deviations and two-way analysis of variance (ANOVA).

Methodology

The descriptive analytical approach was adopted.

Results

In answering the first question of the study, which is:

1. What are the attitudes of the students of the faculty of education towards the use of mobile phone applications in open learning systems in mathematics?

the arithmetical averages, standard deviations, and trend domains were extracted as shown in the following table.

Table 3: The arithmetic means and standard deviations of the trend domains using mobile phone applications

Domain	Percentage	Arithmetic Mean	SD
Mathematical thinking	75%	37.33	5.956
Achievement motivation	76%	37.81	6.295
Development of Social and emotional skills	77%	38.51	5.968
Application technology	96%	39.30	6.036
Total	80%	152.94	17.65

It is noted from the previous round that the attitudes of students towards the use of mobile applications in teaching courses was high (80%), and was the highest focus for students in the use of multimedia application technologies in teaching the course through mobile applications. All the domains where the trend towards the application of high application ranked as ascending: motivation for achievement, mathematical thinking, the development of social and emotional skills, and then application techniques.

This is evidenced by the importance of the use of modern, interesting, teaching methods, as the use of the application saved the students time and effort, and led to the provision of diverse sources easily, the application provided various exercises, provided feedback immediately, and the possibility of inquiry from the teacher quickly and easily. It also provided answers and solutions to the problems faced by students, and provided sources and videos that illustrated solutions to some exercises. It is important to note that the students interacted greatly with each other and cooperated with each other positively.

Also the tool encourages students to collaborate, save time, effort, and speed of access to information from the teacher. This finding is consistent with each of Gupta (2012), Ford (2009), and Ismail et al. (2013).

In answering the second and third questions, which are:

2. Are the attitudes of the students of the Faculty of Education different from the use of mobile phone applications, depending on the type of secondary certificate (scientific / arts stream)?
3. Are the attitudes of the students of the Faculty of Education different from the use of mobile phone applications by type of general secondary certificate (employee / non-employee)?

the mean averages and standard deviations were used as shown in Table 4.

Table 4: The arithmetic means and standard deviations of students' attitudes toward mobile applications according to the variables of study (scientific / arts stream) and (employee / non-employee)

Scientific/Arts Stream	Employee/Non-employee	No.	Arithmetic Mean	SD
Scientific	Employee	12	150.25	15.90
	Non-employee	11	156.82	24.76
	Total	23	153.39	20.41
Arts	Employee	16	154.87	17.36
	Non-employee	18	150.67	14.58
	Total	34	152.64	15.86
Total	Employee	28	152.89	16.61
	Non-employee	29	153.00	18.90
	Total	57	152.95	17.65

It is noted from the previous table that the student average of the scientific stream (153.39) is higher than the student average of the arts stream (152.64) and the difference is 0.75. For the employees, the average of the non-employees (153.00) was higher than the employees (152.89).

To study the significance of the differences between the attitudes of students in the faculty of education towards the use of mobile applications according to the type of secondary certificate (scientific / arts stream) as well as employee / non-employee, two-way analysis of variance (ANOVA) was used as shown in the following table.

Table 5: Two-way analysis of variance (ANOVA) to study the significance of the differences between the type of secondary certificate (scientific / arts) and the variable of work (employee / non-employee)

Source	Sum of Squares	Df	Average of Squares	F Value	Level of Sig
Type of certificate	7.97	1	7.97	0.025	0.88
Type of employee	19.05	1	19.05	0.059	0.81
Type of certificate*type of employee	397.31	1	397.31	1.23	0.27
Error	17049.63	53	321.69		
Total	1350850.00	57			

It is evident from the previous table that there are no statistically significant differences ($\alpha \leq 0.01$) between the variable type of secondary level among the students with a previous scientific or arts stream in their attitudes towards the use of mobile applications in teaching mathematics in open learning at Jordan, with f-value 0.025, and there were no significant differences ($\alpha \leq 0.01$) between the variable nature of the student's work in terms of being an employee or non-employee with f-value 0.059.

The previous table showed no differences between employee and non-employee students in their attitudes towards using mobile applications in teaching mathematics courses in the open learning system. Also, there were no differences in trends due to the fact that the students were employees or unemployed, indicates that the use of mobile applications created a positive trend regardless of the type of secondary school certificate, as well as regardless of being a non-employee factor, all classes of students and their types and backgrounds have positively interacted with the strategy used in teaching and increased their activity and interaction.

The researcher noticed that the mobile applications reduced anxiety of students during communication with the teacher, increased their sense of respect for the teacher and the provision of confidence, support with other students. This is indicated by the standards of mathematics education that technology provides support and increases learning (NCTM, 2000).

In the light of the study results, the researcher recommends using mobile applications in teaching students in the open learning systems in Jordan using modern strategies for teaching mathematics courses, and conducting studies on students of schools and universities.

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