ASEAN Journal of Science and Engineering Education

Primary Educators Experts' Validation of The Developed Mathematics Mobile Application to Enhance the Teaching of Mathematics in Nigeria Primary Schools

Eyiyemi Veronica Omolafe

Department of Adult and Primary Education, University of Ilorin, Ilorin Nigeria
Correspondence: E-mail: eyiyemimi@gmail.com

A B S T R A C T S

Mobile learning brought a great benefit to education through, training at any time; training at the place; learner-centered content; and development of teaching and learning. Smartphones and similar mobile devices have changed the way individuals interact with technology and with each other. To ascertain the usability of the instructional mobile application, it must be verified by experts in the area of the subject content. Hence, it is needed to determine the experts' validation of the developed mathematics mobile application before it can be used for instructional purposes. Two instruments were used for the validation process: Primary Education Lecturers' Rating Scale and Primary School Teachers' Rating Scale. Percentage score and mean were used to answer research questions. The percentage score of the rating for the validation of the developed mathematics mobile application by the six Experts shows that the mobile application satisfied the required standard in the field of primary education. The developed mathematics mobile application has the potential to make teaching and learning basic mathematics easy and interesting. The study revealed that teachers can teach the concept of mathematics to primary school pupils either individually or collaboratively through effective utilization of the mobile application. It was recommended that primary educators should employ a mobile application strategy for teaching those abstract and difficult concepts in mathematics.

A R T I C L E   I N F O

1. INTRODUCTION

Technology is a method of skillful utilization of ideas for the benefit of humanity. It is widely used in this current society, most especially for teaching and learning (Bingimlas, 2017). Technology is the application of knowledge and processes to develop systems that are used to solve many tasks or problems and extend human capabilities. It has advanced to a greater level, and it has helped education to become easily available and accessible (Bindu, 2016). Information and Communication Technology (ICT) is communication equipment and software required to organize, study, strategize, and provide support to manage information systems dependent on computer software as well as hardware. These technologies can be utilized to offer anticipated results with little error or flawless, steady, reliable, and interactivity in the learning process.

Contemporary society is highly influenced by ICTs in every aspect of life, including education. The effects are experienced more in the field of education since it has the potential for teachers to transform the teaching methodology to meet individual needs (Yusuf, 2005; Bindu, 2016). Lecturers in institutions of learning use ICT for research collaboration. It has improved education through the online classroom, mobile learning, SMART Board, instant messaging, and texting in a significant way (Raja & Nagasubramani, 2018). Mobile application is self-contained software, designed for mobile devices and used for performing specific tasks for mobile users. It is also called a mobile app, it is a type of application designed to run on a mobile device, which can be a Smartphone or tablet computer. Unquestionably, more students are more determined towards using a mobile phone for every purpose, and in this state, educational apps can be the perfect way to attract students and persuade them to study. Meanwhile, when students are taught basic technology there should be a wide interest in the subject especially now that we are in a technology-driven world, and mobile apps are the most interactive and constructive way to attract students towards studies and enhance their productivity.

Numerous studies reveal that students predict a positive impact from mobile learning. That is, students think that mobile phones help them engage with relevant material and raise their confidence as learners (Mueller *et al.*, 2008). Mobile applications play an important role in education, and the niche is sufficiently promising to attract the attention of many developers from all over the world. Moreover, those mobile phones and apps contain many categories having learning tools and traits, short, mid, and final exams notifications, learning videos issued by teaching staff, and others that achieve success for students' learning process. Mobile technologies play a vital role in the contemporary educational system. The use of mobile technologies for learning provides opportunities for students to collaborate in the learning process, irrespective of gender, level, ability, and disability. Through mobile technologies, students access the views, thought of educators, experts, and researchers all over the globe and communicate directly with them (Sarkar, 2012). Mobile learning is emerging as a powerful medium delivering knowledge and changing students' expectations of learning anytime and anywhere. Current university students, who mostly belong to Generation Y (and can be called the next-generation), are ideal candidates for m-learning because they were born into an emerging world of technology and have grown up surrounded by smartphones, laptops, tablets, and other gadgets. In times ahead, educational institutions will be forced to meet the changing requirements of learners to stay competitive.

The adoption of mobile computing devices, such as cell phones, smartphones, and tablet computers, in higher education, and a great number of surveyed students believe mobile devices are meaningful to their academic success and use their devices for academic

activities. It can be said that these mobile communication devices offer university students the opportunity to carry their university in their own hands (Taleb & Sohrabi, 2012). A vivid clarification of what mobile computing devices constitute has included transportable technologies, such as cell phones, and smartphones, and this may include tablet computers, and netbooks (Valk *et al.*, 2010).

The use of mobile technology in higher education learning should offer the opportunity for students being able to access information and knowledge at any spot and at any point of time from the devices that they are accustomed to "carrying everywhere with them", which they also "regard as friendly and personal" (Traxler, 2009). In one study, students were able to consider their learning styles when using mobile devices and were found to prefer mobile applications to aid learning rather than traditional means such as blackboard and chalks, textbooks, flashcards, maps, and worksheets (Pollara, 2011).

The use of mobile technology is now widespread among university students due to its flexibility and portability among many other uses. Students' adaptation of these technological tools has certainly deepened and encouraged a lot of research on mobile learning. It can be said then that the proliferation of mobile technology use in learning has indeed offered a plethora of opportunities to support the teaching-studying-learning processes. As attested, mobile learning opens the door for a new kind of learning known as 'here and now learning'. This type of learning takes place when learners have access to information 'anytime and anywhere to perform authentic activities in the context of their learning' (Martin & Ertzberger, 2013). Similarly, this study seeks to explore some of the ways that mobile technology has positively impacted higher education students' learning.

Primarily, mobile learning studies are concerned with the issue of effectiveness (Wu *et al.*, 2012). The expectancy is that through the use of mobile technology, positive learning outcomes must be met (Wu *et al.*, 2012). Since research has revealed that learning is increased when students are engaged in active learning, a major step in the improvement of students' learning with mobile technology is therefore through active learning. Active learning involves students in "talking and listening, reading, writing, and reflection, all possible through the use of a mobile device" (Franklin, 2011).

In a study, respondents confirmed the aspects of 'collaboration' and 'communication' efforts made while engaged in learning. For example, students believed that taking part in discussions via applications based on written communication enhanced their learning. To further buttress this point, research has again demonstrated that active and interactive ways of learning help learners acquire knowledge aside from developing students' critical thinking skills. Besides, these active and interactive ways empower learners to solve problems in a variety of situations as well as help them think independently. From the study, students agreed that being constantly connected with their mates through mobile technology had an improvement in their learning. Moreover, it is argued that through the use of mobile technology, students can help one another on projects or assignments. Just as in the study, students acknowledged participating in both synchronous and asynchronous discussions via mobile technology. Also, lecturers can provide and exchange information faster with their students as "web links can go beyond the regular curriculum of a textbook and make greater learning possible" (Wurst *et al.*, 2008). Thus, it is believed that one way of improving students' learning is getting feedback from their teachers (Hwang & Chang, 2011).

The characteristic of mobile technologies, which includes wide usage areas, time and space independence, and portability, is remarkable. These features provided to the user, the idea of using mobile technologies in education. The use of mobile technologies in education has influenced the formation of mobile learning (Korucu & Bicer, 2018). Mobile learning can be

seen as the application of mobile or wireless devices to learn on the move (Park, 2011). Studies reported that m-learning is an extension of e-learning, but that it differs because it uses mobile technologies rather than computers as a medium (Keengwe & Maxfield, 2015). Park, (2011) attributed the increasing popularity of mobile learning to innovations in application and social networking sites, including wikis, blogs, Twitter, Facebook, and Myspace, among others. Mobile learning also involves learning from different perspectives and the use of mobile devices to learn. Some benefits of m-learning over other forms of learning include life-long learning, learning inadvertently, learning in the time of need, learning independent of time and location, and learning adjusted according to location and circumstances (Korucu & Alkan, 2011).

The use of the new mobile and wireless technologies is huge progress in promoting mobile learning, proper utilization of these technologies depends solely on human factors. Mobile technologies, with their pervasive acceptance and powerful functionality, are inevitably changing peoples' behaviors. The use of mobile technology allows for cloud teaching where access to people, resources, and information will float freely regardless of location. Learners in different time zones and locations will be able to access tutors when needed. Mobile technologies are easy means to maintain literacy skills and gain access to information and also facilitate distance learning (Mehdipour & Zerehkafi, 2013). Mobile technologies are more difficult to ignore than traditional desktop technologies since mobile technology now plays such an important role in our day-to-day lives for a variety of different purposes (Traxler, 2009). Mobile technologies are becoming more personal with the introduction of gesture-based interaction and affective computing. Devices can interpret gestures made by learners and respond appropriately based on the gesture. When a learner holds a mobile device, the device will read the physiological state of the learning to detect the learner's emotions.

Using mobile technology to reach students will benefit advanced levels of education by increasing enrolment and having a broader student population since students in different age groups will be able to access course materials anywhere and anytime (Lowenthal, 2010). With communication technology, learners can use mobile technology anywhere and anytime to access educational resources (Hassan *et al.*, 2012). Numerous advanced education organizations are actualizing mobile learning to provide flexibility in learning. Many drastic changes have taken place for the higher education sector because of the new developments in information communication technologies using computers smartphones and apps. International organizations such as United Nations have recognized information communication technologies as a useful tool in different learning sectors. Accordingly, many developed countries invest information communication technologies in their infrastructure. Focusing on technology-based learning methods is to cope with the various learning methods among young people and even third world countries are making efforts to benefit from technological expansion in the field of computers and smartphones.

Teachers use technology for teaching because it motivates pupils and offers a different mode of lesson presentation. It also engages students and helps to create a more exciting learning environment. There are several ways to incorporate devices into the curriculum. Particularly those subject that appears unappealing and difficult for learners such as mathematics. Therefore, schools must make every effort to keep the classroom technologically connected to make the teaching and learning of mathematics interesting (Aris & Orcos, 2015). Mathematics is one of the most important subjects in the education system and is studied at all levels of education, from elementary school to university. It is so because mathematics is a necessary branch of knowledge required for learners to support their learning success in the future. Mathematics is also one of the tools of scientific thinking that

are needed to develop the ability of logical, systematic, and critical thinking of learners. Moreover, mathematics is required by everyone in daily activities. Therefore, students need to have the good mathematical knowledge to face the future (Benidiktus *et al.*, 2017).

Nowadays, children are growing up in a world permeated by mathematics; mathematics has been widely used as seen through the technologies used in homes, schools, and workplaces. Many educational opportunities and good jobs require high levels of mathematical expertise. Mathematics is a universal, utilitarian subject, that is, so much a part of modern life that anyone who wishes to be a fully participating member of society must know basic mathematics. For learners to participate fully in society, they must learn mathematics with understanding, how to connect mathematical ideas, and how to reason mathematically. Learners who cannot reason mathematically are cut off from whole realms of human endeavor. Learners without mathematical understanding are derived not only from opportunity but also from competence in everyday tasks, mathematics instruction should emphasize such variables that result in learning with understanding to meet the changing demands of society (Dickel & Denis, 2018).

In the statement of problems, many researchers have attempted to find out the causes of pupils' poor performance in mathematics. The problems identified include poor teaching methods applied to teach mathematics, inadequate instructional materials, pupils' misconception of mathematics as a difficult subject; mathematics teachers' attitude towards teaching the subject, poor teaching skills, and lack of active participation by the pupils among others to be responsible for pupils' poor performance in the subject. Practical-oriented classes are expected to enhance a better understanding of the learned concept and thus improve pupils' academic performance. Mobile technologies (Smartphones) with so many existing features and future potential uses are not broadly accepted and utilized in Nigerian schools at any level. It must also be emphasized that despite the new opportunities that mobile technology presents in empowering individuals, transforming the teaching and learning processes, as well as fostering the development of skills in the new millennium. There are still gaps to be filled as regards the appropriate utilization of mobile technologies in the Nigerian education system. Hence, the need to explore the strategies of teaching some concepts of mathematics using the mobile application. The present study, therefore, intends to check the suitability of the developed mathematics mobile application before it can be used for mathematics instruction among primary school pupils in Kwara state Nigeria. To successfully use mobile applications for instruction, professionals or experts in the area of the subject content must verify the application to ascertain its usability.

In the research questions, this study provided answers to the following research questions:
(i) What are the primary education lecturers' ratings for the validation of the developed mathematics mobile application?
(ii) What are the primary school teachers' ratings for validation of the developed Mathematics Mobile Application?

In the research Instruments, Primary Education Lecturers' Rating Scale: This validation form was designed by the researcher to guide the researchers in ascertaining the opinions of the experts on whether the developed app conforms with the acceptable standards and procedures in the fields of primary education. The three experts rated the mobile application using a 4-points Likert scale (Strongly Agree = 4, Agree = 3, Disagree = 2, and Strongly Disagree = 1). Primary School Teachers' Rating Scale: Primary School Teachers' Rating Scale was developed to guide the researcher to obtain the opinions of respondents on whether the developed mathematics mobile application is in agreement with the acceptable standards and procedure in basic mathematics instruction. The three Primary School Teachers

independently rated the relevance of the mobile application using a 4-points Likert scale (Strongly Agree = 4, Agree = 3, Disagree = 2, and Strongly Disagree = 1).

In the Validity and Reliability of the Instruments, Primary Education Lecturers' Rating Scale was validated for both face and content validity by three lecturers within the Department of Adult and Primary Education University of Ilorin, Nigeria. Following the lecturers' validation reports, some items of the research instrument were corrected, adjusted, and modified as directed to reinforce the validity. A validated questionnaire was used to ascertain the expert's opinion on whether the developed mathematics mobile application conforms with the acceptable standards and procedures in the fields of primary education. The experts were requested to express their views on whether they strongly agree (SA), Agree (A), disagree (D), or strongly disagree (SD) with the statement on the validation questionnaire presented to them as they responded while observing the mobile application. A pilot study was administered from Kogi State University, Nigeria for the reliability of the research instrument. The research instrument was reliable at 0.85 at 0.05 level of significance, using Cronbach Alpha SPSS statistical tool. Three Primary School Teachers from a selected primary school in Ilorin South, Kwara state of Nigeria also participated in the validation process of the mathematics mobile application. The teachers were requested to express their views on whether they strongly agree (SA), agree (A), disagree (D), or strongly disagree (SD) with the statement on the validation questionnaire presented to them as they responded while navigating through the mobile application.

2. METHODS

Descriptive research of the survey type was adopted for this study. This method was considered the most suitable design for this study because it involves selecting a chosen sample from a large population. This study validated a mathematics mobile application to be used for mathematics instruction in primary schools in Ilorin, Nigeria. The population for this study comprised all primary education lecturers and primary school classroom teachers in Ilorin, Nigeria. The target population was all primary education lecturers in the University of Ilorin, Nigeria, and all primary school teachers in Ilorin south. Descriptive statistics of percentage scores were used to analyze the research questions. The distribution of the expert participants is shown in **Table 1**.

Table 1 shows that 6 experts participated in the invalidation of the developed mathematics mobile application. Three Primary Education Lecturers with a total of 50% of which two of them are male with one female and Primary School Teachers with a total of 50% of which two of them are female with one male. This implies that half of the respondents are female while the other half of the respondents are male. It shows that an equal number of Primary Education Lecturers and Primary School Teachers participated in this study.

Table 1. Demographic information of the expert participants based on gender.

Respondents	Gender		Frequency	Percentage (%)
	M	**F**		
Primary Education Lecturers	2	1	3	50.0
Primary School Teachers	1	2	3	50.0
Total			6	100.0

3. RESULTS AND DISCUSSION
3.1. Research Question 1: What are the primary education lecturers' ratings for the validation of the developed mathematics mobile application?

The Primary Education Lecturers' rating for the validation of the developed mathematics mobile application was carried out by three (3) lecturers in the Department of Adult and Primary Education University of Ilorin, Ilorin Nigeria. The experts rating scale contains Ten items. The percentage of the rating of each of the items and grand mean scores of the three (3) lecturers is shown in **Table 2**.

Table 2 shows the percentage score of the three lecturers in the Department of Adult and Primary Education University of Ilorin ratings for the validation of the developed mathematics mobile application (SA = 20.6%, A = 73.5%, and D = 5.9%) shows that the Developed Mathematics Mobile Application satisfied the required standard in the field of Primary Education. The reason being that ten out of the twelve items were agreed and strongly agreed upon by the three experts, only two out of the items were disagreed upon and none of the experts strongly disagree on any of the listed items.

Table 2. Percentages and mean score of the primary education lecturers' rating for the validation of the developed mathematics mobile application.

S/N	STATEMENTS	SA	A	D	SD	Mean
1.	The Interface of the developed mathematics mobile app is user friendly	0(0%)	2(66.7%)	1(33.3%)	0(0%)	2.67
2.	The interface of the developed mathematics mobile app is easy to navigate	1(33.3%)	2(66.7%)	0(0%)	0(0%)	3.33
3.	The developed mathematics application is innovative	0(0%)	3(100%)	0(0%)	0(0%)	3.00
4.	The contents in the developed mathematics mobile app are relevant to learners needs	0(0%)	3(100%)	0(0%)	0(0%)	3.00
5.	The topics in the developed mathematics mobile app are in coherent order	1(33.3%)	2(66.7%)	0(0%)	0(0%)	3.33
6.	The picture quality of the developed mathematics mobile app is good enough to stimulate learners' interest	0(0%)	3(100%)	0(0%)	0(0%)	3.00
7.	The developed mathematics app is relevant to learners needs	0(0%)	3(100%)	0(0%)	0(0%)	3.00
8.	The developed mathematics mobile app will enhance the presentation of mathematics concept	0(0%)	3(100%)	0(0%)	0(0%)	3.00
9.	The developed mathematics mobile app has a resemblance to other well designed educational mobile application	1(33.3%)	1(33.3%)	1(33.3%)	0(0%)	3.00
10.	The design and structure of the developed mathematics mobile app is clear and understandable	0(0%)	3(100%)	0(0%)	0(0%)	3.00
11.	The developed mathematics mobile app can aid learners and teacher's interaction	1(33.3%)	2(66.7%)	0(0%)	0(0%)	3.33
12.	The information in the developed mathematics is relevant to age group curriculum	0(0%)	3(100%)	0(0%)	0(0%)	3.00
	Total	**4(20.6%)**	**30(73.5%)**	**2(5.9%)**	**0(0%)**	**GM: 3.06**

3.2. Research Question 2: What are the primary school teachers' ratings for validation of the developed Mathematics Mobile Application?

Table 3 shows the percentage score of the three primary school teachers' ratings for validation of the developed Mathematics Mobile Application. It shows that the developed

mathematics mobile application satisfied the required standard for basic mathematic in primary schools (SA = 56.7%, A = 43.3%). The reason being that all the items were agreed and strongly agreed upon by the three experts, especially in the aspect of strongly agree, none of the experts disagree or strongly disagree on any of the listed items.

Table 3. Percentages and mean score of the primary school teachers' ratings for validation of the developed mathematics mobile application.

S/N	STATEMENT	SA	A	D	SD	Mean
1	The developed mathematics mobile application is adequate and can help to achieve the stated objectives	3(100.0%)	0(0%)	0(0%)	0(0%)	1.00
2	The developed mathematics mobile application can concretive the abstract concepts in mathematics	3(100.0%)	0(0%)	0(0%)	0(0%)	2.00
3	The developed mathematics mobile application contains detailed and accurate information in mathematics	2(66.7)	1(33.3%)	0(0%)	0(0%)	1.33
4	The developed mathematics mobile application can be used to teach any in basic mathematics	2(66.7)	1(33.3%)	0(0%)	0(0%)	1.33
5	The usage of mathematics mobile application would enhance teaching and learning in basic mathematics	2(66.7)	1(33.3%)	0(0%)	0(0%)	1.33
6	The topics on the developed mathematics mobile application are accurate to the scheme of work	2(66.7)	1(33.3%)	0(0%)	0(0%)	1.33
7	The developed mathematics is user friendly and easy to navigate	3(100.0%)	0(0%)	0(0%)	0(0%)	1.00
8	The developed mathematics design and images is appealing to primary school pupils	3(100.0%)	0(0%)	0(0%)	0(0%)	1.00
9	The developed mathematics mobile app would aid assimilation and easy retention for pupils	1(33.3%)	2(66.7%)	0(0%)	0(0%)	1.67
10	The developed mathematics mobile app is suitable for pupils' cognitive needs	1(33.3%)	2(66.7%)	0(0%)	0(0%)	1.67
	Total	**22(56.7%)**	**8(43.3%)**	**0(0%)**	**0(0%)**	**GM: 1.67**

3.3. Discussion of Findings

This study investigated the primary educators' experts' validation of the developed mathematics mobile application to enhance the teaching of mathematics in Nigeria primary schools**.** The results of the experts' validation of the mathematics mobile application by the six experts: Primary Education Lecturers and Primary school teachers revealed that the developed mathematics mobile application satisfied the required standard and can be used to achieve the stated objectives. Mobile technologies play a vital role in the contemporary educational system. As it provides numerous opportunities for students to learn anytime and anywhere. The use of mobile technologies for learning provides opportunities for students to collaborate in the learning process, irrespective of gender, level, and ability. Educational Mobile applications are new and advanced learning management software that has changed the educational field. These applications are running on small handhold mobile devices which

are movable and accessible from anywhere and anyplace. Mobile learning management systems positively influence online students' academic performance.

4. CONCLUSION

This study concluded that the developed mobile application will promote the teaching and learning of basic mathematics concepts in Nigerian basic schools. Experts' in primary education reported that the mobile application is well developed and conformed to the curriculum standard of NERDC. With the current status of information and communication technology (ICT) in Nigeria, there is still a wide gap to be bridged in the area of a mobile application for teaching and learning. This study concludes that mathematics mobile application has the potential to make the teaching of basic mathematics concepts easy and interesting as mathematics concepts that seem too abstract can be made simple with the aid of the developed mobile app. It was recommended among others that primary school teachers should employ the habit of using a mobile application for teaching their pupils to enhance teaching and learning of mathematics in Nigerian basic schools.

5. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

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