

# The Development And Assessment Of An Educational Mobile Learning Application In Mathematics For Grade Seven Students

Ruth Ann Garcia-Santos

**Abstract :** This study provides innovative ways of teaching and learning, the application developed allows teachers to upload their lessons or modules that can be viewed by their students via wireless network connection. Students can understand their lesson effectively using available simplified lessons in the application created by several teachers. The app also enables teachers to do personalize exercises and quizzes that assess students' understanding with the lesson and allow the students to apply what they have learned. The developmental method of research was employed in the study and this method consisted of two phases. The first phase was the development, which follows the stages of mobile development life cycle (MDLC) namely; planning, designing, coding, testing and deployment. The researcher used PHP, my SQL server to develop the application. The second phase was the evaluation of the developed application. The technical characteristics-ISO 9126 was evaluated by IT Professionals. The instructional use, graphical user interface (GUI) was evaluated by teachers. Lastly, the learning engagement and graphical user interface were evaluated by students. The suggestions given by the group of respondents may be considered for future enhancement of the study.

**Index Terms:** Mobile learning Enhancer, application, MDLC, E-learning, lessons, instructional use, Mobile learning, PHP, Mysql

## 1. INTRODUCTION

Computer technology has advanced so rapidly and it has invaded different walks of life. Computers, mobile phones and modern gadgets have become an increasing part of people's lives. Such modern devices have brought much impact to the progression of human daily lives in terms of communication, business, including education. Not only students but parents and teachers as well love mobile technology as they regularly use it for personal reasons. E-learning becomes a way of life in school. It includes numerous types of media that deliver text, audio, images, animation, including local intranet or extranet, and web-based learning. According to Jackson (2008), educational technology is not restricted to individual computer use. It can involve other equipment and applications, such as video conferencing, digital television (allowing students to interact with programs at their own pace), electronic whiteboards, and digital cameras. West (2013) underscored that mobile phones, tablets and other devices have become more prevalent and affordable nowadays and that its use can be extended to learning to maximize its worth. The developments in computer technology somehow influence students' learning modes. Instead of bringing the needed printed materials like books whenever they go to school, these can be installed to their mobile phones. This lessens the burden of the students in carrying heavy loads of printed materials in their bags. Many of the Filipino students in their early years of study are struggling to learn difficult subjects like mathematics. This may result to poor performance in the latter part of their studies. One way of addressing this problem is by implementing modern tools aside from the traditional teaching method. Also, teachers should not only rely on books in providing Mathematics activities to avoid the annoyance of students in the said subject. Thus, there is need to develop a way to combine technology and learning. Mathematics is a subject that must be learned comprehensively and should be

applied in everyday living. It goes beyond the classroom's four walls and the school's confines.

### Mobile Technology and Learning

Over the past 20 years, technology has transformed society and changed many aspects of daily life. The proliferation of technology has led to a growing consensus among educators and the general public that it should play a more integral role in students' education. (Culp et al., 2003 CEO forum on Education and Technology) Districts and schools implement technology initiatives for different reasons. Program goals include increasing students' economic competitiveness, reducing inequities in access to computers, raising student achievement, increasing student engagement, creating a more active learning environment, and making it easier to differentiate instruction according to students' needs

### (Bonifaz & Zucker, 2004)

Within the United States and Canada, the phrase "e-learning" is often treated by users as a synonym for "online learning"-a more recent term, the very construction of which implies a fundamental relationship between e-learning practices and Web-based technologies like the internet. However, as many educational scholars have pointed out, the earliest examples of e-learning practice significantly pre-date the invention of the Web beginning with the invention of email in the early 1970s and continuing with the establishment of innovative "virtual schools" Barbour and Reeves (2009)

In the Philippines, the government aimed to become an e-service hub, and the IT service sector has been growing rapidly. Initiative innovative teaching and learning and becoming an ICT-enabled education have started more than a decade ago. In 1997, a National Information Technology Action Agenda for the 21<sup>st</sup> century, also known as IT 21, was formulated to formalize the country's vision to be globally competitive through information technology (Republic of the Philippines -National Information technology Council, 1997; UNESCO Bangkok). In the present time, strategically to make the country a "digitally empowered, innovative, globally competitive, and prosperous society where everyone has reliable, affordable and secure information access in the

• Ruth Ann Garcia Santos, Master of Science in Information Technology, Philippines, Head Database System Technology College of Information and Communications Technology, CICT & Graduate School Faculty PH-09973602585. E-mail: ruthanngsantos@neust.edu.ph

Philippines” (Philippines Digital Strategy, s2011) Among the many specific objectives, PDS aims to use ICT in education and training as a means to provide equitable access to opportunities. As a result, empowered and improved lives of every Filipino can be attained. The use of ICT in teaching environmental science and education is a unique opportunity for teachers. It provides significant benefits to the teachers as well as the learners and other stakeholders. These benefits include: provision of a qualitative access to education. Republic Act 10650, or the “Open Distance Learning Act,” signed by President Benigno Aquino III on the ninth of December 2014, seeks to expand and further democratize access to quality tertiary education through the promotion and application of open learning as a philosophy of access to educational services. According to West (2013) as mobile phones, tablets, and other connected devices become more prevalent and affordable, wireless technology can dramatically improve learning and bring digital content to students. Students love mobile technology and use it regularly with their personal lives. Technology-rich activities can sustain high-levels of student engagement and peer collaboration compared to less technology focused activities. Educators need to figure out how to harness mobile platforms for instructional purposes and employ them to boost educational learning. A majority (52 percent) of students in Grade 6-12 believe having access to a tablet computer is an essential component of their ultimate school. Fifty-one percent of school administrators agree with these sentiments as well. As a country, we need to educate the next generation of scientists, inventors, engineers and entrepreneurs. Educating a workforce that is effective in global context and adaptive as new jobs and roles evolve will help to support our economic growth. Mobile learning makes it possible to extend education beyond the physical confines of the classroom and beyond the fixed time period of the school day. It allows students to access content from home, communicate with teachers, and work with other people online. The value of mobile devices is that they allow students to connect, communicate, collaborate and create using rich digital resources. West (2013) cited that devices such as smart phones and tablets enable innovation and help students, teachers and parents gain access to digital content and personalized assessment vital for a post-industrial world. Mobile devices are essential tools to improve learning for students. This study aimed at providing a modern tool for teachers’ teaching and students’ learning in the form of Educational Mobile Learning Application (EMLA). The application allows teachers to develop lessons that can be viewed by their students via wireless network connection. They can also provide personalized exercises and quizzes that assess students’ understanding on the lesson. Teachers who are having a hard time delivering their lessons using limited books as references can possibly enjoy teaching using adequate electronic references available in the application. The application can greatly help teachers in teaching because the application auto generates an answer and solution to every exercise. The application serves as an inspiration to teachers to continuously search for a better way of teaching. One of the great features of the developed application is the capability to be viewed in different devices such as laptop, tablets and smart phones. The schools do not need to spend money in paying internet connection because application can run without the use of an internet. The application can run using only wireless network or wired area network.

## 1.1 Statement of Objectives

Objective 1: The development of EMLA based on the following Mobile Development Life Cycle (MDLC):

- Planning
- Designing
- Coding
- Testing
- Deployment

Objective 2: The Assessment on the technical qualities of EMLA based on the following ISO 9126 standards:

- Functionality
- Reliability
- Usability
- Efficiency
- Maintainability
- Portability

Objective 3: The assessment of the Mathematics teachers on EMLA based on the following:

- Instructional Use
- Graphical User interface

Objective 4: The assessment of the Grade 7 students based on the following

- Learning Engagement
- Graphical user interface

## 1.2 Scope and Delimitations

This study was delimited to the development and assessment of Educational Mobile Learning Application (EMLA) for Grade Seven students in the subject Geometry. For the development of the application PHP, CSS, Java and MySQL were utilized. Adobe photo shop was used for the design. This application has the ability to be viewed in several electronic devices like desktop, laptops, tablets and smartphones. Another feature of this application is that it can be run or operated with devices that are powered by different operating systems such as android, windows and IOS. However, Mobile Mathematics Learning Enhancer (EMLA) is a native application which means that the user should be connected in wired network or wireless network in order to view its content. This study provides three users with different uniqueness in function; students, teachers and administrator. The students are capable viewing lessons, dictionary exercises and quizzes with results. Teachers are capable of uploading and viewing of lessons, dictionary, exercises and quizzes with results. However, this application will not provide record of progress history of the students and will not be the primary basis of teachers in computing the actual grades of the students. Administrator is capable of adding, deleting, and editing lessons, exercises and quizzes as well as words in the dictionary and images in the data bank. Lessons should be reviewed and approved by the administrator first before it can be viewed by students. Also, the administrator is capable of creating a user account for the teachers. The application is not capable of correcting human errors such as typographical encoded words, wrong questions and other error committed by the user. It is strongly recommended that every lesson, exercise and quiz should be carefully checked by proper authority before uploading.

## 2.1 Research Design

The developmental method of research was used in the study. According to Richey (2005), as cited by Garcia (2012),

developmental research encompasses designing, developing, and evaluating instructional programs, processes and products that must meet the criteria of internal consistency and effectiveness. The most common type of developmental research involves situations in which the product-development process is described, and the final product is evaluated. In this study, the development process of the EMLA was described and assessed by the IT experts and end-users.

**2.2 Research Locale**

The study was conducted at the College of Information and Communications Technology (CICT), General Tinio campus, Cabanatuan City, Philippines the instructional use of the EMLA was conducted at San Josef National High School in the **Division of Cabanatuan City Philippines.**

**4. RESULTS AND DISCUSSION**

**4.1 Development**

The EMLA was developed following the five phases of Mobile Application Development Life Cycle. These phases are described below:

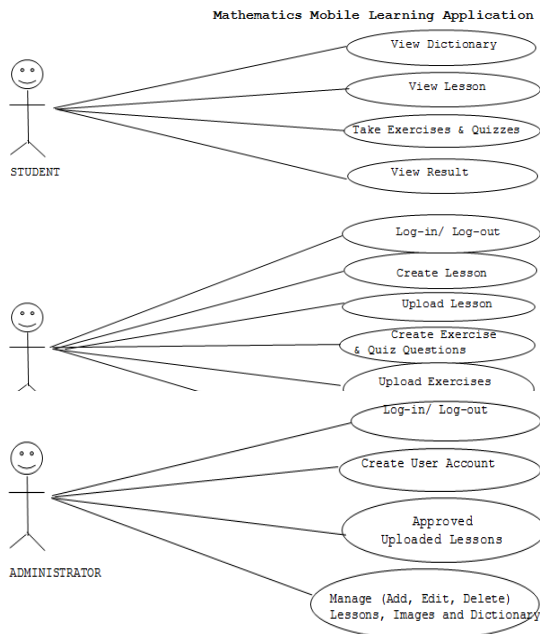
**Phase 1 - Planning**

In the planning phase, the researcher conducted interviews to prospective end users of EMLA and consultations with IT experts. Their comments served as additional inputs in designing the Application. A Gantt chart was used in used to monitor the development of the Application.

**Phase 2 – Designing**

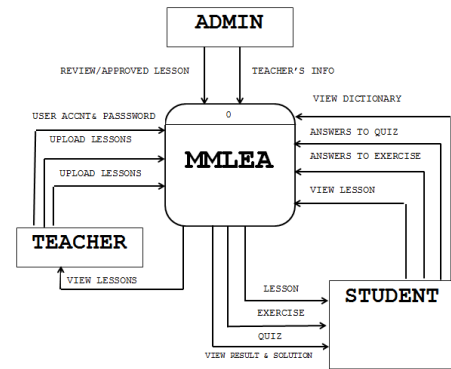
In this phase of development, lightweight proto type was made to determine the feasibility of the Application. Several diagrams were made to visualize the logical design of the EMLA.

The Use Case Diagram is the overview of the usage requirement of the system.



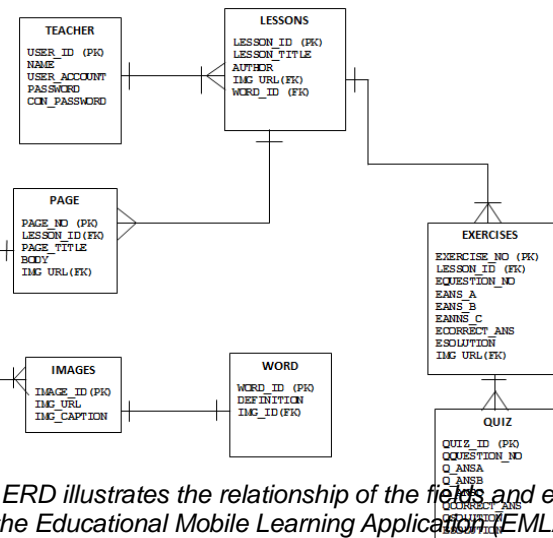
**Fig. 1.** illustrates the relationship between the user and the different use cases the user is engaged in.

The context Diagram shows the entities in the Application and the information that passed on to one another.



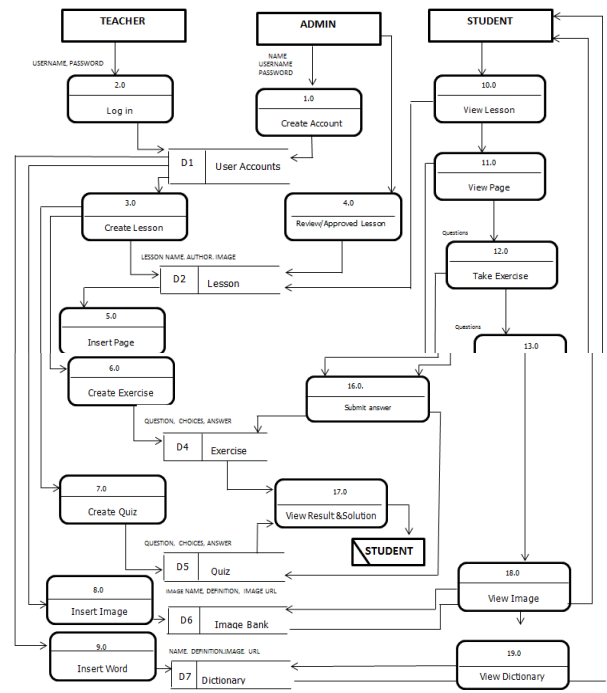
**Fig. 2.** illustrates the boundaries of the system and identifies the flow of information between the system and the boundaries of the system.

Entity Relationship Diagram (ERD) is a data modeling technique that graphically illustrates an information system's entities and the relationships between those entities



**Fig 3.** ERD illustrates the relationship of the fields and entities in the Educational Mobile Learning Application (EMLA).

A data-flow diagram is a way of representing a flow of a data of a process or a system.



**Fig 4.** DFD provides information about the output and input of each entity and the process itself.

### Phase 3 – Coding

This phase translates the design into an Application. The researcher used PHP database, MySQL server to develop the application. The researcher also used wireless area network-based connection.

### Phase 4- Testing

This phase is one of the most important phases of any development life cycle model. It is where the application is examined to determine whether the recommended requirements defined in phase I are achieved. This phase is conducted simultaneously with Phase 3. This was done to detect and modify needed features right away.

### Phase 5 - Deployment

This is the final phase in the development of the Application. After the testing has been conducted, and the assessment of the Application was sought from the IT professionals and end-users, the Application is now ready for deployment in mobile phones, tablets, and desk tops. A systematic examination in the actual environment was conducted to check the possible errors that may occur. The EMLA was assessed by three groups of respondents namely IT professionals, mathematics teachers, and Grade 7

## 4.2 Assessment by IT Professionals

The EMLA was assessed by IT professionals in terms of its technical qualities as set by ISO standards'

### 4.2.1 Functionality

Functionality is a set of attributes that bears on the existence of a collection of functions and their specified properties (ISO 9126). The functionality of the Application was assessed in terms of its capability to maintain the electronic lessons of the teacher to be used as learning aid for students and the capacity to store numerous lessons, words and images. The

Application has also features for students to review their lessons and take exercises. The descriptors of Functionality with mean ratings ranging from 4.3 to 4.6 were ability to maintain the electronic lessons of the teachers, capability to be used as electronic teaching aid for students, provision of features for students to review their lessons, and capacity to store numerous lessons, words and images. These descriptors were all rated excellent. On the provision to students to take exercises, the mean rating was 4.10 (Very good). When rated as a whole, the mean rating on the functionality of the Application was excellent. This means that the Application almost met all the requirements required on the functionality of the EMLA and no modification was recommended by the IT professionals to improve its quality.

### 4.2.2 Reliability

Reliability is a set of attributes that bears on the capability of software to maintain its level of performance under stated conditions for given period of time (ISO 9129). The reliability of the Application was rated excellent by the IT professionals. The mean ratings ranging from 4.00 to 4.5 indicated the excellent ratings on the capability of the Application to handle input errors, performance of the Application at specified level in case of faults or infringement on its specified performance. The Application was also free from major errors. These results showed that the Application is able to maintain its level of performance under stated conditions. The excellent ratings given by the IT professionals are indicative of the very good reliability quality of the EMLA.

### 4.2.3 Usability

Usability refers to the capability of software to be used for its intended purpose. (ISO 9126) The usability of the Application was assessed using two descriptors namely: ability to learn the operational procedure of the application, and the use of interface. The developed Application showed very strong evidence on its usability as revealed by the mean ratings of 4.30 in its ability to learn the operational procedure, and 4.50 on the use of the interface. The computed grand mean of 4.40 showed the excellent usability of the Application. These results also mean that the end users can use the Application easily. No modification was recommended by the IT professionals on this quality of the Application.

### 4.2.4 Efficiency

Efficiency denotes a set of attributes that bears on the relationship between the level of performance of the application and the amount of resource used under stated conditions. It is the extent to which time or effort is well used for intended task or purpose. (ISO 9126) The mean ratings given by the IT professionals on the efficiency of the Application ranged from 4.40 to 4.60. These numerical ratings have qualitative descriptions of excellent. The IT professionals found very strong evidence on the attributes of the Application to respond to user's command, prompt response to user's command, and to withstand the duration of use in performing its functions. With these attributes found by the IT professionals in the Application, no modification was recommended to the researcher

### 4.2.5 Maintainability

Maintainability is the characteristic of software that bears on the effort needed to make specified modifications. (ISO 9126)

Strong evidences were found on the attributes of the Application to trap incorrect inputs, to modify it in case environmental change occurs, and to respond to risk of unexpected effect of modification. These attributes indicated that no effort was needed to modify some specifications on the Application. The mean ratings given by the IT professionals within the interval 4.50 to 4.60 were qualitatively described as excellent

#### 4.2.6 Portability

Portability refers to a set of attributes that has the ability to be transferred from one environment to another. (ISO 9126)

The 4.60 Mean Rating given by the IT professionals reveal that the EMLA is portable and accessible to many electronic devices.

**TABLE 1**  
SUMMARY OF RATINGS TECHNICAL QUALITIES

Quality Characteristic	Mean Rating	Qualitative Description
Functionality	4.34	Excellent
Reliability	4.27	Excellent
Usability	4.40	Excellent
Efficiency	4.50	Excellent
Maintainability	4.53	Excellent
Portability	4.60	Excellent
Grand Mean	4.44	Excellent

The table 1 shows the summary of ratings given by the IT professionals on the technical qualities of the EMLA. The Application is ready to be installed and utilized in electronic gadgets like mobile phones, tablets, desktops for instructional use of teachers and students. The IT professionals rated the technical qualities of the Application excellent and were strongly convinced that the EMLA will serve its intended purpose.

### 4.3 Assessment by Teachers

#### 4.3.1 Instructional Use

Instructional use refers to a medium of media used for conveying knowledge and information to a student.

**TABLE 2**  
ASSESSMENT ON THE INSTRUCTIONAL USE

Descriptor	Mean Rating	Verbal Description
Attribute to accept the uploaded lessons from peers teaching the same lesson in the developed application	5.00	Excellent
Attribute to view the lesson by peers.	4.90	Excellent
Attribute to accept uploaded exercises	5.00	Excellent
Attribute to accept uploaded quizzes	4.90	Excellent
Attribute to view results of students' exercises and quizzes	5.00	Excellent
Grand Mean	4.96	Excellent

The instructional use of the Application was rated excellent by mathematics teachers as revealed by the computed grand mean rating of 4.96 to all descriptors. Teachers were strongly convinced that the Application has the attribute to accept the uploaded lessons from peers teaching the same lesson, and uploaded lessons can be viewed by peers in the same way.

Exercises and quizzes can also be uploaded in the Application, and the results of these when taken by the students can be viewed by both teachers and students.

#### 4.3.2 User Interface

Graphical User Interface (GUI) is a program interface that takes advantage of the computer's graphics capabilities to make the program easier to use

**TABLE 3**  
ASSESSMENT ON THE USER INTERFACE (TEACHERS)

Descriptor	Mean Rating	Verbal Description
Appealing design in terms of screen layout, and colors	4.70	Excellent
Presence of prompts and warning messages	4.90	Excellent
Easy interaction with icons and menus	4.80	Excellent
Grand Mean	4.80	Excellent

The Application was assessed excellent as shown by the grand mean rating of 4.8. The design in terms of screen layout, and colors, presence of prompts and warning messages, and easy interaction with icons and menus have shown very strong evidence of existence. The mathematics teachers have no suggestions on the GUI of the Application. This suggests that the development of the Application was well done.

### 4.4 Assessment by Students

#### 4.4.1 Learning Engagement

Learning Engagement refers to the degree of attention, curiosity, interest, optimism, and passion that students show when they are learning or being taught, which extends to the level of motivation they have to learn and progress in their education.

**TABLE 3**  
ASSESSMENT ON LEARNING ENGAGEMENT

Descriptor	Mean Rating	Verbal Description
Interesting to use when viewing the uploaded lessons	4.64	Excellent
Easy to interact with in taking exercises and quizzes	4.72	Excellent
Immediate feedback on the results of exercises and quizzes taken	4.74	Excellent
Capability of the Application to revisit or review the lessons when needed	4.70	Excellent
Grand Mean	4.70	Excellent

The students gave excellent rating on the Application in terms of their learning engagement. This is shown by computed grand mean rating of 4.7. The students also said that they appreciated taking exercises using the Application because an immediate feedback is provided to them regarding the answers that they gave. They were able to check for themselves their readiness to take the quizzes. When they found out that some answers given were incorrect, they can easily revisit the menus and review the lessons. The students claimed that using the Application in their mathematics subject gave them the first and wonderful experience in using their

handheld mobile phones and desktops in learning

#### 4.4.2 User Interface

Graphical User Interface (GUI) is a program interface that takes advantage of the computer's graphics capabilities to make the program easier to use.

**TABLE 4**  
**ASSESSMENT ON THE USER INTERFACE (STUDENTS)**

Descriptor	Mean Rating	Verbal Description
Appealing design in terms of screen layout, and colors	4.60	Excellent
Presence of prompts and warning messages	4.62	Excellent
Easy interaction with icons and menu	4.72	Excellent
Grand Mean	4.65	Excellent

The students gave an excellent rating (4.65) on the GUI of the Application. They students said that the EMLA has an appealing design in terms of screen layout, and colors. The presence of prompts and warning messages was also evident. Interaction with icons and the menus was also easy. In general, the students claimed that the design of the Application was not difficult to follow as the GUI was familiar to them. An analysis on the assessment made by the three groups of respondents results to the excellent development of the EMLA. The IT professionals found the adherence of the quality characteristics of the Application to the quality standards of software or application development. The technical qualities sufficed the criteria required in software development. In fact, no modification was recommended to the developed EMLA. The excellent ratings given by the mathematics teachers show that they welcome the innovation to use a developed Application as a tool in teaching. In this era of digital age, teaching would be easier and more convenient to them since their students are hooked of using electronic gadgets in their everyday lives. Hence, it's not quite difficult to motivate the students to use their gadgets in their studies. However, the teacher-learner interaction was viewed to have been minimized in this context. The social aspect of learning is lessened as the students interact with their own electronic gadgets. Hence, the teacher should not confine his/her pedagogy in developing students' conceptual understanding through the use of the Application. The Application should only be used to supplement classroom instruction. The excellent ratings given by the students on the use of the Application can be construed as a positive acceptance by the students in this mode of learning. Instead of disallowing the students to use their computer gadgets, they should understand that its use can be extended in their studies.

## 4. CONCLUSION

The Application serves its purpose as a teaching and learning tool for teachers and students. The Application is an innovative tool to make use of the power of computer technology in the teaching-learning process. The Application adheres to the quality requirements of software or application development set by ISO. The Application was well-developed as it was found complete and satisfactory in its purpose for development by IT professionals. No modification was recommended on the technical features of the Application. The teachers found the

Application excellent to use for instruction. The features of the Application incorporated with the GUI are an innovative and modern tool for teaching. The enjoyment of the students in using the Application proves that computer gadgets have a variety of important uses. When using the Application, social interaction between teachers and students is lessened as the students have only direct engagement with the computer devices, hence, the teacher and the students should not entirely rely on the use of the Application when teaching and learning mathematics.

## ACKNOWLEDGMENT

The researcher wishes to extend her most sincere gratitude and appreciation to the people that contributed and extended their valuable assistance in the preparation and completion of this study.

## REFERENCES

- [1] Anderson, Rick (2011). "Can Mobile Devices Transform Education" Association for Supervision and Curriculum Development. February 11, 2011
- [2] Sisah Technologies (2010) "Mobile Learning" Computers and Education, 46:3 Apr. 2010, 280-293
- [3] Seels, B. B., & Richey, R.C. Instructional technology: The definition and domains of the field. Washington, DC: Association for Educational Communications and Technology (1994).
- [4] MJ Rosenberg, R Foshay " E-learning: Strategies for delivering knowledge in the digital age"- Performance Improvement, Wiley Online Library 2002
- [5] Dongson Zhan, J Leon Zhao, Ling Zhou, Jay Numaker Jr" Can E-Learning replace classroom learning" vol 47 no 5 May 2014
- [6] Mohamed Ally, Josep-Prieto-Blazquez "What is the future of mobile learning in education" January 2014
- [7] Venkata N. Inukollu, Divya D. Keshamoni, Taeghyun Kang, Manikanta Inukollu "Factors Influencing Quality of Mobile Apps: Role of Mobile App Development Life Cycle" October 2014
- [8] Luvai F. Motiwalla "Mobile Learning: A framework and evaluation" Computers & Education November 2007
- [9] Cobcroft, Rachel S., Towers, Stephen J., Smith, Judith E. & Bruns, Axel" Online Learning and Teaching (OLT) Conference 2006" September 2006
- [10] Samsiah Bidin, Azidah Abu Ziden "Adoption and Application of Mobile Learning in the Education Industry" Procedia- Social and Behavioral Sciences Volume 9, October 2013 page 720-729
- [11] Collado, Marcelino C. "Android Mobile Learning Application for computer fundamentals". (Unpublished manuscript)