MOBILE BASED APPLICATION FOR CURRICULUM CONTENT DELIVERY IN KENYAN PRIMARY SCHOOLS

BY

AMWAYI ABEL IMBOSA

UNITED STATES INTERNATIONAL UNIVERSITY - AFRICA

SPRING 2018
MOBILE BASED APPLICATION FOR CURRICULUM CONTENT DELIVERY IN KENYAN PRIMARY SCHOOLS

BY

AMWAYI ABEL IMBOSA

A Project Report Submitted to the School of Science and Technology in Partial Fulfillment of the Requirement for the Degree of Master of Science in Information Systems and Technology

UNITED STATES INTERNATIONAL UNIVERSITY - AFRICA

SPRING 2018
STUDENT’S DECLARATION

I, the undersigned, declare that this is my original work and has not been submitted to any other college, institution, or university other than the United States International University Africa for academic credit.

Signed: ___________________________ Date: __________________________

Amwayi Abel Imbosa (ID No: 633444)

This project has been presented for examination with my approval as the appointed supervisor.

Signed: ___________________________ Date: __________________________

Joshua Rumo Ndiege, PhD

Signed: ___________________________ Date: __________________________

Dean, School of Science and Technology
ABSTRACT

The growth of technology specifically the mobile devices has been exponential and this is evident in the growth of smart phones and mobile devices around the world. The growth has also encouraged its usage in educational environments such as in schools. In several countries the smartphones have been introduced in the various schools so as to aid in learning and many other different benefits. In Kenya, the government through the digital literacy programme, has provided tablet devices to various schools in the country. There are however challenges of delivery of the curriculum through the devices. This study looks at the challenges in delivery of curriculum content in one of the primary schools within Nairobi in Kenya and proposes a mobile based application for use in curriculum delivery. The aim is to advance knowledge of mobile learning using mobile applications in developing countries. The study employed design science research in the development of the proposed artifact. An initial survey was used alongside the literature review to identify functional requirements for the system. This initial survey revealed there were challenges experienced in the current curriculum delivery initiatives used in the school. From the sample surveyed, the students felt that: the current teaching methods employed were not suitable; current delivery was not helpful and there was lack of new ways to help the students learn better. The literature review provided knowledge on mobile learning and the challenges that have been experienced in the development of mobile applications for learning. Further, the application was subject to evaluation for relevance. The evaluation of the application was undertaken by a convenience sample population of one class that comprised of 28 primary school students and 5 teachers. The general outcome affirmed that the mobile application can be utilized to deliver learning content in primary schools. It will be valuable for primary schools to consider utilization of mobile technology to help supplement and improve efforts towards efficient and effective curriculum delivery.
PUBLICATION

Refereed Conference Paper

ACKNOWLEDGEMENT

I would like to thank the Almighty God for his guidance throughout the master’s degree program. I owe special thanks to the lecturers that have assisted me at every stage during the journey. I would also like to thank my supervisor for valuable guidance and support that has enabled me to complete the project.
DEDICATION

I would like to dedicate this work to my family who have been my support system throughout this journey. It is though their encouragement that is have been able to come this far in my studies.
# TABLE OF CONTENTS

STUDENT’S DECLARATION ........................................................................................................ iii
COPYRIGHT .............................................................................................................................. iv
ABSTRACT .............................................................................................................................. v
PUBLICATION ........................................................................................................................ vi
ACKNOWLEDGEMENT .......................................................................................................... vii
DEDICATION ........................................................................................................................ viii
TABLE OF CONTENTS .......................................................................................................... ix
LIST OF TABLES .................................................................................................................. xiii
LIST OF FIGURES ................................................................................................................ xiv

Chapter 1 : Introduction ....................................................................................................... 1
1.1. Background of the Problem .......................................................................................... 1
1.2. Statement of the Problem ........................................................................................... 5
1.3. General Objective ....................................................................................................... 6
1.4. Research Objectives .................................................................................................... 6
1.5. Importance of the Study ............................................................................................. 7
1.6. Scope of the Study ........................................................................................................ 7
1.7. Definition of Terms ..................................................................................................... 7
1.8. Chapter Summary ........................................................................................................ 8

Chapter 2 : Literature Review ............................................................................................. 9
2.1. Introduction .................................................................................................................. 9
2.2. Current Delivery of Learning Curriculum .................................................................. 9
2.3. Development of Mobile Learning Application Prototype ........................................ 11
2.4. Evaluation of the Usability of the Mobile Learning Application Prototype ............ 14
2.5. Research Approach .................................................................................................... 16
2.6. Chapter Summary ....................................................................................................... 18
Chapter 3: Methodology ........................................................................................................20

3.1. Introduction ......................................................................................................................20

3.2. Research Design .............................................................................................................20

3.3. Population and Sampling Design ..................................................................................22

  3.3.1. Population ..................................................................................................................22

  3.3.2. Sampling Design and Sample Size ............................................................................23

3.4. Data Collection Methods ..............................................................................................23

3.5. Research Procedures ......................................................................................................23

3.6. Data Analysis Methods ..................................................................................................24

3.7. Ethical Consideration ......................................................................................................25

3.8. Chapter Summary ...........................................................................................................25

Chapter 4: System Implementation .......................................................................................27

4.1. Introduction .....................................................................................................................27

4.2. Analysis ..........................................................................................................................28

4.3. Modelling and Design ....................................................................................................29

  4.3.1. Use Case Modelling .................................................................................................30

  4.3.2. Use Case Narration ..................................................................................................31

  4.3.3. Sequence Diagram ..................................................................................................32

4.4. Proof of Concept ............................................................................................................33

  4.4.1. Technologies Used ....................................................................................................33

  4.4.2. Results of Development .........................................................................................34

  4.4.3. Testing .......................................................................................................................40

4.5 Chapter Summary ............................................................................................................41

Chapter 5: Results and Findings ............................................................................................43

5.1. Introduction .....................................................................................................................43

  5.1.1. Demographic .............................................................................................................43
5.2. Current Delivery of Curriculum ................................................................. 44
  5.2.1. The Current Teaching Delivery ............................................................ 44
  5.2.2. Suitability of Current Teaching Methods ............................................. 45
  5.2.3. Technology Incorporation into the School System .................................. 46
  5.2.4. Technology Aiding Students to Learn .................................................. 47
  5.2.5. Learning with Mobile Applications ...................................................... 48
  5.2.6. Using Learning Application to Learn .................................................... 49
5.3. Development of the Mobile Learning Application Prototype ....................... 50
5.4. Evaluation of the Mobile Application Prototype ......................................... 51
  5.4.1. Ease of Using the Mobile Application ................................................... 51
  5.4.2. Ease of Learning using the Mobile Application ...................................... 52
  5.4.3. Mobile Application User Experience ................................................... 53
  5.4.4. Delivery of Learning Content ............................................................... 54
  5.4.5. Motivate Students to Learn ................................................................. 55
  5.4.6. Mobile Learning Anywhere .................................................................. 56
  5.4.7. Relevance of the Mobile Learning Application ....................................... 57
  5.4.8. Mobile Application Content Language ................................................ 58
  5.4.9. Mobile Application Customized Learning Content ................................ 59
5.5. Chapter Summary ....................................................................................... 61

Chapter 6 : Discussion, Conclusions and Recommendations ............................ 62
  6.1. Introduction ............................................................................................. 62
  6.2. Summary ................................................................................................. 62
  6.3. Discussion ............................................................................................... 63
    6.3.1. Current Curriculum Delivery .............................................................. 63
    6.3.2. Development of Mobile Learning Application Prototype ..................... 64
    6.3.3. Evaluation of the Mobile Learning Application Prototype ..................... 65
6.4. Conclusions.............................................................................................................67

6.4.1. Current Curriculum Delivery ........................................................................67

6.4.2. Mobile Learning Application Prototype .........................................................67

6.4.3. Evaluation of the Usability of the Mobile Application Prototype .................67

6.5. Recommendations ...............................................................................................68

REFERENCES .............................................................................................................69

APPENDICES .............................................................................................................74

APPENDIX I: STUDENT QUESTIONNAIRE ..........................................................74

APPENDIX II: TEACHER QUESTIONNAIRE .........................................................77

APPENDIX III: SAMPLE CODE SOURCE ....................................................................79
LIST OF TABLES

Table 3-1. Design Science Phases ................................................................. 21
Table 4-1. Use Case Narration ........................................................................ 31
Table 4-2. Test Cases ..................................................................................... 40
Table 5-1. Student Gender Distribution .......................................................... 43
Table 5-2. Teacher Gender Distribution .......................................................... 44
LIST OF FIGURES

Figure 2-1. Research Process Flow ................................................................. 17
Figure 4-1. Prototyping Model ................................................................. 27
Figure 4-2. Use Case Model ................................................................. 30
Figure 4-3. Sequence Diagram ................................................................. 32
Figure 4-4. Splash Screen ................................................................. 34
Figure 4-5. Second Page Illustration ................................................................. 35
Figure 4-6. Second Page Illustration ................................................................. 35
Figure 4-7. Subject Selection ................................................................. 36
Figure 4-8. Home Navigation ................................................................. 36
Figure 4-9. Assessment ................................................................. 37
Figure 4-10. Level One Lesson One ................................................................. 37
Figure 4-11. Level One Lesson Two ................................................................. 38
Figure 4-12. Level Two Lesson One ................................................................. 38
Figure 4-13. Level Two Lesson Two ................................................................. 39
Figure 4-14. Level Two Lesson Three ................................................................. 39
Figure 4-15. Level Three Lessons ................................................................. 40
Figure 5-1. Students’ Findings on whether Current Delivery is helpful ................................................................. 45
Figure 5-2. Teachers’ Findings on Curriculum Delivery ................................................................. 45
Figure 5-3. Students’ Findings on Teaching Method Suitability ................................................................. 46
Figure 5-4. Teachers’ Findings on Teaching Method Suitability ................................................................. 46
Figure 5-5. Students’ Responses on Incorporation of Technology in Schools ................................................................. 47
Figure 5-6. Teachers’ Responses on Incorporation of Technology in Schools ................................................................. 47
Figure 5-7. Students’ Responses on whether Technology will help Students Learn ................................................................. 48
Figure 5-8. Teachers’ Responses on Technology Aiding Students Learn ................................................................. 48
Figure 5-9. Students’ Responses on whether Students can Learn better using Mobile Applications

Figure 5-10. Teachers' Responses on Students Learning better with the aid of Mobile Applications

Figure 5-11. Students’ Responses on Usage of Learning Application to Learn

Figure 5-12. Teachers’ Responses on Usage of Learning Application to Teach

Figure 5-13. Students’ Responses on Introduction of Technology

Figure 5-14. Students' Responses on Delivery of Learning Content via the Mobile Application

Figure 5-15. Students’ Responses on Ease of Learning using the Mobile Application

Figure 5-16. Teachers' Responses on Ease of use of Mobile Application

Figure 5-17. Teachers' Responses Students Learning Using the Mobile Learning Applications

Figure 5-18. Teachers’ Responses on Ease of Use of the Application

Figure 5-19. Students’ Responses on User Experience

Figure 5-20. Teachers’ Responses on User Experience

Figure 5-21. Students' Responses on Usage of Applications to Deliver Learning Content

Figure 5-22. Teachers' Responses on Mobile Application Delivering Learning Content

Figure 5-23. Students' Responses on Mobile Application Motivating Students to Learn

Figure 5-24. Teachers' Responses on Motivating Students to Learn

Figure 5-25. Students' Responses on using Mobile Application to Learn Anywhere

Figure 5-26. Teachers' Responses on Learning Anywhere using the Mobile Application

Figure 5-27. Students’ Responses on Mobile Learning Application Content

Figure 5-28. Teachers' Responses on Relevance of Learning Content

Figure 5-29. Students’ Responses on whether the Content Language used was Understandable
Figure 5-30. Teachers' Responses on whether the Content Language used was Understandable .................................................................59

Figure 5-31. Students' Responses on Customized Content based on Students' Abilities ..60

Figure 5-32. Teachers' Responses on Customized Content Based on Student Abilities ...60
Chapter 1 : Introduction

1.1. Background of the Problem

The growth of technology specifically the mobile devices has been exponential and this is evident in the growth of smart phones and mobile devices around the world. The growth has also encouraged its usage in educational environments such as in schools. In several countries the smartphones have been introduced in the various schools so as to aid in learning and also help improve the digital literacy. In Kenya, through the digital literacy programme the government has introduced the use of tablets in various primary schools. However, there is a challenge in the delivery of the learning content to the students as the curriculum delivery is not well defined or guidelines are non-existent in using the mobile smart phones and tablets to aid in learning in schools in developing economies such as Kenya. This results in various smart phones or devices being used to deliver the curriculum, however, these have not been contextually appropriate. This is evident based on the various studies that have focused on mobile learning through the development of frameworks or prototypes but have encountered some challenges. This study focuses on the use of the mobile application to deliver learning content to students.

The emergence of new technology brings about new opportunities that can be used to influence and improve current processes and also solve some of the challenges being faced in developing economies. An emerging technology around the world is the mobile technology, the advances in mobile technologies have enabled users to be able to access multimedia materials and its portability has enabled learners gain knowledge without the bounds of time and space (Lin, Lin, Yeh, & Wang, 2016). The advancement of the mobile technology has resulted in other forms of utility as the new technology can be used to help improve and assist daily life activities. Technology has grown rapidly and is changing various aspects of life and when used wisely it can be used to support learning (Salman & Antonius, 2017).

The mobile phone technology can be used in innovating new ways of learning and content delivery around the world. This has resulted in the various schools around the world looking at different ways of delivering learning content through the use of the smart phone devices. This new method of education content delivery through mobile devices is referred to as mlearning (Parhizkar, et al., 2012).
Mlearning can be defined as any sort of learning that occurs when the learner takes advantage of mobile technologies to learn (Al-Hmouz & Freeman, 2010). In addition, mobile learning can also be described as the use of a mobile application to access information and learning material from anywhere at any time through the use of a mobile device (Parhizkar, et al., 2012). Previous research has shown that when the mobile technology is used well and appropriately it can support and extend traditional material in valuable ways and increase the cognitive development in toddlers (Ramnarain-Seetohul, Beegoo, & Ramdhony, 2016). The mobile learning growth has been as a result of the growth of the mobile technology. However, mobile learning provides a challenge, this is because with the introduction of the new way of learning, new methods of curriculum content delivery need to be addressed.

Content delivery is advancing and this is due to the introduction of the technology. Over the years, advancement in the learning process has greatly been influenced by the latest developments in the information and communication technology (Özdoğan, Başoğlu, & Erçetin, 2012). Research by United Nations Educational, Scientific and Cultural Organization (2012) shows that many educational policies make reference to the technology but few focus on how this will influence the delivery of education in the future. This has however not hindered teachers from integrating technology in the classroom activities (Gu, Tzou, & Hoda, 2014). Various researchers have been able to begin the initial stages of the process mobile learning and how content is to be delivered to the students.

The studies have shown that technology does indeed play an important role in complimenting the learning in various institutions. For example a study by Gitonga, Muuro, & Onyango (2016) showed that technology introduction in the classroom can be used in the teaching and learning. In their study, Joel and Mussa (2015) found that in various countries in Africa use of learning management systems were being used to compliment the traditional face to face classroom sessions so as to widen access to education. This shows that technology is growing and can be used to compliment traditional education in that it can be used to deliver learning content. Various researchers have also undertaken research to investigate various objectives of the mobile learning. For example a study by Salman and Antonius (2017) aimed at investigating the possibility of using a mobile application to help in teaching children to learn the alphabet.

In China research by Mingyong (2015) in Hubei aimed at investigating the adoption of mobile technology in English instruction in the institutes of higher vocational education.
The study focused on seven areas of mobile technology such as; the adoption level of the mobile technology; possibility of adopting mobile technology; obstacles of the mobile technology; the availability of the devices to students; interest of the leadership in purchasing mobile devices and benefits from adopting the use of mobile technology and unsatisfactory results about the adoption of the mobile technology. The research found that even though data of current adoption exists, more research needed to be done, in order to be able to develop mobile learning applications that can be used in the various schools.

Furthermore, a study by Sheng-Hung (2012) in Malaysia focused on the integration of the learning objects and knowledge map as a learning sequence suggestion in the mobile learning environment, technologies involved, applications and the usability, accessibility, evaluation and effectiveness. The model developed from the research can be implemented to enhance learning experiences in mobile learning. The researchers provided great insights into important aspects that can be used in the mobile learning.

In their study Passey and Zozimo (2016) explored the context, development and outcomes of a Cross-European training program and the development of the mobile learning in classrooms in The Netherland, England, Greece and Italy. The research found that there was rapid intake and use of devices however long-term integration may need more focus on specific learning activities. They further suggested that more research needs to be done as this area of study was still underdeveloped because it was a new technology.

Mobile learning applications can also be used to help students learn certain concepts. This resulted in Ojanen, et al (2015) conducting a study aimed to identify if mobile phones and ICT- based learning games could be a way of supporting children’s early grade literacy skills in Zambia. They developed a learning game which they introduced in a primary school, they were able to find that for students who played the game they were able to perform better in a post assessment test. The study was also expanded to many African countries such as Namibia, Tanzania and Kenya. The mobile application however did not provide curriculum content to the students so that they can be able to learn.

In South Africa, a study by Molebatsi and Phorah (2015) reviewed previous articles and previous studies which relate to the use of mobile devices for portable learning instruction or mlearning and assessed the potential and the versatility of mlearning for mobile education in institutions of higher learning. The study found that students in South Africa were already using the mobile devices in their learning processes in one way or another.
This was however not structured form of mlearning as the content they were accessing was not relevant and did not adequately provide the best results to the students.

A study in Malaysia by Harfield et al. (2013) aimed to develop a mobile application to develop a support environment for teachers through the use of tablets for primary school first year education. The mobile application in the tablet enabled the teachers to be able to gain insight on the state of learning. The study was able to demonstrate how the application can be used by teachers to help supplement the learning and teaching process.

Previous studies have also focused the use of mobile applications for education purposes. For example, Salman & Antonius (2017) undertook a study in Indonesia where they introduced a learning game for children learning games. The study aimed at investigating the possibility of using a mobile application to help in a learning environment by helping in teaching the children to learn the alphabet. The application was evaluated by parents whose children have tried the game. The researchers aimed to establish whether it was possible to help children learn through different media such as the mobile phone.

In Tanzania Mahenge, Mwangoka and Simba (2014) were able to undertake a study of proposing a cost effective Mobile based learning content delivery approach for resource and network constrained environments. They aimed to provide a solution that can be able to reduce resources used on the server side so as to enable learning content to be synchronized on the mobile devices. The study was able to design a cost effective mobile based delivery system to facilitate the learning using constrained resources available. This study provided a cost-effective way of how platforms can be developed but they were not able to develop the mobile application that can be used to deliver learning content.

Research by Mandula et al. (2013) focused on the delivery of learning content through the mobile devices. They investigated how ontologies can be used to represent knowledge for sharing and using content among mobile learning systems. Their study involved the development of a prototype which was used in the delivery of the learning content. The findings of the study were that they were able to deliver sample learning content through the mobile phone but more research needs to be undertaken to survey the efficiency and the usefulness of the system. The prototype that was develop did not achieve any usefulness to their target audience with regards to how curriculum content is to be delivered.

Previous studies have also attempted to develop frameworks, for example Crompton (2017) in her study explored the theories and the empirical evidence of educator technology
integration to develop a framework for integrating mobile technology and learning. The study found that the framework could help in the adoption of the mobile technology for learning use. The framework developed can be used to guide the introduction of the mobile technology in the learning process.

In Australia, Al-Hmouz & Freeman (2010) research was based on the development of a framework to describe the various factors that play an important role in the delivery of the learning content to mobile learners. The framework which was developed allows for the consideration of various individual learning styles that differ, device and application capabilities, material structure and the delivery format to the user. The goal of the framework was to provide a logical structure for adapting learning content to the mobile phone users who learn through them.

The various studies have aimed to investigate whether the delivery of learning content through a mobile device was possible through various modes of research. Some of the researchers focused on the adoption of the mobile devices in learning environments others focused on the delivery of the learning content in the mobile devices and whether this was feasible. Some of the trends that were common in previous studies was that mobile learning was still in its infancy stages and that more needed to be done (Al-Hmouz & Freeman, 2010).

The various researchers have provided great knowledge to this area of study. however, it is evident that from the various research that they have undertaken, none has been able to address clearly the delivery of the mobile application in a primary school environment and how the mobile applications have been able to support the traditional mode of learning. The area of study is still in its infancy stages and this study will provide the opportunity to clearly address the challenge of how the curriculum content is to be delivered through the various mobile smart devices used by the students through the use of a mobile application.

1.2. Statement of the Problem

The advancement of the mobile technology has resulted in other forms of utility as the technology can be used to help improve and assist daily life activities. Technology has grown rapidly and is changing the various aspects of life and when used wisely it can support learning (Salman & Antonius, 2017). The introduction of mobile technology in schools such as in Kenya through the digital literacy programme by the government of Kenya provides an opportunity to deliver learning content through the mobile tablet
devices. The challenge is how to deliver the learning content via the tablet devices. There are little or no concrete steps that are to be followed so as to guide the delivery of curriculum content through the devices.

As mentioned, Crompton (2017) in her study explored the theories and the empirical evidence of educator technology integration to develop a framework for integrating mobile technology and learning. The study found that the framework could help in the adoption of the mobile technology for learning use. The framework developed can be used to guide the introduction of the mobile technology in the learning process.

In an attempt to provide a logical structure for adapting learning content to the mobile phone users who learn through them. Al-Hmouz & Freeman (2010) focused on development of a framework to describe the various factors that play an important role in the delivery of the learning content to mobile learners. The framework which was developed allows for the consideration of various individual learning styles that differ, device and application capabilities, material structure and the delivery format to the user.

The studies illustrate that some effort is being made to develop frameworks, but more needs to be undertaken to guide the delivery of curriculum content through the mobile technology so as to ensure that best practices are achieved so as to deliver learning content. Furthermore, it is important that such applications address the unique needs of learners. Previous studies have identified some of the challenges of learning using the mobile applications and this study aims to further knowledge in this area by developing contextualized relevant mobile learning application that supports the learners in Kenya.

1.3. General Objective

The general objective of the study is to develop a contextually relevant mobile solution prototype for the curriculum delivery.

1.4. Research Objectives

To achieve the stated general objective, the following research objectives will be used:

1. To investigate the current challenges with the delivery of curriculum content.
2. To develop a mobile learning application prototype.
3. To evaluate the usability of the proposed mobile learning application prototype.
1.5. Importance of the Study

The study aims to develop a mobile learning application prototype for learning purposes. Previous studies have identified that there has been a challenge with the adoption of the mobile devices and this has impacted the delivery of the content. This has been due to several factors such as complexity of the application and the devices, lack of support services and also competencies when using the mobile application. The study will help contribute to research on the ways in which delivery of the mobile application can be undertaken.

The study is also important because it will expand the research of the usage of mobile phones in the learning environment in primary schools within the Kenyan context. The study will enhance the research on the mobile learning by demonstrating the introduction of the mobile application in primary schools. This will contribute to current research on mobile learning in schools within Africa.

Technology is changing and the way we learn is also changing, with the growth of the mobile devices the study will illustrate how mobile applications can be used. It will enhance research and aim to validate that mobile learning can be a new way of learning.

The government of Kenya through Kenya Institute of Curriculum Development (2016) released guidelines that will help in providing guidelines of how mobile applications will be developed by content providers. The guidelines provide a blue print of what needs to be achieved to develop mobile applications for the various academic levels. The study will provide an avenue for evaluating the application of the guidelines.

1.6. Scope of the Study

The study employed a case study of Bidii primary school in Nairobi. The population used was a convenience sample of one class comprising of 28 primary school students and 5 teachers. Due to the limitations of the study, the type of smart phone device used was android based with android version of 6.0.

1.7. Definition of Terms

1. Mlearning

Mlearning can be defined as any sort of learning that occurs when the learner takes advantage of mobile technologies to learn (Al-Hmouz & Freeman, 2010).

2. Adoption: This refers to the processes of taking up and practice.
3. **Android**: This refers to a mobile smartphone operating system.

4. **iOS**: This refers to a mobile smartphone operating system.

5. **Curriculum**: This refers to a set of courses which constitute an area of specialization.

6. **Mobile Application**: This refers to a smartphone-based software that is used in mobile devices so as to perform various tasks.

### 1.8. Chapter Summary

Curriculum delivery in many areas around the world has followed the teacher student in a classroom model. This has been the norm in many areas around the world. The growth and use of technology is influencing changes in everyday life. A main area where the technology is being used is in education. The mobile technology growth has resulted in the use of the mobile phones to deliver learning content to students in various areas from kindergarten, primary schools and universities.

Various studies have conducted research on the use of mobile applications to deliver learning content. Some of the previous studies have focused on the development of frameworks that can be used in supporting the learning in schools. The frameworks have provided a sample blue print of how mobile applications can be developed to help deliver mobile content to students. The frameworks provided several steps that might be followed in the development of the mobile applications.

Studies have also been conducted on the use of mobile applications to deliver learning content. However, they have not been able to fully illustrate the possibility of delivering curriculum content in primary schools through the mobile application. The study will survey the current state of content delivery through previous literature. The study will also undertake the mobile application development that will be used in the study and focus on the evaluation of the mobile application.

The next chapter presents the theoretical base for the study by evaluating studies based on the current state of curriculum delivery and some of the present challenges and the development of the mobile learning application.
Chapter 2: Literature Review

2.1. Introduction

The previous chapter focused on the introduction of study and presentation of the problem. This literature review section presents the theoretical base of the study. The chapter aims to establish the theoretical foundation of the delivery of learning content through the use of a mobile application.

The delivery of learning content through the use of a mobile application has been undertaken in various studies. In this study three objectives were to be achieved; to investigate the current delivery of curriculum content, to develop a mobile learning application prototype and to evaluate the usability of the proposed mobile learning application prototype.

2.2. Current Delivery of Learning Curriculum

The delivery of the learning curriculum is different in many developing economies across Africa. This may be due to several factors such as the government policy of the specific country, structure of the education system in the country and also the language of the specific country. The different factors influence the different delivery modes that are present in the different countries. Various learning delivery modes have been evaluated through the previous literature to establish where the challenges are and how the introduction of the mobile application can be utilized to address the gaps that exist.

In Mauritius, one major challenge is that the children in the preprimary schools are not following the same curriculum and this is because the schools are using different tools to learn (Ramnarain-Seetohul, Beegoo, & Ramdhony, 2016). This is a challenge as the children are taught through different ways and differing content which is disadvantageous to the primary school students. The delivery is not well structured and does not provide a good foundation to the students.

On the investigation of current curriculum delivery in the African continent, Namalefe (2010) focused on the various curriculum and the structures that are present in the east Africa countries. The various countries that were investigated were Kenya, Tanzania and Uganda. The review focused on the curriculum that is being offered in the different countries and the some of the factors that influence the introduction of ICT in schools in East Africa. The review focused on the current state of the various countries, their mode of
delivery of the curriculum, aims of the various curriculum and the structure of the education structure. This identified the current state of the education system and delivery of its curriculum. The findings provided the state as is in the various countries and this provided great insights into the mode of curriculum delivery in the mentioned countries.

In Uganda, Namalefe (2010) reported that the countries’ national primary curriculum emphasizes on the development of functional literacy and numeracy, effective communication skills in the local languages, appreciation of diversity in cultural practices, traditional and social organization, acceptance of variety in beliefs and social values, and a sense of national identity. The aims of the curriculum were to be achieved through the delivery of the curriculum in mother tongue instruction from primary 1 to primary 4, after the primary 4 the teaching instruction will be done in the English language.

To delve further in the curriculum of Uganda primary schools, Namalafe (2010) reported that the Uganda primary school has eleven subjects. She reported that there was integration both within the individual subjects and across the curriculum which is aimed at integrating learning and the application of the knowledge and the skills. This illustrates that there is effort to ensure that the curriculum is able to be used to impart knowledge and skills. The current delivery of the curriculum is through the traditional delivery of the curriculum, with the growth of the new technologies other forms of curriculum delivery should be introduced in the various primary schools.

In Tanzania, the education system is based on a 7-4-2-3 system, 7 years in primary, 4 years of ordinary education, 2 years of advanced secondary education and a minimum of 3 years in the tertiary education (Tanzania Institute of Education, 2013). The Subjects in the primary schools include Kiswahili, Mathematics, English, Science, Geography, History, Civics, Sports and personality, Vocational studies, Information technology and General science. The language used in the delivery of the curriculum is through the Kiswahili language. Kopweh (2014) in his thesis reported that Kiswahili is the official language in Tanzania and is the language used when teaching in primary schools however in the secondary schools the language used to teach in the schools is English.

In Kenya, Namalefe (2010) reported that the primary school curriculum is designed to provide functional and practical education that caters to everyone and can help them proceed to the secondary education. The primary education is the first phase of the formal education system and this takes eight years to complete. The mode of delivery for the
curriculum is through the classrooms and through the English language as the mode of delivery. This is similar to the other east African countries. The method of delivery is through the teachers in classrooms. Kenya is however different as compared to the other East African countries this is because of the introduction of new technology devices for the primary school students.

The Government of Kenya in 2013 introduced the digital learning programme targeting learners in all public primary schools and is aimed at combining the learning process and the digital technologies (ICT Authority, 2016). This is the new approach that the government of Kenya is aiming to deliver the content. This is also due to the realization that there are new needs in the ever-changing environment. This will enable the introduction of new ways of delivering the curriculum to the students. The introduction of the new learning devices can be viewed as effort from the Government institutions to innovate the learning process and also the mode of curriculum delivery.

In order to ensure that the curriculum that is being delivered, the Ministry of education has also developed different curriculum designs that can be used by teachers to deliver curriculum to the students in the lower Primary (Kenya Institute of Curriculum Development, 2017). The designs are aimed at guiding the teachers as they deliver the learning content to the students. The teachers can be able to design their own learning delivery but as long as they stay bound to achieving the desired learning outcome. This provides an opportunity for the introduction of the new ways of learning and also the delivery of the learning curriculum in the various primary schools in Kenya.

2.3. Development of Mobile Learning Application Prototype

The development of mobile applications that are meant for the mobile learning have been an emerging trend. This is still an emerging area and previous studies have been able to study ways of developing the mobile applications through the establishment of the frameworks and also through the development of the mobile applications through the various different mobile development technologies for the specific smartphones. The various mobile learning applications have focused on different aspects of the mobile learning process and depending on the objectives of the various researchers.

In South Africa, Molebatsi and Phorah (2015) in an aim to solve the significant challenges that occur with the delivery of the quality of education they reviewed the previous studies on mobile learning and then assessed the potential and versatility for building the mobile
learning and its use in the various schools in South Africa and what benefits they may have. Based on their review of the literature they established that the learners had smart phones that could be used and there was intention to use the devices to supplement the learning process. The smart phone devices were available however the applications to support learning were still in their infancy stages. There were no mobile applications that catered for the learning and the delivery of education.

In their research, Mahenge et al. (2014) were able to propose a cost effective mobile based system that bridges the gaps in existing eLearning systems this by allowing significant bandwidth saving through offline use of learning contents. The system that they had proposed would be able to enable the synchronization of the learning content to the mobile devices offline. The framework which they had proposed would be able to be used to guide the development of the mobile learning application that deliver learning content in resource and network constrained environments. The researchers, however, noted that third world countries still face the challenge of internet connectivity and availability of resources to support it. The study that was undertaken aims to not rely on bandwidth and internet connection and ensure that the application works in different environments across emerging economies.

Kanala, Nousiainen and Kankaanranta (2013) were able to conduct a study based on a free trial and expert evaluations of a prototype mobile application. The aim of their study was to explore the use of a prototype of a mobile writing application which they referred to as Ruff. Some of the reasons for developing the mobile application were to encourage children to learn, to make learning more interesting, to encourage different learners to engage in learning and to encourage and support different types of learning. The study was undertaken and a few challenges were encountered, the symbols of the button used in the application were not easily recognizable and also the content provided had too many questions and this made it difficult for the students to understand what they were supposed to do in the task. The mobile application jargon that is used in an application has an impact on the people who use it and the mobile application developed should ensure that any jargon used is easily understandable to the users and especially the primary school students.

In their study Gu, Tzou and Hoda (2014) were able to explore the design and the development of a mobile application based on the apple devices platform. The mobile application was aiming to deliver learning content of the English language. The application which was developed was aimed at primary school aged children in New Zealand schools.
The application was designed to be easy to learn and aimed at engaging the children. The researchers were able to design the mobile application and they were able to implement the mobile learning application. The mobile application enabled all the students to go through the same content. However, the researchers assumed that all the students are at the same level, this resulted in some of the students having a challenge with the content. The mobile application that they had developed was not catered to specific abilities of the students, the mobile application developed in the study caters to the individual abilities of the student. This is to provide the relevant content to each primary school student using the application.

In Zambia, Ojanen, et al. (2015) were able to develop a mobile learning game that was installed in the tablet phones. The aim of the learning game was to study whether the game would be able to increase literacy skills in primary school children. The game and learning content was loaded into the tablets and the students used the game for learning purposes. However, it was not evident whether children learned using the game. The game could not provide the student with content suitable to their level of ability. The mobile application was not catered to the students who were using the application and was not able to fully identify the benefits of the mobile application.

In South Africa, learning mathematics has been identified as a major barrier to understanding mathematical concepts that exists (Mcnulty, 2016). It is for this reason that the Cambridge University Press, South Africa, developed an application to aid in this. The application was able to give the users the ability to search math terms in English, Toggle between the English the local languages. This enabled the students to be able to connect well with the concepts to engage in a constructive way. The mobile application focused on ensuring that the student was able to comprehend what the questions meant. However, the mobile learning application did not provide learning content for the students to further assist them in learning. The mobile application that was developed in the study was able to provide learning curriculum for the students so that they may be able to learn.

In Kenya, various institutions have attempted to deliver curriculum content to students through other means than the traditional instruction in a classroom where the teacher delivers the learning content. In order to address the challenges that arise with the cost of text books, Kyatabu (2012) a company in Kenya aims to deliver the learning content through the use of mobile application. The mobile application delivers the text books through the mobile application. This provides the students with affordable learning content, that is current and relevant to the students. The mobile application however does not
provide any form of learning as it only provides the student with the specific text book that they require this is a gap in many of the existing mobile learning applications. The study aims not only to deliver content but enable the students to be able to learn from the mobile application by delivering specific learning content to each primary school student when they use the mobile learning application.

In the quest to deliver learning content to the students in primary schools, Kenya faces similar challenges as have been witnessed in the other developing economies. However, the Kenya Government is making strides to bridge some gaps that are clearly evident and pursue different avenues to deliver learning content. It introduced the digital learning literacy programme, the program is aimed at learners in all public primary schools and is aimed at integrating the digital learning technologies (ICT Authority, 2016). This prompted the Kenya Institute of Curriculum development (2016) to develop a set of standards that are all aimed at guiding the development of the mobile learning applications that will be used to deliver quality learning content in the various schools that is relevant to the students.

The Institute proposed nine general standards that can be used to guide the development of the mobile applications to deliver learning content. The application should be education centric, should provide a means of communication between the students and teachers, provide stability and data handling, simple to use user interface, application should work perfectly with the all languages, good battery performance, comply with the local privacy policy, free of spelling error and to ensure that the application is secure to use (Kenya Institute of Curriculum Development, 2016). The standards that have been provided are to be followed as a guide to aid in the development process.

This illustrates that the mobile learning is still in its infancy stages in Kenya and more so in various developing economies, Therefore the study will be able to enhance the various gaps that exist and enable knowledge expansion in the area of mobile learning for students in the primary schools or equivalent. It will enable the guidance of the development of mobile learning applications that deliver learning curriculum to the primary school students.

2.4. Evaluation of the Usability of the Mobile Learning Application Prototype

Various researches have been able to conduct studies based on mlearning and its usage based on specified factors. In their study Gu et al. (2014) were able to evaluate a mobile application that delivered learning content to students. The application was evaluated on
two factors that are engagement and effectiveness. On evaluation of the mobile application based on the engagement, some usability functionalities were discovered. Based on the application, the students found it difficult to use the drag and drop feature of the application. The students found a challenge in using the features as what they had expected was different from what they experienced. This was even after the attempts to make the application more intuitive by the addition of sound effects. The mobile application was not easy to use for the students and this provided a negative experience to the users. The mobile application developed in the study aims to provide an easy to use experience as this a gap in recent mobile applications.

On the evaluation of the mobile application based on effectiveness, the students were able to answer all the questions with relative ease. This was however a concern as it is because on evaluation on whether the students had been able to learn something new the majority of the participants mentioned that the content that had been provide was too easy and they were not able to gain something new. This shows that the mobile application was not effective as it did not provide learning content specific to the particular needs of each. The mobile application developed in the study will be able to provide learning content that is specific to the knowledge level of the student. This will ensure that they are able to learn better from the learning content that has been provided.

In their development of their quiz application for the study, Ziden and Rahman (2012) investigated the usability of the mobile learning application. The application that they had evaluated required students to type a certain code and use the code to send to a number. The students however found this difficult to use, this is because of the technical jargon that was being used. The study concluded that there was need for the applications to ensure that they are easy to use for the intended users. The technical jargon that had been provided by the students provided an unpleasant experience to the students. The mobile application used in the study ensured that jargon used in the application was easy to understand for the students and enabled them to use it easily.

In Mauritius, Ramnarain-Seetohul et al., (2016) were able to evaluate their android application which was used to deliver learning content to preprimary students. In their evaluation, they established that the mobile application was not easy to use for the students. This is a common occurrence to the mobile learning applications in the emerging economies this is due to the mobile learning applications being in their infancy stages. The
mobile application developed in the study aims to provide an easy to use experience to the students. This is because most of the mobile applications do not have the learners

In their study Özdoğan, Başoğlu and Erçetin (2012) had the aim of identifying the independent intermediary factors which contribute to the success and adoption of mlearning applications. They did this by evaluating various factors that 9th grade students in Istanbul would find as factors that could contribute to the success and adoption of the mlearning application. They were able to observe that usefulness and facilitating conditions are the key determinants of attitude towards use. In their study, they found that the existence of a positive use performance and other facilitating conditions ensure adoption easier while the external factors and reward did not have direct impact to the use of the mobile learning application. The mobile application developed in the study will aim to provide usefulness of the mobile learning application for the primary school students.

2.5. Research Approach

The research approach will be design science process methodology. The design science main aim objective is to develop technology-based solutions this is by developing an artifact in the form of a construct, a model, a method, or an instantiation (Vaishnavi, Kuechler, & Petter, 2017). The steps taken in the research study can be further illustrated by the Figure 1, it shows the various steps that were undertaken in the study.
Figure 2-1. Research Process Flow
2.6. Chapter Summary

The curriculum delivery area of study has been investigated by various researchers specifically the delivery of the learning content through the use of mobile devices. Research has shown that the concept of the mobile learning is still in its infancy stages. However various studies have been undertaken to evaluate its delivery, development and the evaluation of the different mobile learning applications.

This informed the objectives of the study that were undertaken. The objectives that were undertaken were; to investigate the current delivery of the curriculum content, to develop the mobile learning application to address the identified challenges and to evaluate the usability of the mobile learning application. The objectives were studied based on the previous studies that focused on the mobile delivery of learning content through the use of a mobile application.

On the investigation of the current delivery, research had shown that in most countries the delivery of the curriculum was determined by the general education structure of the country, the national language of the country and in some cases the government policy in place for the country. The curriculum delivery in most developing economies was similar as they had similar challenges as well as positives. The previous studies have shown that various countries such as Kenya were beginning to embrace new ways of delivering learning content to the various schools.

The embrace of new technology to aid in the delivery of learning content to supplement the current curriculum was evident. Previous research has been able to undertake the development of the mobile applications to aid in the delivery of the learning content. The different researchers undertook the development of the applications using different technologies. However, in most studies the development of the mobile application was not undertaken as they focused on development of models that are to be used.

The Mobile applications were then evaluated based on specific aspects. The various researchers undertook their studies by evaluating their mobile applications through surveys from students and in some cases the teachers. The research has shown that most of the applications were easy to use but needed some improvements to ensure that they served the purpose. The respondents also evaluated the applications based on user experience and relevance. The mobile applications were found to have good user experience. In terms of
the relevance some of the applications should provide relevant content so as to suitable for the targeted audience.

In the next chapter illustration of the methodology of the study will be undertaken. The chapter will focus on the research design, data collection methods, research procedures and the data analysis methods. In Chapter 4 I will undertake the system implementation to undertake the development of the mobile application.
Chapter 3: Methodology

3.1. Introduction

The chapter will focus on the steps that were used in the study. It focuses on the research design, population of the study, the sampling procedures and the research instruments that were used. The chapter also focuses on the data collection procedures and the method that was used to analyze the data. The study aimed to achieve the following objectives:

1. Investigate the current delivery of curriculum.
2. Develop the mobile learning application prototype.
3. Evaluate the usability of mobile learning application prototype.

3.2. Research Design

The research approach will be design science process methodology. The design science main purpose is to develop technology-based solutions this is by developing an artifact in the form of a construct, a model, a method, or an instantiation (Vaishnavi, Kuechler, & Petter, 2017). The design science main focus is on the creativity in the design and the development of solutions that have utility. Delport, Solms and Gerber (2017) in their work they mention that design science aims to develop and provide instructions for actions that are practically applicable. This illustrates that the research design approach is effective in solving challenges using information systems and software engineering in the design of constructs, models or instantiations and this would be the best fit for the study.

Design science includes seven steps which are; design as an artifact, problem relevance, design evaluation, research contributions, research rigor, design as a search process and communication of research. This study put into use the seven steps and the chapter elaborates how each step was applied to the study.
## Table 3-1. Design Science Phases

<table>
<thead>
<tr>
<th>Research Design Principles</th>
<th>How applied to study</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Design as an artifact:</strong> An artifact is an object that is created or developed to achieve certain objectives. Design science results in the creation of a construct, model, method or instantiation.</td>
<td>The artifact developed in the study was a mobile learning application. The researcher was able to look at previous studies and this formed the requirements of the artifact.</td>
</tr>
<tr>
<td><strong>2. Problem Relevance:</strong> Design science aims to solve challenges this by using technology solutions.</td>
<td>The problem in the study was that mobile technology was being introduced in schools in Kenya but the challenge of curriculum delivery through the tablet devices existed. There are no proper guidelines to guide the delivery of the learning content.</td>
</tr>
<tr>
<td><strong>3. Design Evaluation:</strong> The artifact must be demonstrated through defined evaluation methods.</td>
<td>The evaluation of the artifact through questionnaires was undertaken by presenting it to the teachers and students.</td>
</tr>
<tr>
<td><strong>4. Research Contributions:</strong> There must be verifiable contributions in the areas of design methodologies and the development of the artifacts.</td>
<td>In chapter two, the study covered the previous studies research on mobile learning, development and the evaluation of the applications. Several gaps were identified and this were the basis of functional requirements that were developed to be used.</td>
</tr>
<tr>
<td><strong>5. Research rigor:</strong> The rigor cycle provides as previous knowledge to the research so as to ensure that there is no re-invention of the wheel in research.</td>
<td>In this study, based on the previous studies a gap was realized this was after looking at the previous solutions. A detailed literature review was undertaken and from this formed the functional requirements of the mobile learning application. This then formed the basis of the development of the mobile learning application. Which was evaluated for relevance.</td>
</tr>
</tbody>
</table>
3.3. Population and Sampling Design

3.3.1. Population

According to the data from the Kenya National Bureau of Statistics (2015) it is estimated that there were 9 million Primary school students who have been enrolled in the schools in Kenya. The number of students enrolled is greatly due to the introduction of the free primary education in the year 2003 by the Kenyan Government. This resulted in the increased number of students who have since enrolled over the years. This has been the trend ever since, the number of children that have been enrolled in the various primary schools in Kenya has continued to increase over the years.

Furthermore, statistics from the Kenya Institute of Curriculum development (2014) indicate that as of 2014 there were about 29,460 schools. This has been increasing by an average of 5% annually. During the undertaking of the study the number of the schools was greater. The study was undertaken in one primary school in Nairobi, Bidii primary school. The school is situated in Nairobi Eastland Area. Data from the school administration show that the school has the 3 streams per class from class one to class eight, the average population per class is 45 pupils per class.

In addition to the students, data from the school Bidii Primary (2017), reveal that they have a total of 39 teachers as per the time of the study was being undertaken. The Teachers
facilitate the delivery of the curriculum to the students and play an important role in the pupil’s educations. The teachers participated in the study.

3.3.2. Sampling Design and Sample Size

The public school was selected because the greater percentage of pupils in Kenya go to public schools in Kenya. This means that students in the public setting face the same problems and the same challenges. The public school selected would be a blueprint of the situation around the country and would be able to provide valuable insights into the delivery of the curriculum through a mobile learning application.

The sample frame included the students and the teachers. This was due to the limited time that the study was undertaken and the available resources at the researchers’ disposal. The study was undertaken by class seven students from the primary school. The teachers were all teachers who were teaching the class seven pupils in the school.

Sampling method that was used in the study is convenient sampling. This was due to limitations of the study, they were then given the android mobile phones and were able to access the application when they completed they were given the questionnaires to fill in. The teachers were also given the mobile application and were then provided with questionnaires to fill in.

3.4. Data Collection Methods

The data was collected through primary data, the primary data was collected through the use of questionnaires. The questionnaires were undertaken by the students and the teachers who are the students’ supervisors. The questionnaires were handed to both the students and the teachers after going through the mobile application. The mobile application was introduced to the students and they were then able to use the application.

The student and the teachers were then handed the questionnaires so as to collect the data. The questionnaires used was developed into two different sections. The questionnaires focused on the research objectives and investigating the current delivery of the curriculum and evaluation of the mobile application. The two sections are based on the research objectives and aimed to provide relevant data on the objectives. The questionnaires were handed to both the students and the teachers.
3.5. Research Procedures

The researcher developed the mobile learning application before presenting it to the target population. The mobile application was developed using the open source software jet brains’ android studio. The application took a week of development, tasks involved include the design of the mobile application, development of the mobile application, Content addition and validation through testing and ensuring that the application can be used by the students and the teachers.

The researcher had developed the questionnaires that focused on investigating the various aspects of the research questions. The researcher was able to then visit the school and meet with the school management and was able to seek permission so as to be able to use the school for the study. The researcher was able to set an appointment for conducting the study in the school and also request for an adequate number of pupils who would be able to undertake the study. The researcher then visited the school on the agreed date of the appointment.

During the visit, the researcher was able to administer the mobile application to the selected students who were selected randomly. The students were able to use the application for a set period of time. The students were each given the mobile smartphone so as to access the mobile application. Due to the limited devices, the researcher was using to conduct the study, the students were each allocated a time slot of ten minutes with the smart phone. The selected teachers who were part of the study were also given the mobile smartphone so as to use the mobile learning application.

The questionnaires were then handed out to the pupils when they had completed using the mobile learning application. The students then handed the questionnaires back to the researcher once they had completed filling the questionnaire. The teachers were also handed the questionnaires after using the mobile application and once completed filling the questionnaire they handed the questionnaires back to the researcher. The study was completed in a day.

3.6. Data Analysis Methods

The data from the questionnaires from the students and the teachers were both analyzed, the data from the questionnaires was tabulated in a Microsoft Excel then the data was imported into the IBM SPSS. The data was then analyzed using the descriptive statistics which included, frequencies and percentages. The data from the questionnaires was split
into two major sections. The first section dealt with the current analysis of the curriculum content delivery and the second section contained a compilation of questions that focused on the evaluation of the mobile learning application.

The analysis of the first section analyzed descriptive statistics based on the responses which were based on the Likert scale. The scale focused on responses based on respondents selecting options in the scale. The scale in specific order was, Strongly Disagree, Disagree, Neutral, Agree and Strongly agree. The first section analyzed the respondent’s responses to the current curriculum delivery through percentages.

The analysis of the second section analyzed the responses which were also based on the Likert scale. The second category of the questionnaires was based on similar order of responses which were Strongly Disagree, Disagree, Neutral, Agree and Strongly agree. The responses were also analyzed through the descriptive statistics. Various graphs which elaborated the various responses between the selected genders were analyzed.

The data analysis was done for both the teachers and the students. Both groups of respondents were analyzed through the use of the IBM SPSS. The analysis followed the same format and analyzed the data through the use of the descriptive statistics. The analysis from the data received was able to provide insight on the objectives of the study which were, current curriculum delivery and the evaluation of the mobile learning application.

3.7. Ethical Consideration

There were a number of ethical issues that were addressed in the course of study. The school administration provided consent for the study to be undertaken. The participants were provided with a clear statement of purpose so they could make an informed decision. The study was done under the time allocated by the school administration. Respect and anonymity was also considered and no information would be used to reveal to identify the participants.

3.8. Chapter Summary

The chapter focuses on the procedures that were used in the study. It focuses on the research design, population of the study, the sampling procedures and the research instruments that were used. The chapter also focuses on the various procedures that were undertaken in analyzing the data. The chapter focuses on the population, data collection methods, procedures and data analysis methods.
The population that was focused on involves the primary school going children and the teachers who supervise them. The sample that was selected for the study were the school going children of the school. The method of data collection was through the use of questionnaires. The questionnaires were administered to both the students and the teachers. This was done after the students were able to go use the mobile application and then the questionnaires administered to them. The teachers who were selected to participate in the study were also provided with the mobile application and then provided with the questionnaires for the data collection.

The data was analyzed through the use of the IBM SPSS. The analysis tool provided descriptive analytics of the data from the questionnaires. The analysis provided will be discussed in detail in the chapter five. The data analysis will provide an understanding on the objectives that were aimed to be achieved in the study. In the next chapter, discussion of the system, implementation and the process involved.
Chapter 4 : System Implementation

4.1. Introduction

Software development follows a set of processes best suited for the implementation of new software. The implementation of the mobile learning application followed the prototyping model for the implementation. The prototyping model was suitable so as to be able to develop the mobile application at a faster and more efficient rate as compared to other software development cycles. Sabale and Dani (2012) describe the prototyping model as which places more effort in the creation of the software and its implementation. They further describe the model as that which requires more user involvement and allows them to interact with the system and provide feedback of the software. The prototyping model also enables the faster evaluation of the application and quick feedback (Dennis, Wixom, & Roth, 2014). The steps followed to develop the prototype were requirements analysis, system modelling and design, implementation and testing of the mobile application. Prototyping performs the analysis, design and the implementation phases concurrently in order to quickly develop a simplified version so as to give users for evaluation and feedback (Dennis, Wixom, & Roth, 2014).

Figure 4-1. Prototyping Model

Source: Adapted from Dennis, Wixom and Roth (2014).
4.2. Analysis

The analysis involved the acquiring of requirements that would be able to guide the development process. Sommerville (2011) in his book describes this phase as which the system services, constraints and goals are established. This phase provides a foundation of the development process and also the quality of the software being developed, in this case the mobile learning application. The analysis phase focused on previous studies where mobile learning applications were developed and also the objectives of the study, the phase also focused on the requirements by Kenya Institute of Curriculumn Development (2016) who released guidelines illustrating how mobile applications focusing on the education should be developed by content providers. The requirements were categorized in two sections this were the user requirements and system requirements.

Sommerville (2011) described the user requirements as statements of what services the system is expected to provide to the system users, he also elaborates on the system requirements as more detailed descriptions of the software systems services, functions and any constraints. The user requirement of the mobile learning application is to access the current curriculum using a mobile phone using a mobile application. The system requirements were further categorized into functional and non-functional requirements. This is so as to have more detailed functionalities for the mobile learning application. The functional requirements describe the statements of services the system should provide, nonfunctional requirements refer to the constraints offered by the system.

In this study the functional requirements were derived from two sources; secondary data from the literature review as presented in chapter two; and a survey conducted at Bidii primary school to establish the needs for the mobile learning application.

The requirements are categorized in two, the functional requirements that are to be achieved and the non-functional requirements of the mobile learning application. The functional requirements include:

- A student shall be able to open the application.
- A student shall be able to navigate through the application.
- A student shall be able to access learning content through the application.
- A student shall be able to read through the learning content provided.

The Nonfunctional requirements were as follows:
• The mobile application should enable adequate response time.
• The mobile application should be easy to use.
• The mobile application should be reliable.
• The mobile application should be secure.

4.3. Modelling and Design

System modeling is a part of a process of developing abstract models of a system with each presenting a different view or perspective of that system (Sommerville, 2011). The system modelling and design phase builds from the first phase of the analysis and requirements specifications. The models are the physical representations of the various aspects of the system. The models form a representation of the system of its functionalities and interactions. Sommerville (2011) elaborated the four different ways of developing the models this are, an external perspective, interaction perspective, structural perspective and the behavioral perspective.

The interactions perspective involves the user inputs, outputs and processes involved. The two interaction models of use case modelling and the sequence diagrams were used to elaborate the model of the mobile application. The modelling of the mobile learning application was undertaken through the Microsoft Vision tool. The use case modelling illustrates that interactions that occur in the system and also the users of the system and their specific functions that will undertake in the system.
4.3.1. Use Case Modelling

Figure 4-2. Use Case Model
4.3.2. Use Case Narration

The Table 4-1 below elaborates the use case of the mobile learning application.

Table 4-1. Use Case Narration

| Actors  | 1. Students  
|         | 2. Teachers  

| Pre-condition | Users access the application through a pre-installed application on the android platform.  

| Post-condition | Once the application installed the actors can then access the application features.  

| Basic flow | The use case begins once the actors access the installed soma learning application.  

|         | a) The actor selects the preferred language  
|         | b) The actor then selects the preferred list of either topic text content or video.  
|         | c) The actor then selects the desired learning lesson.  
|         | d) The actor then views the selected learning lesson.  

4.3.3. Sequence Diagram

The sequence diagram elaborates the processes involved when the student interacts with the soma mobile application. The sequence diagram elaborates on the following.

- Sequence of subject selection.
- Sequence of topic selection.
- Sequence of Lesson selection.
4.4. Proof of Concept

4.4.1. Technologies Used

The development process of the learning mobile application began by acquiring content that will be used to develop the learning content. The learning content was acquired from one of the books that are approved by the Ministry of Education Science and Technology. The Ministry of Education Science and Technology (2015) through the ICT Authority released a list of approved text books and other instructional materials for both the students and teachers that have been approved from the Kenya Institute of Curriculum Development as at the time of the study was being undertaken. This enabled the researcher to acquire the relevant curriculum that has been approved.

The Subject selected was the English subject. One of the subjects that the primary school students have been performing poorly is the English language. Kotut (2016) in his research argues that poor academic performance in the Kenyan national examinations has been attributed to the low proficiency in the English language, this is because it is the mode of delivery of the English subject. This shows that high number of students have a challenge in the English subject and this is resulting in a ripple effect and this is affecting the other subjects and this affects the performance.

The development of the application was on the android platform. The android platform provides open source tools that can be used to create android based mobile applications. The tool that was selected to aid in the development of the android mobile application was the Android Studio. The android studio provided a range of functionalities as at the time the study was being undertaken. The development tool provided the researcher with the different functionalities of design and the development of the mobile learning application. The tool proved to be a useful and effective tool based on the various tools that existed currently in the market place and is the recommended mobile application development tool as at the time the study was being undertaken.

The development process of the mobile application was done in one week. This included the design and the development process. The Android studio tool provided tools for the design process and the enabled the development using the java programming language to enable the business logic. Once the development process was completed Android studio provided various testing functionalities that enabled the application to be of quality. The application was now ready to be tested by both the teachers and the students.
4.4.2. Results of Development

The mobile application flow was as follows.

Figure 4-4 shows the first screen to be displayed once one opens the application. This also enables some application configurations to be set during the start of the application.

![Figure 4-4. Splash Screen](image)

The Figures 4-5, 4-6 and illustrate the second pages of interaction with the application. The student or teacher can swipe right till the fourth screen where they can then proceed to the next pages. The interaction enables the student to be able to know what is in the application.
Figure 4-5. Second Page Illustration.

Figure 4-6. Second Page Illustration

Figure 4-7 displays the selection of the subject to be undertaken. The student can be able to select the subjects available.
Figure 4-7. Subject Selection

Figure 4-8 shows the list of activities within the selected subject. In this version of the application there are two this are the Topics and the videos. The topics contain the various topics within the selected subject and the videos are video content that can aid in the learning process. The user selects the desired option and then proceeds to the next step.

Figure 4-8. Home Navigation

Once the student proceeds to the next step, the student is assessed based on their skill level. This is so as to provide the student with learning content that suits their skill level. This enabled the student to go through learning content that is suitable so that they can be able
to learn well. Figure 4-9 illustrates some of the questions that the student answers so as to be able to proceed to the next level. Based on the student’s score they will be directed to either of the three levels namely level 1, level 2 and level 3.

**Figure 4-9. Assessment**

The different level illustrates the different levels of mastery of the subject at hand. Level one is the first level of knowledge building and introduction to the various topics. This forms as the base of the particular subject. Figure 4-10 shows the first lesson of the first level, as mentioned the first level contains the first level of mastery of the particular subject at hand. Figure 4-11 illustrates the second lesson of the first level.

**Figure 4-10. Level One Lesson One**
Figure 4-11. Level One Lesson Two

Figure 4-12 illustrates the second level lesson, Lesson two is more detailed and provides an extra level of mastery of the subject as compared to the first level.

Figure 4-12. Level Two Lesson One

Figure 4-13 and 4-14 illustrate the second level of the subject which the student goes through.
Figure 4-13. Level Two Lesson Two

Figure 4-14. Level Two Lesson Three

Figure 4-15 illustrate the third level lessons, this is the highest level for the students to be able to learn. The third level is the highest level of mastery when using the mobile application for the subject that has been selected.
4.4.3. Testing

The testing phase involved the evaluation and quality assurance before the application was presented to the target audience. Table 4-2 illustrates the test case that was used to evaluate whether the application met the required standard.

Table 4-2. Test Cases

<table>
<thead>
<tr>
<th>STEPS</th>
<th>TEST STEPS</th>
<th>EXPECTED RESULT</th>
<th>ACTUAL RESULT</th>
<th>STATUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ensure application is installed</td>
<td>application is installed</td>
<td>PASS</td>
<td>COMPLETE</td>
</tr>
<tr>
<td>2</td>
<td>Check if First screen appears</td>
<td>page appears with logo</td>
<td>PASS</td>
<td>COMPLETE</td>
</tr>
<tr>
<td>3</td>
<td>Check if application proceeds to the next page</td>
<td>proceeds to the next page</td>
<td>PASS</td>
<td>COMPLETE</td>
</tr>
<tr>
<td>4</td>
<td>Check if the application provides assessments</td>
<td>Assessment page appears</td>
<td>PASS</td>
<td>COMPLETE</td>
</tr>
<tr>
<td>5</td>
<td>Check if the fields are clickable</td>
<td>Clickable</td>
<td>PASS</td>
<td>COMPLETE</td>
</tr>
<tr>
<td>6</td>
<td>Check if the assessment buttons are clickable</td>
<td>buttons can be clicked</td>
<td>PASS</td>
<td>COMPLETE</td>
</tr>
</tbody>
</table>
### 4.5 Chapter Summary

The chapter focuses on the implementation process of the mobile learning application. The chapter focuses on analysis, modelling and the elaboration of the proof of concept. The chapter also focuses on the development tools used and the implementation process followed, this is the waterfall software development model. This involved the various steps such as requirements, design, implementation and testing processes.

The analysis focused on ensuring that the various requirements both user and system requirements were met. The modeling process involved the creation of the abstract models that elaborated the system structure and relation to its components and environment variables. The models created were the use case model and the sequence diagram. The models illustrated the flow and actions of components within the application.
The development process involved the development of the mobile application using the android development tools such as android studio. The development tools enabled the development of the mobile application and the testing of the mobile application. The results of the development process elaborate the flow and processes within the application. The next chapter focusses on results of the study and its findings.
Chapter 5 : Results and Findings

5.1. Introduction

The chapter focuses on the results and the findings of the study as was set out in the research methodology. It highlights the findings of the study based on the data that has been collected from the respondents who were mainly the students and the teachers. The chapter is organized in the various sections this are based on the research objectives of the study that had been set out to be achieved.

The research objectives were to survey the current curriculum delivery, to develop the mobile application and to evaluate the mobile learning application. The chapter will focus on the survey of the current curriculum delivery based on the responses of the teachers and the students. The chapter will also focus on the evaluation of the mobile application this will entail various aspects of the mobile learning application.

According to the responses 33 out of 33 respondents from the public school were able to return their questionnaires. The response rate for the questionnaire was 100%. The response rate was commendable and this was made possible by the teachers who assisted in supervising the process. This ensured that all students who participated in the study were able to give their responses and teachers as well.

5.1.1. Demographic

From the results illustrated in Table 5-1, 53.6% of the students who participated in the study were male while 46.4% of the students who participated in the study were female. Even though the selection of the students was randomly selected it shows that the number of male is students slightly higher than the female in the class that was selected to conduct the study.

Table 5-1. Student Gender Distribution

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>15</td>
<td>53.6</td>
</tr>
<tr>
<td>Female</td>
<td>13</td>
<td>46.4</td>
</tr>
<tr>
<td>Total</td>
<td>28</td>
<td>100.0</td>
</tr>
</tbody>
</table>
From the Table 5-2, 60% of the teachers who participated in the study were female, 40% of the teachers were male. The number of teachers in the school is 39 as per the records from the school indicate. Those that were selected to participate in the study were class seven teachers in the school.

Table 5-2. Teacher Gender Distribution

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>male</td>
<td>3</td>
<td>60.0</td>
</tr>
<tr>
<td>female</td>
<td>2</td>
<td>40.0</td>
</tr>
<tr>
<td>Total</td>
<td>5</td>
<td>100.0</td>
</tr>
</tbody>
</table>

5.2. Current Delivery of Curriculum

5.2.1. The Current Teaching Delivery

The research sought to establish the current state of curriculum delivery and to find out whether the current delivery was helpful. From the results as depicted in Figure 5-1, 35.7% of the students disagreed that the current curriculum delivery was helpful. However, this was tied with 35.7% of the student’s respondents who Agreed that the current curriculum delivery is helpful. The results also illustrate that 7% of the respondents were neutral and 3.6% strongly disagreed that the current delivery is helpful.
The research sought to find out from the teachers as well whether the teaching delivery was helpful to the students. From the results as shown in Figure 5-2, based on the question on whether the current curriculum was helpful, 60% Agree that the curriculum was helpful while 20% were neutral and 20% disagreed. This was interesting to note this is because a minority of the teachers who deliver the content were of the opinion that the mode of curriculum was not helpful to the students.

The study also sought to establish whether the teaching method was suitable. According to Figure 5-3, shows that 36% were of the opinion that it was suitable for them, 25% were neutral while 21% disagree and 18% strongly disagree that the current teaching method is suitable for them.

This shows that the majority of the students found that the current method of curriculum delivery which was teaching was not suitable for them.
The study also sought to establish from the teachers as to whether the current teaching method was suitable for the students. According to the Figure 5-4, 60% of the teachers strongly agree that the current teaching method is suitable while 40% agree.

The study sought to establish whether technology needs to be incorporated into the current school system. With regards to whether technology needs to be incorporated into the learning system, as depicted in Figure 5-5, 50% of the students strongly agreed that technology needs to be incorporated. The study also shows that 39.3% agree and 10.7% were neutral. This shows that the students want technology to be used in the primary learning system.
The study also sought to establish from the teachers whether technology needs to be incorporated into the school system. According to Figure 5-6, 60% of the teachers strongly agree and 40% agree that technology needs to be incorporated into the school system. This shows that the teachers are of the opinion that technology needs to be introduced. This would help in reducing their workload as well as provide other ways of learning to the students.

![Figure 5-6. Teachers’ Responses on Incorporation of Technology in Schools](image)

**5.2.4. Technology Aiding Students to Learn**

The study also sought to establish whether technology will aid in helping students learn. According to Figure 5-7, based on the responses on whether technology will aid in helping students learn, the students were all in agreement as 60.7% strongly agreed and 39.3%
agreed. This shows that the students have the opinion that the technology will aid them in learning.

**Figure 5-7. Students’ Responses on whether Technology will help Students Learn**

The study also sought to establish from the teachers whether technology will aid in helping students learn. According to Figure 5-8, teachers were asked whether technology will aid in helping the students to learn. The results show that 60% Agree while 40% strongly agree. This illustrate that the teachers are all of the opinion that technology would help the students to be able to use it to learn or supplement their learning.

**Figure 5-8. Teachers’ Responses on Technology Aiding Students Learn**

**5.2.5. Learning with Mobile Applications**

The study sought out to establish whether students can learn better with the aid of mobile applications. The results from this as depicted in Figure 5-9 were that 42.4% strongly agreed and 39.3% agreed this shows that the majority of the students are of the opinion that they could be able to learn better through the mobile applications. In addition, 10.7% of the student respondents disagreed while 3.6% strongly disagreed and 3.6% were neutral.
With regards to whether students can learn better with the aid of mobile applications, 60% of the teachers agree and 40% of the teachers Strongly agree. The teachers are of the opinion that the students can be able to learn through the use of mobile devices.

5.2.6. Using Learning Application to Learn

The study sought out to establish whether the students had used any learning application to lean prior to the study. According to the Figure 5-11, when asked whether they had used...
the mobile application to learn. The student respondents to the answer No was 67.9% while those who said they had used a mobile learning application was 32.1%. This may be due to several factors that the students do not own the mobile phones so they may be able to use them for that purpose.

![Figure 5-11. Students’ Responses on Usage of Learning Application to Learn](image)

According to Figure 5-12, teachers were asked whether they had used technology to assist in teaching. The results for this was that 100% of the respondents indicated that they had not used a technology device to teach.

![Figure 5-12. Teachers’ Responses on Usage of Learning Application to Teach](image)

5.3. Development of the Mobile Learning Application Prototype

The second objective of the study was aimed at developing a mobile learning application that can be used to deliver learning content. The research sought to find out the current state of deliver and whether technology needs to be introduced into the learning. As depicted in Figure 5-13, the majority of the students felt that technology needs to be incorporated.
Figure 5-13. Students’ Responses on Introduction of Technology

The research study sought to find out if the mobile learning application can be used to deliver learning content. As depicted in Figure 30, 50% of the students agree, 39% strongly agree and 11% were neutral.

Figure 5-14. Students' Responses on Delivery of Learning Content via the Mobile Application

5.4. Evaluation of the Mobile Application Prototype

5.4.1. Ease of Using the Mobile Application

The study sought to find out based on the research objective of evaluation of the mobile application whether learning using the mobile application was easy for the student. The results as depicted in Figure 5-15, 67.9% of the respondents strongly agree and 32.1% of the respondents were of the opinion that the learning application was easy for them to use.
for learning purposes. This means that majority of the students found it easy for them to use the application so as to be able to learn.

![Pie chart showing student responses on ease of learning using the mobile application. 68% agree, 32% strongly agree.]

**Figure 5-15. Students’ Responses on Ease of Learning using the Mobile Application**

Interesting to note was that when the students were asked whether the mobile application was easy to use. The respondents were also of the opinion that the application was easy to use. According to Figure 5-16, 67.9% of the respondents strongly agree and 32.1% agree.

![Pie chart showing teacher responses on ease of use of mobile application. 68% agree, 32% strongly agree.]

**Figure 5-16. Teachers' Responses on Ease of use of Mobile Application**

### 5.4.2. Ease of Learning using the Mobile Application

The study sought to find out whether the mobile application that they used in the study was easy to use. According to Figure 5-17, the teachers agree that the mobile learning application will enable easy learning for the students 40% of the teachers agree and 60% strongly agree. In addition, when asked about whether teaching using the mobile application would be easy for them 80% agree while 20% strongly disagree as depicted in Figure 5-18. This shows that some had the view that this would be easy to use both for
themselves as teachers and for the students to use the mobile learning application to be able to learn.

Figure 5-17. Teachers' Responses Students Learning Using the Mobile Learning Applications

Figure 5-18. Teachers’ Responses on Ease of Use of the Application

5.4.3. Mobile Application User Experience

The study also sought to find out whether the mobile application provided a good user experience. According to Figure 5-19, 42.9% of the students were of the opinion that they Agree that the application had a good user experience. In addition, 28.6% of the student respondents strongly Agree, 17.9% were neutral and 10.7% disagree that the mobile application had a good user experience.
The teachers when asked a similar question as to whether the mobile application has a good user experience 60% of the teachers agree and 40% strongly agree as depicted in Figure 5-20. This shows that the majority if the respondents are of the view that the mobile application has a good user experience.

**Figure 5-20. Teachers’ Responses on User Experience**

**5.4.4. Delivery of Learning Content**

The study also sought to find out if the mobile application the respondents used can be used to deliver learning content According to Figure 5-21, the students were asked whether the mobile learning application can be used to deliver learning content. 10.7% of the students were neutral, 50% of the students agree and 39.3% of the students strongly agree that the mobile application can be used to deliver learning content to students.
As depicted in Figure 5-22, teachers were asked whether the mobile application can be used to deliver learning content. 20% of the teachers agree and 80% of the respondents strongly agree that the mobile application can be used to deliver learning content for the primary school students.

The study sought to find out if the mobile learning application can be used to motivate students to learn. According to Figure 5-23, the students were asked as to whether the mobile learning application can be used to motivate primary school students to learn. 3.6% of the students were neutral, 50% agree and 46.4% strongly agree that the mobile learning application can be used to motivate students to learn.
The teachers were asked whether the mobile learning application can be used to motivate students to learn. 20% of the respondents were neutral while 80% agree that the mobile learning application can be used to motivate the students to learn this is as depicted in Figure 5-24.

![Bar Chart](chart1.png)

**Figure 5-23. Students' Responses on Mobile Application Motivating Students to Learn**

The study sought to find out from the respondents whether the mobile learning application can be used to learn anywhere. According to Figure 5-25, the students responded as follows, 3.6% were neutral, 53.6% agree and 42.9% of the students strongly agree that the mobile learning application can enable learning anywhere.

![Pie Chart](chart2.png)

**Figure 5-24. Teachers' Responses on Motivating Students to Learn**

**5.4.6. Mobile Learning Anywhere**

The study sought to find out from the respondents whether the mobile learning application can be used to learn anywhere. According to Figure 5-25, the students responded as follows, 3.6% were neutral, 53.6% agree and 42.9% of the students strongly agree that the mobile learning application can enable learning anywhere.
As depicted in Figure 5-26, the teachers were positive that the mobile learning application can be used to enable learning anywhere. This is illustrated in that 60% of the teachers agree and 40% of the teachers strongly agree that the mobile learning application can enable learning anywhere. This shows that the mobile learning application can be used to learn without being location dependent as compared to the legacy classroom model.

Figure 5-26. Teachers' Responses on Learning Anywhere using the Mobile Application

5.4.7. Relevance of the Mobile Learning Application

The study sought to find out whether the mobile learning application was relevant to the students. According to Figure 5-27, 3.6% of the students were neutral, 46.4% agree and 50% of the students strongly agree that the mobile learning application contained learning content that was relevant. This can be attributed to the fact that the content was acquired from approved curriculum content from the ministry of education.
According to Figure 5-28, the teachers responded as follows 40% agree and 60% strongly agree that the mobile learning application contained learning content that was relevant to the students.

Figure 5-28. Teachers' Responses on Relevance of Learning Content

5.4.8. Mobile Application Content Language

The respondents were able to answer the questionnaire question with regards to the mobile application content language that was used in the mobile learning application. Previous mobile learning applications did not provide content language that the respondents understood. The study aimed to find out whether the application content language was easy to understand. The findings of their response are as follows.

According to Figure 5-29, 39.3% of the students agree and 60.7% strongly agree that the mobile learning application content language that was used was easily understandable to the students.
Figure 5-29. Students' Responses on whether the Content Language used was Understandable

As depicted in Figure 5-30, 80% of the teachers agree while 20% of the teachers strongly agree that the content used was easily understandable. This shows that both the teachers and the students are of the opinion that the language used in the mobile application can be easily understood as one uses the mobile application.

Figure 5-30. Teachers' Responses on whether the Content Language used was Understandable

5.4.9. Mobile Application Customized Learning Content

The mobile learning application aimed to provide customized learning content to the students depending on their ability. The study aimed to find out whether the students were able to experience customized content based on their abilities. Based on their interaction both the students and teachers responded as follows on the questionnaire.

The study aimed to according to Figure 5-31, 17.9% of the students were neutral, 42.9% of the students agree and 39.3% strongly agree. This shows that the mobile application was able to intelligently evaluate the student’s ability and be able to provide customized content.
This was through the evaluation process that then provided the student with optimized content that suited their level.

Figure 5-31. Students' Responses on Customized Content based on Students' Abilities

As depicted in Figure 5-32, 20% of the teachers were neutral, 40% of the students agree and 40% strongly agree that the mobile application had customized content based on the student’s abilities.

Figure 5-32. Teachers' Responses on Customized Content Based on Student Abilities
5.5. Chapter Summary

The chapter focuses on the results and the findings of the study as was set out in the research methodology. The chapter analyzed the results of the responses by both the student and the teachers. The results analyzed provided an in-depth analysis on some of the objectives that were to be achieved in the study. The findings revealed the possibilities that were possible using the mobile learning applications and delivering learning content to the students. The teachers who participated in the study provided great insights into current state of curriculum delivery and were able to validate the need of the mobile learning application to deliver learning content.
Chapter 6 : Discussion, Conclusions and Recommendations

6.1. Introduction

The chapter reviews the results and findings of the study as elaborated in the previous chapter. The findings of the study are based on the responses received by the respondents who were the teachers and the students. The chapter provides an in-depth discussion on the findings and elaborates on the views of the researcher. The study’s summary has been presented with the three research objectives that were aimed to be achieved. Finally, the chapter provided the researchers discussion, conclusions and recommendations that can be used for further improvements in the future.

6.2. Summary

The general objective of this research study was to deliver curriculum learning content through a mobile learning application to primary school students. The research addressed the following objectives. To investigate the current delivery of curriculum content; to develop the mobile learning application prototype and finally to evaluate the mobile learning application prototype.

The research approach employed in the study was the design science methodology which incorporated the seven steps. The target sample population used in the study was the class seven pupil and the teachers. Data was collected via the use of questionnaires. The questionnaires were administered to the students and teachers and the data from the questionnaires analyzed.

The data from the questionnaires was analyzed and this informed the findings on the three objectives which the study focused on. The findings on whether the current teaching methods are suitable show that 35.7% of the students agree, 25% of the students were neutral 21.4% disagree that the current delivery is helpful while 17.9% of the students strongly disagreed. All of the teachers agreed that current delivery was helpful as 60% of the teachers strongly agreed and 40% agreed. Regarding the integration of technology into the school system 50% of the students strongly agreed, 39.3% of the students agree while 10.7% were neutral. The teachers when asked about the integration of technology 60% of the teachers strongly agree and 40% agree, this means that all the teachers were in unison that technology needs to be integrated.
The second research objective of the study was the development of the mobile learning application prototype. On the delivery of learning content via a mobile application, 50% of the students agree that it can be used to deliver learning content, 39.3% strongly agree while 10.7% were neutral. Regarding the delivery of learning content using the mobile application, the teachers 80% strongly agree and 20% agree that learning content can be delivered via the mobile learning application.

The findings regarding the third research objective on evaluation of the mobile learning application on the ease of using the mobile learning application, the findings show that 67.9% of the students strongly agree and 32.1% agree that the mobile learning application was easy to use. The findings illustrate that 67.9% of the teachers strongly agree and 32.1% agree, this shows that the teachers found the application to be easy to use. On the user experience, 60% of the teachers agree and 40% strongly agreed that the mobile application had a good user experience. This shows that teachers and most of the students felt that the mobile learning application had a good experience.

6.3. Discussion

The section interprets the findings of the research study based on the study objectives this is in comparison with the previous studies. The study explores the current state of curriculum delivery, development of mobile learning application prototype and new ways of curriculum delivery through the mobile learning application. The study highlights the various gaps that exist in existing research on mlearning and makes recommendation for further research in the study area.

6.3.1. Current Curriculum Delivery

The findings on the current curriculum delivery reveal that 35.7% students agree that the current delivery is helpful, 35.7% disagree, 25% were neutral and 3.6% strongly disagree. The teacher’s findings reveal that 60% agree that the curriculum delivery is helpful while 40% disagree. This finding reveals that there is a different feeling between the teachers and the students. The teachers are of the view that the curriculum delivery is helpful but not all the students agree to this. This may be due to several factors that may also be linked to the performance this is due to the attitude that the students have on the curriculum. This is in line with Lichodi (2015) where he established that student performance was also dependent on the students’ attitude.
The findings on the suitability of the teaching methods reveal that 35.7% of the student respondents agree that the current teaching method is suitable for them, 25% of the students were neutral 21.4% disagree and 17.9% of the student respondents strongly disagreed. This shows that majority of the students of those who disagree and those that strongly disagree are higher. The students feel that the teaching methods that are currently being used are not fully impacting them in a positive way. This may be due to a need to innovate and introduce new ways of teaching.

The solution to the new way of teaching might be the introduction of technology. The findings on whether technology needs to be incorporated into the school system reveal that both the teachers and the students would like that technology be introduced into the school system. The findings reveal that 60% of the teachers strongly agree and 40% agree while 50% of the students strongly agree and 39.3% agree. The students are also of the opinion that the technology will aid in helping them to learn as per the findings when asked whether technology will aid them in learning. This goes in line with the findings of Lin et al. (2016) where they established that mobile devices have become important communication media for delivering content and contributing to mobile learning. The students appreciate the growth of technology and they are open to new ways of learning and this is evident from their responses, this is similar to the finding that Kanala et al. (2013) found that new technologies can be used to support personalized and situated teaching. Technology presents an opportunity in that it can be used to supplement existing learning processes and help optimize current processes that are existing in the different schools. This is as depicted from the findings on whether the teachers and the students had used mobile learning application to learn, the teachers responded that majority of them had not used a mobile learning application.

6.3.2. Development of Mobile Learning Application Prototype

The findings of the use of the mobile learning application reveal that the mobile application that was developed was able to deliver learning content to the students. The mobile application was able to provide approved learning content from the ministry of education and curriculum governing bodies. This is in line with previous studies who were able to develop mobile applications for learning, studies by Lin et al. (2016) where they established that mobile devices can be able to deliver learning content. The mobile application was able to provide the students with relevant content based on the student’s ability. This had
been a challenge in the previous studies as students felt the content that was provided did not suit them.

Based on the content as well, the findings reveal that the content language that was used in the application was understandable. All the students (60.7% strongly agree, 39.3% agree) the teachers were of a similar view. The content language that was used in the previous studies was a challenge in that students could not be able to understand the application and the instructions and this was a challenge. In their study, Ziden and Rahman (2012) had a challenge where the content language that was used to use the application was not easily understandable to the users. The study aimed to ensure that the language used to navigate and use the application was easily understandable to the students.

The mobile application was developed and installed in an android based mobile phone for the students to use and evaluate. This was also provided to the teachers for their evaluation of the mobile learning application. The evaluation of the mobile application forms the third objective of our study.

6.3.3. Evaluation of the Mobile Learning Application Prototype

The findings on the evaluation of the mobile learning application based on ease of using the mobile learning application indicate that 67.9% of the students’ respondents strongly agreed and 32.1% agree. The teachers were of the same view as 67.9% strongly agree and 32.1% agree that the mobile learning application was easy to use. The findings are in line with Ramnarain-Seetohul et al. (2016) where they observed that majority of the students found it easy to use the mobile learning application. The study also revealed that mobile learning application provided a good user experience when using the application, from the students’ responses 42.9% of the students were of the opinion that they Agree that the application had a good user experience, 28.6% of the student respondents strongly Agree, 17.9% were neutral and 10.7% disagree. The findings also reveal that all the teachers were of the opinion that the mobile learning application provided good user experience. This enabled the respondents to use the application easily as the user experience enables utility of the application to be achieved. The utility of the application was to deliver learning content. The findings of the user experience are in line with the findings that Venter and Wet (2016) established that the mobile learning application they had developed provided good user experience and enabled retention of students to the application.
The study sought to find out whether the learning content that was in the application illustrated that it was possible to deliver learning content. The study revealed that majority of the students agreed to this as 50% agreed, 39.3% strongly agreed as 10.7% were neutral. The teachers all agreed the learning content can be delivered through a mobile application. This is in line with a study undertaken by Gu et al. (2014) in their study to investigate the development of a mobile learning application where they established that it was possible to deliver learning content as majority of their respondents had positive responses. The study also sought to find out whether the customized content that the students received was suited to their knowledge level. The study shows that, 42.9% of the students agree, 39.3% strongly agree while 17.9% were neutral. The study also shows that 40% of the teachers strongly agree, 40% agree and 20% were neutral. This shows that based on the customized content of the mobile application the students were able to go through learning content that was suitable for their knowledge level. The findings are in line with Cheng (2014) where the study established that mobile learning providers should tailor their needs in accordance with the various levels of learners’ personal level of knowledge. This provides an opportunity for the students to improve and be able to proceed to the next levels.

The study sought to establish whether the mobile application can be used to motivate the students to learn. The study shows that 50% students agree, 46.4% strongly agree, while 3.6% were neutral. The study also shows 80% of the teachers agree that the mobile application can be used to motivate the students. This is because the mobile application provides a different avenue other than the traditional way of content delivery, the use of the application would be used to motivate the students to learn more as it also provides other advantages. The findings are in line with the findings from the study Kanala et al. (2013) undertook to investigate the use of a mobile learning application to support children learning motivation, where they established that motivation among the children had improved after using the mobile learning application.

Some of the advantages are location independence. The study sought to find out whether learning can be done anywhere other than the classroom setting. The study revealed that after using the application, 53.6% of the students agree, 42.9% strongly agree while 3.6% were neutral. The study also revealed that the teachers agree that when using the mobile learning application can be done remotely without being dependent on the location. The portability of the mobile smartphones enables this. The mobile can be easily carried to any remote area and be used even though one is not in school, and this enables learning to be
done anywhere at any time. This is in line with the findings that Mahenge et al. (2014) where they found that the mobile learning application can be able to deliver learning content without being bound by place and time.

6.4. Conclusions

6.4.1. Current Curriculum Delivery

The research study evaluated the current delivery of the curriculum content and various challenges were identified. The challenges that were identified are linked to the current state of delivery of the learning content. The findings indicate that majority of the student were of the opinion that the current curriculum delivery was not helpful the findings reveal that this could be improved via different methods. The findings reveal that majority of the respondents felt that the teaching methods were not suitable, this may be due to several factors. In order to provide a solution, the findings reveal that a high percentage of the respondents were of the opinion that technology be integrated into the learning system. Many studies have attempted to solve this but have encountered different challenges.

6.4.2. Mobile Learning Application Prototype

The findings reveal that the mobile application was able to deliver learning content to the students. The study revealed that the mobile application can be used to deliver approved learning content to the students. The mobile application was able to provide customized curriculum based on the students’ level of knowledge. This provided the student with relevant content which is suitable to them. The research indicated that majority of the respondents both the teachers and the students were able to use the application and revealed that it was possible to deliver learning content.

6.4.3. Evaluation of the Usability of the Mobile Application Prototype

The research study indicated that the mobile application can be used to deliver learning content to the students. The study revealed the satisfaction of the mobile application and its usage in the school setting. The study indicated that mobile application was easy to use and provided a good user experience to the respondents. The findings also illustrate that the respondents were satisfied with curriculum content and the jargon used in the application which enabled the respondents to use the application. The study found that it was possible to deliver learning content through the use of a mobile learning application.
6.5. Recommendations

The following are recommendations from this study.

The current delivery of content can and should be supplemented through various ways to ensure that students can be able to learn better. Current systems should ensure constant innovation to ensure that students are taught and learn better.

Schools should maximize on the use of technology so as to be able to help supplement and improve in different areas. The growth of the mobile application is still growing and devices will be readily available. There is an opportunity to create frameworks that strengthen the mobile learning application so as to have maximum utility.

Researches should further the study of the mobile learning by establishing better ways of delivering learning content, seamless use of the mobile learning application with existing learning tools and also establish efficiency of use of the mobile learning application.
REFERENCES


http://kytabu.com/about-us/


computational analysis and knowledge management (ABLAZE 2015) (pp. 506 - 508). IEEE.


APPENDICIES

APPENDIX I: STUDENT QUESTIONNAIRE

Delivery of Curriculum Content through Mobile Application

Questionnaire - students

1. What is your Gender?

☐ MALE  ☐ FEMALE

2. Current delivery of learning content

   Kindly fill in the questionnaire with the suitable response.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>The current teaching delivery is helpful</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The current teaching method is suitable</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technology needs to be incorporated in the school system</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technology will aid in helping students to learn</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Students can learn better with the aid of mobile applications</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Have you ever used a learning application to learn something?

☐ YES
3. Evaluation of mobile application

Kindly tick/Select box with the preferred suitable response.

<table>
<thead>
<tr>
<th></th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning using the mobile application was easy for me.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The mobile application has good user interface</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The mobile application has a good user experience</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The mobile application can be used to deliver learning content</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The mobile learning application can motivate students to learn</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The mobile learning application can enable learning anywhere</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The mobile learning application contained learning content that was relevant.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The mobile learning application content language was easily understandable</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The mobile learning application had customized content based on my abilities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX II: TEACHER QUESTIONNAIRE

Delivery of Curriculum Content through Mobile Application

Questionnaire - teachers

1. What is your Gender?

- [ ] MALE
- [ ] FEMALE

2. Current delivery of learning content

Kindly fill in the questionnaire with the suitable response.

<table>
<thead>
<tr>
<th></th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>The current teaching delivery is helpful</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The current teaching method is suitable.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technology needs to be incorporated in the school system</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technology will aid in helping students to learn</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Students can learn better with the aid of mobile applications</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Have you ever used another technology device to assist in teaching?

- [ ] YES
- [ ] NO
3. Evaluation of mobile application

Kindly tick/Select box with the preferred suitable response.

<table>
<thead>
<tr>
<th></th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning using the mobile application was easy for me.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Learning using the mobile learning application will be easy for the students.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The mobile application has good user interface.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The mobile application has a good user experience.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The mobile application can be used to deliver learning content to the students.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The mobile learning application can motivate students to learn</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The mobile learning application can enable learning anywhere</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The mobile learning application contained learning content that was relevant to the students.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The mobile learning application content language was easily understandable.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The application had customized content based on student’s abilities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
public class splash extends AppCompatActivity {

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_splash);
        Thread thr = new Thread{
            @Override
            public void run()
            {
                try{
                    sleep(1500);
                }
                catch(InterruptedException e){
                    e.printStackTrace();
                }
                finally{
                    Intent i;
                    i = new Intent(getApplicationContext(), illustration.class);
                    startActivity(i);
                }
            }
        };
        thr.start();
    }
}
public class MyViewPagerAdapter extends PagerAdapter {
    private LayoutInflater layoutInflater;

    public MyViewPagerAdapter() {
    }

    @Override
    public Object instantiateItem(ViewGroup container, int position) {
        layoutInflater = (LayoutInflater) getSystemService(Context.LAYOUT_INFLATER_SERVICE);
        View view = layoutInflater.inflate(layouts[position], container, false);
        container.addView(view);

        return view;
    }

    @Override
    public int getCount() {
        return layouts.length;
    }

    @Override
    public boolean isViewFromObject(View view, Object obj) {
        return view == obj;
    }

    @Override
    public void destroyItem(ViewGroup container, int position, Object object) {
        View view = (View) object;
        container.removeView(view);
    }
}
private void addBottomDots(int currentPage) {
    dots = new TextView[layouts.length];

    int[] colorsActive = getResources().getIntArray(R.array.array_dot_active);
    int[] colorsInactive = getResources().getIntArray(R.array.array_dot_inactive);

dotsLayout.removeAllViews();
    for (int i = 0; i < dots.length; i++) {
        dots[i] = new TextView(this);
        dots[i].setText(Html.fromHtml("&#8226;"));
        dots[i].setTextSize(35);
        dots[i].setTextColor(colorsInactive[currentPage]);
        dotsLayout.addView(dots[i]);
    }

    if (dots.length > 0)
        dots[currentPage].setTextColor(colorsActive[currentPage]);
}

private int getItem(int i) {
    return viewPager.getCurrentItem() + i;
}

private void launchHomeScreen() {
    // prefManager.setFirstTimeLaunch(false);

    //assessment
    startActivity(new Intent(illustration.this, Assessment.class));

    // startActivity(new Intent(illustration.this, select_subject.class));
    finish();
}
public class illustration extends AppCompatActivity {
    private ViewPager viewPager;
    private MyViewPagerAdapter myViewPagerAdapter;
    private LinearLayout dotsLayout;
    private TextView[] dots;
    private int[] layouts;
    private Button btnSkip, btnNext;

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_illustration);

        viewPager = (ViewPager) findViewById(R.id.view_pager);
        dotsLayout = (LinearLayout) findViewById(R.id.layoutDots);
        btnSkip = (Button) findViewById(R.id.btn_skip);
        btnNext = (Button) findViewById(R.id.btn_next);

        // layouts of all welcome sliders
        layouts = new int[]{
            R.layout.welcome_slide1,
            R.layout.welcome_slide2,
            R.layout.welcome_slide3,
            R.layout.welcome_slide4};

        // adding bottom dots
        addBottomDots(0);

        // making notification bar transparent
        changeStatusBarColor();

        myViewPagerAdapter = new MyViewPagerAdapter();
        viewPager.setAdapter(myViewPagerAdapter);
        viewPager.addOnPageChangeListener(new ViewPagerPageChangeListener);

        btnSkip.setOnClickListener(new View.OnClickListener() {
            @Override
            public void onClick(View v) {
                launchHomeScreen();
            }
        });
    }
public class home extends AppCompatActivity {
    ListView homelist;
    Intent i;

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_home);
        Toolbar toolbar = (Toolbar) findViewById(R.id.toolbar);
        setSupportActionBar(toolbar);

        homelist = (ListView) findViewById(R.id.list1);

        homelist.setOnItemClickListener(new AdapterView.OnItemClickListener() {
            public void onItemClick(AdapterView<?> parent, View view, int position, long id) {
                switch (position){
                case 0:
                    i = new Intent(getApplicationContext(), lesson.class);
                    startActivity(i);
                    break;
                case 1:
                    Toast.makeText(getApplicationContext(), ""+position, Toast.LENGTH_SHORT).show();
                    break;
                }
            }
        });
    }
}
public class Assessment extends AppCompatActivity implements View.OnClickListener {
    int score1, score2, score3, score4, score5, score6, score7;
    int counter = 0;
    Button sb;
    RadioGroup rd2, rd1, rd3;
    RadioButton btn1, btn2, btn3, btn4, btn5, btn6;
    Intent i;

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_assessment);
        Toolbar toolbar = (Toolbar) findViewById(R.id.toolbar);
        setSupportActionBar(toolbar);
        //initialize the parameters
        rd2 = (RadioGroup) findViewById(R.id.rggroup2);
        rd1 = (RadioGroup) findViewById(R.id.rggroup1);
        rd3 = (RadioGroup) findViewById(R.id.rggroup3);

        //set the onclick actions
        int resu = score2;
        // Toast.makeText(this, "number"+counter, Toast.LENGTH_LONG).show();
        sb = (Button) findViewById(R.id.button9);
        sb.setOnClickListener(this);
    }

    @Override
    public void onClick(View view) {
        int selectedrbbutton = rd1.getCheckedRadioButtonId();
        if (selectedrbbutton != -1) {
            RadioButton selectedRadioButton = (RadioButton) findViewById(selectedrbbutton);
            btn1 = (RadioButton) findViewById(R.id.radioButton4);
            if (selectedRadioButton.getId() == btn1.getId()) {
                score2 = 0;
                String selectedRadioButtonText = String.valueOf(selectedRadioButton.getId());
            } else {
                score2 = 2;
            }
        }
    }
}