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RESEARCH ESSAY PROPOSAL

Submitted in partial fulfillment of requirements for the degree of Master of Education in Mathematics Education

TITLE:

THE READINESS OF JUNIOR SECONDARY SCHOOLS TO ADOPT M-TECHNOLOGY IN MATHEMATICS TEACHING AND LEARNING; THE CASE OF KGATLENG REGION

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Abstract

The purpose of this proposed study is to find out if the junior secondary schools in Botswana are at a state of adopting mobile technology into the teaching and learning of mathematics. Studies reflect that mobile devices are becoming ubiquitous and their proliferation may force education systems around the globe to change their educational policies. In the context of Botswana, there is a concern that such devices (mobile devices) are distracting learners to stay focused in their school work. As a result, they are not allowed to be used in nearly all government schools. Perhaps this challenge may be turned into an opportunity by making learners to use the same devices for their learning. The objectives guiding the study are; to investigate students and Mathematics teachers' perceptions towards mobile learning, to determine the relationship between students' accessibility to mobile devices for the teaching and learning of Mathematics, to assess the flexibility of the school authorities to employ mobile learning (m-learning) and to find out how conversant mathematics teachers are with regard to m-learning. A mixed design approach through the use of questionnaires and interviews will be used for data collection. The sample shall comprise of 360 students and 24 teachers. The participants will be randomly selected. Descriptive statistics and thematic analysis of qualitative data will be used to come up with relevant conclusions

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Chapter 1: Introduction

1.1 Preamble

Education is going through dramatic changes and as a result it has been evolving over the years (Thorsen, 2006). Each day, new ways of improving education are developed and implemented. Today we talk of emerging issues or contemporary issues surrounding education such as globalization and technology. Technology is one of such important contemporary issues surrounding education. According to NCTM (2008), it is one of the strongest forces in the contemporary growth and evolution of mathematics and mathematics teaching. NCTM (2008) views technology to be an essential tool for learning mathematics in the 21st century. Therefore, technology has to be made easily accessible as it can change the quality of learning lifestyle. This can however work effectively if used wisely (Thorsen, 2006). This implies that one should understand technology and use it for best results. Thorsen (2006) highlighted that technology in education is more than just machines. Thorsen (2006) viewed technology in education as a way of serving students and teachers transparently rather than focus on instruction. As a result, technology in education helps teaching and learning to suit the modern times as the world is gearing towards a digital world.

The purpose of this study therefore, is to assess the readiness of junior secondary schools to adopt m-technology in mathematics teaching and learning, taking the Kgatleng region in Botswana as the case for the study. There has been a declining performance of students in Botswana more especially among secondary school students (Thobega, 2014). The spotlight has been on the declining performance, raising concerns over whether the educational system is failing most learners or not. The methods of teaching that are used can be integrated with that of the global system to improve the quality of learning. In this case, the combination of e-learning

and classical learning with a teacher in a classroom needs to be assessed to see whether it cannot bear great fruits for Botswana's education development.

Several countries around the world have over the years battled challenges that affect the output and quality of their educational systems. Thobega (2014) highlighted that it is important to approach learning holistically, to ensure that learners are in a position to make the most of their education. That aspect motivated the conduction of this study. This study will therefore probe to see how teaching and learning in the context of Botswana can adopt m-learning and make the most of it in the teaching and learning of mathematics. Can mathematics learning be coupled with technology in Botswana? Hence it is important to assess the state of the education system to adopt technology in the learning and teaching of Mathematics.

1.2 Background

Mathematics plays a very important role in technology and science and the field of mathematics has benefited from technology throughout its history (Taleb, Ahmadi & Musavi, 2015). The world around us is permeated by mathematics and its technological applications. For example, bridges are built using mathematical concepts, mobile phone signals are encoded using mathematics, and credit cards are encrypted using mathematical models (Brunette, nd). From the past, modern information and communication technologies (ICTs) have penetrated into all areas of human activity including education. It is absolutely normal that ICT play an important role also in the sphere of education hence a huge development of computer supported learning should be observed.

Technology can be used to enhance the student's learning with interaction and information. The question should more accurately be how to utilize technology and replace ineffective methods of teaching with more effective ones. The new technologies that are available have helped to reform education and streamline the process to increase the overall

amount of knowledge that current students possess. Many argue that we should focus education on using technological tools since students will end up using these tools in the post-education world. However, this assertion does not mean that technology usage should replace the learning of basic skills that students are expected to acquire. Technology usage should not replace the student's learning of basic skills.

Johnston-Wilder and Pimm (2004) stated that in England for example, in 2003, an extensive government training programme for primary and secondary teachers in relation to ICT was conducted. The intent of the training programme was to bring all teachers (in terms of ICT knowledge and competence) to the level of recent newly qualified teachers in the area, for whom ICT had played a growing part in their official preparation to become teachers. Nevertheless, and perhaps unsurprisingly, the Office for Standards in Education inspection reports for England indicated a very wide variety of uptake and sophistication of pedagogic use of such technology in the service of the teaching and learning of mathematics (Johnston-Wilder & Pimm, 2004). The question of how to ensure confident and well-qualified users of technology in mathematics classes remains both a significant and challenging one. We take it as axiomatic that computers and mathematics have a special relationship with one another.

In Africa, according to a report prepared for the International Congress of Mathematics in Seoul (2014), Mathematics education is facing numerous problems at all levels in Africa, despite the strong mobilization of governments and international support. The report showed that the rise in primary-level enrollments has brought an increase in the secondary education population as well as a problematic increase in the tertiary education population without being matched by teaching resources, adequate learning environments, or logistical and financial support. In the report, there was a recommendation that perhaps the most important need is better training and professional development of mathematics teachers, particularly at the secondary school level. However, this can be augmented when ICT is integrated and developed in the teaching and

learning of mathematics from secondary school on, and when e-learning and distance training become an integral part of professional development (International Congress of Mathematicians, 2014)

In Botswana secondary schools, technology is very good, but not fully utilized. Internet usage, for example, stands as low as 5% of the population (Isaacs, 2007). Nonetheless, the use of internet has been growing gradually in the past years. Isaacs (2007) indicated that there was and still is a considerable disparity in terms of urban and rural access to ICT services. Challenges include the relatively high cost of Personal Computers (PCs), the lack of electricity in many rural locations, and high charges for internet usage. In addition, the internet needs to be made more relevant to the Batswana, through the development of local on-line content tailored to the needs of the population. Botswana incorporated policies for information communication services for example in the Botswana Vision 2016 for the pillar of an educated and informed nation. The Revised National Policy on Education, Republic of Botswana (RNPE 1994) also proposed a curriculum for computer awareness which was developed for junior secondary schools and has since been implemented. The curriculum aimed to equip learners with computer skills that can be applied in all subjects. The other policy is that of the *Maitlamo*: National ICT Policy. *Maitlamo* aims to provide a communications network that meets high international standards and also to ensure that the country has the skills to be an ICT leader. Its key goals are for Botswana to become a sub-Saharan ICT hub, to create an enabling environment for the growth of an ICT industry in the country (Isaacs, 2007).

In the era that we live in, the world is becoming more digital. There is introduction of digital gadgets each day. Some of them are becoming fabric of society. One of the common digital devices which are becoming overly used in the society are mobile devices. Therefore technology has even become ‘mobile’. The youth or students who live in this era are however exposed to this digital world (Franklin & Peng, 2008). It is common to see the students holding

MP3 players, mobile phones or even tablets and iPods. Such devices are commonly called mobile devices. These devices have turned out to be ubiquitous and available to and owned by a wide range of age groups including students (Baran, 2014). The community, including students use mobile devices such as mobile phones, iPods, tablets, and MP3 players for communication purposes, social networking and playing music (Franklin & Peng, 2008). Could the use of these mobile devices be looked into, to perhaps augment how ICT has been used in education? Now, with all the background information outlined, there is a need to assess the readiness of Botswana to adopt the mobile learning in the Mathematics teaching and learning. This however, as stated, the case of Kgatleng will be the focus of the study.

1.3 Definitions of mobile technology and mobile learning

Mobile technology basically refers to the use of mobile devices. Mobile devices are portable, handheld communication devices connected to wireless network that allows users to make calls, text messages and run applications (Skillen, 2015; Baran, 2014; Taleb et al., 2015). Mobile devices include gadgets like mobile phones, tablets, iPads, iPods, MP3 players and electronic notebooks. There are said to be mobile since it is easy to move with them around or carry them around easily.

According to Baran (2014), mobile learning emphasizes on the mobility, access, immediacy, situatory, ubiquity, convenience and contextuality. That means it is easy to get hold of mobile devices and hence one can learn at their convenience. This is because of the portability of mobile devices. Mobile learning involves learning interactions in which participants use mobile devices such as cellphones (Franklin & Peng, 2008). This type of learning emphasizes learning anywhere and anytime. This is because learners can gather information, access it and process it even outside the classroom (Botzer & Yerushalmy, 2007). In this study, *mobile*

learning and *mobile technology in the teaching and learning of mathematics* will be used interchangeably.

1.4 Brief history of m-learning

Mobile learning, which is sometimes just called m-learning arose because of ubiquity of mobile devices and seeing the need for revolution in teaching and learning (Yerushalmy & Ben-Zaken, 2004). Benefits to technology in education have encouraged developed countries to come up with pedagogical systems to employ mobile learning in teaching and learning. For instance, some countries have since made the use of computers and handheld devices mandatory (UNESCO, 2012; Skillen 2015). Though desk tops are part of many cultures, it is not easy to carry them around, hence employing of handheld devices.

At the same time portable computers and Personal Digital Assistants (PDAs) could be ideal but they are usually expensive and cannot be afforded by all students (Yerushalmy & Ben-Zaken, 2004). To address this, companies like Casio have since developed calculators which provide specific applications (Yerushalmy & Ben-Zaken, 2004). Today different education systems in different countries have adopted the use of mobile devices in the classroom, and particularly in the teaching and learning of mathematics. Research has shown that some education systems have been rigid in introducing mobile devices in the mathematics classroom claiming it can distract the learning process, but recommendations have since been given for them to do away with that mindset. Research has shown that countries which practice m-learning have benefited from it (Yerushalmy & Ben-Zaken, 2004). Prior to the introduction of mobile devices in the teaching and learning, mobile devices have been in use in banks and other companies. For example, mobile banking or cellphone banking is one of the important achievement of m-technology. Ibrahim and Walid (2013) mentioned that the use of technology has been utilized extensively in the area of commerce and finance (m-commerce and m-banking), also in the field of medicine and public health (m-health). Since m-technology has

significant results in the different field, it is worth trying it in the class situation. Perhaps it could be significant in augmenting the teaching and learning.

1.5 Rationale of study

Mobile devices have turned out to be ubiquitous in Botswana. Most learners today own cellphones, MP3 players and even tablets or they at least have an easier access to them. The ubiquity of these gadgets cannot be overlooked. They could however bring a significant contribution in the teaching and learning of mathematics. Today we talk of cellphone banking; this is where one could do bank transactions whenever and wherever they are. This has actually assisted many people to be free from long queues, to make prepaid payments at convenience, to send money at convenience and to easily transfer funds. Seeing all the benefits of mobile technology in banking could imply that even in teaching and learning of mathematics it could be useful hence the need to explore about the potential usefulness.

1.6 Statement of the problem

The use of m-technology is becoming more prolific. It is becoming fabric of society. Its exponential growth alone signals a change in how people connect to each other and enjoy the internet through the use of mobile devices. Mobile internet usage in the country is becoming more apparent as most people are getting their hands on more mobile devices. Kgatleng region also, experience the same massive growth of mobile usages more especially among youth and students. The challenge that may arise could be students focusing on these mobile devices through social networks. This may reduce their time spent studying. Many learners today are so 'hooked' into social networks, which consume their time. This could affect performance of learners in their studies. Besides, the traditional pedagogical approaches are becoming less interesting to the current generation of learners. Would it be useful to turn the challenge into an opportunity? Could the introduction of mobile technology in the teaching and learning of mathematics be a way of turning the challenge into an opportunity?

1.7 Purpose of the study

The study is concerned with exploring the vitality and benefits of mobile technology in the teaching and learning of mathematics in Botswana. The researcher is concerned about knowing how Batswana are ready or prepared to embrace the new development of mobile technology in the teaching and learning of mathematics in Botswana. The study will find out if teachers have the necessary expertise and technical know-how about m-learning. It will also analyze whether the country is in a position to infuse m-learning in the classroom depending on the availability of mobile devices. Therefore, the study will find out if the ubiquity of mobile devices may suggest adopting it in the teaching and learning.

1.8 Research Objectives

1. To investigate students and Mathematics teachers' perceptions towards mobile learning.
2. To determine the relationship between students' accessibility to mobile technology tools for the teaching and learning of Mathematics.
3. To determine the flexibility of the school authorities to employ mobile learning.
4. To find out how conversant mathematics teachers are with regard to m-learning.

1.9 Research question

What is the state of readiness by junior secondary school communities in Kgatleng Region to adopt m-learning for mathematics?

1.10 Significance of the study

This study will be conducted to contribute to coming up with recommendations which could help in educational reforms and improvement of policies. This could however help in addressing the issue of low performance in mathematics at junior secondary schools in Botswana putting into account m-technology as a tool or method of enhancing learning and teaching. The

study will take into account the ubiquity of mobile devices and how they could be used to improve pedagogical approaches in mathematics. The results of this study could be shared with the policy makers, curriculum developers, teachers, educational department personnel and other stakeholders. This could however inform them about what is currently transpiring in the field of education. Therefore, they would have some knowledge which would help them to device some new reforms in the structure of education and the structure of teacher training in Botswana. Perhaps teaching and learning could be enhanced and made to be more relevant.

The study will give vital knowledge about development of e-learning in the country. Even though it would be a case study, the results may be adopted in the development and advancement of knowledge to the stakeholders like the Ministry of basic education, students, parents as well as the Botswana Examinations Council. Through its recommendations, the study will suggest the policies and strategies which can be put in place to ensure that the levels of m-learning participation are encouraged for the betterment of the academic well-being of the junior secondary school students. The study may also help in setting a foundation for future studies related to the use of technology in the teaching and learning of mathematics.

1.11 Theoretical Framework

Mobile learning appears to have very diverse theoretical perspectives and approaches (Viberg & Gronlund, 2012). In a systematic analysis of the literature, Viberg and Gronlund (2012) found a large number of different approaches and theories employed in mobile learning research. They emphasized that the theories and models applied in mobile learning most often originate from previous theories of learning like constructivism and situated learning theory. The theory guiding this study therefore, is the Connectivism which is termed to be a learning theory for digital age introduced by Siemens (2004). It aims to provide insights into the learning skills and tasks needed in a digital era. According to Siemens (2004), this theory integrates the principles of chaos, network, complexity, and self-organization theories. It also acknowledges

that learning is no longer an internal, individualistic activity and that the ways in which people work and function are altered when new tools are utilized (Siemens 2004.).

The approach emphasizes the importance of information and linking it to the right people. Efficient information navigating and filtering are particularly important. From this point of view, mobile devices offer the ability to connect with information and resources whenever there is a need. Learning connections can take place in the classroom, at home, or on-the-go whenever needed (Stoerger, 2013). The adoption of this theory is therefore, important for the conduction of this study.

1.12 Delimitations

The study is delimited to Kgatleng district. Kgatleng district was chosen as the researcher works in the same region as it would be more convenient in terms of distance. There could be other factors which may affect secondary education, but this study delimited itself only to readiness of the education system to adopt m-technology in Mathematics learning and teaching. The focus will only be on the junior secondary schools. The focus in put on junior secondary schools students since at their age, most of them begin to be more exposed to mobile devices as opposed to primary schools pupils. The three year junior secondary school period is also longer enough to allow the researcher to conduct the research as opposed to the short, less than two years period at senior secondary schools.

Chapter 2: Literature review

2.1 Introduction

This chapter reviews literature related to the importance of technology in education vis-à-vis that of m-learning in mathematics education. The review will be divided into different themes being: The impact of technology in the teaching and learning of mathematics, implications of m-technology in the teaching and learning of mathematics, importance of m-technology in the teaching and learning of mathematics, Botswana as it benchmarks from other countries, the Botswana's current situation regarding m-technology as well as challenges related to mobile learning.

In research, studies are conducted with in-depth analysis, insight and intensive logical thinking. According to Sarantakos (1997), the contributions of the earlier researches are of great help to define the scope for further research, to provide an input to the researcher about all the areas which have been studied and to examine the gaps in the existing practices applicable to the problem under study. Review also guides the researcher and helps him/her to understand the rationale of the other researchers for conducting the research in the area which he/she has selected and also helps the researcher to look into various aspects and dimensions of the study.

2.2 The impact of technology in the teaching and learning of mathematics

The importance of educational technology in the teaching and learning of mathematics cannot be overlooked. Mathematics is considered an important subject (Garegae, 2012). Taleb et al. (2015) further cements that mathematics is not only for science but it is also an important tool for people to solve everyday life problems. It is one of the core subjects that are offered from primary school to senior secondary school. For mathematics subject being offered as core across these levels, implies or suggests its vitality in the curriculum at large. It is therefore compelling to look at the impact educational technology brings in such an important subject.

Studies show that a scientifically rich curriculum is the one that integrates technology in pedagogy (NCTM, 2008). In a study by Niess (2005), it is reflected that technology is an essential tool in a learning environment not only in the curriculum but also in the instruction. The same study also reflect that technology brings about a sense of working independently. Furthermore, it is also shown that in an environment where technology is used mathematics becomes more realistic to learners. Learners tend to have exploratory skills and hence make sense of what they are learning. Educational technology helps in the development of flexible strategies in learning mathematics when technology is used. It also stimulates a sense of deeper understanding of mathematics meaning of concepts. This was affirmed by a study by Skillen (2015) who states that technology is of specific importance as it transforms the landscape of teaching and learning. It helps both the teachers and the learners to explore and discover some things for themselves. Learners tend to make more sense of what they are learning when using technology and hence it becomes easy for them to make sense out of concepts and hence grasp them. This was reflected by a study by Kyriakides et al (2015), noting that technology can transform learning by creating an educationally rich and dynamic environment that increase autonomy in students and promoting deep, hands on learning. Therefore, the use of technology in mathematics education can make abstract concept in mathematics more tangible and hence easily internalised.

In a study conducted by Drijvers (2012), on the digital mathematics in education: why it works (or it doesn't), there has always been questions surrounding mathematics education and technology. The study showed that there is more to it than just thinking of technology and its inception in the mathematics curriculum. The question is not about whether technology works or not. It is about three major things being the design, the role of a teacher and the educational context. The use of technology in mathematics should be used in such a way that it would be beneficial to both the learner and the teacher. Thorsen (2006) asserts that the use of technology

in the mathematics classroom can be very beneficial if it is used wisely. The teacher should also play a wise role in making sure that technology benefits the lesson. In addition Burghardt, et al. (2010), in his/her study which was conducted in New York, found out that learners who were introduced to technology in mathematics found mathematics to be more important and more interesting. This change of attitude worked positively for students as it improved their mathematical skills. In the same study, it is reflected that learners were able to show their mathematical skills better when using technology. One of the benefits of using technology in learning is that ICT can foster a powerful learning environment (Smeets, 2005). Some of the characteristics outlined are; active and independent learning by pupils, co-operative learning and that the curriculum is adapted to the needs and capabilities of individual learners. In the same study it is also stipulated that ICT could promote high-order thinking. It is also pointed out in the same study that ICT can foster problem solving skills which are an important component in mathematics teaching and learning (Smeets, 2005).

2.3 Implications of Mobile technology in the teaching and learning of Mathematics

The ubiquity of mobile devices such as cell-phones, MP3's, palm tops, tablets and PDAs has driven curiosity among researchers to explore if it could be of value to the teaching and learning process. Skillen (2015) asserts that mobile technologies are fast growing in the lives of many, especially the youth, across the globe thereby forming an integral part of the fabric of society. Skillen (2015) further stated that as mobile technology is growing, research on the use of mobile technology particularly in mathematics education, is growing rapidly as an area of interest. This is because mobile devices and applications become more accessible among students. Many studies have actually reported high accessibility of mobile devices among the youth, of which some reported that in the near future almost every young person will be owning at least a mobile phone (Franklin & Peng, 2008). In a study by Yerushalmy and Ben-Zaken

(2004), it is reflected that as of August 2003, the mobile phone penetration in Hong Kong was at 98.2% and it was anticipated that by 2004 almost everyone will be owning at least one mobile phone. This is to emphasise how mobile devices have actually become accessible and a part of lifestyle in other countries. Many studies, particularly in mathematics education, are still carried out to-date to figure out how mobile learning can be infused in the teaching and learning of mathematics (Skillen, 2015; Fabian, Topping & Barrow, 2016). Kyriakides, Meletiou-Mavrotheris and Prodromou (2015) further emphasize that in recent years there has been a rapid adoption of mobile devices in education. Therefore, the dominance of fixed computers is rapidly lessening creating a platform for the growth of flexible ubiquitous alternatives that have great implications in learning either formal or informal settings. Kyriakides et al. asserted that at this rate at which mobile technology is rapidly growing, it is becoming a *must* to be adopted in the mathematics classroom.

Studies show that mobile technology in the teaching and learning or mobile learning could be beneficial (Fabian et al., 2015; Kyriakides, 2015; Taleb et al. 2015). Although there is no significant evidence of enhancement in achievement due to mobile learning in most of the available studies, researchers still anticipate more positive outcomes as time goes by. In fact, the study on mobile technology in mathematics education is still at infant stage. Some studies are still carried out to-date to establish facts. Some studies include experimental researches whereby a certain mobile technology is used in a certain group of students and then they are observed for a certain period of time. The extract below is from a study by Fabian et al., (2015) to show the implication of mobile technology in mathematics performance:

> Positive gains were found in most of the elementary studies with only three out of twenty-one students finding no significant difference between those who used mobile devices and those who did not. In the middle school level, the same pattern can be

observed, with more studies supporting claims that the use of mobile-based activities improve mathematics achievement (p 96).

This shows a great opportunity for enhancement in mathematics achievement through mobile learning. More studies report a positive outcome of mobile learning in mathematics education. Kalloo and Mohan (2012) asserted that mobile learning has in the past years proven to be successful in many different contexts. One of these include improvement in reading and mathematical skills. In their study conducted in South Africa, results revealed an increase in mathematics scores by 3.36% in 18 weeks (Kalloo & Mohan, 2012). This is a significant improvement considering also that the change was within a short period of time. Perhaps if mobile learning is further elongated on the target group, there might be quite significant and desirable results.

Albeit the fact that the use of cell-phones and MP3s could be distracting to learners, maybe there could be ways devised to turn that challenge into an opportunity. Studies show that as mobile technology advances it can perhaps cause a revolution in education. This means that it could change the pedagogical approaches in a way which would make life easy for both the teacher and the learner. Many researches emphasize situated learning. That is, learning can take place wherever the learner is; a learner would not need to be in the classroom setting in order to learn. Skillen (2015) is in support of this emphasizing that nowadays students learn readily and immediately, everywhere at any time, travelling and above all 'in motion'. This is further affirmed by Vainio, Walsh and Varsaluma (2014) who highlight that the era of mobile devices and services have opened up a whole new way of creating possibilities to learn or access information everywhere and at any time.

As there are increasingly many studies on mobile technology and its affordances in the teaching and learning, perhaps the teacher factor in the whole process is being left behind. This

was highlighted by a review on research on mobile learning in teacher education by Baran (2014). In the same study it is asserted that teacher support and teacher training have been the least explored topics in mobile learning research. Adoption of mobile learning will ultimately imply reforms in teacher education and training. Skillen (2015) affirms this by suggesting a change and review in teaching practice. Teachers will have to be taught to successfully employ mobile technology in their pedagogical approaches.

In a study by Mahamad, Ibrahim and Taib (2010), they see mobile technology to be a tool that would relieve students from heavy textbooks, hectic schedules of both the teacher and the learners and to high cost of desktops. If mobile learning is done well, some of the bulky exercises in the students' textbooks could just be assigned from mobile devices. Through mobile learning, the duty of the teacher facilitating learning will reduce as students will be getting instruction from the mobile devices. Lastly, desktops are more expensive as compared to mobile devices. Therefore by choosing mobile technology, some costs could be cut (Ibrahim & Walid, 2014).

In 1987, Resnick's study suggested that another significance of mobile learning is that it challenges our conception of learning to move beyond a dichotomy between formal learning and informal learning, for the design of a seamless learning space linking the two modes of learning. From traditional perspectives, school learning emphasizes individual cognition, mental activities without the use of tools, and learning in general contexts (Resnick, 1987). Even though that is the case, it has been vividly clear that educational research increasingly recognizes the fact that a significant amount of learning is happening in informal settings outside of school and through the use of technology.

Policy implications to mobile technology are highlighted by a study by UNESCO (2012). In particular, the study specifically puts its focus on the Education for all (EFA) policy. The study reflects that mobile technology in education tries to address five goals out of the six of the EFA policy. The six goals for EFA policy are: early childhood care and education, universal primary education, lifelong learning, adult literacy, gender parity and equality and Education quality. Adoption of mobile technology would however customize the teaching and learning to satisfy the demands of these goals.

2.4 Importance of m-technology in the teaching and learning of mathematics

One of the key importance of using m-technology in the teaching and learning is being able to study *wherever*, *whenever* and *whatever* (Skillen, 2015; Fabian et al., 2015; Kalloo & Mohan, 2012). This means that by using mobile learning as a mode of learning, one will be able to study whatever they want to study without constraints or limitations, in any place of their interest and in any area they like. This will consequently reduce the load of the teacher. The teacher would not have to always 'load' information to the learners. This will also not limit the learning process to the classroom setting only. Therefore mobile learning promotes convenience in the teaching and learning (Ibrahim & Walid, 2013; Taleb et al. (2015).

Mobile learning provides an educationally rich and dynamic atmosphere that increase learners' autonomy (Kyriakides et al., 2015; Taleb, 2015). This will allow them to intensify hands on learning even in ways they were never able to with previous pedagogical approaches. By working autonomously, it means learners will not be dictated about what they should learn and when. Through m-learning, learners can even cover more material within a short period of time. Learners can even have a chance of studying supplementary material that will help them increase their scope of knowledge. Typically m-learning allows for exploration and discovery in learning. Skillen (2015) affirms that by mentioning that m-learning helps learners have a greater

scope on what they are learning and can actually assist them to customize whatever they are learning. Fabian et al. (2015) further indicated that mobile learning allows for conceptualization of mathematics. The same study also reflects that learners can actually make investigation outside the classroom at their convenient time. Learners will therefore be able to make sense about what they are learning as compared to when they are just having a lecture in class. Fabian et al. (2015) emphasized that mobile technology bridges ways of instruction allowing learning to be situated in a real-world context. That way learners may see mathematics as *tangible* and not just abstract. This may build the learners' confidence in familiarizing themselves with mathematical concepts. Consequently, outcomes in terms of achievement, may turn out to be positive. In other words, the use of technology in the mathematics classroom may contribute to enhanced performance.

A number of studies have reflected mobile learning as a tool for learners' engagement and as a platform for promotion of learners' collaborative learning which makes them fully engaged (Fabian et al, 2015; Taleb, 2015; Baran, 2014). Skillen (2015) asserts that mobile learning promotes engagement, motivation and productivity among learners. Mathematics is a subject which requires a high level of engagement for best result. So there could be an anticipation of improved performance in mathematics if the learners are more engaged. Baran (2014) supported this by confirming that engagement with mobile devices could be beneficial in the learning process. This collaboration of learners can also build good relations amongst learners which helps them to have a good learning environment. It also stirs some interest in students' learning. Learners get to appreciate that they can do certain things on their own without being in a 'rigid and formal' class setting. Developing of interest could imply change of attitudes and perception towards mathematics. Wrong attitude towards mathematics is one of factors that lead to poor performance in mathematics. Mobile learning can also help learners to develop strong eagerness to learn.

One intriguing apart about m-learning is that it corrects one as they solve problems, so they would not have to wait for the teacher to do the corrections. In some mathematics applications like Microsoft Math, as one submits the answers, both the correct and the wrong ones will be identified and the correct answers will also be provided. This can also promote students' engagement, achievement and attitudes. Fabian et al. (2015) suggested that improving in achievement of learners in mathematics can actually change their self-concept of mathematics.

2.5 Mobile learning as practiced in other countries

In a study by UNESCO (2012) entitled "Turning on mobile learning in Africa and Middle-East", it is reflected that some countries are already a step ahead regarding m-learning research and implementation. Countries like Kenya and South Africa have started the mobile learning programs in their schools.

2.5.1 South Africa:

The country is a mile ahead in terms of infusing mobile technology in the education system. There are quite a number of projects for mobile learning in the quest to develop quality instruction in mathematics. They have a project called Nokia's *Mobile Mathematics (MoMath)* which was developed in 2007. The focus of the project was to encourage learners to use mobile phones to access curriculum-aligned mathematics content and to engage in competitions, quizzes and peer-learning based on lessons related to mathematics (UNESCO, 2012). The other project is called *DuniaMoja*, which has also been piloted in Tanzania and Uganda. The work phrase *"DuniaMoja"* is a Swahili word meaning 'one world', (UNESCO, 2012). The application provides access to course material, enables students to research and do assignment. The application also facilitates communication and interaction between students (UNESCO). The *Dr Math* projects was also piloted in South Africa. *Dr Math* is a mobile based mathematics tutoring

program that uses *MXit*, a free instant messaging application. *M4Girls* is also a South African project which was aimed at developing mathematical and technological skills of girls in Grade 10 (UNESCO, 2012).

2.5.2 Egypt:

The *Egypt's Message Sent program* was developed in 2007. It is used in mobile phones to increase numeracy and literacy among women in Egypt (UNESCO, 2012).

2.5.3 Tanzania:

Tanzania embarked on a project called *BridgeIT* which provide teachers with access to digital video content. This project showed how mobile phones could act as conduits for delivery of curriculum-centered content in a classroom (UNESCO, 2012).

2.5.4 Cyprus

An educational puzzle game available on iPad and Android devices called *A.L.E.X* was piloted in Cyprus according to a study conducted by Kyriakides et al in 2015. *A.L.E.X* is an entertaining programming puzzle that lets players control a robot along a path. It provides basic introduction to programming concepts and logic but at the same time it has the potential to promote a number of concepts and procedures embedded in the school mathematics curriculum (Kyriakides et al., 2015).

2.6 The Botswana's current situation regarding m-technology

2.6.1 Overview

Mobile technology is a tool which is already functional in some departments other than the education sector in Botswana. Commercial banks use mobile technology for processing of transactions. Users have a chance of processing their transactions, pay other people, receive money, receive short messages (SMS) from the bank and pay bills using their phones. The First

National Bank Botswana (FNBB) and other commercial banks in Botswana for instance, have some mobile banking platforms of which consumers benefit from. With the same service, consumers can process their bank transactions wherever and whenever. This makes it convenient for them as they will not need to go to the bank and get into long queues. This is an indication of the existence or prevalence of mobile technology usage in Botswana to be tapped from.

2.6.2 Botswana's National ICT Policy (Maitlamo Policy)

Maitlamo ICT policy was initiated to develop the national adherence to ICT. This policy was also built on government's initiatives of achieving vision 2016. It is envisioned that the national ICT policy will position Botswana for sustained digital age as a way of achieving social, economic, political and cultural transformation of the country. As a result, the policy was infused in different governmental departments (Maitlamo's National ICT Policy, 2004). Education is not an exception. The policy reflects that "Botswana must look at the introduction of ICT into the formal education system as soon as possible, both as a subject and as an educational tool" (page 5). The policy states that in ICT-driven countries, technology in education is infused as early as kindergarten yet in Botswana there is no ICT education in primary schools and only a few computers could be found in secondary schools. Today ICT has been infused in all curricula administered in secondary schools in Botswana. The new Junior Secondary school syllabus has been enriched by including topics on the use of computers. For example, students are expected to have acquired skills in the use of spreadsheet in solving algebraic problems (Maitlamo's National ICT Policy, 2004).

2.6.3 The extent at which technology is used in the mathematics classroom

In a study by Garegae (2012) it is reflected that computer awareness programme was introduced in junior and senior secondary schools as a way of making students computer literate. In the same study it was reflected that the 2006 ICT policy focused on the school connectivity

and assumed that availability of computers in schools is a guarantee for computer literacy and ICT subject integration. Does this really mean that availing computers in schools imply the use of ICT in schools? Does it mean these computers are used effectively? Does is it mean teachers have the expertise of integrating them in their teaching and learning of mathematics? Some studies however show that technology is not effectively integrated in the mathematics classroom because of lack of adequate professional training and lack of access to computer (Garegae, 2012). Baran (2014) affirms this by pointing out that teacher support and training regarding m-learning has been the least explored topic. Baran (2014) further states that m-learning is under-theorized in teacher education. This may contribute to technology not being used effectively, or not being used at all.

Some secondary schools have recently been issued with tablets to be used in the teaching and learning. The schools were given fifty (50) tablets as a programme done on pilot bases. Linchwe II JSS, where the researcher works, is one of the schools which have benefited from this initiative. This is done in phases. The tablets are packed with educational software which could be used in the classroom setting to aid the teacher. However schools are still lagging behind in trying to infuse tablets in their everyday teaching. This could be attributed to the fact that there is no organized structure to dictate to them how they could employ the technology in their teaching and learning.

Currently, in Botswana, most public schools do not allow students to bring cellular phones to schools. Looking at how mobile devices are becoming increasingly ubiquitous, policies of schools and the education system at large may be forced to be revised. The proliferation of the mobile devices may force a change in such policies discouraging learners to bring mobile devices to school. On the other hand, some students do not own, or they do not have access to mobile devices especially in remote areas.

2.7 Mobile learning applications

As mobile devices are becoming ubiquitous, there are applications devised each day geared towards enhancing pedagogical approaches. Studies show that there are thousands of mobile applications geared towards enhancing the teaching and learning of mathematics. Some of these are still under exploration to see how best they could be of value in the mathematics classroom. Some have already been used to carry out researches. Below are some of mobile applications which have already been employed by different countries to try to enhance mathematics teaching and learning.

A.L.E.X: This is an educational puzzle game available on iPad and Android devices (Kyriakides et al., 2015). *A.L.E.X* is an entertaining programming puzzle that lets players control a robot along a path. It provides basic introduction to programming concepts and logic but at the same time it has the potential to promote a number of concepts and procedures embedded in the school mathematics curriculum

Microsoft Math: This is a free on-line high school learning support service based on the curricula. It has thousands of mathematics exercises. It gives instant, interactive feedback. It also has a portion where a learner can ask for a hint and also to read theory and examples (UNESCO, 2012).

Math4Mobile: this is an application which includes cellular applications designed to support mathematics learning (Botzer and Yerushalmy, 2007). This allows learners to work out mathematics problems wherever they are.

WhatsApp: This is a chat forum which allows people to text, share pictures and make both audio and video calls. Learners together with teachers can form mathematics based WhatsApp groups to share assignment and maths tutorials.

MMS: This is a messaging platform which allows users to exchange photos. Teachers and learners can share mathematics related pictures such as graphs and geometrical figures.

Blogs: This is a shared on-line journal where people can share experiences and hobbies. Learners can post their questions in mathematics related blogs and then a teacher or other peers can have a chance of answering the questions.

2.8 Challenges linked with mobile learning

Just like other pedagogical approaches, mobile learning has its own challenges. By adopting mobile learning, teachers will be faced with a huge task of getting learners appreciate the technology; being able to manipulate it and use it in the context of learning. Skillen (2015) suggested that when looking into the limitations and challenges of adopting mobile learning, three aspects being situational, institutional and dispositional should be taken into consideration. Situational aspect include, the funding, the technical know-how of teachers and time. Many studies report failure of employing mobile technology being exacerbated by low expertise of teachers in the area. Funding may also be a challenge as the government may not be able to provide all schools with all necessary mobile resources. There may also be a limited time in trying to help learners appreciate the technology.

The second aspect, being the institutional barriers, include lack of technology support professionals, insufficient funding and lack of adequate professional development (Skillen, 2015). If the institution is failing to offer professional development for teachers and also to provide the structures which would allow mobile technology to run smoothly, then it may not be sustained. Lastly is the dispositional aspect. This one is focused on the teachers' attitude towards the technology. If teachers are too reluctant, then mobile learning may not be as successful as it could potentially be.

Al-Hunaiyyan, Alhajri and Al-Sharhan (2016) conducted a study that aimed at investigating the students' and teacher' perceptions toward the use of mobile devices in learning, and to understand the challenges that affect its implementation. Although m-learning is used in the developed countries and considered as an effective educational tool, it is was not yet fully utilized in Kuwait, as a developing country. Their study reported on the results of a survey conducted on 623 students, and 132 instructors in order to understand their perceptions and opinions about the effectiveness of the use of mobile learning. An analysis of the quantitative survey findings was presented and the findings indicated that students and instructors are very familiar with mobile devices and its applications. The results also revealed that students and instructors had positive perceptions of m-learning, and indicated that video-based social media applications are widely used among them. However, the study reported some social and cultural issues that may act as barriers to m-learning implementation. According to Al-Hunaiyyan et al. (2016), within educational environment, it is a challenge to implement efficient m-learning projects due to the complex environment that incorporates management, pedagogical, technological elements, social, and cultural issues. Ntloedibe-Kuswani (2014) highlights that having more access to resources like mobile technology and being more independent makes one to disrupt the traditional way of learning, a phenomenon they term disruptive learning. However, disruptive learning needs high intelligence and wisdom so as to maneuver through traditional or cultural way of learning alongside new approaches of learning, particularly the ones that involve technology. Vainio et al. (2014) points out that there are still unresolved issues pertaining to culture in terms of infusion of new technology in the teaching and learning. Another problem posed by mobile technology in teaching and learning is that, even though it is easy to access, sometimes it may be difficult to understand the content hence learners may develop lack of trust in it (Ibrahim & Walid, 2014).

However, all the challenges pointed out do not nullify the good contribution mobile technology can put in the teaching and learning of mathematics. The theory that guides this study, Connectivism, emphasizes on networking and situated learning. Despite the fact that schools may not be at the utmost state of adopting mobile learning, it is evident that networking can be useful in teaching and learning, as well as learning whatever and wherever. The proliferation of mobile devices cannot be ignored. Their ubiquity may hasten them being infused into the education sector in Botswana. Even if the implementation of mobile learning can tarry in Botswana, at some point teachers and student will need to network through them for a better learning.

2.9 Conclusion

From the literature under review, there is no doubt that the development and adoption of mobile technology continues to impact our society and education. To make sustainable impact in school, future research should consider not only the affordances of technology itself, but also the pedagogical aspects of learners, learning environments, and learning goals hence the aim of this study. With this rapid increase of mobile devices in our society we cannot turn a blind eye on the affordances it has in the teaching and learning process. From what has been discussed above, there is clearly an evidence of benefits of mobile technology. There has been a great concern of mobile devices delaying students to study. Perhaps this is the right time to take advantage of the same gadgets to make them useful to students learning process. Studies have shown that mobile learning has worked and is working in the teaching and learning of mathematics, so our country should consider adopting it. The question that still remains; do we have enough resources, do we have trained personnel to facilitate it, does the environment allow us to carry out the activity? After answering these questions we will be able to adopt it in our teaching and learning as the benefits thereof are convincing.

Chapter 3: Methodology

3.1 Introduction

This chapter outlines the manner in which the study will be conducted. The research design of the study will be discussed. Also, the chapter brings an appreciation of how data is going to be collected stating all the steps of data collection procedures to the processing of data until it is ready for consumption. On the chapter, the researcher will explain clearly the population and the sample he will be working with to collect data and all the sampling procedures which will be followed. Validity, reliability and ethical considerations will also be considered in this chapter.

3.2 Research design

This study will employ a Pragmatic paradigm which encompasses a mixed method approach using both the quantitative as well as the qualitative designs. A paradigm is a conceptual framework or theoretical orientation that informs the researcher on the choice of research problem investigated (Chilisa & Preece, 2005). The quality standards of the Pragmatic paradigm are objectivity, validity and reliability as well as quality which can be modified with the use of triangulation of data, methods and theories (Willis, 2007).

For the quantitative section, the study will seek to find out the extent for which mathematics teachers are conversant with m-learning. In this section, the study will also probe as to how much ready Botswana is to adopt m-learning. This will be informed by answers which show how much students are exposed to mobile devices, the school facilities and teacher conversance. Descriptive statistics of means and standard deviation will be used to analyse the extent at which teachers are conversant with m-learning. Quantitative approach is useful in large samples and gives the opportunity for the results to be generalised. Its loophole is that it is more of quantity than quality or words. In other words the advantage of probing in data collection is

always compromised in quantitative studies. Using a quantitative approach to complement the qualitative design will therefore be beneficial for this study.

Now, this gap of lack of probing in the quantitative approach will be filled with the qualitative methods in this study. Qualitative research approach is a type of research which seeks answers to a given question. It helps collect evidence and it produces findings that were not determined in advance. The strength of this research approach is that it directly gets opinions, perspectives and standpoints from respondents (Chilisa & Preece, 2005). The design is relevant in this study since the researcher seeks to get opinions from teachers about their preparedness to embrace mobile technology in secondary school mathematics. The qualitative approach through the use of interviews will probe, from teachers, their attitudes and perceptions with regard to m-learning. A survey type of qualitative approach will be carried out to collect data from the selected sample (Chilisa & Preece, 2005).

3.3 Population and setting

A population is any group of individuals with one or more characteristics in common which are of interest to the researcher (Best & Kahn, 2006; McMillan & Schumacher, 2001). The population of this study therefore, comprises of the students and the mathematics teachers of Kgatleng junior secondary schools. There are ten junior secondary schools in Kgatleng being; Artesia, Bakgatle, Borwa, Ithuteng, Linchwe, Kgamanyane, Madikwe, Radikolo, Oodima and Sedibelo Junior Secondary Schools.

The reason why teachers will be part of the population of the proposed study is that the teachers are in a position of influence, both as opinion leaders and administrative leaders, in the education environment. Therefore, they have day-to-day interactions with pupils hence they are able to gauge the impact of inclusivity from a class setting enabling them to establish relevant recommendations for improvement as far as mobile learning and teaching will be concerned. Otherwise, students form part of this study as they are central in the study. Irrespective of the

shortcomings that exists already, for example, students being deterred to bring cell-phones to school, their contribution in this study is apparent.

3.4 Sampling Procedures

The sample shall comprise of mathematics teachers and students from the ten junior secondary schools in Kgatleng region. The Kgatleng region will be chosen since the researcher has been working in the village for the past six years hence he is accustomed to the place. The fact that he works in the area, would make it easy for him to conduct the research since all the schools are reachable. Therefore, both Convenience and Purposive sampling will be employed in selecting the teachers. For students, the random sampling technique will be used.This sampling method was chosen in order to avoid biasness and to ensure that each student has an equal chance of being selected. The students will be given paper pieces written numbers up to 5. Each student with 5 written on the paper will be selected to be part of the sample. The method is great for its inferential or generalisation ability. Also, it is of importance to note that it is only simple random sampling that ensures scientific and valid estimation of the truth, every other method of sampling only approximates this estimate with varying degree of success depending on the amount of error accumulated based on non-scientific sampling and measurement processes (Amin, 2005).

3.5 The Sample

A sample size of 360 students and 24 mathematics teachers will be used. The sample size of students of 360 is large enough to help in finding results. The number is large since the students will be only doing the questionnaires and not the interviews. The 24 that makes up the number of teachers is approximately a third of mathematics teachers in Kgatleng. Only a third of the whole population of the teachers will be used since they would be answering both the

questionnaires and the interviews. It is useful to have a smaller sample size for conducting interviews to account for issues of time management.

3.6 Instrumentation

The instruments used to collect data for this study are the questionnaires and interview guides. The students will be given questionnaires to answer, while teachers will be given both the questionnaires and the interview. The researcher will use questionnaires because the population is literate and large. In this study, a questionnaire will be used to obtain students' knowledge and perceptions on the issues as well as perceptions towards mobile technology on their mathematics learning and teaching respectively. A 5-Likert Scale on the questionnaire (SA = Strongly agree, A = Agree, N = Neutral, D = Disagree and SD = Strongly Disagree) will be used. A questionnaire consists of a series of questions and other prompts for the purpose of gathering information from respondents (Denzin & Lincoln, 2005). The researcher will develop closed-ended questions as well as open ended questions. The closed ended questions are easy to fill, save time and they will keep the respondents focused on the readiness of Botswana junior secondary schools in adopting m-learning. Questionnaires also enables the researcher to get what they want without having to express themselves.

Furthermore, open ended questionnaire encourages participants to express themselves broadly and encouraged respondents to give meaningful answers, using their own knowledge and or feelings (Bell, 1999). This will help inform this study in a broader sense as the respondents will be saying out extra knowledge which beefs up the one which was extracted from questionnaires. They will give more information about how much they know about mobile technology, its implications and attitudes attached to it by the respondents. The questionnaire is divided into sections delineating personal information, questions about knowledge of m-learning, attitudes about m-learning and readiness to adopting m-learning. Questionnaires will be

administered during break and lunch times so that the researcher does not tamper with the teaching and learning program.

3.7 Validity and Reliability

Reliability will seek to measure consistency over instruments and over groups of respondents (Wiersma & Jurs, 2005). Reliability will be checked through the use of a Chronbach's Alpha which gives the level at which the variables, teacher's knowledge on m-learning and readiness to adopt m-learning in mathematics education in Botswana, show consistency. Validity is the extent to which the instrument measures what it is supposed to measure (Denzin & Lincoln, 2005). In this study, it would accurately interpret results that is, teacher knowledge and expertise on m-learning, teacher attitudes and the readiness of the country to adopt m-learning. Validity of the questionnaire will be obtained by presenting it to two professional people which include the researcher's supervisor and an expert in the area. This is done because content and constructing validity is determined by expert judgment (Amin, 2005).

Furthermore, the researcher will conduct a pilot testing of the instruments on a small number of junior secondary students in order to check the errors, wording and content validity as well as checking whether the questions are easy to understand. In addition, for qualitative data, in order to ensure the trustworthiness of the data collected, the researcher will make sure that his presence will not affect the outcome of the interview. This researcher will do this by first explaining to the respondents that the data collected will be solely used for research purposes and not for personal use. The researcher will also emphasise anonymity so that the respondents feel free to answer.

3.8 Data collection

According to Denzin and Lincoln (2005) research literature has shown that the purpose of the study determines the methods that can be used for data collection. They also indicated that studies that look for measurement and causal relationship between variables go for quantitative

method while studies that look for social constructed nature of reality go for qualitative method. As discussed before, this study will combine both of the data collection methods. Data collection will be done in parallel. This means that both the quantitative and qualitative gathering of data will be done at the same time. In order to limit errors, special instructions like how to tick appropriately, anonymity, how the Likert scale works and how to address open-ended questions will be given during the administration of the instruments. The research assistants will also be used in the process of data collection. This will be done to help the researcher to be able to cover the schools under study well in time. On the other hand, the researcher will use assistants with an intensive research background. Even though that is the case, there will be a week of training which will include the familiarisation of the questionnaire as well as the interview guide. This will be done to produce a quality, reliable and valid data. As for interviews, to ensure the capturing of the exact words from respondents, the researcher will use an electronic recorder to record the responses. The researcher will also have a note pad to keep recording important points about respondents' views and perceptions about m-learning in mathematics education.

3.9 Ethical Considerations

It is crucial to seriously take ethical considerations into account by any scholars when they are proposing research that involves going out to the field in order to construct some form of data for analysis (Cresswell, 2008). For this study, the researcher will seek permission from the deputy Vice Chancellor of academic affairs of the University of Botswana as well as the Ministry of Basic Education to conduct the research. The researcher will assure respondents that the study will be strictly academic and that utmost confidentiality would be observed. The data used in this study will anonymously be coded and cannot therefore be traced back to individual students. The respondents, especially the students will be assured that the study will by no means intrude in their family privacy as some information about mobile phone usage at home would be needed. The core participants who would of the study will be given consent form to

read on the details of the study and their rights to participate. The consent form will include the purpose, objectives of the study and data collection techniques. The participants will also be notified that participation would be voluntary and that they would be allowed to withdraw at any time without interfering with their academic work. Emphasis will also be put on confidentiality and privacy of information that they will give during the interviews.

3.10 Data Analysis

Data analysis is a process through which data collected from the research field is processed in order to deduce conclusions (Cohen, Manion & Morrison 2000). Data from questionnaires will be compiled, sorted, edited, classified and coded into a coding sheet and analysed using a computerized data analysis package known as Statistical Package for Social Science (SPSS). Univariate analysis will be conducted to provide descriptive statistics. Means and standard deviation will be used to find how much learners are exposed to mobile devices and how much they use mobile devices. The means and standard deviation will also provide descriptive analysis of how much learners want m-learning to be implemented. Descriptive statistics in terms of means and standard deviation will also be used to see much teachers know about m-learning and how much teachers are ready to adopt m-learning. Qualitative data however will be analysed thematically. This involves the extraction of themes from data. Themes generated will be in line with the research objectives or questions guiding this study. These include teachers' perceptions and views regarding m-learning. Themes will be coded by considering similar characteristics. More specific categories of themes will then be derived from general themes. The data analysed will then be consolidated to help in presentation and interpretation of results.

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APPENDIX A

P O Box 150242

Tonota

The Director

Ministry of Basic Education

Education Research Unit

Gaborone

Dear Sir/Madam

Re: REQUEST FOR PERMISSION TO CONDUCT RESEARCH

This letter serves to request for permission to conduct a study on the readiness of Botswana Junior Secondary schools to adopt mobile technology in the teaching and learning of mathematics in Kgatleng.

I am currently doing my final year in Master of Education (Mathematics Education) at the University of Botswana. I am therefore conducting my final year research project of which I will need participants from junior secondary schools in Kgatleng Region. The participants of the study will include students and mathematics teachers.

I am anticipating a positive response from your office. It will be my pleasure if I am granted the permission.

Yours faithfully

Tapologo Mabotho (Mr.)

P O Box 150242

Tonota

The Director

Kgatleng Regional Operations

Mochudi

Dear Sir

Re: REQUEST FOR PERMISSION TO CONDUCT RESEARCH AT KGATLENG JUNIOR SECONDARY SCHOOLS

This letter serves to request for permission to administer questionnaires and interviews in Kgatleng Junior Secondary schools as part of my final year Masters project.

I am currently doing my final year in Masters of Education (Mathematics Education) at the University of Botswana. Therefore, I am conducting a research which will require participation of some students and teachers in different junior secondary schools in Kgatleng Region. The results of the questionnaires and interviews will be solely used for the project, hence anonymity and confidentiality will be observed.

I hope my request will be considered. Thank you in advance for your anticipated positive response.

Yours faithfully

Tapologo Mabotho (Mr.)

APPENDIX B

Interview for teachers.

i) How often do you use mobile devices such as phones, tablets and iPads in a week?

ii) How often do you use internet in your mobile devices in a week?

iii) What are the things you use internet for?

iv) Have you ever heard about Mobile Learning? How?

v) How much do you know about Mobile Learning?

vi) Do you think Mobile Learning can be something that can be adopted as a method of teaching and learning of mathematics? How?

vii) Do you think Mobile Learning can be used in teaching your students? How?

viii) What is your opinion regarding students coming with mobile devices such as phones to school? Explain your answer.

ix) Do you feel Botswana is at a state to adopt the use of mobile technology in the teaching and learning of mathematics? Why?

x) What do you think the challenges of using mobile technology could be?

APPENDIX C

Questionnaire for teachers.

May you kindly spare fifteen minutes of your time to answer this questionnaire. Your confidentiality is assured. Thank you.

SECTION A

DEMOGRAPHIC INFORMATION

Please tick (√) the appropriate box

Gender: Male ☐ Female ☐

Position: Assistant teacher ☐ Teacher ☐ Snr. Teacher II ☐ Snr. Teacher I ☐

Age: less than 25 ☐ 26 – 35 ☐ 36 – 45 ☐ over 45 ☐

Work Experience: 0 – 5 years ☐ 6 – 10 years ☐ 11 – 15 years ☐

16 – 20 years ☐ more than 20 years ☐

SECTION B

Please tick (√)

Key: SD – Strongly Disagree D – Disagree N – Neutral

A – Agree SA – Strongly Agree

		SD	**D**	**N**	**A**	**SA**
1.	I know about mobile learning					
2.	Mobile learning should be considered as a method of instruction					
3.	Learners should allowed to bring their mobile devices to the mathematics classroom					

4.	Mobile learning can change students' attitude towards the learning of mathematics					
5.	Mobile learning can make the teaching of mathematics easier					
6.	Mobile learning can enhance understanding of the taught concepts					
7.	Mobile learning can improve performance of students in mathematics					
8.	Teachers of mathematics should be resourced on mobile technology in the teaching and learning of mathematics					
9.	Most students cannot afford mobile devices					

SECTION C

YES/NO questions. Please tick (√)

1. Do you have easy access to internet? (YES/NO) Why?
2. Do you have internet in your mobile device? (YES/NO) Why?
3. Do you ever use internet in your mobile device to research/prepare for your lessons? (YES/NO) Why?
4. Do you think your phone/tablet/iPad (Mobile device) can be useful in students learning mathematics? (YES/NO) Why?
5. Have you ever heard about mobile technology in the teaching and learning of mathematics? (YES/NO) Why?
6. Do you think Mobile learning can impact the teaching and learning of mathematics? (YES/NO) Why?
7. Do you think we are ready in Botswana to adopt mobile technology in the mathematics classroom? (YES/NO) Why?

APPENDIX D

Questionnaire for students

SECTION A

STUDENTS' PERSONAL INFORMATION

Please tick the appropriate box

Name of school: _____

Age: 12 – 13 ☐ 14 – 15 ☐ 16 – 17 ☐ 18 and above ☐

Gender: Male ☐ Female ☐

Form: Form 1 ☐ Form 2 ☐ Form 3 ☐

SECTION B

Please tick (√)

1. Do you have access to mobile devices such as cell phones and tablets?(YES/NO)
2. Do you have phone/tablet? (YES/NO)
3. Do you have access to internet in your phone?(YES/NO)
4. What do you normally use internet in your phone for?(YES/NO)

   Social networks ☐ Researching ☐ Other ☐ Specify: _____
5. Are you in any social media? (YES/NO) Why?
6. How often do you get in social media? Rarely ☐ Slightly often ☐ Very often ☐
7. Do you ever use social media for educational purposes?(YES/NO) Why?
8. How long per day do you use your phone

   1 hour ☐ 2 – 5 hours ☐ more than 5 hours ☐
9. Do you think you can use your phone to learn mathematics? (YES/NO) Why?

10. Do you think using your phone to learn mathematics can be useful to you? (YES/NO)

    Why?

11. Are you willing to use a phone/mobile device to learn mathematics? (YES/NO)

SECTION C

Please tick the appropriate box

Key: SD – Strongly Disagree D – Disagree N – Neutral

A – Agree SA – Strongly Agree

		SD	**D**	**N**	**A**	**SA**
1.	I am aware that a mobile phone can be used for educational purposes					
2.	I believe the use of mobile devices like phones can better the teaching and learning of mathematics					
3.	I believe mobile learning help change my attitude towards mathematics					
4.	I believe we should be allowed to bring cell-phones to school to use them for educational purposes					
5.	Most students have access to mobile devices such as cell-phones and tablets					
6.	I believe Botswana students in junior secondary schools are ready to welcome learning through mobile devices					
7.	I believe mobile technology is very convenient					
8.	Mobile learning can allow me to study anywhere, at my own pace					
9.	Botswana should include mobile learning part of the curriculum					