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TOPIC:

Teaching and Learning in Multilingual Mathematics Classrooms Through the Use of an Instructional Mathematics Application Programme

A Research Report Submitted to The Faculty of Humanities, University of the Witwatersrand, Johannesburg, in Partial Fulfilment of the Requirements for the Degree of Master of Mathematics Education

by

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DECLARATION

I declare that the work of this Research Report is my own work except where indicated otherwise. I have followed the required conventions in referencing the thoughts and ideas of others.

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ABSTRACT

Mathematics classrooms are often characterized by various teaching aids including, more recently, handheld devices that are often loaded with a Mathematics Application (App) so as to provide assistance in enhancing learners' Mathematical understanding. However, the same App can be a hindrance if the Language of Learning and Teaching (LoLT) is not carefully considered in the App design stage. This study investigated what possible language issues might exist that currently could be overlooked by focusing on one Mathematics Application called onebillion©. Engelströms' (1999) Expansive Activity Model was the framework chosen for this study. In collecting data, mapping the App to the curriculum documents, interviews were conducted with Grade 1 teachers and learners, along with two classroom observations. The study established that, there were no major language issues in regard to the isiZulu language as used in the App as compared to curriculum language and as per teachers' own experiences, in particular taking into account the context where the participants were situated. It is a recommendation that during translation stage, the official curriculum documents be thoroughly consulted so as to ensure minimal language inconsistencies. Regarding future research, I would propose that other language studies be carried out (on the App) for the other African languages in different contexts, as language nuances such as pronunciation, dialects etc. have different implications for different African languages.

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CHAPTER ONE
GENERAL INTRODUCTION TO STUDY

Studies have shown that early mathematics learning and reading skills are a great predictor of later achievement in the learner's academic life (Duncan et.al, 2007). The Curriculum and Assessment Statement (CAPS) policy document in South Africa emphasises that

> Foundation Phase Mathematics forges the link between the child's pre-school life and life outside school on the one hand, and the abstract Mathematics of the later grades on the other hand. In the early grades children should be exposed to mathematical experiences that give them many opportunities "to do, talk and record" their mathematical thinking (CAPS, pp10)

These texts suggest that if a learner has a solid understanding of mathematics in the early school years, the chances are that this would positively influence later performance in mathematics. The inverse may also be possible. One of the key ingredients to successful mathematics learning is communication within the mathematics classroom. Teachers, the textbooks they use, and the mathematical programmes they employ in the course of teaching, all need to communicate mathematical ideas to learners. These learners need to understand and communicate back their understanding. There are many ways that this communication can take place, however one integral part which is essential for successful communication, is language. The connection between mathematics and language cannot be ignored as mathematics is taught in- and through language, and especially so in the context of South Africa where multilingualism is the norm rather than the exception (Adler 2001; Adler & Pillay, 2017; Barwell, 2009; Boulet, 2007; Pimm, 1981).

Barwell (2009) argues that the learner's proficiency, or lack thereof, in the language of learning and teaching (LoLT) plays a major role in their mathematics performance, compared to their peers who are monolingual. This emphasises the role that language plays in the everyday teaching and learning of mathematics. The current mathematics classroom is characterised by the use of various teaching aids to help learners understand certain mathematical concepts and develop a deeper conceptual understanding (Jenkins, 1957). At times, technological applications are used in the classroom for the same aim, to reinforce mathematical concepts and aid understanding (Ferrini-Mundy & Breaux, 2008).

For the purpose of this research, I intended to investigate on how the use of a Mathematics Application (App) called onebillion© enabled (or not) the teaching and learning of mathematics in classroom situations. One way in which the App had enabled teaching and learning of mathematics had been through the home language provision that is offered by the App in order to enhance mathematics access to the learners in a certain social context who were not English first language speakers. Roblyer and Doering (2013) identify the six principles that ought to be present in every school mathematics program. These are as prescribed by the National Council of teachers of Mathematics (NCTM) namely: equity, curriculum, teaching, learning, assessment and technology. Focusing on the last item which is technology, Roblyer and Doering (2013) argue that technology can enable the teacher to move towards a more learner-centred approach and thus allow for context to be embraced in the mathematics classroom. Furthermore, they argue that technology can enable the (elementary-age) learner to engage experientially with mathematics, using real-life and concrete reasoning, as opposed to abstract reasoning. Technology affords what they term "virtual manipulatives" which can be manipulated as need be. Sharples et al. (2016) in their study of mobile learning found that technological devices such as computers and mobile phones (including tablets and iPads) are tools that assist the learners in the process of acquiring knowledge. The South African context is unique, given its history with Apartheid and the its aftermath which is currently being experienced (Adler, 2001; Phakeng & Essien, 2016). In recognition of the necessity to ensure equal access to education for all, the language in education policy (1996) has made provision for foundation phase learners to receive instruction in their mother tongue supporting conceptual growth as well as ensuring that there is a continuity between the learners' home language and the LoLT. The South African School Act, under Language in Education Policy, allows for a learner to choose the language of teaching when applying to schools. Additionally, the learner is allowed to learn in his/her mother tongue throughout primary and high school years (Schools: Law and Governance, 2014). Despite this provision, there is a prominent trend whereby schools continue to offer English as the LoLT, even though the majority of the learners are African and are able to understand, talk and write in one of the 10 official South African languages (Barwell, Chapsam, Nkambule, & Setati-Phakeng, 2016).

This study focuses on an App developed by onebillion©, which focuses on providing mathematics in various languages, for core mathematics concepts in the first four years of schooling, from reception to Grade 3. The App is available in App store and Google play in a variety of languages (onebillion©, 2018). The App offers children mathematics in a colourful,

fun and interactive way that is relevant to the early-grade mathematics learner. This App allows each learner to engage with the App independently (following the instruction of the in-App tutor), choosing the type and frequency of content engagement, whilst providing immediate feedback to the learner. Gamification is applied, as there are increasing levels to be promoted to, based upon passing quizzes. This allows for the child's knowledge and achievement to be monitored and evaluated (Pitchford, 2015, 2019). The content in onebillion© App has been aligned with the South African national curriculum and although was initially developed in English it has been translated into several other official South African languages; isiZulu in the case of the current study. The App has been piloted in a South African Province and has been used by Grade 1 learners.

Translating the mathematics register from one language to another (English to isiZulu in the case of this study) is not a straightforward enterprise. The extent to which language issues can be found in mathematics Applications that have been translated from one language to another has not been an explicit focus in research. This study sets out to investigate this phenomenon, Thus, the purpose of this study is to investigate what possible issues might exist in translating mathematics Applications from one language to another. To achieve this, the study focused on the onebillion© mathematics App that is offered in isiZulu, centring on the mathematical language/register used in the App. This study was informed by the research questions below:

1. How does the isiZulu mathematics language in the onebillion© App compare to the isiZulu language found in the Curriculum materials used by the teachers and the learners in Grade 1?
2. What are the teachers' experience of the isiZulu mathematics language as it is used by the App?
3. What language issues are embedded in the use of the App and what has the App enabled the teachers and learners to understand better?

Together these questions will help me map the mathematics App to the curriculum and highlight the teachers' view of the language as used in the App, which in-turn could have had implications on the mathematical understanding of the learner.

1.1 Significance of the Study As mentioned above, language plays a critical role in mediating the understanding of the concepts in mathematics (Adler 2001, Adler & Pillay, 2017; Barwell, 2009; Boulet, 2007; Pimm, 1981). The contribution that this research intended to make to the larger body of mathematics research was that, whilst

mathematical content is often critically scrutinised before a roll out of an intervention, it is important that we do not overlook the role which language can play in ensuring that the learning that is offered to the learner is not diluted or impeded simply by overlooking the importance of language during the design stage of the App.

1.2 Conclusion

This introductory chapter has given the reader a snapshot of what the study intended to achieve and the contribution it intended on making in the field of research. The second chapter will explore the theoretical framework that was used in this study, as well as the rationale behind it. The reader will then be presented with a review of relevant literature which covers the different concepts of this study such as mathematics as a specialised language, multilingual context as well as technology and mathematics in the third chapter. The subsequent chapter outlines the methodology that was used to carry-out this study, along with the ethical considerations, validity and reliability fulfilment as well as how the data was analysed. Chapter five deals with the findings of this study in relation to the research questions. Finally, the sixth chapter will conclude with a discussions and conclusion of the findings as stated in the fifth chapter.

CHAPTER TWO
THEORETICAL FRAMEWORK

2.1 Introduction

The chapter will introduce, explore and substantiate the theoretical framework used in this study. Consideration was given to the context, as well as the aims of the study. This helped guide the framework, which is discussed below.

2.2 Activity Theory Unpacked

The theoretical framework that was used to inform this study was Engelström's (1999) Expansive Activity Model. This theory has its etymology in Vygotsky's (1978) work on mediation, which engages with how learning is mediated by cultural signs and tools. Engelströms' (1999) Expansive Activity Model (Figure 1), adds on to the mediation theory of Vygotsky, the work of Leontev on action and activity highlighting division of labour, and constructs a system that takes into account the object, subject, mediating artefacts, rules, community and division of labour, as presented in Figure 1 below. These are further explained below. The main idea behind model is that when analysing how children come to know, it is important to look at the entire system that informs the child's actions, and it is important to consider the context in which learning takes place. The child does not come to know on his/her own but in the context of the society in which s/he is part of (Engelström, 1999).

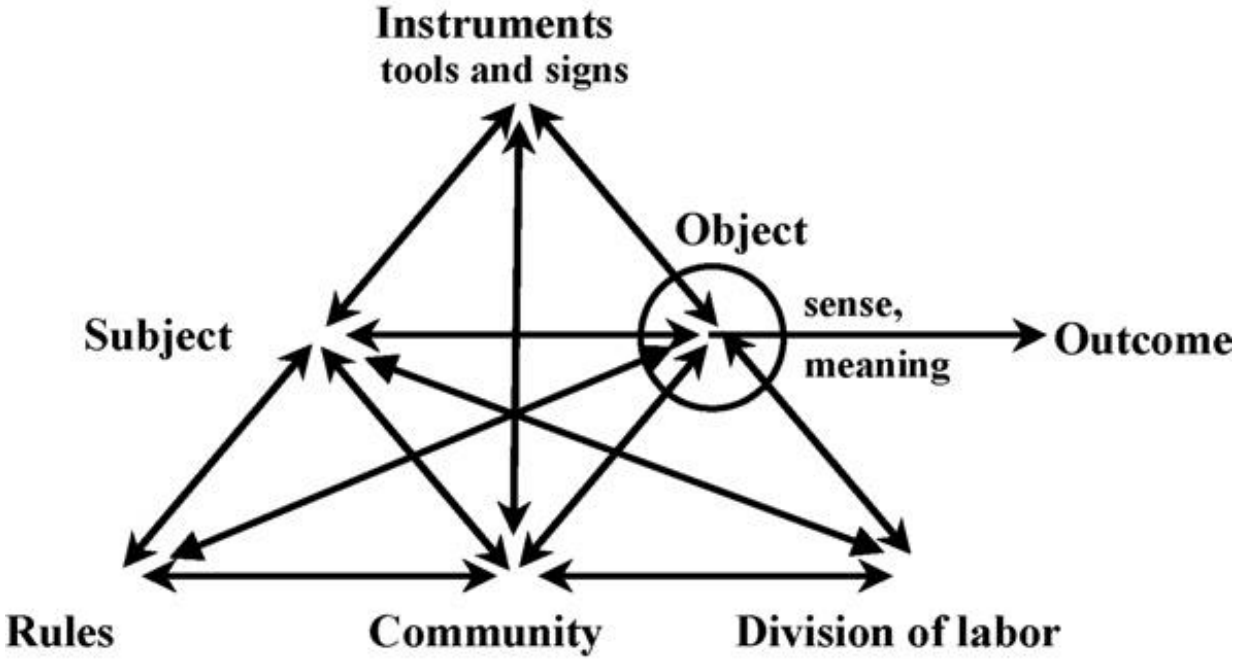

Figure 1: Engelström's expansive activity model

- **Object**: "…the object is more than just a goal or product. Objects are durable concerns and carriers of motives; they are generators and foci of attention, volition, effort, and meaning" (Engeström, 2015, 16). Thus, the object represents the rationale for an activity, which needs to be transformed and/or acquired. In the current study, mathematics was seen as the object of the system. The existence of the onebillion© App and the isiZulu language are meant to facilitate access to deeper understanding of the mathematics concepts.
- **Outcome**: This is closely related to the object, and represents the final acted upon object. In this study the main outcome was the enhanced understanding of mathematics concepts
- **Subject**: Kuuti (1995) terms the subject as an actor as well. The individual(s) who acts upon the object, using tools available is/are termed 'subject' in this framework. In the context of this study both the Grade 1 teacher and the learners acted upon the Mathematics that is in the App and as such, they were both subjects of this framework
- **Instruments (Mediating Artefacts)**: Vygotsky (1978) identifies two kinds of tools. "Technical tools are intended to manipulate physical objects (e.g. a hammer) while psychological tools are used by human beings to influence other people or themselves (e.g., the multiplication table, a calendar, or an advertisement)". These tools enable the subject(s) to manipulate and transform the object (s), but as much as the tool allows. As such the tool can play two roles, one as an enabler and another as a constrainer. The mathematics App that had been stored in the iPad and the isiZulu home language were both seen as tools that were being used in this study to enhance the learning of mathematics for the Grade 1 learners.
- **Rules**: Rules "cover both explicit and implicit norms, conventions and social relations within a community" (Kuuti, 1995, 25). Every social context is characterised and organised by the collective and individual rules and norms. The learning context is no different. In the classroom which the learners use the App, there were rules that governed the classroom. An example of such rules included, that each child must work individually on an iPad, having logged in using their individual login details so that the App was able to track the progress of each child etc.
- **Community**: There exists a "…systemic relations between an individual and his environment in an activity…" (Kuuti, 1995, 25). The individual does not exist and function in isolation, s/he is always interacting with the greater society. Even though

the learners worked on the App individually, they belonged to the larger mathematics community, which included their fellow Grade 1 learners as well as their teachers and ultimately the school that they attend.

- **Division of Labour**: "refers to the explicit and implicit organization of a community as related to the transformation process of the object into the outcome" (Kuuti, 1995, 25). Engelström uses a hunting metaphor as used by Leontev, which shows how the group of hunters, although all have one objective and that is to catch the animal being hunted, each one has a role to play, one to distract the animal, one to attack the animal etc. This means that each of them has their own roles to play (Engelström 2015, 1999, 1987).

  In this study the roles of the teacher and learner differed significantly, in comparison to the roles in the traditional mathematics classroom. The App placed the responsibility of learning on the learner, whilst the teacher was meant to assume the role of the facilitator and monitor.

2.3 Instruments (Mediating Artefacts) as a Focus of this Study

It is important to note that when a learner is in a process of learning, the learner does not do so in isolation, as mentioned above. There are various factors which bring about this enhanced learning, one of which is instruments/mediating artefacts. Special attention has been paid to this factor. Vygotsky (1978) described it as signs and tools that together mediate learning. He referred to language as a tool which could enable the individual to act upon their surroundings or object. Tools provide an extension in which the individual is able to manipulate his/her environment. In the context of learning the learner uses the tool given to him/her to act upon the knowledge in order to better understand what they are learning. Engelström (1999) highlights that the relationship that exists between these factors of the activity theory are at times complex and as such do not necessarily work in harmony with other factors. In this study there were two specific tools that were used to mediate learning, namely, language and technology. The learner used the isiZulu language as a tool to access the mathematics that is presented through another tool which is technology. Through the combination of these two tools the learner is able to enhance his/her mathematical learning and understanding. It is important to note that the two tools, language and technology, whilst meant to contribute in the process of accessing and understanding the mathematics, can also impede that learning. Thus, before even considering how they might work in relation to other factors of the theory, it is important that the language and technology (mediating artefacts) factors are themselves acting

as enablers in the learning environment rather than impediments. In order to ensure this, the concept of transparency as described by Lave and Wenger (1991) shed some light on how these tools should function.

Lave and Wenger, (1991) describe how transparency denotes the visibility as well as invisibility in the same context of a practice. In their work Lave and Wenger (1991) explain this using an analogy of a window. A window allows individuals inside to be able to see what exists outside. However, at the same time this window becomes visible as a window because of the function it serves. In this current study the notion of transparency is very relevant because, whilst technology and language nuances exist, the shift should be to make them as inconspicuous to the learning process as possible and as such permitting learners to have access to the mathematics learning and understanding rather than impeding this access.

For this study the notion of transparency was superimposed over the notion of instruments/mediating artefacts. This combination is crucial in highlighting the important role that mediating artefacts play in the process of learning. However, this also highlights the importance of ensuring that greater care is taken in confirming that mediation that is meant to enable learners in learning and understanding mathematics achieves exactly that. Tools and signs should therefore be seen as an extension of the learners' daily environment, so that language and technology do not create obstacles in the learning process, but rather enhances it.

Using the concept of transparency and described above, Setati et al. (2008), in their work dealing with home/mother tongue, propose that language and technology should be used in such a way that it does not impede or interfere with mathematics learning. When the LoLT/technology interferes with dialogues or expression and mathematical activities of learners and teachers, then language/technology is seen to be a visible resource. Therefore, the focus should rather be to ensure that the LoLT/technology become an invisible/transparent resource. Thus, if the learners are able to express (verbally and in written form) their mathematics activities freely in a language of their choosing, they should be encouraged because it shifts the focus to the content of the mathematics rather than their expression and language use.

This current study is not the first study that uses the work of Engelström (1999) in analysing learning and technology as well as communication. In developing their theory of mobile learning and later learning theory for the mobile age, Sharples, Taylor, & Vavoula, (2005; 2016) also used Engelström's (1999) model of expansive activity model and changed some of

the terms so as to best suit their theory. Whilst Sharples et. al's (2005; 2016) work address the technology landscape, the theory tended to focus more on communication as a central feature to their theory and as such, the theory is to a large extent informed by other communication theories. This is why I have rather used Engelström's (1999) original expansive activity model as my theoretical lens.

2.4 Conclusion

This chapter has demonstrated how and why the Expansive Activity Model fits with the current study as well as to what parts of this framework were central to this study. It is important to keep in mind that even though much focus was on the tools aspect of the framework, the access to and enhancement of mathematical understanding is why this App exists in the first place. As such, the construct of tools stands out because the present study is about language issues that might be found in the use of the App, which may enable or constrain the intended access to the Mathematics. In the next chapter, literature that exists in regard to the different components that inform this study has been outlined.

CHAPTER 3
LITERATURE REVIEW

3.1 Introduction

In this chapter, literature relating to mathematics as a specialised language, multilingualism and technology in the mathematics classroom, and the nuances that come with these concepts have been discussed. This has been done by reviewing what has been written in regard to how language is understood, used and interpreted in the mathematics classroom. As this study focused on mediating artefacts and in particular the isiZulu language, the ever-increasing presence of technology in the mathematics classroom cannot be ignored. As such, studies in regard to this field have also been explored, critiquing the incorporation of technology into the classroom.

Kilpatrick et al. (2001) defined mathematical understanding as one which is comprised of five intertwining strands, namely: conceptual understanding, procedural fluency, strategic competence, adaptive reasoning and productive disposition. In order for the learners to be able to construct the mathematical understanding that is required of them, these strands in their intertwining nature need to be at work within the mathematics classroom. Emphasis on conceptual understanding at early age can assist in ensuring that the learners have a good foundation for concepts that will be taught on higher grades. Hence, Kilpatrick et al.'s (2001) definition of mathematics proficiency encompasses what should characterise the mathematics classroom. Furthermore, it is important to highlight that the most efficient way in which the learner can be seen to display the five mathematics strands is through dialogue in his/her interaction with the teacher and peers in the mathematics classroom. Therefore, key to the teaching and learning of Mathematics is dialogue in the mathematics classroom. There needs to be a language in which the teacher and learners can converse, and a teacher to facilitate learning, hence, mediation (Vygotsky, 1978). Through language, communication in the mathematics classroom is possible, which in turn enhances learning of mathematics (Boulet, 2007; Pimm, 1981). Through the use of language, the teacher is able to elicit from learners their understanding of concepts being taught (Lobato, 2005). There are three components that are key to this study: mathematics language as a specialized language, multilingualism and the mathematics classroom, as well as technology and mathematics. This focus is crucial because, as mentioned in the previous introduction chapter, early grade mathematics has been seen as a key foundation in later success of mathematics learning in primary school children (Duncan

et.al, 2007). It is no wonder much research focuses in the early grades of primary school, in trying to ensure that these young learners and the way in which they learn is understood by educators and researchers (Saracho & Spodek, 2008)

3.2 Mathematics Language as a Specialised Language

The language of mathematics is characterised by symbols and words that are only applicable in the mathematics context which is the mathematics classroom (Pimm, 1991 and 1981). These papers highlight this point even further to say that mathematics is not a natural language in which one can converse with others such as English. Mathematics has its own register, the same way that all other natural languages do, such that certain words that would be used in the English register have a different meaning in the mathematics classroom (register). An example of such words/terms would include, volume, operation, point, mean, figure, product, rational, odd, etc. (Meiers, 2010). These words have a different meaning in the everyday language as compared to their meanings in the mathematics classroom. Furthermore, mathematics is condensed and often expressed in its symbolic forms which makes it harder to grasp at times the meanings behind the symbols (Pimm 1991).

In working towards a mathematics classroom in which learners get enculturated into the mathematics and language of mathematics, Boulet (2007) highlights the importance of teachers using the correct mathematics register in explaining and communicating with learners and also allowing for learners to have discussions in which they are given the chance to practice and develop the mathematical register. But as Pimm (1991) highlights it is not an easy task to move the learners from the informal ways of speaking mathematics to more formal ways of speaking, let alone to the formal written language. However, he does propose a way in which a teacher can enculturate their learners into ultimately representing their mathematics in more formal ways. Pimm (1991) proposes that the teacher allows the learners to transform their spoken language into informal written language and thereafter work on making it more formal. Alternatively, they can start with informal language and work with learners to ensure that their responses become more formal and thereafter document those formal responses. In either of these strategies, Pimm (1991) argues that the teacher has to be intentional and as such ensure that the learners get the chance to communicate their work and their ideas publicly with other learners and in an expected formal mathematics register.

3.3 Multilingualism and the Mathematics Classroom

The purpose of mathematical language is to assist in building mathematical ideas and meanings, and thereafter communicate them with peers (Pimm, 1981). In this interaction language plays an important role. Often times communicating these mathematical ideas and meanings, can be encumbered by possible natural language complexities (Pimm, 1991).

It is a reality that mathematics is taught in various languages across the world and within the country borders themselves. What this means is that the learners at large from an early elementary level, learn the mathematics with its register in their mother tongues. The implication here is that when learners enter primary school, more often than not, know and are be able to communicate in the LoLT which is in their mother tongue. However, at this point they will encounter a mathematics language or vocabulary that they have not been previously exposed to outside of the schooling context. This supports Karpov's (2007) review of Vygotsky's followers' notion of scientific concepts which learners get exposed to in the schooling environment in which learners would otherwise only have access to spontaneous concepts which are developed from their everyday activities.

Recent years have been characterised with major shifts amongst nations in terms of migration for various reasons such as wars or individuals, families looking for asylum and better working or business opportunities. These movements have taken place within regions and provinces, as well as within countries (Zolberg, 1989). Zolberg anticipated what we are now experiencing in terms of global migration. Most of Western and European studies on possible language issues in the Mathematics classroom are done in the light of this kind of migration in mind (Barwell, 2009; Moschkovich, 2015). This complexity is coupled with what Barwell (2003) terms "linguistic discrimination" describing how political powers have influence as to which language is favoured whether it be representing the minority or the majority. Thus, as these migrations occur, these individuals are confronted with new cultures and other geographical specific experiences, whilst often having to learn a new language so as to be able to assimilate in the new environment.

In Africa it is no different, migration from one country to another or within provinces, language issues prevail. African countries are characterised with varying language policies. Oftentimes the language policies that have been decided by the ruling parties, often represent what needs to be implemented without clear implementation plans as to how these are to be implemented at the different levels concerned, all the way to the classroom (Bamgbose, 1999).

In South Africa, there are 11 official languages which is inclusive of sign language (Stein, 2017). Furthermore, as mentioned in the introduction, learners are entitled to be taught in their mother tongue throughout their schooling years. Therefore, depending on which province/district the learner might be situated, his/her context will in most case determine which LoLT s/he will be exposed to. In the migration from rural to metropolitan cities and vice versa could imply that the language of LoLT that the early grade primary school children will be exposed to change especially if it is a vernacular language. These learners will also be required to continue their early primary studies in mathematics in the local language that school uses, whether they are fluent in the language or not. Thus, the notion of multilingualism comes in at all levels of schooling and in various contexts. The focus is particularly on early primary (Foundation phase) not only due to this study but because by the time the learner reaches the fourth grade the LoLT would often change into English (Stein, 2017). This is as a result of political nature of South Africa as a country. Parents are often influenced by past experience of how language was used as an oppressive tool, and therefore feel that mastery of the English language will provide their children with better opportunities. As a result, oftentimes most of the African parents will prefer that their children be taught in English as LoLT believing that this will provide a better future for them (Setati, 2005).

It is challenging when the learners have to learn mathematics and the register that comes with it as they enter formal schooling years. The challenge is magnified if the language offered for mathematics is not the learners' first language which may result in the greater difficulty for the learner when it comes to their mathematics learning. This is because the learner has to learn the language of mathematics and the LoLT. Another important factor to keep in mind is that of dialect variation within a language and especially so the African languages. For example, within the KwaZulu Natal (KZN) province, it is assumed that the entire province has one dialect of isiZulu. However, research finds that geographical locations have developed their own dialects of isiZulu within KZN, which further varies from the isiZulu spoken in Gauteng province (Cook, 2006). Furthermore, it is assumed that the teachers that are in the mathematics classrooms which offer mother tongue as LoLT in mathematics are also fluent in these languages and that they have been trained adequately to teach in the first language on offer by the school.

It is further assumed that the teachers who are found in the mathematics classroom are able to teach in the multilingual context that they find themselves in. However, this is not necessarily the case, too often the (pre-service) teachers are not sufficiently equipped to deal with the

multilingual classrooms (Essien, 2010). Clarkson (2009) highlights on how there is not one specific way of describing mathematics classrooms that are situated in multilingual context in an identical manner. Instead, Clarkson (2009) has grouped these contexts to the following four categories: firstly, there are contexts which a monolingual teacher finds him/herself teaching a class with monolingual and multilingual learners; secondly there is a context whereby, the monolingual teacher is teaching a class that is comprised of multilingual learners all speaking same languages; thirdly, there exists a multilingual classroom whereby the teacher and the learners are both multilingual but the LoLT is in a language that is not a first language to either of them; lastly, there is a multilingual context in which the multilingual teacher teaches multilingual learners is a shared language. This important contribution from Clarkson applies to the context of South Africa and depending in which school one is situated/looking at, all these contexts can exist in one school, within different classrooms.

For the experienced teachers, working in multilingual classrooms poses a number of dilemmas that they continuously have to confront such as code-switching, mediation as well as transparency (Adler, 2001). Hence mathematics Apps such as onebillion© are seen to be of value as they try mitigate the home language deficit, whilst overcoming the teacher's dilemmas by having ready-made App that has already been translated into the home language which is the LoLT that the learner is exposed to in school.

The high concentration of indigenous languages found in South Africa makes for teaching and learning contexts that are rather complex and would differ significantly from those such as practiced in other countries (Adler, 2001; Gorgorio & Planas, 2001). The language being practiced at public schools are a manifestation of the language policy of the country and furthermore the language policy of the school, at both these levels there is high political interference. However, there is one more level in which language policies are influenced and that is at the implementation level, which is found in the classroom, where the implementation of the language policies is highly dependent on the teacher found in the classroom (Adler, 2001; Bangbose, 1999).

3.4 Technology and Mathematics Teaching and Learning

Technological advancement is rampant, and the mathematics classroom is no exception. Most of the primary school going children have at different levels been exposed to technology, whether at home or/and at school (Jukes, McCain, & Crockett, 2010). There has been a view that technology assists learners to learn better than the traditional way of teaching. Loveless

(2002) brings to the fore a number of key points with regards to the use of ICT in the primary classroom, which include features such as interactivity (allows the learner to do much in different ways with immediate feedback), provisionality (the learner is able to try different alternatives, keep track of what has been done and so on), capacity and range (speaks to the large amount of data that can be accessed by the learner and teacher) and speed (because a lot of work is automated and happens in a speedy manner, technology affords time in which learners can ask questions in regards to where they are struggling and giving them more time to engage with what they are doing), all of which when combined enhance the authenticity of the user-experience. She however cautions on the mismatch of how the technology is used in the homes versus how it is used in the classroom, the pace, the independence, the structure and so on (Loveless, 2002).

However, Jewitt (2006) argues that some technology helps some learners to learn in some contexts. She highlights that the notion that technology is the answer to the ailing education sector is reflected in government policies and their budget allocations that are geared towards "technologising" the classroom. Hence, often the developers of these programmes position their offerings as a solution to learning and teaching issues that are found in the classroom (Loveless, 2002). However, Jewitt (2006) argues that teacher's resistance to change, inadequate funding or failure of government policies, are not to blame for the long-time failure of incorporating technology into schools but rather the way that the technology is designed impedes its own implementation.

The critical role of the teacher in using technology in the classroom and especially the mathematics classroom cannot be emphasised enough. The knowledge of the teacher towards technology can impact the way technology is used in the classroom. If the teacher is not comfortable with the technology s/he will likely ensure minimum (surface level) usage or neglect it altogether. In a programme like onebillion©, one key aspect is that the implementation of the App requires minimum mediation of the teacher for the student learning to happen. This is because the teacher voice is preloaded, and the learner is guided by what the teacher in the App is instructing, and as such allows for direct interaction between the learner and the technology and the teacher role is thus minimised.

Koehler and Mishra (2009) provide a very useful framework that defines what is needed from the teachers' point of view for technology to be successfully integrated in the classrooms. They propose technology, pedagogy and content knowledge (TPACK) as a framework to work with in developing and enhancing the teacher's knowledge in regard to technology integration in

the classroom. Koehler and Mishra (2009) base their work on Shulman's (1986, 1987) work on types of knowledge that teachers possess. They note the intersection that occurs between the three types of knowledge to bring about Pedagogical content knowledge as described by Shulman (1986, 1987), Technological content knowledge as well as technological pedagogical knowledge. They argue that it is important that the teacher has knowledge of what pedagogical assumptions underlie a certain content of the work s/he teaches, what is applicable in that context and how best to represent it taking into account the learners previous content knowledge, this speaks to the pedagogical content knowledge (PCK) the teacher is meant to have. Secondly the teacher needs to have knowledge of the technology that is available and best suited to her subject matter, and how technology can enhance or constrain the content being taught and vice versa, this knowledge is what is termed Technological content knowledge (TCK). Thirdly, the teacher needs to understand the extent to which and how technology implemented in the classroom can have an effect on the teaching and learning context, this knowledge is termed Technological Pedagogical Knowledge (TPK). The combination or overlapping of these three knowledge (PCK+TCK+TPK) bring about what is now known as Technological Pedagogical and Content Knowledge (TPACK). Koehler and Mishra (2009) describe TPACK as follows,

> …TPACK is the basis of effective teaching with technology, requiring an understanding of the representation of concepts using technologies; pedagogical techniques that use technologies in constructive ways to teach content; knowledge of what makes concepts difficult or easy to learn and how technology can help redress some of the problems that students face; knowledge of students' prior knowledge and theories of epistemology; and knowledge of how technologies can be used to build on existing knowledge to develop new epistemologies or strengthen old ones (p. 66)

From Koehler and Mishra's (2009) abovementioned points it is clear that the teacher who is not well versed in the PCK, or the TCK and TPK can only partly utilise the resourcefulness that technology has potentially on offer in the teaching and learning context. Leendertz et al. (2013) in their investigation on how TPACK influences the teaching and learning of mathematics for Grade 8 found that, more learning and better results were evident in TPACK teachers, as opposed to Non-TPACK teachers (Leendertz, Blignaut, Nieuwoudt, Els, & Ellis, 2013).

In reviewing on how far we have come with regard to technology in the classroom, it's worth mentioning the concerns that emanate from research in regard to the use of technology

especially so in the classroom setting. Jukes et al. (2010) cites the work of Small and Vorgon (2008) as well as Medina (2008) in regard to some of the concerns with the use of technology such as, how the use of high technology computers, smart phones are altering the way the brain functions in the children, weakening the old ways and strengthening new ones at the expense of cognitive skills. Another concern is lack of face-to-face interaction and communication, which will impact the development of "interactive social skills", such as lack of empathy as that part of the brain is rarely stimulated by the new way the brain functions. Multitasking is another character that emerges from the digital generation, of which whilst it can be appreciated, it proves difficult when a learner is required to concentrate on one task at a time, as typically seen in classrooms. Other concerns include, children engaging less in physical activities, not spending enough time with nature and most importantly the addictive nature that the digital age brings with makes these young learners obsessive over their digital activities.

3.5 Conclusion

This chapter has reviewed the different literature that are available in which the current study can draw wisdom from. In highlighting the subcomponents that have to be taken into account when doing this study, namely, mathematics as a specialized language, multilingualism and the mathematics classroom, as well as technology in the teaching and learning of mathematics. The above discussion makes mention of a number of other frameworks such as Kilpatrick et al.'s (2001) five strands of mathematical proficiency, Koehler and Mishra (2009) TPACK which was built upon Shulman's (1986,1987) work, amongst others. These literatures have been explored in order for me to engage with the current study with a better sense of what has been theorised thus far, in regards to the different concepts that (in)directly form part of this study. However, hereforth Engelstrom's (1999) Expansive Activity Model will be the only framework that will inform the reminder of the study.

CHAPTER 4
METHODOLOGY

4.1 Introduction

This chapter discusses the chosen methodology for this study, highlighting the instruments used for collecting the required data as well as how the data collected was analysed. Issues pertaining to ethics, validity and reliability of this study are also discussed in this chapter.

4.2 Research Design and Methodology

Yin (2016) argues that Qualitative research affords the researcher the ability to conduct an in-depth study of the phenomenon in their everyday context. This study aimed at exploring the rich descriptions of the teachers and learners' own individual experiences in relation to the Mathematics App onebillion©. Thus, this study is qualitative in nature.

A case study research approach was undertaken, with the onebillion© App being the object of the study. This method allowed for in-depth description and understanding of the language nuances associated with teachers and learners interacting with the App, which has been created to support the learners' understanding of basic mathematical skills.

In this instance the object of study was thus the onebillion© App and as such the Case Study research approach was adopted. In utilising this approach the data from the interviews, the mapping exercise as well as observation all centred around the App (McMillan & Schumacher, 2010)

4.3 Sample

Onebillion© ran a pilot study through their implementing partner for a year in 2017. During the Pilot year, two teachers and Grade 1 learners were involved in the project. This implies that whilst the teachers might have remained the same from the pilot study year (2017) to the year in which data was collected for the present study, the Grade 1 learners of 2017 have in the meantime progressed to Grade 2. Subsequent to the completion of the pilot study in which only two Grade 1 teachers were involved, there are now five Grade 1 teachers that have been using the App in the classroom and as such all the Grade 1 teachers have been working with the App. Therefore, the sample consisted of two teachers who initially had assisted the learners with the App during the pilot stage as well as the other three teachers who were teaching the Grade 1 learners at the time of the study, and as such interact with the App. The sample also included

7 randomly selected learners from the Grade 1 class (year 2018) who have access to the App. A total of 7 learners and 5 teachers were interviewed for this study.

4.4 Methods of Data Collection

Various methods of data collection were used in this study. Firstly, semi-structured interviews were conducted with teachers and learners and their responses were recorded. The open-ended questions allowed for the participants to voice their experiences without the confinement of the researcher's preconceived ideas (Creswell, 2012; Yin, 2016). Secondly observation in both the traditional and App classrooms were observed. A non-participant observer role was applied, and classroom observations were noted. Lastly, curriculum documents were collected and analysed with the App in mind and proved useful when text interrogation was done (Cresswell, 2012)

4.4.1 Interviews

The interview questions focused on the teachers and the learners' perception of the isiZulu language as utilised by the App. In particular, I wanted to find out if the teachers had noticed any language (in)consistencies between the isiZulu language used in the materials used in the traditional classroom and the isiZulu used in the App. Therefore, interview questions such as those listed below were asked.

The semi-structured Interview questions asked to the teachers were as follows:

1. Are you an IsiZulu home language speaker?
2. If no, do you feel that you are fluent enough in the IsiZulu Language to be able to use it as a LoLT in your classroom or do you also mix with English or other languages?
3. What materials do you use to teach mathematics daily in your classroom? How do you compare the language used in the materials you used daily and the isiZulu language in the App. Can you give an example? (based on answer given)
4. How do you find the isiZulu language as used in the App? (Probe: Do you feel that the IsiZulu Language in the App is adequate enough to be used by you in the classroom?)

Let us talk about the Grade 1 learners in your class

5. Do you feel that the App has helped you and your learners understand the mathematics better? How so? Please explain with an example of how this has happened.
6. Are all the learners in the classroom IsiZulu home language speakers?

a) If yes, did they easily understand the IsiZulu language in the App or did they (in the beginning) ask for clarification? Was this clarification language based or mathematical register (new terms they don't know) based?

b) If no, how did this play out in the classroom? Did / do they require more assistance in the use of the App than the rest of the learners in the classroom?

7. Has the use of the App enabled you and the learners in improving the IsiZulu mathematics register?
8. Are there any language issues that you would like to discuss that you and/or leaners have encountered as you used the App?
9. Do you have any additional comments and/or recommendations in regards to the App and the language being used in the App?
10. If at no point the issue of dialect has come up during the conversation above, mention it now. Ask the teacher if she feels that there are any dialect nuances that should be taken into account.
11. Would you have preferred the App in English instead of isiZulu? Why?

The semi structured Interview questions asked of the Grade1 learners were as follows:

1. Do you like the work you do on the App?
2. What do you like the most about it? (Probe: does it help you understand Mathematics better? How)
3. Can you understand what the lady is saying? If No, why can't you understand her?
4. Does she use the same isiZulu words like the ones your teacher uses when she is teaching you in class? explain

With regards to the Grade 1 learners, taking their age into account, interview questions were simplified, leaving room for elaboration when appropriate. The focus in the learners' questionnaire was to see whether the language used in the App to tutor them had been easily understood, and whether this had been different from the LoLT used in the traditional mathematics classroom.

These questions were developed in English and translated into isiZulu so that the teachers and learners had a better understanding of the question and were comfortable to answer and explain themselves. A translator was used during the interviews, which were audio-taped and transcribed for analysis.

4.4.2 Observation

Two classrooms observations were carried out: firstly, classroom language usage between learners and teachers in the traditional classroom setting, and secondly, I observed the same classes in the mobile classroom where the learners engaged with the mathematics App. It is useful to mention that this observation was carried out without a schedule as I simply observed the similarities and differences between the traditional classroom and the mobile classroom, where the App was in use.

4.4.3 Document Analysis

Basit (2010) speaks of document analysis as a less invasive way of gathering data, whilst allowing the researcher to see what is on record and what has been omitted with regards to a certain phenomenon. In this study, documents were reviewed that are used to inform the traditional mathematics classroom (the teacher and learner materials) as well as the App itself. The intention in doing this analysis was to establish whether or not there were any inconsistencies between the mathematics register that the learners encounter in the mathematics classroom and that encountered in the App. This analysis assisted in triangulating the findings that would have emerged from the data collected from the interviews and observations of the class.

4.5 Validity and Reliability

For the purpose of this study, the work of Maxwell (1992) was explored, as it concerns rigour in qualitative study. Maxwell (1992) outlines different kinds of validity that are possible in Qualitative research. The nature of this current study and the analysis process thereof relies heavily on what Maxwell term Interpretive validity. However, at the foundation is the descriptive validity that emanates from the accurate recording of what I had heard and observed. In the context of this study, all the interviews were recorded and thereafter transcribed before analysis was done. Because the participants' own words were used in making sense of the data, which was analysed and the subsequent findings were the result of what was expressed by the teachers and learners themselves, interpretive validity is thus attained (Maxwell, 1992).

Furthermore, Cohen et al. (2011) warns researchers from allowing their preconceived ideas to interfere with the data collection. Misinterpreting the answers from the respondent so that they fit with the preconceived notions of what the researcher expected to find in the field.

When it comes to observations, Cohen et al. (2011) warns that the mere presence of the researcher (observer) can cause those being observed to act differently to how they would usually act. Furthermore, the current situation being observed is always excluding the preceding events. Thus, what was being observed might not be all that there is to it. Rather as a researcher what I observe, is all that I can make inference to. To deal with these issues, triangulation of data sources and methodologies is suggested by Cohen et al. (2011). In this study, to ascertain reliability, internal consistency would be desired. This would be noted from the data emanating from the Mapping exercise, along with interviews and observations.

4.6 Ethical Considerations

An information letter in regard to the study was given to the Principal of the school. This letter detailed the purpose of the study, as well as consent and information regarding terminating the study. As the current study formed part of the bigger study, approval from parents and the District were obtained prior to the commencement and visit of the study. Furthermore, ethics clearance was obtained from Wits' Ethics Committee in Education of the Faculty of Humanities, before the research participants were interviewed. The names of participating teachers and learners have not been mentioned in any of the transcribed materials to ensure anonymity and confidentiality.

4.7 Data Analysis

In analysing the data gathered, Hardmans' (2008) framework was adapted and used in a manner that fits the context and the focus of my study. Hardman's framework as represented in Table 1 below, corresponds to Engelströms' (1999) Expansive model which is the theoretical framework for this study. Both frameworks contain similar categories of analysis, namely: subject, tools, object, outcome, community, division of labour and rules. Hardmans' framework has been adapted in a manner that fits the context of the current study. An example would be where Hardman's has utilized Bernsteins' (1996) work in her framework I have not made use of that as it was not the focus of this study and thus not relevant. The adapted framework is represented in Table 1 below.

Concept	**Questions to ask when analysing data**
Object	What is the object/focus in using the App?
Instruments (tools)	What does the teacher say about the ease of using the App from the teacher's perspective? And the learners? What does the teacher/learner say about the isiZulu language used in the App?

	Is there any inconsistencies in the isiZulu Mathematics register used in the App and the one used in the learning materials? Does the teacher have to explain to learners how to use the App?
Outcomes	Have learners demonstrated better understanding of the mathematics concepts they have engaged with in the App? Can this be proven by the teacher, if yes, How?
Division of Labour	What responsibilities do teacher/ learners have when working with the App?
Community	What community is involved in the leaning of mathematics when using the App?
Rules	What kinds of rules were present in the interaction found in the traditional classroom compared to the classroom where the App was used?

Table 1 An adaptation of Hardmans' (2008) Table 1 AT Checklist

Once the interviews were completed, they were transcribed and analysed through coding (Creswell, 2012). Coding allowed a breakdown of the extensive transcribed data into smaller labelled parts, which brings about similarities in between text allowing for themes to emerge. Hardmans' (2008) framework was used to make sense of the data gathered and group them into different themes. In drafting up the coding structure, Hardman's questions were used in coding the data. The coding structure that emanated from this framework is represented in Table 2 below.

Phenomenon	Focus	Component	Code	Indicators/recognition rules
Object (O)	Object of Focus (OoF)	Mathematics (M)	OoFM	What did learners and teachers mention when asked about the App, is it the mathematics or the iPad functionality? E.g. When the learners were asked what they like about the App, one of the learners answered "...I like the one with the moving car and I can press it and put different colours...", this implies the object of Focus was the Mathematics as content is mentioned rather than the iPad functionality
		Other	OoFO	This was seen when teachers and or learners mentioned the functionality of the iPad rather than the App itself or other things that might have been a focus for them and not the Mathematics. This is seen in utterances such as, "…there are not enough iPads and as such the time the learners can spend on the App is shortened…" OR "… they enjoy it they enjoy it as well as it's like the cell phone at home some wish to use their parents cell phones and some stay with grannies. Grannies don't use these type of modernised Apps so they use the old type of old phones. When they come here they get these iPads which has different things..."
Instruments (tools) (T)	isiZulu Language (iL)	Tool: isiZulu Language Similarities (S)	TiLS	These were similarities that were found between the App and the isiZulu Language as mentioned by the teachers and learners as well as those in the Curriculum documents. This was seen in utterances from teachers such as, "…for we are saying siyahlanganisa even in the App it says hlanganisa..." It also applied to the similarities between the isiZulu Mathematics register in the App and the Curriculum documents. This was seen when the Mathematics register used in the App was the same as the one found in the curriculum documents.
		Tool: isiZulu Language Dissimilarities(D)	TiLD	These were dissimilarities found between the App and the isiZulu Language as mentioned by the teachers and learners. This was seen in utterances from teachers such as, "... sometimes they jump, they miss the words in the App which has been used in the App they don't understand it..." It also applied to the dissimilarities between the isiZulu Mathematics register in the App and the Curriculum

				documents. This was present when the Mathematics register used in the App was not the same as the one found in the curriculum documents.
		Tool: isiZulu Language experience (TE)	TiLTE	What was the teacher's experience of the language as used in the App? Would they have preferred it in English? Were there any possible Dialect issues? This was seen in utterances such as "In grade R is an early grade, maybe there could be a combination that at the beginning of the year maybe it be in Zulu and then transition to English later on in the year…" referring to utilising isiZulu as well as English. Another teacher mentioned "It doesn't need to change. It's really listening from the learners' side…" when asked about different dialects.
Outcomes (O)	Mathematics Learning / deeper Understanding (M)	Enabling/constraining performance?	OMPG	This was indicated when teachers mentioned higher pass rate or better marks. "It has improved my mathematics as well as the learners'…" would be one of the statements that I looked for in the transcription
		isiZulu Mathematic register improvement (iR)	OMiR	This was indicated when teachers explicitly mentioned or referred to the isiZulu register being used by the learners, which was not the case before. E.g. of an utterance would have been "...an example would be a circle, they didn't know that in isiZulu they would call it indingiliza..."
Division of Labour (L)	Who does What (WdW)	Teacher (T)	LWdWT	From observation, what is the teacher's responsibility when it comes to using the App
		Learners (Ls)	LWdWLs	From observation, what is the learner's responsibility when it comes to using the App
Community	Classroom	Mathematics Teaching and Learning community (from Observation) (TLC)	CTLC	From observation, what kind of community exists in this learning space i.e. school community, Grade 1 mathematics community, community of the Grade 1 mathematics teachers, the geographical context of where the school is situated etc.
Rules ®	Rules of Engagement (RE)	Traditional Mathematics classroom (T)	RET	What observation was made in regard to the rules that governed the classroom where the App was not in use? i.e. leaners could answer questions posed by the teacher in a manner of a choir answering, etc.
		Working on the App (A)	REA	What observation was made in regard to the rules that governed the classroom where the App was being

				used? i.e. Each learner is expected to work on their own, etc.

Table 2 The Coding Process for the Interviews and Document Analysis

From the onset it is important to remind the reader that the App was designed to provide access and enhance the learners' mathematical understanding. With this in mind, it follows that Object (mathematics) would be the focus of the analysis. Mathematics is at the core, whilst all other components work/interact with each other for the mathematical task. Therefore, findings in regard to what the object of focus was to the learners and teachers is imperative as this determines to what extent the learners had access to mathematics. However, knowing that in the learning space there are other components that influence the teaching and learning in any mathematics classroom, this study has focused specifically on the language aspect.

When looking at Table 2, it is quite clear that the Tools (or instruments/mediating artefact) used seem to form part of the majority of the analysis task, and in particular the isiZulu language as a tool. This is particularly so because the study itself is centred in looking at the language as utilized by the App. According to Vygotsky (1978) in the process of coming to know when human beings interact with objects in their environments, there is never a direct relationship between the subject and the object. This relationship is always mediated by tools that are physical and/or psychological and through these tools, is the subject able to access and make meaning of the object (Vygotsky, 1978; Kuuti, 1995). The subjects would have no access to the object if there was no mediating artefact or tools involved. Meaning that the teachers and learners in this study would have none or limited access to mathematics if there was no language enabling this access.

In providing answers to the research questions, I looked at how the isiZulu language (in the App) as a tool is aligned to the various curriculum materials. I also, looked at the teachers' and learners' own experience in regard to how they find the isiZulu language in the App as an enabler (or not) of access to mathematics. It is thus important to look at what the teachers had to say about the isiZulu language and the mathematics register as used in the App and whether the language enabled or constrained the learners in accessing the mathematics.

Having highlighted the weight that Tools carry in this study and being quite aware of the fact that the interaction between the tools, subject and object are often influenced and even directed by other components of the framework as illustrated in Table 2 above, it is important to remember that at the core if this study, access to mathematics is key. As such all the other

components interact and influence each other in a manner that will either enable or constrain the learners' access to the mathematics. This is represented in Figure 2 below which represents the analytical framework for the current study.

In addition to the above analytical task, any other findings that were interrelated to the above findings were highlighted within those categories. And, any other findings that might not have necessarily been part of the categories were also discussed, but separately so.

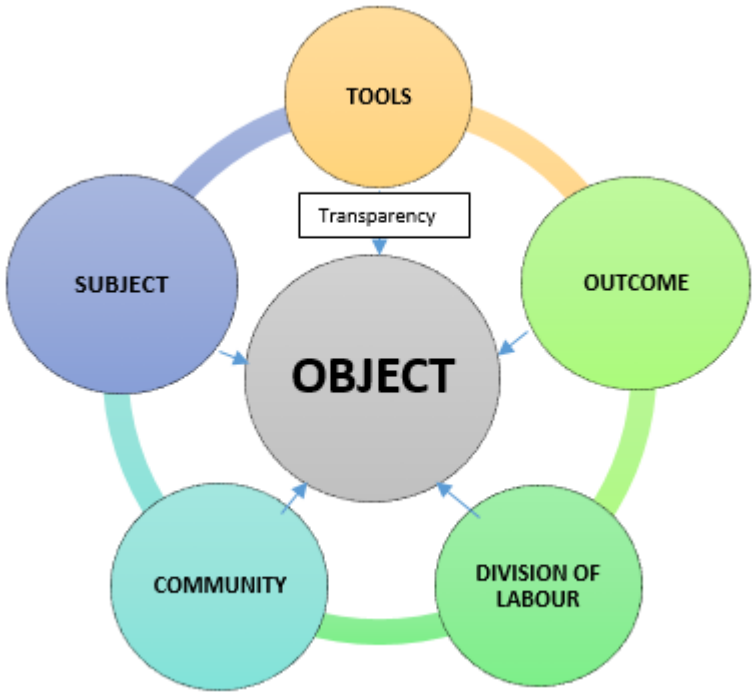

Figure 2 Analytical Framework

In analysing the data gathered through the mapping exercise, the interviews with the learners and teachers, as well as the observation exercise, the following themes were used in making sense of the data:

a) Focus on the Mathematics and the improvement of the isiZulu Mathematics Register

In this category, findings relating to whether the object of focus had been mathematics or other. If access to mathematics is the central aim of the App, then the mathematics should be what is mentioned in the teachers and learner's utterances. Furthermore, the improvement or acquisition of the mathematics register by the learner was also discussed in this section. Even though this represents the outcome component of the framework, it is closely linked to the

object. As such the discussion of these two components is intertwined and as such discussed together.

b) isiZulu Language Similarities and Dissimilarities

In this category, data that was gathered from different sources which was interrogated as to what (dis)similarities were found. When looking at the mapping exercise what was similar in terms of the isiZulu words used in the App as compared to the isiZulu language used in the Curriculum documents. Furthermore, similarities according to the teachers' own experiences were noted. The learners' responses in regard to the similarity of the language used in the App and the isiZulu being used by their teacher was also discussed here. The discussion around what dissimilarities emerged from the mapping discussion was analysed and findings outlined in this section.

c) Other imbedded Language Issues

This category focused on other aspects of language issues that emanated from the study that were highlighted by teachers (and learners) of which went beyond the scope of language similarities and dissimilarities.

d) Other important Findings

Lastly, this section looked at findings that spoke to the App, but not directly to any of the categories as outlined by the analytical framework. The implications of these findings were also discussed.

4.8 Conclusion

This chapter has outlined the research methodology used in this study which is qualitative in nature, using a case study approach. The data collection methods have also been outlined and discussed. These included the combination of classroom observation, semi-structured interviews and App analysis. The adaptation of Hardmans' (2008) framework enabled the structuring of the coding categories. The analytical framework was discussed with the relationship between the various findings of the study were illuminated and discussed accordingly.

CHAPTER 5
ANALYSIS AND FINDINGS

5.1 Introduction

The focus of this research has been to establish the extent to which language issues can be found in Mathematics Applications that have been translated from one language to another. As argued previously, this has not been an explicit focus in previous research. In particular, this study focused on the onebillion© Mathematics App that is offered in isiZulu and an evaluation of the language issues that may have been embedded in the use of the App and the effects thereof.

During this study the teachers and learners were interviewed using semi-structured interviews. Furthermore, a mapping exercise was done whereby the different materials used by teachers and learners in their traditional mathematics classroom were compared to the onebillion© App in terms of the isiZulu language. The semi-structured interview questions and the process of mapping the onebillion© App against the curriculum documents were all structured in a way that would contribute in answering the research questions below:

1. How does the isiZulu mathematics language in the onebillion© App compare to the isiZulu language found in the Curriculum materials used by the teachers and the learners in Grade 1?
2. What are the teachers' experiences of the isiZulu mathematics language as it is used by the App?
3. What language issues are embedded in the use of the App and what has the App enabled the teachers and learners to understand better?

5.2 Findings

5.2.1 Mathematics and the isiZulu Mathematics Register

From the onset of this study it been made clear that the enhancement of the learners' mathematical understanding is the core function of the various tools that the teacher can bring into the mathematics classroom. The onebillion© App is no exception. This relates directly to Engelströms' (1999) concept of 'object of focus' and this will be my starting point with regards to the discussion on findings.

It emerged that there were two distinct objects that were the focus in this study; the first being the mathematics and the second was anything but the mathematics such as, the iPad the technological functionalities etc. The following are the results that emerged from the analysis. Firstly, the learners' object of focus was the mathematics. They were the ones who seemed to see beyond the iPad functionality and into the mathematics. When asked what they enjoyed the most about onebillion© App, five out of six learners mentioned mathematics related concepts as seen in Excerpt 1 below.

EK	Do you like the work you do in the App?
L2	I like it when we draw, and pressing the button that flashes, and drawing the shapes
L4	I like it. I like the games, the counting one. It's easy and fun
L5	Yes, it teaches me shapes and numbers, and I can put the numbers into the square and out again
L6	Yes, I like the numbers

Excerpt 1

Thus, it seems for the learners the mathematics stood out and as such they engaged with the mathematics and spoke of it more than the technology, which is a positive outcome in itself. What this implies is that the tools (the iPad, the isiZulu language) are in this case, a transparent tool (Lave and Wenger, 1991; Setati et al., 2008). Neither the technology nor the language seem to be getting in the way of learning.

Secondly, the teachers noticed some improvement in the learners' understanding of mathematics including the acquiring of new mathematical register, allowing for the learners to obtain mathematical language or register that the learners might not have had before. The teachers' responses in regard to the improvement of the isiZulu language in their learners are seen in Excerpt 2 below.

T2: "…You find that they go much faster when they are doing it by the App. And when you come with your lesson you find that they have already mastered this, the lesson that you are…let's say maybe you are teaching about shapes. They do it in the iPad and then when you come with your lesson you find that it comes easier, it makes it easier for them as they have done it already in the iPad…".
T3: So an example would be where the learners would refer to white as "iwhite" or brown as "ibrown", however, now they know the correct term for brown is ntsundu"".
T3: "…what the app does it is that it challenges the learners but also gives them the visuals to see and listen and see and it does help in terms of improving them. Because when they don't hear something they try again and try

again until they get it like what is nxantathu what is like a triangle, until they understand the difference between the triangle and the circle and the rest. So, it's nice because they can go back on their own until they get it."
T4: it helped us a lot with mathematics, an example is addition. For my learners and me as a teacher it has helped improved my teaching because sometimes I see how the teaching happens in the App and I try to teach like how it's done tin the App and adopt some of the stuff into my teaching. And it relates very well to the learners, it seems like they pick up things quicker. It has improved my mathematics as well as the learners' seem to pick it up easier
T5: Yes, it has improved. An example would be a circle, they didn't know that in isiZulu they would call it indingiliza. They would call it like an egg, or a zero but now they actually use the right terminology. In Zulu because they have learned to say it in fact there is a Zulu word to call a circle.

Excerpt 2

One of the teachers in Excerpt 2 highlighted how the learners' fluency in the isiZulu language itself has increased, giving examples such as the concept of colour. This teacher indicated that learners did not know the isiZulu terms for the colour white or brown and they would refer to it as "iwhite" or "ibrown". However, as a result of working with the App, they have developed the correct isiZulu register for those terms. This confirms that the learners are building a mathematics register of scientific concepts in their own home language (Vygotsky, 1978). Pimm (1991) stresses the importance of learners being given the opportunity to make use of the mathematics register therefore ensuring that in the long run they gain control over the mathematics register and thus be able to converse, and even more so, to reason like mathematicians. This is being achieved here as the learners are equipped with the correct mathematical register in their own home language allowing them to access the mathematics and thus having the desired outcome which is the better understanding of mathematics. In this case the mathematics register comes through their home/first language and is such an advantage, given that the teacher does not have to focus on the learners' fluency in the LoLT but rather on developing the mathematics register, in the language which the learner already understands.

Another important finding in terms of the improvements of the mathematics is that in addition to the learners' mathematics improvement, the App has had an effect on the teachers as well. Teacher 4 in Excerpt 2 mentioned how the engagement with the App has informed her own teaching. As such the App has benefited both the learners and in other cases the teacher.

However, whilst for most teachers and the learners the mathematics in the App was the focus, there were other teachers who made reference to the technology aspects such as the fact that

the learners like to touch, and play on the iPad, and also how there are not enough iPads for them all to use at once. This is seen in the below Excerpt 3, looking specifically at two teachers' responses.

T1: It helped us a lot because, one, they enjoy it they enjoy it as well as it's like the cell phone at home some wish to use their parents cell phones and some stay with grannies. Grannies don't use these type of modernised Apps so they use the old type of old phones. When they come here, they get these iPads which has different things which helps them to, actually it motivates them to, it helps them a lot. Yes, they enjoy it, it helps them to concentrate because when the person is talking there, they need to listen very well …Yes they look at cartoons they go straight to cartoons. Why can't they concentrate in this App?
T4: Because this other one the App is more practical, and more visual for them and kids tend to like things that are visual. So, they are able to translate what they have seen visually into there and see it now but it helps to be able to see and be able to move things around

Excerpt 3

The above responses highlight how the teacher's experience of the App might have been impacted by their focus on other aspects of the App such as the iPad it comes in and the technology that it employs. This is contrary to their learners who seem to see the mathematics and not the technology as such. Teacher 1 in Excerpt 3 added that the addition of cartoons, and the learners' access to smart phones are reasons why they enjoy the App. Whereas the learners mentioned that they enjoyed the App because of the content.

Another finding in this discussion is the relationship that emerges between Engelströms' (1999) concepts of the object of Focus (the mathematics), the rules (of the App usage), the division of Labour (who is responsible for what) and all this within the community of Grade 1 learners and teachers. An analysis of how these components came together to demonstrate the form in which the learner has access to the mathematics was conducted. One of the rules is that each child works independently and at their own pace and are allowed to repeat the different concepts more than once. Because the learner is responsible for their own learning and as such the progress is determined by how fast they understand certain concepts, oftentimes the learner would outpace the teacher in the traditional classroom and as such the learners would be exposed to certain mathematics concepts before they were taught in the classroom. Teacher 2 in Excerpt 2 above shows evidence of this having happened in her class before. She found out that there were concepts that had not as yet been covered in class, but the learners had already come across whilst using the App. By the time the teacher introduced the work to the class the learners were able to grasp the mathematical concepts easier because of their prior exposure to

the concepts and associated terminology. This allowed the teacher to accelerate the rate of introduction of new concepts. Another rule that exists as part of engaging with the App is that the learner has the freedom to go back and try again and again and make multiple attempts and practice and make sense of their own learning without having the constraint of time limits or teacher availability that are imposed in the traditional classroom. Thus, this means once more that the child can progress at their own pace. Thus, the rules that exists in this mathematics community are those which allow the learners to have access to the mathematics without having to wait for the teacher to introduce the content. This, to some extent, places the responsibility for learning on the learner themselves. This resonates with Engelströms' (1999) concept of division of labour which in this case takes the learning out of the hands of the teacher and places the responsibility on the student. This makes the mathematics classroom learner-centred and as such the teacher becomes the facilitator. Schmittau (2004) in analysing Davydovs' curriculum, highlights the importance of allowing learners to take control of their own learning and to see the connections for themselves. In this case as the learner interacts with the App and learns through trial-and-error, providing a space whereby the learner can make sense of his own mistakes and have an opportunity to problem-solve and see the correct connections.

As encouraging as this might seem, for another teacher this is viewed as an issue. One teacher saw this as misalignment in timelines between when the content was being taught in the traditional classroom and when the content was engaged with via the App. Once again one teachers' experience differs from another and as in this case one seems to be content with the student pacing whilst the other seems to see it as an issue, as the learners are exposed to the content before they have done it in class. This once more relates to Engelströms' (1999) concept of division of labour, in this instance the teacher has no control on the sequence and pacing of the learner.

From the above findings from the teachers and learners it is evident that the App is assisting in the teaching and learning of the mathematics which is key in any study that aims to do just that such as onebillion©. However, in enabling this learning to happen language is key. Hence, below I discuss the findings in relation to the isiZulu language as used by the App and any other findings that might have impacted the object of focus from being the mathematics to something else.

5.2.2 The isiZulu Language Similarities and Dissimilarities

In this section, there is a focus on what Engelström (1999) calls tool(s), in this case the App which is the IsiZulu Mathematics App. The findings from the mapping exercise is initially explored, whereby the isiZulu language in the app was mapped against the curriculum documents, to determine the (dis)similarity in the isiZulu language used in both contents, a number of findings emerged. Table 3 below has been used to show the two concepts that were chosen for this exercise which are numbers and shapes. These are represented in English and thereafter in the isiZulu language as found in the App or the curriculum documents. The following are the findings that emerged in this exercise.

Concept	**Onebillion App**	**Curriculum Documents**
Numbers	**Nombolo**	**Inombolo/izinombolo**
0	Not mentioned	Ziro/uziro/okungekho
1	kunye	Kunye
2	Kubili	Kubili
3	Kuthathu	Kuthathu/okuthathu
4	Kune	Kune
5	Kuisihlanu/kuhlanu	Kuhlanu/okuhlanu
6	Kuisisthupa	Isithupha/isithupa
7	Kuisikhombisa	Isikhombisa
8	(ku)isishiyagalombili	Isishiyagalombili
9	(ku)isishiyagalolunye	Isishiyagalolunye
10	(ku)ishumi	Ishumi/ka-10, ku-10e-10, ezi-10, eshumini
Shapes	**Onebillion App**	**Curriculum Documents**
Circle	indilinga	Indingilizi/indilinga
Triangle	unxantathu	Unxantathu
Square	isikwele	Isikwele
Rectangle	raktango	Unxande
Oval	ovali	Ukusaqanda

Table 3 Similarities and Dissimilarities between the isiZulu Language used by the App versus the Curriculum Documents

Firstly, when it comes to number concepts the base 10 numbers are similar. This is taking into account that some of the words have prefixes (ku-) whilst others do not. However, one observation that emerged was that, onebillion© did not make mention of number zero and as such could not find an isiZulu word for number zero in the App to compare to the curriculum document in which the terms ziro/uziro/okungekho were used. Secondly, under the concept of

shapes whilst some names remained similar others differed significantly. As an example, the word used by the App “raktango” could not be found in the curriculum documents but rather “unxande” has been used. The shape Oval has been named as “ovali” by the App whilst the curriculum document has used the name “ukusaqanda”.

With the knowledge of the inconsistencies found in the mapping exercise, there was an interest in noting how the teachers’ and learners’ experiences spoke to the similarities and dissimilarities and perhaps whether it was noted at all.

It is important to once more remember that the exercise of translating the App from English to isiZulu was to enhance the access that the learners would have to the mathematics that is offered in the App. Zevenbergen (2000) argues that the more the synergy between the learners’ language and that of the mathematics, the greater the chances that the learner will succeed in understanding the mathematics. As such it is important that the isiZulu used in the App provides this synergy in ensuring that the language is clear and similar to the language they use as the LoLT. Hence the concept of transparency as discussed in the previous chapters

Before delving into the similarities and dissimilarities discussion, it is important to remember the context in which the learners and teachers interviewed in this study emanate from, as this impacts their experience in regard to the isiZulu language. The school is based in the rural parts of South Africa whereby isiZulu is the first language spoken in the community. This means that the learners come into the school with much understanding of the everyday isiZulu language. Once in school, these learners are involved in the school and mathematics community in which isiZulu is used a LoLT. This creates an environment where the learners do not have to translate concepts from one language to another once in school and as such the language barrier is reduced significantly. This might not be the case in other parts of the country, whereby the learner may be exposed to a LoLT which differs from their home/first language. This relationship is highlighted by Engelström (1999) as one between the subject in this case the teachers and the learners, his/her tool(s) in this case the App and the community in which the subject is contextualised.

Now, in regard to the similarities and dissimilarities of the isiZulu language used by the App, most teachers agreed that it was adequate in providing access to the mathematics for the learners through their home language, which in this case is isiZulu. To a large extent the teachers agreed that there were no serious issues when it came to the isiZulu language as used by the App. This is seen in Excerpt 4 below whereby the different teachers express how the

isiZulu in the App is not contradictory but similar to the language they use in the traditional mathematics class with their learners.

EK: and, when you look at for example books from Jika iMfundo[1] the ATP [2] and all those materials when you compare the isiZulu in there in those materials and the isiZulu in the App, in the Onebillion, how does it compare?
T1: isiZulu in the App, I mean in the Jika iMfundo, the isiZulu is ok. It works well with the work books the department supplied us with. And the ATP as well it goes aligned, it goes in line. It is just that in the App, (laughs) sometimes the isiZulu is not in details, we are just isiZulu speakers. It's just like the learners don't sometimes don't understand the tone for the accent for the App. It's just, it's like, it's taken from people who don't speak isiZulu and then they, its not from the Zulu speaker. That is how I can say,I mean the accent for the speaker in Zulu in the App its not like, sometimes they jump, they miss the words in the App which has been used in the App, they don't understand it its just that the person who is speaking maybe in the App is not a Zulu speaker, because it says "wenza kahle" (one tone-incorrect one according to the teacher) , they understand u-wenza- kaaahle (another tone – the correct one according to the teacher, however the tone does not change the meaning of the word). You get that. "that is good" "kuhle uphumelela kahle, uphumelele kaaahle, u-phu-melela Kaaahle (imitating the in-App tutor's tone compared to how it should be). Some other learners don't understand uphumelela kahle (directly translated to "you have succeeded well"), they just miss that. Some of the words from the they are not suitable for learners because it was translated by the people who are not Zulu, this is what I can say. It may be improved by, I would rather say a person who is fluent in isiZulu like…could just get in there and use this deep isiZulu for the people who live in the deep rural Natal of Phongolo. People in o Phongolo, some other learners here they smell something like isiSwati, they don't easily understand some of the words, because in this part in this village we are near by the border line, the Swazi people are just nearby. So sometimes Swazi leaners come here because their parents are here, they just don't clearly understand the Zulu words. That's somehow a challenge.
T1: Yes, like if I say they speak of shapes they say "unxantathu" that is a triangle and in Zulu it says "unxantaaa-thu" and then in the App sometimes they say "unxaantaaathu" so they miss the words these ones because they are just used to simple language which is "unxatathu" in the app it says Unxantaaathu(different pronunciation). Yes, the pronunciation of the word it comes to disturb them
T2: …it's alright, because most of the time we teach our we also teach maths in isiZulu. So, its fine… For we are saying diyahlanganisa even in the App it says hlanganisa
T2: …it's the isiZulu they know there are no words that they never knew. It's just the isiZulu

[1] Jika iMfundo is a Province-wide programme to improve learning outcome in KwaZulu-Natal Zenex (2019)

[2] ATP stands for Annual Teaching Plan. This is a document that outlines what content should be taught in which school term of the school year

T3: The words that are used in the App are correct isiZulu words but sometimes there is difficulty because the words used in the App are not the words the learners are using in the daily basis…
T3. In the beginning they needed help because of the accent, you could tell that the people who translated the content into Zulu they are not like Zulu speaking so their pronunciation of the words sometimes it was a little bit confusing for the learners so needed help to get used to it. So, it's like people borrowing a bit of isiZulu and putting it there.
T4: The isiZulu used is not contradictory, is fine. It adds value in addition to the materials provided by the department.
T5: They all go well together… I feel like they are the same, it actually explains nicely to the learners, I don't find any problems with it.

Excerpt 4

However, having said that there were concerns that were mentioned. One teacher in particular showed concern when it came to the isiZulu accent as used by the in-App tutor, in Excerpt 4 above, response by teacher 1.

This teacher went in great detail in explaining how for her as an isiZulu first language speaker, she has found that the accent of the in-App tutor is not that of a native Zulu person. She goes further to describe how the way the in-App tutor pronounces some isiZulu words, and how there are certain emphasis that are missed by the in-App tutor. Teacher 3 in the above Excerpt went as far as to say that the in-App tutor is not a native Zulu and rather someone who has borrowed the isiZulu language. The above responses were the reason why the issue of dialect was one of the interview questions. When teachers were posed the question regarding dialects[3], and whether they felt the same about the accent used etc, at first, they indicated the in-App tutor pronunciation and accent were alright. So, in this instance it seems that, it really depended on individual teacher's experience rather than a collective. However, further probing revealed that, it seemed for some teachers that although there might exist different dialects of isiZulu, this does not affect the comprehension of the isiZulu language as used in the App.

The interviews with the learners confirmed the above finding. When asked whether they understood the in-App tutor, all learners agreed that they did. Furthermore, they highlighted that even though the in-App tutor sometimes uses different words from the ones their teachers uses in class they still understood her. The different words that the learners might have picked

[3] According to the Cambridge Dictionary a Dialect is a form of a language that people speak in a particular part of a country, containing some different words and grammar, etc.

up are such as the name of a circle having two terms being used in the App namely, indilinga and indingilizi. Other inconsistencies are seen in Table 1 above, which highlights how certain concepts have different terms as used in the App versus in the curriculum documents and teachers.

5.2.3 Other Embedded Language Issues

There were other language issues that were mentioned by the teachers which did not specifically speak to the language (dis)similarities, these form part of the key findings. One such finding is the lack of vocabulary for some common mathematical terms that the teachers are experiencing and as such they resolve to continue using the English vocabulary in these instances. In this case the equal sign (=), was a term in which the teachers had deliberated as to what it is called in isiZulu and decided to continue using the English word 'equals' instead. It would be useful to reiterate the number zero that is missing in the App that came about as the result of the mapping exercise as outlined in Table 1.

Taking into account all the feedback received from the teachers in regard to the App, a question was posed as to whether they would prefer to have the App solely in English or isiZulu. Their responses are captured below in Excerpt 5. The answer was in varying degrees, English. This is because for some, they see English as the language in which learners will need to be conversant in the future so why delay the introduction of it. For others, the importance of having the isiZulu language being used in foundation phase was emphasised, with a proposal to gradually implement English later on in Grade 1.

	EK: Would you prefer the App in English or in isiZulu, now that you have been exposed to the App? And why?
	T1: I would prefer it in English. (Laughs) Because it will help us boost their English. It will help us, it will help them to concentrate. Actually, they love this English it's just that it's their first time. When you introduce a new word they become excited. They just love English, it's just that we as teachers are…I don't know how I should say this…but, I just love English, it will help them to go well with this English. But it will be a mis understanding, because other things they will learn it in English…they will learn in Zulu and this app will be learning… but I prefer English (she say this in a stern affirmative voice) English has short words, short nice words…
	T2: In English. It makes them know how to understand English. I can remember in the beginning they started in isiZulu and they go to English, they just grasp and it helps them with Vocab. They end up knowing that when they say "take this" "put it in" "match this" they end up knowing the language without being taught by just listening and looking at the objects that they are working on.

	T3: Me, I would like it in English in order to improve my English
	T4: We use home language for teaching and learning throughout, except English, they are fine to us.…myself not for learners…its fine in isiZulu but in Maths it would help to have it in English. Because I find some concepts very hard in terms of translation, an example would be 3D shapes. Sometimes it's just very hard to explain them in Zulu, and sometimes I have to ask help from other teachers to say how have you explained this, the 3D shapes. Niningwane…this is the data. In Zulu we say it niningwane…but in English we use data. So, we just call it data of what, data of what etc.
	T5: isiZulu, Zulu is their home language its easier, it's a language they know already. So, you are not trying to bring a different language which is a second language to them and bringing concepts that they don't know as well that you are trying to explain to them in a different language. But here at least you only introducing just concepts the language is already in place.

Excerpt 5

One of the teachers expressed that she wanted the App to be fully in English so that she could improve her own English language as well. Teacher 5, however, appears to have a strong stance that the App should remain in isiZulu. She sees the importance of using the learners first language in which they are already fluent in to introduce the mathematics to them, and as such the language barrier is reduced and the focus remains the acquiring of the mathematics. Setati (2005) highlights a paradox that the teacher in her study finds herself, firstly, utilising English as a LoLT a language that promises and prepares her learners to have a chance in accessing social goods. Especially that according to research English is seen to be the language of the world. However, in the context like South Africa it once was used as a tool of oppression (Setati and Adler, 2001). Secondly, what Setati (2005) also highlights is the knowledge that the teacher has that in promoting the learner's home language in mathematics enables them access into the mathematics but also at the same time redresses the injustices of the past. This paradox seems to be similar to what the teachers in this current study are facing. Whilst they know the importance of using the learners home language as LoLT, they however, also acknowledge that in the long run, for their learners to be able to access these social goods, they would benefit from mastering the English language. Hence their recommendations to transition from the App in isiZulu to English in the second year of schooling onwards.

Essien's (2010) study of preservice teachers and their perceptions of using home language as LoLT highlighted that one of the concerns that teachers brought up was that the home language terms are often long. A sentence in a home language is at times translates to a single term in English and thus making the use of home languages in classrooms cumbersome. This is seen in this study in the above Excerpt 5 with teacher 1 and teacher 4 who make mention of why

they prefer the App would be fully in English. This preference is brought about that English terms are rather short whilst the same terms translated into isiZulu words a quite long and can be cumbersome to work with.

5.2.4 Other Important Findings

This section details findings that emanated from the study which did not fit into the initial categories, but are important to mention as it can have an impact on the overall experience of the App especially so for the learners. When the teachers spoke of the iPads, reference was made to the insufficient number of iPads for the class. This is seen in teacher 4 and 5 in Excerpt 6 below.

T4: The only challenge the learners encounter is that the iPad themselves cannot cater for all the learners. And so sometimes they don't always get a chance and as such have to be rotated. As they are not enough for all. The iPads are fewer than the number of learners. The iPads are 15 and the learners in the class are 35 so they have to rotate them
T4: Because this other one the App is more practical, and more visual for them and kids tend to like things that are visual. So they are able to translate what they have seen visually into there and see it now but it helps to be able to see and be able to move things around
T4: …in every classroom they have at least 30 leaners. So, the time each child spends on the gadget is very little because they have to pass it on to the next person then the next person to share. So, if there is something that can be improved, is to get more. So, each learner gets the full-time benefit of working on the iPad.

Excerpt 6

Teachers mentioned that there were not enough iPads and as such learners had only limited time that they could engage with the iPad. This is so because of the large class numbers. The implications of this is discussed in the following chapter.

5.3 Conclusion

This chapter shared the findings that emanated from the study. The results from the mapping exercise as well as the responses from the teachers and learners have been analysed and presented here. This has been done in taking into account the theoretical and analytical frameworks and the relation thereof and using these two frameworks to make sense of the data gathered. What follows is the discussion in regard to these findings.

CHAPTER 6
DISCUSSIONS AND CONCLUSION

6.1 Introduction

This concluding chapter will begin with a discussion regarding the findings highlighted in the previous chapter. Secondly, limitations encountered during the study are explored, as well as recommendations for future research. This study set out to answer the following three research questions:

1. How does the isiZulu mathematics language in the onebillion© App compare to the isiZulu language found in the Curriculum materials used by the teachers and the learners in Grade 1?
2. What are the teachers' experiences of the isiZulu mathematics language as it is used by the App?
3. What language issues are embedded in the use of the App and what has the App enabled the teachers and learners to understand better?

Below is a discussion of findings, in answering the research questions stipulated above.

6.2 Discussion

This discussion will start by looking at the key focus of this research which was whether the isiZulu language in the App has enabled or constrained the learning of mathematics with understanding.

Firstly, it is important to note the fact that learners can progress in the App at their own pace, which implies that the learners can outpace the teachers' traditional classroom sequence and pacing. As mentioned by some of the teachers this was advantageous for both the teachers and the learners. When the learners were exposed to the content in the App before it was taught in the traditional mathematics classroom the learners would have had exposure to the terms (mathematical terms in isiZulu) and as such would have a better understanding of the content and grasp the work much faster when the teacher teaches them the content. This is because the teacher would not have to teach the isiZulu mathematical register first, before the content as the learners have had the exposure to the isiZulu terms before. Thus, exposure to the mathematics register that might (not) have been covered in the traditional mathematics classroom is done by the App and at times before the teacher presents this in the traditional classroom. This was a key finding, which came to light during data collection.

Secondly, there are some language issues regarding the isiZulu as used by the App. However, these issues do not appear to impede learning. The teachers' responses to a large extent support the notion that the isiZulu language as used in the App is adequate for the teaching and learning of the mathematics, albeit for dialectical differences. The learners themselves gave no indication of misunderstanding the in-App tutor. Thus, the only caution in this case is what emerged from the Mapping exercise. Even though it has been mentioned in previous chapters that there exists dialect phenomenon in some African languages, it appears to have an insignificant effect when it came to the isiZulu teachers concerned. The learners were able to understand the language in the App, in spite of the differences. This is related to Barwell's (2016) reference to Bakhtin's (1981) work on unitary language and heteroglossia. He describes unitary language as language that is complete and fixed, whilst heteroglossia accounts for the diversity of language when in use, at different places and time, depending on speakers and activities involved and so on. Perhaps, in trying to look for these similarities I might be confining the language to a unitary language instead of acknowledging that the language evolves as it moves from one community to another. As such these teachers might have found the App to be compatible with their community but this might not be the reality in another Zulu-speaking region based in another province, based on their use of the isiZulu language.

In regard to other language issues, Setati's (2008) notion of English being chosen for better life seems to suffice in this study but in addition to this, what seems to be interesting is that the teachers seem to want to know English, for themselves and the learners so that they are fluent in English and not necessarily because it guarantees a better life.

It can be interpreted that the preference of leaning toward English seems to be influenced by the fact that the teachers find themselves at times at a dilemma whereby even though they might want to use their home language, they however lack of vocabulary or the complexity thereof. Introducing these seemingly complex words to the learners is a daunting task itself. As such, one would rather use English and its short words to get the message across. However, this is but part of a bigger problem, which is the lack of preparation of the preservice teachers who are about to enter the ever increasing multi-cultural, multilingual and super-diversified classroom (Barwell, 2016; Essien, 2010).

Another point of discussion is that because the teachers are from a context that has isiZulu as a first language in use (at home, at school), there were insights could have noticed that might not have been the case if the teacher interviewed was not an isiZulu first language speaker. There is, therefore, doubt that some of the insights such as their comments about the accent of

the in-App tutor would necessarily come up as a point of discussion. Thus, the community in which the teachers and the learners are from has had direct contribution in the level in which they can utilise the isiZulu in the App and engage with it in the way they have.

What might seem like an issue of not having enough iPads has implied repercussion. The limited number of iPads with time can highly impact the duration in which each learner gets to spend on the App. This means that if the study had intended for the learner to spend at least an hour's time on the iPad each week and the learner instead spends 15 minutes each week, the intended impact would have been greatly reduced. Thus, the contact time with the mathematics in the App would be significantly reduced and as such might impact /deter desired results.

In summary, and in response to my research questions, the findings answered these questions adequately. In reference to the first research question, the mapping exercise and the interviews with the learners enabled concluded that there are minor language inconsistencies between the App and the Curriculum language. However, these inconsistencies were insignificant, and therefore did not disrupt the learning of mathematics for these Grade1 learners. This was confirmed by the teachers and leaners who affirmed that from their experience with the App the language as used by the App was adequate, which answers the second research question. Lastly, in regard to other possible embedded language issues, what emerged was the nuances of the teacher's own preference for the App to be in English from the beginning for the various reasons as discussed above and in findings.

6.3 Limitations to this Study

One great limitation was the distance in which the school involved in this study was based. This greatly limited time spent engaging with the teachers and learners and as such the interviews and observation exercises had to be done within a very short time. Additionally, not being a first language isiZulu speaker, I feel that there are instances that I could have engaged more with the interviewee however the language barrier inhibited that, and as such much reliance is put upon the interpreter.

6.4 Recommendations

It is important that the concepts as covered in the curriculum documents be taken into account in a greater detail so as to ensure that, the isiZulu terms remain the consistent so as to reduce any language barriers on the learners' side.

During the observation, it was clear that the learners enjoyed greatly the engagement they had with the App. As mentioned by the teachers in the findings chapter, it was clear that only few learners could work at a time (class rotation scheduled by teachers), but also for a very limited time so as to allow other learners to use the App as well. It is therefore strongly recommended that sufficient resources are available so as to get the maximum impact of the programme.

6.5 Conclusion and Further Research

The study was based in a rural part of South Africa whereby the teachers and learners are all isiZulu first/home language speakers. It is not clear what the results would be in a different environment, such as a Setswana home language community using the App in isiZulu simply because the school in which they attend offers isiZulu as the LoLT. In this instance I have Johannesburg which is in the Province of Gauteng in mind. According to the Provincial Report from stats SA (Census, 2011) Gauteng has a mixture of all the 11 official languages because of the migration from other provinces into Gauteng. Johannesburg represents the business hub of the province of Gauteng, and it is not rare to find schools offering different LoLT even within the same districts. Schools found in Johannesburg would be hosting many different home language learners and, as such, not so unitary in terms of language as the context is for the current study. This implies that there would be a high number of different languages represented in the classrooms at any point. Because of this, one may find the situation whereby, there are classrooms in which the teachers will share the home language with the learners, or whereby the teacher shares the home language with some learners and there will be classrooms in which the teacher will not share their home language with the learner (Clarkson, 2009). In this instance, having an App like onebillion© which has the capacity of being translated into these different languages (including foreign languages such as French), could provide great advantage for the learners in these classrooms. This will also reduce the language barrier that might exist between the teacher and the learners. Further research in this kind of context would bring about richer data and recommendations that could address the limitations that are currently experienced in most classrooms across the world, due to the migration phenomenon.

It should be noted that there has been various studies conducted in different countries, shedding light on how the onebillion© App has enabled (or not) learner's performance in Mathematics (Pitchford, 2015, Pitchford et al., 2019). The current study which has been done in South Africa, has focussed mainly on language nuances in regard to isiZulu as used in the App hence

the mapping exercise of the isiZulu language in the App compared to the isiZulu that is found in the curriculum documents.

Lastly, there is the issue of dialects in African languages. This is one in which further studies in South African context could investigate. Because in some African languages a change in the tense or tone of the word changes the meaning of the word. But in languages like isiZulu, this does not seem to be the case. This could have an impact in an App like onebillion© that provides the App in many African languages. The argument of tone that the one teacher brought up might not mean much in this study but could have much more serious implications in other languages (Cook, 2006).

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APPENDIX A

LEARNER AND TEACHER INTERVIEW TRANSCRIPTS

Children Interviews

Interview 1.

EK: Do you like the work you do in the iPad? If yes what do you like?

Lr1: Yes, I like the Zulu and Maths.

EK: does it help you understand maths better?

Lr1: Yes. I like the one with the moving car and I can press it and put different colors

EK: Can you understand what the lady in the App says?

Lr1: Yes

EK: Does the lady in the App use the same isiZulu words that the teacher uses in the classroom.

Lr1: Yes, they are the same.

Interview 2.

EK: Do you like the work you do in the iPad. If yes, what do you like about it?

Lr2: I like it when we draw, and pressing the button that flashes, and drawing the shapes

EK: Can you understand what the lady in the App is saying?

Lr2: Yes, I can hear her.

EK: does she use the same isiZulu words like the one the teacher uses in the class? Can s/he give an example of term(s)?

Lr2: yes, they are the same. The teacher will tell us to draw the circle (indingiliza) and the lady in the app will also say the same thing.

Interview 3

EK: Do you like the work you do in the iPad. If yes, what do you like about it?

Lr3: Yes, you choose your name and then use it. And you can do anything you want to do. I like pressing.

EK: Does it help you to understand maths better?

Lr3: Yes.

EK: Can you understand what the lady is saying in the App?

Lr3: Yes, I can hear her

EK: Does the Auntie in the App use the same words as theTeacher in the classroom?

Lr3: Sometimes I don’t understand the words the lady says, sometimes the auntie is faster than the teacher.

Interview 4

EK: do you like the work you do in the iPad. If yes what do you like about it?

Lr3: I like it. I like the games, the counting one. It's easy and fun

EK: Does the counting in the App help him when he has to count in class?

Lr3: Yes, it helps me

EK: Does the auntie in the App use the same words as your teacher in the class?

Lr3: Yes, they use the same words. I hear auntie, only at the beginning I could not understand her, but now I do.

Interview 5

EK: Do you like the work you do in the One Billion App? What do you like the most?

Lr3: Yes, it teaches me shapes and numbers, and I can put the numbers into the square and out again

EK: Can you understand the auntie in the App.

Lr 3: Yes

EK: Does she use the same words as the teacher in the classroom.

Lr 3: Sometimes they don't use the same words.

Interview 6

EK: Do you like the work you do in the App?

Yes, I like the numbers.

EK: Can you hear what the lady is saying in the App? Yes, I can hear her.

EK: Does she use the same isiZulu words as the ones the teacher uses in the classroom?

Yes they are the same

TEACHER INTERVIEWS

Interview 1

EK: Are you an isiZulu Home Language speaker?

T1: Yes I am

EK: In your classroom which materials do you use to teach, not in the 1billion classroom but your own maths classroom?

T1: I use resources like, counters, these bottle tops, I use charts yes number charts, I use general counters the principal bought us counters, we use counters we use counters sometimes we use stones, I have mentioned the bottle caps, sometimes we use these sticks for for sweets, yes they come with them, they bring them in class so we use them, yes sometimes we use matchsticks we just use a lot of materials to count with. Yes, we also have an abacus, but they are a few actually a few abacus. We (repeatedly) share one big abacus we take it to the other class anyone who wants to use it just go and fetch it. And we also have weather charts which were bought by the principal, we use them and a lot of charts we use

EK: and are there any materials from the department that you use that tell you what you need to do

T1: we get these the aligned lesson plans and the trackers we use for Jika iMfundo and we also use the books rhe work books we use yes work books for learners. Those are the materials which come from the department

EK: and, when you look at for example books from Jika iMfundo the ATP and all those materials when you compare the isiZulu in there in those materials and the isiZulu in the App, in the Onebillion, how does it compare?

T1: isiZulu in the App, I mean in the Jika iMfundo, the isiZulu is ok. It works well with the work books the department supplied us with. And the ATP as well it goes aligned, it goes in line. It is just that in the App, (laughs) sometimes the isiZulu is not in details, we are jut isiZulu speakers. Its just like the learners don't sometimes don't understand the tone for the accent for the App. Its just, its like, its taken from people who don't speak isiZulu and then they, its not from the Zulu speaker. That is how I can say, I mean the accent for the speaker in Zulu in the App its not like, sometimes they jump, they miss the words in the App which has been used in the App, they don't understand it its just that the person who is speaking maybe in the App is not a Zulu speaker, because it says "wenze kahle" (one tone-incorrect one according to the teacher) , they understand u-wenze- kaaahle (another tone – the correct one according to the teacher). You get that. "that is good" "kuuhle upumelele kahle, upumelele kaahle, u-pu-melele Kaaahle (imitating the in-App tutor's tone compared to how it should be said). Some other learners don't understand pulemelele kahle (different tone-incorrect), they just miss that. Some of the words from the they are not suitable for learners because it was translated by the people who are not Zulu, this is what I can say. It may be improved by, I would rather say a person who is fluent in isiZulu like…could just get in there and use this deep isiZulu for the people who live in the deep rural Natal of Phongolo.

EK: and is there anything specific that you can say, so for example how you explained the accent is there maybe even content, you know like where they speak about space on top bottom middle etc, is there anything specific you have noticed that there is a problem with the language with the way they have translated, anything you can think of?

T1: Yes, like if I say they speak of shapes they say “unq/cathathu” that is a triangle and in Zulu it says “uncathaaa-thu” and then in the App sometimes they say “unqhathaaathu” so they miss the words these ones because they are just used to simple language which is “unqathathu” in the app it says UnqahtaaathU(different pronunciation). Yes the pronounciation of the word it comes to disturb them

EK: How about things like dialects:
T1: this is why am mentioning this (inaudible0 there are other parts like uThungulu otheu parts like uLundi, they don’t have this challenge of people who don’t lnow how to pronounethe..even the Zulu is not well pronounced because of these people. They cant say some of the words in proper Zulu. That could be challenging as well.

EK: Lets talk about the learners in your class do you feel that the App has helped you and the learners attain the mathematics better and if so how so.

T1: Alright, I can say that the proposal was …it helped us a lot. It helped us a lot because, one, they enjoy it they enjoy it as well as it’s like the cellphone at home some wish to use their parents cellphones and some stay with grannies. Grannies don’t use these type of modernised Apps so they use the old type of old phones. When they come here they get these iPads which has different things which helps them to, actually it motivates them to, it helps them a lot. Yes, they enjoy it, it helps them to concetrate because when the person is talking there they need to listen very well. If they don’t listen they will miss some of the words, they will miss some of the comments which the person who is talking in the App says. Like “wenze kahle” they will miss that, but if they listen properly they will get that.

EK: and in mathematics do you feel it has helped, are they performing better?

T1: Yes, it helps them so much, they perform better. I don’t know what we can say but in maths our school is going psh psh(intending higher or better and better). The numbers which are placed there its better. if you say just show me the number in the app they can take the numbers away yet when they have written there the number will remain there even if you say scratch the number to show that you have taken it away. But in the App they enjoy it a lot because they take it away and it goes away. If you say there is a missing number there just go and look for the number they just take it and put it , you know they see its been taken away they can put it as well. Because if you say write them down scratch it and it will still remain there. So kubenza ka bha enjoy….(Zulu sentence)..but they enjoy these ipads they help us a lot.

EK: Are all learners in your classroom isiZulu home language speakers?

T1: Yes, I have one. I can say no she is not a Swati she is just its just that she doesn’t have this birth certificate her mother doesn’t have, actually she doesn’t have an ID number so I always shay she is a Swati but she speaks Zulu.

EK: Did the learners understand the isiZulu Language that is in the App well enough to be able to do the work?

T1: Yes, yes, yes.

EK: Did they ask for help / assistance in the beginning

T1: In the beginning the gentleman did explain into them how shall it go, just to explain how it works. In the beginning only, how it works, you should listen to what it says, but some miss what has been said and but a little. But now they no longer need it.

EK: When they were asking for help was it because they didn't understand or or didn't hear?

T1: They just didn't hear, they skipped the question. I mean they didn't get the question. By the time it was asked. They didn't hear it well. Not that they didn't understand it.

EK: Do you think the App has helped the learners understand the Mathematics register?

T1: So much, it helps them so much. It's just that we don't know how to explain this word "equals" we just use it as it is in English. The sign equals (=) we just use it as equals. We just don't know how to interpret it. We just say equals and they say equals. It normally happens we use this subtracting and we mix everything there . but it helps them so much

EK: Are there any isiZulu language issues in the App that you would like to bring to the fore

T1: I would suggest that maybe onebillion would use one language like when they use indilinga for example a circle has got many words. Sometimes they call it indilinga, sometime the call it indingiliza, you see there is a problem there. Some other learners that struggle with isiZulu cannot read indingiliza, but they can read indilinga. That one is short. Use short words I would advise the Onebillion to use short phrases. Short words, not longer words. TheSe people they struggle with their home language, how they struggle with their home language. isiZulu they struggle. They are struggling with writing it and reading. Let me say they struggle with the reading, because the App would come with the word. Let me say they are mentioning days of the week and then in isiZulu they would say uncembelo…and they would not already read, learned ca/qa because that would be learned in the 3rd term. But when they see it there they will struggle, what is this word? They won't be able to read this word because they will come across it in the 3rd term int heir learning.

EK: So is there a term misalignment as well?

T1: Yes, in this coming along with this term things should be done in term 3. This already being done in term 1. In this apps they are doing it in term 1 yet in in their actual language they will meet it in term 3 or term 4.

EK: Would you prefer the App in English or in isiZulu, now that you have been exposed to the App? And why?

T1: I would prefer it in English. (Laughs) Because it will help us boost their English. It will help us, it will help them to concentrate. actually, they love this English it's just that it's their first time. When you introduce a new word, they become excited. They just love English, it's just that we as teachers are…I don't know how I should say this...but, I just love English, it will help them to go well with this English. But it will be a misunderstanding, because other things they will learn it in English…they will learn in Zulu and this app will be learning… but I prefer English (she say this in a stern affirmative voice). English has short words, short nice words

EK: As for you in class do you like to mix English and isiZulu?

T1: Me as a teacher, I would prefer to mix all these things. Because we love to give instructions in English. Yes, this thing is actually we do it it's just that I don't know how we hide it because, when I teach them English, I use these alphabets, letters of the alphabets. When the other teacher comes with her letters of the Alphabets in isiZulu, it collides with mine. I don't know what I can say. Me I call things as they are in English these sounds and whatever, and then they come with theirs. But I would prefer my maths be done in English

EK: Would the learners themselves enjoy learning Maths in English ?

T1: As long as it is in the App. But when its written down they would struggle but as long as it is in the App, because they would be the person who is speaking there in English they would love him.

EK: So do you think the learners enjoy the app because of the contents?
T1: Yes they look at cartoons they go straight to cartoons. Why can't they concentrate in this App

Interview 2

EK: Are you an isiZulu home language speaker?

T2: Yes.

EK: What materials do you use to teach Mathematics in your classroom?

T2: Real objects, charts, yeah those counting materials, abacus which was bought by the school.

EK: Any materials for the department?

T2: No

EK: What materials do you use to prepare for the classroom i.e ATPS etc?

T2: Sometimes we go out and collect stones and sticks and also use the objects that are in our classrooms.

EK: How do you find the isiZulu App as used by the App?

T2: It's alright, because most of the time we teach our we also teach maths in isiZulu. So its fine...(inaudible) what we did do during our teaching lessons. For we are saying diyahlanganisa even in the App it says hlanganisa.

EK: so you find that its is consistent in how you would use the terms in class

T2: Yes, it is.

EK: do you feel that the App has helped your learners to understand Maths better? Can you give an example?

T2: A lot. Maybe You find that they go much faster when they are doing it by the App. And when you come with your lesson you find that they have already mastered this, the lesson that you are…let's say maybe you re teaching about shapes. They do it in the iPad and then when you come with your lesson you find that it comes easier, it makes it easier for them as they have done it already in the iPad.

EK: Are all the learners in your classroom isiZulu Home language speakers?

T2: Yes, all of them are.

EK: Do you find that they understand the isiZulu in the App, from the beginning or was it different in the beginning?

T2: Some of them, as children are never the same. Some of them, but most of them they do understand. Sometimes they didn't understand what they were supposed to do and what she is asking and to do.

EK: Was that because of the isiZulu language?

T2: Yes.

EK: Has the mathematics register improved? and have you seen the difference and how?

T2: Yes, when the learners go to the iPad/App first, by the time they teach the concepts, it's easier for them and they grasp the concepts easier. Because they can visualise how its looks like and how it sound like as well

EK: do you have any other language issues that you would like to bring to the fore such as issues of dialect?

T2: It has been accommodated. It's the isiZulu they know there are no words that they never knew. Its just the isiZulu.

EK: If you had the choice to have the App in English or isiZulu, which would you choose?

T2: In English. It makes them know how to understand English. I can remember in the beginning they started in isiZulu and they go to English, they just grasp and it helps them with Vocab. They end up knowing that when they say "take this" "put it in" "match this" they end up knowing the language without being taught by just listening and looking at the objects that they are working on.

EK: Do they grasp the concepts in isiZulu the same way as they grasp in English?

T2: It's the same way in isiZulu and English. In English they don't have a problem.

EK: Is there anything else you would like for onebillion to change?

T2: Its alright.

EK: Have the learners improved in their mathematics since using the App? How

T2: A lot. In their marks, their classwork and in their tasks. It helps a lot.

Interview 3

The teacher initiated the conversation:

T3: They enjoy, and it helps them with developing their listening skills, because they have to listen carefully from the person giving them instruction in the App. It improves their concertation because they really have to focus and be there and listen and focus. You can see they enjoy, helps with the development of small muscles as they move with their fingers. It helps even with knowing how to write and recognise their name their names. As every time they need to flog in they have to look up their name on the list and choose their names before going into the App

EK: Are you an isiZulu home language speaker?

T3: Yes

EK: What materials do you use in your classroom:

T3: wallcharts, counters for mathematics, we use wallcharts for shapes, counters for counting. The teacher would draw and cut out money and bring it to class when teaching about money so that the learners can see that this is R1, R5, R 200.

EK: Are there any materials form the department that you use to prepare for class?

T3: no, only charts

EK: When comparing the isiZulu in the material

T3: the words that are used in the App are correct isiZulu words but sometimes there is difficulty because the words used in the App are not the words the learners are using in the daily basis. An example such as color, even though they are speaking in isiZulu they would generally refer to ibrown, or iwhite. They would refer to the colors in white, brown green. Now when it is said in isiZulu , you say it in actual isiZulu, like how you say brown in isiZulu ntsundu…it seems foreign all of a sudden. It's like a word they don't know but it's in fact a word they know what brown is. But they are not used to that word said in Zulu way of speaking in the community.

EK: Do you feel that the App has helped you and your learners to understand the mathematics better?

T3: Yes, it has. Besides the language issue of the words, but what the App does it is that it challenges the learners but also gives them the visuals to see and listen and see and it does help in terms of improving them. Because when they don't hear something they try again and try again until they get it like what is nqatatu what is like a triangle, until they understand the difference between the triangle and the circle and the rest. So, it's nice because they can go back on their own until they get it.

EK: Did the learners as for assistance when using the App? How?

T3: In the beginning they needed help because of the accent, you could tell that the people who translated the content into Zulu they are not like Zulu speaking so their pronunciation of the words sometimes it was a little bit confusing for the learners so needed help to get used to it. So it's like people borrowing a bit of isiZulu and putting it there.

EK: Did then learners have a lot of isiZulu to learn as (EK refereeing to specialised isiZulu school language)

T3: Yes.

EK: Is there improvement in how the children now do mathematics using the isiZulu mathematics register. That they are able to do the mathematics better now?

T3: Yes, there is. Because when they do their tasks, class work sometimes they are even able to solve and answer questions now on their own without extra help. So they are able to try out somethings on their own.

EK: Is there any other language issues that we didn't as that you want to mention i.e dialect issues?

T3: No I have not picked up any issues.

EK: Would you like the App to be in English or isiZulu? And Why

T3: Me, I would like it in English. In order to improve my English.

EK: And for the learners, would it be beneficial to them?

T3: In grade R is an early grade, maybe there could be a combination that at the beginning of the year maybe it be in Zulu and then transition to English later on in the year.

Interview 4

EK: are you an isiZulu home language speaker?

T4: Yes

EK: What materials do you use to teach the learners in your mathematics classroom

T4: Charts, real objects…bottle tops, sticks for the suckers and use them if they are doing counting and for example you are saying a 10 plus 5, they literally take ten and then plus 5 and then they count and

say oh...it is 15. Or if you take away 8 is that. Things that they can relate to things that they can see easily. sometimes we do colors of things they can relate to be it birds, but things they can actually relate to that they know that are not foreign to them. If you talking about birds they can see oh we all know birds, cows, chickens, things they can relate to.

EK: How is the isiZulu in the App compare to the isiZulu found in your classroom materials?

T4: The isiZulu used is not contradictory, is fine. It adds value in addition to the materials provided by the department. Because this other one the App is more practical, and more visual for them and kids tend to like things that are visual. So they are able to translate what they have seen visually into there and see it now but it helps to be able to see and be able to move things around.

EK: And the language itself has it been (non) problematic thus far whereby learners might ask for help or clarification? Or as a teacher when you go through the App you have picked up something that is language related issue?

T4: No. Its fine in terms of language. The only challenge the learners encounter is that the iPads themselves cannot cater for all the learners. And so sometimes they don't always get a chance and as such have to be rotated. As they are not enough for all. The iPads are fewer than the number of learners. The iPads are 15 and the learners in the class are 35 so they have to rotate them

EK: Have you noticed any improvement in mathematics (register) since the learners have started using the App?

T4: it helped us a lot with mathematics. . an example is addition. For my learners and me as a teacher it has helped improved my teaching because sometimes I see how the teaching happens in the App and I try to teach like how it's done tin the App and adopt some of the stuff into my teaching. And it relates very well to the learners, it seems like they pick up things quicker. It has improved my mathematics as well as the learners' seem to pick it up easier.

EK: How do you feel the App caters for the different variations of isiZulu (dialects) is it adequate?

T4: The app can be used in different context as is. It doesn't need to change. Its really listening from the learners side, but I feel it can be used as it is.

EK: if you had to choose which Language to work with from the first App, would it be English or isiZulu and why?

T4: We use home language for teaching and learning throughout, except English, they are fine to us. Myself not for learners…its fine in isiZulu but in Maths it would help to have it in English. Because I find some concepts very hard in terms of translation, an example would be 3D shapes. Sometimes its just very hard to explain them in Zulu, and sometimes I have to ask help from other teachers to say how

have you explained this, the 3D shapes…niningwane…this is the data. In Zulu we say it inini Ngwane..but in English we use data. So we just call it data of what, data of what etc.

Interview 5

EK: are you an isiZulu home language speaker?

T5: Yes

EK: What materials do you use in your mathematics classroom?

T5: we use the teaching Aids from the department. The charts, the counters, Abacus, the suckers sticks.

EK: do you use any of the isiZulu materials given by the department for preparation and teaching of your own classroom?

T5: I use Jika iMfundo and CAPS

EK: How do you find the isiZulu that is in Jika Imfundo/CAPS compared to the isiZulu in the App?

T5: They all go well together.

EK: How do you find the isiZulu terms used in the different topics, are they similar to those you would use in your classroom?

T5: I feel like they are the same, it actually explains nicely to the learners, I don't find any problems with it.

EK: Let us talk about your learner. Has the App helped the learners understand the maths better, How?

T5: it has helped them, this is based on their marks they have improved when we do assessments. And they have really enjoyed, its enjoyable for them to do, they learn more when they touch.

EK: Are all the learners in your classroom: IsiZulu home language speakers?

T5: yes

EK: In the beginning did the learners ask for clarity in regard to what the in App tutor was asking?

T5: they didn't have a challenge because it was their home language. The only thing they needed help with at the beginning was how to operate the gadget but not in terms of understanding, just in terms of operating the iPad. But once they mastered the operation then it was

EK: Whilst their understanding of mathematics has improved, have you noted any improvement in terms of the mathematics register? Can you give an example?

T5: Yes, it has improved. An example would be a circle, they didn't know that in isiZulu they would call it indingiliza. They would call it like an egg, or a zero but now they actually use the right terminology. In Zulu because they have learned to say it in fact there is a Zulu word to call a circle.

EK: Are there any isiZulu language issues that you would like to mention such as those related to dialects?

T5: No it can be replicated.

EK: If you had to choose to have the App in isiZulu or English from the beginning and why?

T5: isiZulu, Zulu is their home language its easier, it's a language they know already. So you are not trying to bring a different language which is a second language to them and bringing concepts that they don't know as well that you are trying to explain to them in a different language. But here at least you only introducing just concepts the language is already in place.

EK: Anything else you would like to add/ comment?

T5: Not in the content just the number of iPads. In every classroom they have at least 30 leaners. So, the time each child spends on the gadget is very little because they have to pass it on to the next person then the next person to share. So, if there is something that can be improved, is to get more. So, each learner gets the full time benefit of working on the iPad.