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DECLARATION

I declare that this is my original research for the purpose of the dissertation, *An exploration of mathematics classroom culture in selected early grade mathematics classrooms in Malawi* and that this work has not been submitted to any other university, either in part or in its entirety, for the award of any degree.

___________________________   _______________
Tionge Weddington Saka     Date
The importance of a numerate person in the development of a country cannot be overemphasized. Literature from Malawi however reveals consistent poor achievement of learners in mathematics. Much as there are many factors that affect the achievement of learners in Mathematics, the issue which I investigated in this study was the type of classroom culture that currently exists in early grade mathematics classrooms in Malawi. I situated the problem in current theories of children’s mathematics learning, specifically, to search for signs of learning (and of teaching) that are coherent with current theory of learning. I thus do not only describe the classrooms, but do so with a specific orientation to mathematics learning with reference to children’s number concept development, arguing that foundations for mathematics are laid in the early grades. With that, I investigated what I argue appears to be a cemented, ritualistic culture of mathematics classrooms, which may be one of the obstacles in the way of enculturation into mathematical thinking of young learners.

The study aimed at providing a detailed (“thick”) description of the culture of selected standard 1 (In Malawi, standard is used for grade) mathematics classrooms in five primary schools in Malawi at three different points in the school year. Specifically, the objectives of the study are: to find out what constitutes the culture of standard 1 mathematics classrooms in the sampled schools; to explore possible enablers of learning as well as possible challenges to learning, related to the routines and the patterns of activity in the classrooms and also the bigger community of the schools and to explore the utility of cultural historical and activity theory (CHAT) as an educational-anthropological lens for the current study.

This study employed a qualitative research design with case study approach that was informed by ethnographic stance as an orientation tool to data collection and analysis, yielding a thick description of the culture of early grade mathematics classrooms. Learners from standard 1, numeracy and mathematics teachers for standard 1 and head teachers (principals) from five primary schools in Zomba City, Malawi, constituted the sample. Data were mainly collected through naturalistic observation, as such the main data collection instrument in this study was the researcher himself. Qualitative content analysis: a tool for reduced, condensed and
grouped content was used in the analysis of the qualitative data that was collected in this study.

Though some learning is taking place in the mathematics classrooms, the study revealed a culture that does not fully support the effective development of early number concepts. Using the activity theory, contradictions were evident in the classrooms during the learning of the number concepts. There exists a number of challenges to the learning of early mathematics. The findings of this study will contribute to; the body of knowledge about CHAT as an analytical lens for studying mathematics classroom culture in the early grades; the theoretical body of knowledge on early grade mathematics education in Malawi, the body of knowledge in education using ethnographically informed case study designs and will inform practice in primary schools in Malawi.

**Keywords:** Activity theory, mathematics classroom culture, number concept in children, numeracy
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DEDICATION

This thesis is dedicated to my Lord and personal Saviour, Jesus Christ, God the Father and the Holy Spirit.
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CHAPTER 1:
ORIENTATION AND BACKGROUND OF THE STUDY

1.1 INTRODUCTION
This study is about the classroom culture that currently exists in five standard (Malawi uses standard for grade) I mathematics classrooms in Malawi. I situated the problem in contemporary theories of children’s mathematics learning, specifically, to search for signs of learning (and of teaching) that are coherent with current theory of learning and pedagogy, and which reflects classroom culture as defined by Cobb, Stephen, McCain and Gravenmeijer (2001), Cobb and Yackel (1998) and Seeger, Voigt and Waschescio (1998). I thus do not only describe the classrooms as ethnographic spaces but do so with a specific orientation to mathematics learning with reference to children's number concept development. I argue that foundations for mathematics are laid in the early grades and that the context in which learning takes place is crucial. With that, I investigated what appears to be a cemented, ritualistic culture of mathematics classrooms in Malawian primary schools that I know, and which may be one of the obstacles in the way of enculturation into mathematical thinking of young learners.

1.2 BACKGROUND OF THE STUDY
The education practice in Malawi is, like elsewhere in the world, dependent on the systemic realities and affordances. Human and material resources can enable or obstruct the pathways of young learners. It is well-known that Malawi is a low-income country. It is a densely populated country with a per capita gross domestic product (GDP) of USD 381 in 2015 and its population was projected at 17 million in 2017 (Malawi Government 2017:9). It has six education divisions and 34 education districts in the public education system. The education system follows an ‘8–4–4’ structure, with eight years of primary education, four years of secondary education and four years of tertiary level education. At the end of the primary level, learners sit for the primary school leaving certificate examination (PSLCE), which determines
their eligibility for entry into secondary school (Ministry of Education, Science and Technology (MoEST) 2016:6). Primary schools in Malawi have high enrolments of learners with very high teacher-learner ratios. The highest enrolments are registered in standard 1. Figure 1.1 shows enrolment trends in primary school since Malawi became independent from British colonial rule.

![Figure 1.1: Enrolment of learners in Malawi from 1964 to 2015 (Source: EMIS data)](image)

Figure 1.1 shows the trend in enrolment since 1964. Generally, the learner enrolment has kept on increasing from one year to the next, with 4,804,194 learners in the 2014/2015 academic year. Figure 1.1 shows that there was a sharp increase in enrolment in the 1994/95 academic year. This was because of the introduction of free primary education in the country. Malawi has grappled with high learner teacher ratios since then. Figure 1.2 illustrates the situation.
Figure 1.2: Learner teacher ratios from 2008 to 2014/2015 academic year. (Source: EMIS data)

Figure 1.2 shows the learner teacher ratios since 2008. The figure shows how high the teacher-learner ratios are in primary schools. There seems to be minimal effort to have the ratio go down. Apart from the high ratios, the Malawi Basic Education review by the Japan International Cooperation Agency (JICA) (2012) revealed that the basic education sector is experiencing numerous challenges. Some of the challenges reported include:

- High repetition rates; it was 18.8% in 2009 which was said to be high compared to that of other countries in Sub-Saharan Africa;
- In 2006, the number of learners per class was 107, whereas it was 105 in 2011, showing little improvement;
- English, Chichewa, and mathematics books showed the same allocation pattern of 0.5 books per learner on average.

The high repetition rates in the system shows how inefficient the Malawi basic education system is. The teacher-learner ratio makes it very difficult for teachers to teach and for learners to learn.

A report by the World Bank (2010:xxxi) notes that the repetition rates in Malawi are the highest in the region and an estimated 1.97 billion Malawi Kwacha (US$1 is equivalent to MWK733) is used annually to deliver primary education services to repeaters. The World Bank also notes that repetition mainly affects standards 1 to 4 of the primary cycle, where the highest repetition rates are to be found.
The Malawi Basic Education review by JICA (2012) and the World Bank report provides some context within which mathematics is taught and learnt.

1.3 THE RESEARCH PROBLEM
The study investigates classrooms to find out what happens in these learning spaces that may contribute to the distressing data from large-scale studies.

1.3.1 Data from various studies
The importance of early number concept development cannot be overemphasized. Platas, Ketterlin-Geller and Sitabkhan (2016:163) note that research across the globe has provided evidence on the predictive relationship of early mathematical knowledge and skills on later academic achievement and economic status. The Government of Malawi (2012:44) recognises the potential that a numerate youth has in fostering the growth of the economy. Several studies carried out in Malawi nationwide agree with this observation. Some of the studies include the monitoring of learning achievement in the Primary Sample Survey (PASS), (Malawi. MoEST 2010), the Southern and Eastern Africa Consortium for Monitoring Educational Quality (SACMEQ) (Malawi. MoEST 2017) and achievement studies by the Malawi Institute of Education (MIE) (Maganga, Mwale, Mapondera & Saka 2010; Malawi Institute of Education (MIE) 2008). A brief description of the studies and their results follow in the next paragraphs to substantiate the observation.

The MoEST (2014) conducted a monitoring learning achievement (MLA) study in 2012. In this study, learners in standards 2, 4 and 7 were targeted nationally. The respondents were given tests in English, mathematics and Chichewa. Results of the study showed that Standards 2, 4 and 7 learners’ mean achievement in mathematics was 40.3%, 55.1% and 36.5% respectively (MoEST 2014). The study revealed that only 5.1%, 11.8% and 0.3% of the learners in standards 2, 4 and 7 respectively achieved desirable levels\(^1\) (level 4).

---

\(^1\) In Malawi, benchmark for learners’ achievement is divided into four levels. Level 1 (0-39)% - Not achieved, Level 2 (40-59)% - partially achieved, Level 3 (60 -79)% – Achieved, Level 4 (80 – 100)% – Exceptionally achieved. Learners with performance that falls under level 1 are considered to be in Need of Assistance, level 2 are considered to have achieved minimum level of performance, level 3 are considered to be in an Acceptable Level of Performance and level 4 are considered to be in the Desirable Level of Performance.
SACMEQ studies focus on an examination of the conditions of schooling in relation to achievement levels of learners and their teachers in reading and mathematics. Standard 6 learners participate in the studies. So far four studies have been carried out. Malawi did not assess learners in mathematics during SACMEQ I. Table 1.1 therefore shows details of results of the three SACMEQ studies where mathematics was assessed.

Table 1.1: Achievement of learners in Mathematics during SACMEQ studies

<table>
<thead>
<tr>
<th>Area</th>
<th>SACMEQ II</th>
<th>SACMEQ III</th>
<th>SACMEQ IV</th>
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<tbody>
<tr>
<td>Malawi mean score</td>
<td>433</td>
<td>447</td>
<td>497.2</td>
</tr>
<tr>
<td>Deviation from previous study</td>
<td>N/A</td>
<td>41</td>
<td>50.2</td>
</tr>
<tr>
<td>SACMEQ mean</td>
<td>500</td>
<td>507</td>
<td>584</td>
</tr>
<tr>
<td>Deviation from SACMEQ mean</td>
<td>67</td>
<td>60</td>
<td>86.8</td>
</tr>
<tr>
<td>No. of countries that participated</td>
<td>14</td>
<td>16</td>
<td>14</td>
</tr>
<tr>
<td>Position of the country</td>
<td>14</td>
<td>15</td>
<td>14</td>
</tr>
</tbody>
</table>

(Sources: Chimombo, Kunje, Chimuzu & Mchikoma 2005, Milner, Mulera, Banda, Matale & Chimombo 2011, Makuwa 2010, Malawi,MoEST 2017)

The table shows that mathematics scores for learners have been improving overtime with 433, 447 and 479.2 in SACMEQ II, III and IV respectively. Much as there was an increase on the overall mean scores for mathematics in SACMEQ IV as compared to SACMEQ III, the mean scores consistently remain below the SACMEQ mean scores for all the three studies and Malawi is consistently at the bottom of the list of country scores.

According to MoEST (2017:130 - 131) there was an improvement between SACMEQ III and SACMEQ IV in terms of the number of learners with higher skills levels in SACMEQ IV as compared to SACMEQ III. In SACMEQ III the majority of learners (51.3%) were at Level 2 while in SACMEQ IV the majority were at levels II (38.1%) and III (37.9) (MoEST 2017:130 - 131). The majority of learners are still operating below the basic skills in SACMEQ IV (Milner, Mulera, Banda, Matale & Chimombo 2011).

The Malawi Institute of Education (MIE) (2008) collected data from 12 districts selected from all the six educational divisions in the country. Among other areas, the study focussed on assessing the learning achievement of standards 2 and 5 learners.
in mathematics, Chichewa and English. The mean scores in numeracy and mathematics for the learners in standards 2 and 5 were 58.4% and 26.63% respectively. Much as the average is greater than 50% for the standard 2 learners’ achievement, the average is very much below 50% for standard 5 learners.

Maganga, Mwale, Mapondera and Saka (2010) carried out a study where the same learners were tested in numeracy and mathematics/mathematics using the same instruments at the beginning and at the end of the academic year in standards 3 and 7. The results showed that standard 3 learners had a mean score of 24.76% during the baseline and 41.16% during the end line. As for standards 7 learners, the mean percentage score was 14.76% during baseline and 24.64% during end of the year. Much as there were significant differences between the baseline and end line mean percentage scores, most learners were not able to demonstrate the skills they were expected to acquire over the academic year.

MoEST (2010) conducted a primary achievement sample survey (PASS) to assess learners’ achievement levels in English and mathematics in standards 3, 5 and 7 and assess the impact of school and home factors on learners' achievement. The study involved 10% of the schools in Malawi and used 10,067 learners as a sample. In mathematics, the mean percentage scores of learners in standards 3, 5, and 7 were 20%, 11% and 11% respectively. The study revealed that less than 8% of the learners attained the grade level proficiency and competences expected in standard 3 and none of the learners scored above 50% in standard 5. In standard 7, 99% of the learners scored below 50% in mathematics.

In Malawi, learners sit for primary school leaving certificate of education (PSLCE) examinations at the end of the primary school cycle and they sit for Malawi school certificate of education (MSCE) examinations at the end of the secondary school cycle. The grading system for PSLCE is such that a learner can score any one of the following grades; A (excellent), B (credit), C (strong pass, D (pass) and F (fail). On the other hand for MSCE, the grading system is as follows; 1 – 2 (distinction), 3 – 6 (credit), 7 – 8 (pass), and 9 (fail). The pass rates of learners in mathematics from 2007 to 2017 has been displayed in Table 1.2.
Table 1.2: Pass rate of learners in mathematics at PSLCE and MSCE examinations

<table>
<thead>
<tr>
<th>Year</th>
<th>Primary school leaving certificate</th>
<th>Malawi school certificate of education</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Pass</td>
</tr>
<tr>
<td>2007</td>
<td>161739</td>
<td>122402</td>
</tr>
<tr>
<td>2008</td>
<td>175928</td>
<td>138030</td>
</tr>
<tr>
<td>2009</td>
<td>185041</td>
<td>115518</td>
</tr>
<tr>
<td>2010</td>
<td>189384</td>
<td>137725</td>
</tr>
<tr>
<td>2011</td>
<td>205342</td>
<td>167222</td>
</tr>
<tr>
<td>2012</td>
<td>217110</td>
<td>170514</td>
</tr>
<tr>
<td>2013</td>
<td>233989</td>
<td>161524</td>
</tr>
<tr>
<td>2014</td>
<td>241200</td>
<td>186784</td>
</tr>
<tr>
<td>2015</td>
<td>249988</td>
<td>167190</td>
</tr>
<tr>
<td>2016</td>
<td>255250</td>
<td>180612</td>
</tr>
<tr>
<td>2017</td>
<td>255718</td>
<td>210513</td>
</tr>
</tbody>
</table>

(Source: Malawi National Examinations Board)

It is clear that the pass rate of learners during PSLCE examinations (ranging from 66.88% to 82.32%) was higher than that during MSCE examinations (ranging from 48.43% to 57.84%).

Table 1.3: The quality of learners’ grades in mathematics at PSLCE and MSCE

<table>
<thead>
<tr>
<th>Year</th>
<th>Primary school leaving certificate</th>
<th>Malawi school certificate of education</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Excellent (%)</td>
<td>Credit (%)</td>
</tr>
<tr>
<td>2007</td>
<td>1.29</td>
<td>2.67</td>
</tr>
<tr>
<td>2008</td>
<td>1.77</td>
<td>3.89</td>
</tr>
<tr>
<td>2009</td>
<td>0.75</td>
<td>2.87</td>
</tr>
<tr>
<td>2010</td>
<td>0.41</td>
<td>1.93</td>
</tr>
<tr>
<td>2011</td>
<td>1.97</td>
<td>5.31</td>
</tr>
<tr>
<td>2012</td>
<td>2.97</td>
<td>4.93</td>
</tr>
<tr>
<td>2013</td>
<td>1.38</td>
<td>2.63</td>
</tr>
<tr>
<td>2014</td>
<td>1.46</td>
<td>3.56</td>
</tr>
<tr>
<td>2015</td>
<td>1.50</td>
<td>2.95</td>
</tr>
<tr>
<td>2016</td>
<td>0.64</td>
<td>2.01</td>
</tr>
<tr>
<td>2017</td>
<td>2.90</td>
<td>5.36</td>
</tr>
</tbody>
</table>

(Source: Calculated by author based on data from Malawi National Examinations board)

It is evident from Table 1.3 that much as the pass rate for mathematics at PSLCE looked high, very few learners got either an excellent (A) grade or a credit (B) grade over the whole period of 11 years. The majority of learners just passed the examinations. A better story is however seen at MSCE where percentages of learners who scored distinctions are relatively higher than those who scored excellent at PSLCE. Generally, more than half of the learners who passed
mathematics got pass grades (7 and 8). The situation in both examinations does not paint a good picture of the learners’ acquisition of mathematical content. It is evident that most learners leave both the primary and secondary schools without a firm grasp of mathematical content as evidenced by their performance described in this section.

Having observed the poor performance of learners in Mathematics at national level, the Malawi government through the Ministry of Education Science and Technology (MoEST) has embarked on reducing the innumeracy rates in primary schools. MoEST through its Education Sector Implementation Plan (II) 2012/2013 – 2017/2018) has one of its policy reform statements as ‘ensure 50% of children reach standard 4 literacy/numeracy by 2017 (MoEST 2014:37). Among the strategies put to meet the objective are assessment of learning outcomes through MLA studies and Early grade mathematics assessments, increase in time spent on learning by one hour, provision of teaching and learning materials such as text books where a ratio of 1:1 is targeted, provision of adequate classrooms to reduce overcrowding and ensure inclusion of learners. MoEST will further offer basic education to out of school children (MoEST 2014:37 - 38).

1.3.2 The problem with large scale data

The studies discussed in the previous section do not capture the everyday reality that is the context from which the distressing data emanates. One way of getting a ‘deep dive’ picture is to capture how teaching, learning, communication and management happens in daily activities and what processes unfold in classrooms in everyday practice. The focus in the studies in Section 1.3.1 was on learning outcomes and logistical information only. Similarly, the policy priority reforms and programmes described above do not capture the culture in classrooms - the typical behaviours, signs and symbols of, especially, the early grades. This study, therefore, is somewhat of a shift from the typical once-off visit to collect data about learners or to gather data from data files of the education system. It sees classroom culture as the place where the problem may be situated, while not ignoring the ‘big data’. In ethnographic terms, it aims to untangle the research problem by giving a thick description (Merriam 2009:28, Wolcott 1994) of the mathematics learning activities in classrooms, signifying its educational cultural practice. It is a study of learners learning in the classroom, aiming to give a glimpse of the observed culture in the
classroom and deriving from that what the possible effect of it can be on learning. This study endeavoured to bridge the gap in knowledge about classrooms of mathematics teaching in the early grades.

This study was broadly aimed at exploring how learners are apprenticed and enculturated (Rogoff 1990, Brown, Collins & Duguid 1989) in the standard 1 mathematics classes. The reasoning for this need to understand what happens in these classes when learning is mediated semiotically (Vygotsky 1978, Kozulin 1990) is that a researcher may then be able to pinpoint some of the entrenched classroom cultural practices that may hinder learning mathematics as conceptual development. This study will be guided by the following question: What is the culture of early grade (specifically first grade) mathematics classes?

1.4 MOTIVATION FOR THE STUDY

I was motivated to carry out this study by a concern about the “way of life” (Wolcott 1994, Hammersley 2014) in early grade classrooms, where a specific cultural stereotype of teaching large classes seems to be dominant. I argue that this pattern of classroom life may form a sociocultural barrier to learning early number concepts and to learn to think mathematically. A study of learners’ experiences within classrooms may contribute to understanding classroom culture that forms the foundation for developing number concepts, by observing classroom activity, as Seeger, Voigt and Waschescio (1998) did, as places where certain norms and values become cultural symbols of learning and engagement and which they describe in the title of their book as “the culture of the mathematics classroom.”

My interest in the learning of children started as early as the mid-1990s. I have taught mathematics in early grades. I have been involved in preparing teachers to teach mathematics in primary schools and I have also carried out a number of studies as an education official in my country (Malawi), where I have observed learners go through mathematics lessons. It has been very clear that despite the efforts made by teachers in their classrooms, the learners’ achievement in mathematics has been consistently poor. This situation triggered my interest in the learning milieu of the early grades. A number of national studies carried out in
Malawi, which were mentioned in the previous section of the chapter, indicate that the achievement of learners in mathematics is very low.

1.5 THE AIM OF THE INVESTIGATION
The aim of the study was to render a description of the culture of selected standard 1 mathematics classrooms in five primary schools. I surmised that such a description could give a better understanding of learners’ encounters with numeracy in these settings. The objectives of the study were to:

1. Find out what constitutes the culture of standard 1 numeracy and mathematics classrooms in the sampled schools;
2. Explore possible enablers of learning as well as possible challenges to learning, related to the routines and the patterns of activity in the classrooms and also the bigger community of the schools;
3. Explore the utility of cultural historical and activity theory (CHAT) as an educational-anthropological lens for classroom culture studies study.

1.6 THEORETICAL FRAMEWORK
The study was conducted with an educational, anthropological stance. Fetterman (2010:6), an anthropologist of education, advises that an appropriate theory can ‘stabilise’ the epistemology of a study. He suggests two types of theories that are commonly used by ethnographers in carrying out ethnographic research, which he refers to as ‘ideational’ and ‘materialistic’ theories. In this thesis these two types are integrated; 1) aspects of sociocultural theory by Vygotsky (1978, 1933), Rieber (1997), Kozulin (1990), which is built on ideas of semiotic mediation as cultural activity - developed further by Leont’ev (1981) and Engeström (2001), which is 2) an expansion of Vygotskian theory to include ‘material’ elements such as ‘distribution of labour”, community’ and ‘rules’, will provide the lens through which the study will be viewed. The theory and how it was utilised is discussed in the next paragraphs. Further, the study also used mathematics classroom culture models as thinking tools to interpret the findings of the study. I use these thinking models for the interpretation of the eight themes that emanated from the data analysis. Combinatorially, they have provided me with a multifocal lens.
1.6.1 Cultural historical and activity theory (CHAT)

Within the overall ethnographic case study approach of this study, CHAT is utilised as a specific analytic lens with which to interpret the observations and other data. As a researcher, I had a “gaze” (Wardekker 2008 cited in Henning, Petker & Petersen 2015:3) upon the classroom activity and reflected on what I noted by way of CHAT, specifically as advised by Engeström (2001; 2015) in what he refers to as ‘activity systems analysis’. This approach to collecting and analysing data therefore called for ‘hanging around’ (Bryman 2012:438) the school as the activity of engaging with mathematics classroom culture was enacted. I specifically utilised the lens of what Ahmed (2014:4) notes about activity theory, namely that the unit of analysis is the activity itself and it takes into consideration the social and cultural setting in which human activity is situated. In the instance of this inquiry the activity was, on the one hand, the learning in the classroom, and, on the other, the teaching, using certain artefacts and tools, as well as signs, such as language. The setting of the five classrooms, within their schools, was the setting in which the ‘socially meaningful activity’ (Kozulin, 1990) was taking place and where the researcher, as the ‘friendly stranger,’ entered as observer. In the use of this lens, it is important to note that it served as a lens and that it was not a way of classifying information. As Wardekker (2008) cited in Henning, Petker & Petersen (2015:3) noted – it is an analytic ‘gaze’ upon activity to assist in theorising.

Activity theory (AT) has a history: According to the first wave of activity theory, activity was an interaction between a ‘subject’ (such as a teacher) and ‘object’ (such as a learner) through mediating artefacts or tools (such as books, curricular language and teaching aids). The interaction (constituting the activity) has a goal (object) and is thus object-oriented, which is, in turn, aimed towards outcomes (children learning mathematics successfully, for instance). Williams et al. (2007) cited in Ahmed (2014:6) explains that the ‘subject’ in activity refers to human actors who work towards a desired goal. The object is both a material entity (something to work on) and the embodiment of vision, idea or purpose. In some literature this is explained as the motivation and the gegenstand (object) (Henning, van Rensburg & Smit 2005).

The notion of mediating artefacts or tools refers to physical instruments (such as computer hardware, equipment), conceptual schemes (such as mind maps, work
plans, strategies) and language tools (i.e.; text, language, mnemonics). In this way, first generation activity theory is commonly expressed as the triad of subject, object, and mediating artefact as seen in the top part of the triangles in Figure 1.3.

In AT, the subject is situated within a group, which interacts with the object through the mediating artefacts, within a specific activity system. An individual’s actions are directed to the collective object-motive of the larger activity (Engeström 1987; 1999b), such as learning mathematics (numeracy). According to Ahmed (2014:6), the theory emphasises analysing the interactions among ‘community’, ‘rules and ‘division of labour’ and their influence on the activity system, thus extended and comprising more than ‘subject’, ‘tools and ‘object. The interactions among different components of an activity system are represented by the connecting lines of dynamics in the activity triangle (Figure 1.3). Ahmed (2014:6) explains that the community refers to groups of individuals/sub-group who share the same object. He also explains that the ‘division of labour’ refers to both the division of tasks among the members of the community and the division of power and status. The oval shape (labelled object 1 in Figure 1.3) indicates the object-oriented actions, which are characterised by ‘ambiguity’, ‘surprise’, and ‘interpretation’ among the subject group, sense-making and possibilities to change. This approach to activity encompasses individual subject/s and their interaction with the community and context.

Considering that an activity is situated within a network of other activities and interacts with other activity systems Engeström (2001: 136) represented the current (third wave of) AT as two interacting activity systems as minimal model (Figure 1.3).

Figure 1.3: Two interacting activity systems as minimal model for the activity theory (Engeström, 2001: 136).
Figure 1.3 shows that the object moves from an initial, situationally boundaried system of ‘raw material’ (object 1) to a ‘collectively meaningful’ object constructed by the activity system (object 2) and to a potentially shared or jointly constructed object (object 3). This, according to Ahmed (2014:6), indicates the dynamic nature of the object in joint activity. An activity system works in interaction with networks of other activity systems, it intersects with rules and instruments from other activity systems (like the management system in an education system, in which the ‘workers’ are the recipients of policy directives from a country’s education department or ministry). This is a vital aspect of the theory, with which I engage to capture classroom culture, in which a single classroom will be looked at as an activity system, connected to other systems.

According to Engeström (2001), the current state of activity theory may be summarised with the help of the following five principles:

1. A collective, artifact-mediated and object-oriented activity system, seen in its network relations to other activity systems, is taken as the prime unit of analysis.

2. The multi-voicedness of activity systems: An activity system is always a community of multiple points of view, traditions and interests. The division of labour in an activity creates different positions for the participants, the participants carry their own diverse histories, and the activity system itself carries multiple layers and strands of history engraved in its artifacts, rules and conventions.

3. Historicity: Activity systems take shape and get transformed over lengthy periods of time. Their problems and potentials can only be understood against their own history. History itself needs to be studied as local history of the activity and its objects, and as history of the theoretical ideas and tools that have shaped the activity.

4. The central role of contradictions as sources of change and development. Contradictions are not the same as problems or conflicts. Contradictions are historically accumulating structural tensions within and between activity systems.

5. The possibility of expansive transformations in activity systems in that activity systems move through relatively long cycles of qualitative transformations. A
full cycle of expansive transformation may be understood as a collective journey through the zone of proximal development of the activity (see Section 1.7.2 for more information on the zone of proximal development) (Engeström 2001:136-137).

The summary of CHAT represented in five principles were crucial in looking at the activity and during the interpretation of the data (see Section 5.3 for example). I propose that a classroom culture is, heuristically, an activity system.

1.6.2 CHAT as lens in the current ethnographic case study

The main reason for deciding to apply this theoretical lens is because it has much potential for writing the ‘way of life’ of classrooms within a framework that invokes the small unit of sampling (the five schools) but that it also inserts (again, heuristically) wider systemic activity. Thus, although I was motivated to see learning and teaching ‘in action’, I was also motivated by the many-layered contexts in which the activity is taking place. When a learner learns, several systems are involved. These include, but are not limited to the classroom, the school, the family/community she/he stays in after school, the policy makers and curriculum developers. This study mainly focused on the classroom, much as it could have been a good idea to look at all these systems.

With regard to the main activity system in this study, the subject is the learners in the classroom. The mediating artefacts include the language, signs and symbols that the teachers were using in the classroom. It also includes other resources that the teacher brought in the classroom which she considered as useful to elicit learning e.g. charts, books, chalkboard and counters. The object of the activity is the learners’ engagement in learning experiences which could lead to the outcome of becoming numerate. The ‘rules’ refer to the norms, conventions and social interactions in the classroom. The ‘community’ includes the teacher and learners in the classroom. The ‘division of labour’ that was studied included the division of tasks among the learners and the teacher and the division of power and status in the classroom and within the school in general. Special focus was however put on how the division of labour among learners and the teacher in the selected classrooms.

According to Roth and Lee (2007:5) CHAT is of interest to education researchers because it has shown to be fruitful for both analyzing data recorded in real
classrooms and designing change when trouble and contradictions become evident in these cultural settings. CHAT was useful for examining the connection between how learners learn in the company of others – especially in the large classrooms of this study.

The current Malawi national primary curriculum is outcomes based. The outcomes-based education (OBE) curriculum is based on a constructivist epistemology\(^2\). These principles are present in the Malawi National primary curriculum (NPC) (Malawi Institute of Education 2006).

1.6.3 Mathematics classroom culture (MCC) as lens in the ethnographic case study

Mathematics classroom culture came on the mathematics educators’ scene in the early 1990’s (Bishop 1988). Since then several studies have been conducted (see Section 2.2). Considering that the study is about the way of life of mathematics classrooms, conceptions of mathematics classroom culture were deemed to be important in the interpretation of the findings of the study. The description of mathematics classroom culture as comprising of social norms, socio-mathematical norms and classroom mathematical practices (Cobb & Yackel 1998) was found to be very helpful for this study. A further discussion of mathematical norms as comprising taken as shared purpose, taken as shared ways of reasoning with tools and symbols, and taken as shared forms of argumentation (Cobb, Stephen, McCain & Gravenmeijer 2001) were also found to be helpful in the interpretation of the study. A comprehensive discussion of mathematics classroom culture can be read in Section 2 of this thesis.

1.7 THE STRUCTURE OF THE THESIS

This thesis comprises five chapters:

- Chapter one presents the background, purpose, aim of the study, specific objectives of the study, the motivation for the study and the theoretical framework that has informed the inquiry.

\(^2\) Cooper (2007), the basic principles of constructivism include: the use of prior knowledge for new learning; active involvement in the learning process through problem solving; and knowledge which is continually changing.
• Chapter two features the literature relevant to the study.
• Chapter three describes the research design, and methodology.
• Chapter four consists of the data that was collected and analysed.
• Chapter five presents a discussion of the analysed data.

1.8 CONCLUSION
This chapter provided the foundation for the thesis, presenting the keystones and setting of the study. The chapter also provided the motivation for the study and established a ‘gap’ of knowledge about classroom culture in large classes of early mathematics learning.
2.1 INTRODUCTION

The unit of analysis of the study is mathematics classroom culture. According to Trochim (2006), the unit of analysis of a study is the phenomenon that one is analysing. Mathematics classroom culture is a specific social interaction – including any semiotic tools or other artefacts implemented. Rogoff (1990) argues that introducing children into the culture of a practice is a social process that can be described in terms of *apprenticeship* learning (Brown, Duguid & Collins 1989). In this study I regard learners as apprentices in the practice of mathematical thinking *and* learning to think mathematically. According to Staub (2007:324), research on mathematics classroom culture has been focussing on the identification of teaching patterns and on the participants’ beliefs and guiding norms, with the assumption that if we better understand the culture and how it affects learners’ achievement gains, this will allow us to advance teaching in significant ways.

Mehan (1979) emphasises that classroom discourse, within the culture that produces it, is patternised and routinized, often in the ‘initiation-reply-evaluation’ (IRE) sequence of pedagogical interaction. In this sequence, a teacher asks a question, an individual learner is then selected to respond, and the teacher evaluates it. According to Mehan (1979:54), “the three-part initiation-reply-evaluation sequence contains two coupled adjacency pairs. The initiation reply is the first adjacency pair. When completed, this pair becomes the first part of a second adjacency pair. The second part of this pair is an act that positively evaluates the completion of the initiation-reply pair”. Figure 2.1 shows how this relationship can be visualised. If teaching and learning activities are contained in such a pattern, it would pose a big challenge to teach in very large classrooms.
Much as this initiation-reply-evaluation sequence may be present in the classroom, Lopez and Allal (2007:253) observed that at the same time,

*It is largely recognized that “every continuing social group develops a culture and a body of social relations that are peculiar and common to its members’ (Gallego et al., 2001, p. 951); this means that above and beyond the common features of a general “classroom culture”, each classroom community develops its own distinctive microculture.*

It is the microculture of mathematics classrooms that is of interest in the present study. If the five ‘microcultures’ turn out to be similar, it may mean that more standard 1 classrooms in Malawi could have similar cultures.

## 2.2 MATHEMATICS CLASSROOM CULTURE

According to De Corte and Verschaffel (2007:247), the importance of culture for mathematics education was brought to the attention of researchers by Bishop (1988) in his book *Mathematical Enculturation: A cultural perspective on mathematics education*. Thereafter, there has been an upsurge of studies on the subject from the 1990s. Examples of such studies include that by Nickson (1992), Seeger, Voigt and Waschesco (1998), Presmeg (2007) and several other studies to be discussed in this section. Staub (2007:319) notes that there is wide agreement that educational cultures are pivotal in shaping the way we live and learn.

### 2.2.1 What is mathematics classroom culture?

Ember, Ember and Peregrine (2007:216) define culture as the set of learned behaviours and ideas (including beliefs, attitudes, values, and ideals) that are
characteristic of a particular society or other social group. This includes the way tools are made and used. Further, according to Thomas (1996), cited in Staub (2007:319), culture refers to a broad array of beliefs and activities shared by members of a group. Applying this definition in the case of this thesis, it would mean the broad array of beliefs, activities and artefactual tools shared by teachers and learners in the mathematics classrooms that I observed. Nickson (1992:102), defines the culture of the mathematics classroom as the ‘invisible’ and apparently shared meanings that teachers and learners bring to the mathematics classroom and that govern their interaction. Staub (2007) furthermore provides two related perspectives on culture. The first one is that culture is viewed as a set of thoughts that are shared among group members and these thoughts guide group members’ actions and provide a common interpretive framework for their experiences. The second perspective, according to Levine and Moreland (1991) cited in Staub (2007:320), is that culture is viewed as a set of customs that embody the thoughts that group members share. Staub (2007:320) adds that customs can be classified as routines, accounts, jargon, rituals, or symbols.

In addition to ways of thoughts, beliefs, and shared patterns of behaviour explained above, Staub (2007) points out that other key elements that are understood to constitute culture are artefacts (such as tools and language), norms, values and institutions. It is on the basis of such elements that the history of society is connected with the present. Key terms related to definitions of ‘culture’ are used in this thesis (Figure 2.2).

![Figure 2.2: Key terms on classroom culture](image)
Although these key terms are shared in descriptions of culture, some researchers have also suggested three conceptions of classroom micro-culture.

2.2.2 Micro classroom culture

Cobb and Yackel (1998) noted that some of the activities that are done in a mathematics classroom may not be directly related to mathematics. They therefore came up with specific aspects of mathematics classroom culture, which are, classroom social norms, socio-mathematical norms and classroom mathematical practices.

Classroom social norms

Social norms, according to Cobb, Yackel, and Wood (1989), cited in Cobb, Stephen, McClain and Gravemeijer (2001:122) are characteristics of the classroom community regularities in classroom activity that are jointly established by the teacher and students. They are not specific to mathematics but apply to any subject matter area. Examples of social norms include explaining and justifying solutions, attempting to make sense of explanations given by others, indicating agreement or disagreement, and questioning alternatives when a conflict in interpretations had become apparent. In the establishment of social norms in the classroom, the teacher oversees the classroom activities and thus serves as 'elder' in the community. According to Cobb, Stephen, McClain and Gravemeijer (2001:123), the teacher “expresses that authority in action by initiating, guiding and organising the renegotiation of classroom social norms”. The learners, however, play their part in contributing to the evolution of social norms. It is hard to imagine this in large classes of young children, who have to adjust to formal education (Henning, Gravett & Van Rensburg, 2005).

According to Cobb and Yackel (1998:168), an analysis of classroom social norms focuses on regularities in the classroom interactions that, from the observers’ perspective, constitute the ‘grammar’ of classroom life. Gergen (1985) cited in Cobb and Yackel (1998:168), adds that such an analysis treats these regularities as manifestations of shared knowledge and ways of doing in everyday practice. It is, once more, unimaginable how young children can even know what their ‘shared knowledge’ of mathematics and classroom behaviour is, considering the home- and the community life of the children who live in and around Zomba City, where my study was conducted.
**Socio-mathematical norms**

According to Cobb and Yackel (1998:169), socio-mathematical norms are the normative aspects of whole-class discussions that are specific to learners’ mathematical activity, for example, what counts as a different solution, a sophisticated solution, an efficient solution, and an acceptable explanation. Cobb, Stephen, McClain and Gravemeijer (2001:124) contend that the analysis of the socio-mathematical norms has proven useful in helping to understand the process by which the teachers foster the development of intellectual autonomy in their classrooms. Cobb et al. (2001:124) conjecture that, in guiding the establishment of particular socio-mathematical norms, teachers are simultaneously supporting their learners’ reorganization of the beliefs and values that constitute what may be called their mathematical dispositions. Voigt (1995) argues that socio-mathematical norms are not obligations that students must fulfil; the norms facilitate the learners’ attempts to direct their activities in an environment providing relative freedom for interpreting and solving mathematical problems.

**Classroom mathematical practices**

Classroom mathematical practices are the taken-as-shared mathematical practices established by the classroom community. They are specific to mathematical ideas. For example, various solution methods that involve counting by 1s are established mathematical practices in standard 1 classrooms at the beginning of the school year.

As part of the process of testing and refining conjectures about mathematical practices, Cobb et al. (2001:129) differentiate between three types of mathematical norms:

1. **Taken-as-shared purpose.** This is concerned with what the teacher and students are doing together mathematically,
2. **Taken-as-shared ways of reasoning with tools and symbols.** This aspect is concerned both with the ways of using tools and symbols that are treated as legitimate and with the taken-as-shared meanings that these actions with tools and symbols come to have in the classroom, and
3. **Taken-as-shared forms of mathematical argumentation.** This deals with criteria that the teacher and students establish in interaction for
what counts as an acceptable mathematical explanation and justification

Voigt (1998:203) says that these norms emerge during the process of negotiation. From the observers’ point of view, meanings taken-to-be-shared do not indicate a partial match of individuals’ constructions. A meaning taken-to-be-shared is not a cognitive element; it exists at the level of interaction.

Lopez and Allal (2007) discuss these three conceptions of mathematics culture as the social dimensions of classroom micro-culture. They also introduce the psychological dimensions of mathematics classroom culture that include individual students’ thinking, which comprises mathematical beliefs, interpretations and modes of reasoning. Cobb et al. (1997) cited in Lopez and Allal (2007:253) argue that this view sees “mathematical learning as both a process of active individual construction and a process of enculturation”.

In relation to the foregoing discussion on understanding mathematics classroom culture, Gill and Boote (2012) carried out an ethnographic case study whose purpose was to examine how the aspects of a culture reinforce each other (and how they resist aspects alien to the cultural system) to understand the sui generis (unique) nature of a culture. In their study, Gill and Boote (2012:8-9) used five indicators of culture: language usage, standard practices, tools and equipment usage, ongoing concerns and values, and recurring problems to describe how they work together to create a culture. The interrelationships between the five indicators are shown in Figure 2.3.
According to Gill and Boote (2012:9) patterns of language use in a culture also help us to see what the cultural group values and (by omission) does not value. How people use tools and equipment indicates a culture’s values and its perceived problems, and shapes what people spend their time doing (and not doing). The recurring problems within a culture give us insight into a cultural group’s values, standard behaviour, and language usage. This view aligns very well with the integrated theoretical framework of this study. Much as the framework depicted in Figure 2.3 appears to be about school culture, Gill and Boote (2012) used it to specifically study mathematics classroom culture, arriving at examples of each aspect/indicator from the analysis of a mathematics classroom they carried out (Figure 2.4).
This multi-dimensional view of mathematics classroom culture informed my thesis.

2.2.3 Studies about mathematics classroom culture

Staub (2007:321-322) warns that research, based on samples of sequence of lessons is desirable in-order to arrive at descriptions of regularities within and differences between classroom cultures. This study has complied with this suggestion by ensuring that multiple visits are made to the classes at different points in the academic year. This eventually assisted in arriving at the description of the culture of the selected sample over a time period.

There is variance in the sampling of not only a population for the case of the investigation, but also the period of time dedicated to the study. De Corte and Verschaffel (2007), in an editorial of a special issue of a journal, note that whereas the investigations into mathematics classroom cultures differ in their design (e.g., large scale versus small scale) focused on what was actually happening during mathematics lessons in regular classes. De Corte and Verschaffel (2007) also noted that all the studies used video recordings of these lessons as a starting point for analysing and comparing classroom practices in an attempt to uncover and grasp the underlying “shared invisibles” such as values, beliefs, and the meanings that combine to create the culture of the mathematics classroom. The observation by De Corte and Verschaffel (2007) had important implications for the methodology employed in this study.

Depaepe, De Corte and Verschaffel (2007:270) present three characteristics of classroom practice and culture that are assumed to enhance students’ mathematical beliefs and problem-solving competencies, namely:

1. Established classroom norms
2. Instructional techniques and classroom organization forms
3. The set of tasks students have to complete.

Further, Depaepe, De Corte and Verschaffel (2007:270) explain that classroom norms are focussed on problem-solving, while the instructional techniques include modelling, non-directive coaching, directive coaching, scaffolding, articulation, reflection, exploration, and praising. Regarding aspects of classroom organisation, they distinguished between whole-class instruction, group work, individual work, and a combined organizational form. As for the activities that students were engaged in,
a task was taken as ‘realistic’ if it referred to contexts that related to students’
experiential worlds, and as ‘complex’ if it went beyond the mere application of a
previously learnt formula or technique. The data of this study showed very few of
these characteristics of mathematics classroom culture.

Stephan (1998) cited in Cobb et al (2001:133) presents evidence that indicates that,
even though social norms were renegotiated throughout the experiment, the general
classroom participation structure was relatively stable. The social norms that she
identified for whole-class discussions can be summarized as follows:

1. Learners were obliged to explain and justify their reasoning.
2. Learners had to indicate non-understanding and, if possible, to ask the
   explainer clarifying questions.
3. Learners were expected to indicate when they considered solutions invalid,
   and to explain the reasons for their judgment.

The study by Stephan sheds more light on examples of social norms. Different
classes may have different social norms, considering the differences of the
personalities involved in establishing the norms. The ones presented here serve just
as examples of social norms that can be established in a classroom, bearing in mind
that social norms are not only found in a mathematics classroom.

Bednarz (1998:73) writes about a collaborative research project that focussed on
teachers’ teaching practices. He concludes that the desire to change classroom
culture and contribute to its evolution certainly requires one to reflect on the
meanings that the teacher gives to the situations. He further highlights the possibility
of changing the mathematics classroom culture and warns that it takes some time. I
agree with Bednarz because it may not be easy to ‘disrupt’ a culture that has taken
time to be established in a classroom and in classrooms and systems that have been
inherited. In agreement of Bednarz (1998), Sullivan, Aulert, Lehmann, Hislop,
Shepherd and Stubbs (2013) suggest ways that teachers might influence classroom
culture positively. The findings of their study suggest that it is possible to foster a
classroom culture in which teachers pose tasks that challenge students and
encourage them to persist when working on those tasks. They noted that the key
elements seem to be the ways the tasks are introduced, the interactive support for
students when engaged in the tasks, collaborative reviews of class explorations, and
assessment against criteria. The authors conclude that a positive classroom culture is not a matter of rules and procedures but the ongoing and interactive support teachers provide that encourages learners to take up the challenge of tasks. From this view it is important to highlight the role of a teacher in fostering a culture of learning and interaction in a class.

Wood (1994) describes two patterns of interaction that are distinct from most studies of classroom discourse. These include the ‘funnel’ and the ‘focus’ pattern. Both patterns are aimed at creating learning situations which enable students to construct mathematical meaning for themselves. Details of the patterns are shown in Table 2.1.

Table 2.1: Patterns of interaction

<table>
<thead>
<tr>
<th>The funnel pattern</th>
<th>The focus pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>• This can generally be described as an interaction in which the teacher creates a series of questions that act to continually narrow the students’ possibilities until they arrive at the correct answer.</td>
<td>• The focus pattern can also be described as a situation in which the essential aspects for solving a problem are brought to the fore. Furthermore, this pattern of interaction can be described as one in which the teacher’s inquiries act to indicate to the child the critical features of the problem that are not yet understood.</td>
</tr>
<tr>
<td>• In this situation, the teacher recognizes that the student is unable to respond appropriately with the correct answer, and therefore attempts to offer guiding questions for the purpose of enabling the student to solve a problem.</td>
<td>• Then the teacher leaves to the child the resolution of the problem.</td>
</tr>
<tr>
<td>• The teacher’s guiding questions direct the student to the aspects that are important in order to solve the problem (e.g., using the doubles and incrementing by one) and through a series of narrowing queries the student arrives at the answer.</td>
<td>• The teacher’s role is one of summarizing that part which is commonly thought to be shared and then drawing the students' attention to a critical point not yet understood.</td>
</tr>
<tr>
<td>• This form of exchange always ends with a solution to the problem at hand.</td>
<td>• This is followed by questioning which first focuses the joint attention and then turns the situation back to the student, letting him/her solve the problem.</td>
</tr>
</tbody>
</table>

Voigt (1998), however, argues that patterns of interaction are not rules people have to follow; the patterns are accomplished by the participants, even unconsciously. Therefore, they may change at any moment: “So, what we have here are neither automatic rituals - repeated endlessly and mechanically, nor instantaneous creations, - emerging uniquely upon each occasion of interaction. These negotiated

In their article, Partanen and Kaasila (2014) describe the negotiation and production of some socio-mathematical norms. Thus, the following new socio-mathematical norms had to be negotiated or produced for the investigative approach: 1) when investigating mathematics, one should approach the topic in a creative way, and 2) when investigating mathematics, different approaches in addition to symbolic methods are approved.

In their study, in a bid to improve the mathematics classroom culture, Hospesova and Ticha (2002) argue that the cultivation of teachers’ self-reflection and the systematic use of collective reflection can change the character and promote the quality of personally-oriented education. In their study, they aimed at creating suitable conditions for promoting reflection. The results of investigation conducted suggests that reflection contributes to the answering of some questions concerning the teaching of mathematics and mathematics classroom culture.

Finally, Ogunkunle, Ekwueme, and Charles-Ogan (2013) investigated the influence of mathematics classroom culture/activities and structure on the academic achievement of the learners. The findings of the study revealed that when a mathematics learning culture is promoted among learners, they learn to love learning.

In this section, I have discussed mathematics classroom culture and selected studies on mathematics classroom culture. It is evident from the examples I have discussed that the teacher plays a pivotal role in the creation of a mathematics classroom culture. Teachers’ beliefs are a driver of their pedagogy, specifically in creating a space that is conducive to learning and the strengthening of a classroom culture for the learning of mathematics.

### 2.3 TEACHERS’ BELIEFS AND PRACTICES

Among several issues that affect teachers’ practice in the classroom is their beliefs related to teaching and learning. Barkatsas and Malone (2005:71) argue that
mathematics teachers’ beliefs have an impact on their classroom practice, on the ways they perceive teaching, learning, and assessment, and on the way in which they perceive students' potential, abilities, dispositions, and capabilities.

2.3.1 Teachers’ beliefs about mathematical behaviour

To begin with, Schoenfeld (1994) defines teachers’ mathematics beliefs as an individual’s understanding and feelings that shape the way the individual conceptualizes and engages in mathematics behaviour. This points to the importance of understanding the mathematics beliefs held by the mathematics teachers. Related to what Schoenfeld (1994) argues, Raymond (1997:552) defines mathematics beliefs as personal judgments about mathematics formed from experiences in mathematics, including beliefs about the nature of mathematics, learning mathematics, and teaching mathematics.

According to Kaplan (1991) cited in Raymond (1997:569) teachers hold two kinds of beliefs: deep beliefs and surface beliefs. In contrast to deep beliefs, surface beliefs are not truly part of a person's philosophy of teaching. Rather, they are beliefs that one thinks one should hold – thus espoused beliefs. Surface beliefs are generally associated with "superficial" practices. A case in point is a study by Raymond (1997:574) in which mathematics teachers' beliefs were studied. Results of this study suggest that deeply held, traditional beliefs about the nature of mathematics have the potential to perpetuate mathematics teaching that is more traditional, even when teachers hold non-traditional beliefs about mathematics pedagogy.

Ernest (1989) considers beliefs to account for differences between mathematics teachers. He conceives beliefs as consisting of the teacher's system of beliefs, conceptions, values and ideology, also referred to elsewhere as the teacher's 'dispositions'. He (Ernest, 1989:20) argues that such conceptions have a powerful impact on teaching through such processes as the selection of content and emphasis, styles of teaching, and modes of learning.

2.3.2 Teachers’ beliefs and mathematics classroom culture

Studies have shown that teachers’ beliefs about teaching and learning mathematics are transferred into classroom practices (Ernest 1989; Raymond 1997). In the previous section, mathematics classroom culture according to Cobb and Yackel
(1998) was discussed, referring to three aspects, namely classroom social norms, socio-mathematical norms and classroom mathematical practices. Teachers’ classroom practices will eventually embody mathematics classroom culture and vice versa. This is what Vygotsky (1978) argued for in his theory of the ‘two planes’ of culture in an individual’s learning from the culture and towards personal forms of the culture, while externalising and helping to shape cultural practices. It is humans who change culture and culture that changes humans and their belief systems.

According to Thomas (1996), cited in Staub (2007:319), culture also refers to a broad array of beliefs and activities shared by members of a group. In the case of this study, it would mean the kind of activities carried out in the mathematics classroom shared by teachers and learners.

### 2.3.3 Aspects of teachers’ beliefs

Teachers’ beliefs about mathematics, teaching and learning, according to Speer (2005), are often described as either ‘professed’ or ‘attributed’. Professed beliefs are defined as those stated by teachers, while attributed beliefs are those that researchers infer, based on observational or other data. This study has utilized much on the work of Ernest (1989) and Raymond (1997) in understanding mathematics teachers’ belief about mathematics, mathematics teaching and mathematics learning. As such, the rest of this subsection is mainly based on their work.

**Teachers’ beliefs about mathematics**

Ernest (1989) looks at the concept of the nature of mathematics as teachers’ belief system concerning the nature of mathematics. Teachers' personal conceptions of the nature of mathematics by no means have to be consciously held views; rather, they may be implicitly held philosophies. Out of several possible variations, three philosophies of mathematics are distinguished because of their observed occurrence in the teaching of mathematics. Table 2.2 presents a summary of the philosophies.
Table 2.2: View of the nature of mathematics and their implication on teaching

<table>
<thead>
<tr>
<th>View of mathematics</th>
<th>Implication for teaching</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic, problem driven view of mathematics as a continually expanding field of human enquiry. Mathematics is not a finished product, and its results remain open to revision (the problem solving view)</td>
<td>Can lead to the acceptance of children’s methods and approaches to tasks</td>
</tr>
<tr>
<td>Mathematics as a static but unified body of knowledge, consisting interconnecting structures and truths. Mathematics is a monolith, a static immutable product, which is discovered, not created (the Platonist view).</td>
<td>Can lead to the teacher’s insistence on there being a single ‘correct’ method for solving each problem</td>
</tr>
<tr>
<td>Mathematics is a useful but unrelated collection of facts, rules and skills (the instrumentalist view).</td>
<td>Can lead to teaching in which mathematics and other subject matter areas are interrelated.</td>
</tr>
</tbody>
</table>

Teachers holding the different beliefs represented in Table 2.2 will act distinctly in their approach to the teaching of mathematics

According to Smith (1996) cited in Gill and Boote (2012:31-32), the belief that mathematics is a fixed set of facts and procedures contributes to teachers’ sense of self-efficacy in the following five ways:

1. It restricts the content that teachers must master to a manageable range;
2. It provides a relatively detailed model of what teachers should do in their teaching;
3. It accentuates the sense of knowledge transfer in teaching;
4. It defines what students should do to learn: listen, watch, and practice;
5. It provides a rough outline of a typical day’s instruction and simplifies issues of planning and classroom management.

**Teachers’ beliefs about learning and teaching mathematics**

Ernest (1989) refers to teachers’ beliefs about learning and teaching mathematics as models of teaching and of learning mathematics. Ernest (1989) defines these models as teachers’ beliefs or mental models of the nature of the teaching and of learning mathematics. To Ernest (1989), it seems appropriate to term these beliefs, ‘models’ since they are sets of ideas (which may include memories of past teachers) on which the teacher ‘models’ his or her behaviour, described by Lortie (1975) as ‘apprenticeship of observation’. It would therefore not be strange to have a teacher teach the way her best teacher was teaching. The way the ‘best teacher’ taught tend to get cemented in memory and activated unconsciously while teaching.
Teachers' beliefs about learning mathematics

Ernest (1989) writes that the model of learning mathematics consists of the teacher's view of the process of learning mathematics, what behaviours and mental activities are involved on the part of the learner, and what constitute appropriate and prototypical learning activities. Thus it consist of aims, expectations, conceptions and images of learning activities and of the process of learning mathematics in general. According to Ernest (1989:23), the following are some of the constructs involved: 1) view of learning as the active construction of knowledge as a meaningfully connected whole, versus a view of learning mathematics as the passive reception of knowledge and 2) the development of autonomy and the child's own interests in mathematics versus a view of the learner as submissive and compliant.

Ernest (1989:23) uses these key constructs to describe the following simplified models of learning mathematics:

- A child's exploration and autonomous pursuit of own interest model
- A child's constructed understanding and interest driven model
- A child's constructed understanding driven model
- A child's mastery of skills model
- A child's linear progress through curricular scheme model
- A child's compliant behaviour model

Ernest (1989:23) argues that the teacher's model of learning mathematics influences both the cognitive and affective outcomes of learning experiences. In the long term, these learning experiences can vary in results from a student who is an interested, confident, skilled and autonomous problem solver, at best, to one who is a disenchanted, non-numerate mathephobe, at worst. This points to the importance of rightly construing how learners learn mathematics. This is where understanding how learners develop number concepts is crucial. In this thesis I argue that development models such as the one of Fritz, et al. (2013) can be helpful for teachers.

Teachers' beliefs about teaching mathematics

According to Ernest (1989), a model of teaching includes mental imagery of prototypical classroom teaching and learning activities, as well as the principles underlying teaching orientations. Ernest (1989:22) juxtaposes 1) a narrow,
instrumental and basic skills type view versus a broader, creative and exploratory view of mathematics teaching and 2) a meaning, understanding, and unified body of knowledge view versus a facts and skills mastery view of mathematics teaching, which focuses on performance and correctness of response;

Ernest (1989) exemplifies these in the use of curricular materials as well: 1) an approach in which mathematics is based on strictly following a text or scheme, versus 2) an approach in which the teacher supplements or enriches the textbook with additional problems and tasks

Ernest (1989:22) sketches simplified models of mathematics teaching as follows:

- An investigational, problem-posing and solving-solving model
- A conceptual understanding enriched with problem solving model
- A conceptual understanding model
- A mastery of skills and facts integrated with a conceptual understanding model
- A mastery of skills and facts model
- A day to day survival model

Ernest (1989:22-23) argues that these models are key determinants of how mathematics is taught, given the contextual constraints which must be accommodated in any school situation. If indeed these models are key determinants on how mathematics is taught, then it is crucial that teachers are assisted to adapt mathematics teaching beliefs that will promote enculturation into the mathematics community.

Using ideas from Ernest (1989) discussed earlier and Van Zoest, Jones and Thornton (1994), Beswick (2012:130) links teachers’ beliefs about mathematics, teachers’ beliefs about mathematics teaching and teachers’ beliefs about mathematics learning. Table 2.3 provides the summary.
Table 2.3: Categories of teacher beliefs

<table>
<thead>
<tr>
<th>Beliefs about the nature of mathematics</th>
<th>Beliefs about mathematics teaching</th>
<th>Beliefs about mathematics learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instrumentalist</td>
<td>Content focussed with an emphasis on performance</td>
<td>Skill mastery, passive reception of knowledge</td>
</tr>
<tr>
<td>Platonist</td>
<td>Content focussed with an emphasis on understanding</td>
<td>Active construction of understanding</td>
</tr>
<tr>
<td>Problem solving</td>
<td>Learner focussed</td>
<td>Autonomous exploration of own interests</td>
</tr>
</tbody>
</table>

Beswick (2004) cited in Beswick (2012) is, however, quick to point out that individual teachers are unlikely to have beliefs that fit neatly in a single category and the beliefs related to specific aspects of the particular context in which the teacher is working can also influence which of their other beliefs are most influential in terms of shaping their practice in that context.

2.3.4 The link between teachers’ mathematics beliefs and practices

According to Ernest (1989:27), teachers’ mental or espoused models (beliefs) of teaching and learning mathematics, subject to the constraints and contingencies of the school context, are transformed into classroom practices. Ernest (1989) points out that there are sometimes disparity between teachers’ espoused beliefs and practice. Šapkova (2013) reports such a mismatch in a study where he studied mathematics teachers in Latvia, Taiwan. The results show that the espoused beliefs of Latvian teachers of mathematics on efficient teaching tend more to a constructivist approach, whilst reported practices are more oriented to a traditional approach.

The following are given as the causes of the mismatch according to Ernest (1989:27):

1. The depth of the espoused beliefs: the extent to which they are integrated with other knowledge and beliefs, especially pedagogical knowledge. If the beliefs are represented in a disconnected way, without rich connections to other beliefs and knowledge, only a limited basis for their enactment exists.
2. The teacher's level of consciousness (mindfulness) of her own beliefs, and the extent to which she reflects on her practice of teaching mathematics, leading towards a greater integration of beliefs and practice. Some of the
key elements in the teacher's thinking, as it concerns practice, are the following:

- Awareness of having adopted specific views and assumptions as to the nature of mathematics and its teaching and learning;
- The ability to justify these views and assumptions; and
- Reflexivity: being concerned to reconcile and integrate classroom practices with beliefs; and to reconcile conflicting beliefs themselves.

3. The powerful influence of the social context. This results from the expectations of others, especially teachers and superiors. It also results from the institutionalised curriculum embodied in adopted texts, the system of assessment, and so on.

The sources explained by Ernest (1989) above lead the teacher to internalise a powerful set of constraints affecting the enactment of the models of teaching and learning mathematics. Lerman (1986) cited in Ernest (1989:27) points out that the socialisation effect of the context is so powerful that teachers in the same school, despite having differing beliefs about mathematics and its teaching, are often observed to adopt similar classroom practices.

Regarding possible causes of existing inconsistencies between beliefs and practice, Speer (2005) claims that methods used to examine beliefs and practices, in some cases, may be the source of perceived inconsistencies between professed and attributed beliefs. Speer (2005:386) observes that data collection methods during research can influence relationships found between beliefs and practices – in some cases, potentially leading to findings that are not accurate portrayals of the situations and suggests that researchers need to be careful when making claims about consistencies and inconsistencies between beliefs and practices and need to select methods that ensure that the methods are not biasing the findings in one way or another.

Thompson (1992:138) argues that the inconsistencies reported in studies indicate that teachers' conceptions of teaching and learning mathematics are not related in a simple cause-and-effect way to their instructional practices. Instead, they suggest a complex relationship, with many sources of influence at work; one such source is the
social context in which mathematics teaching takes place, with all the constraints it imposes and the opportunities it offers. Embedded in this context are the values, beliefs, and expectations of students, parents, fellow teachers, and administrators; the adopted curriculum; the assessment practices; and the values and philosophical leanings of the educational system at large. Raymond (1997) therefore presents a model for understanding such a relationship. Figure 2.5 is a presentation of the model.

![Figure 2.5: The model of relationships between mathematics beliefs and practice (Raymond, 1997:571)](image)

Barkatsas and Malone (2005) agree with Raymond (1997, who reported that the findings of their study suggest that the broad social and cultural climate of a classroom may impact on teachers' espoused and enacted beliefs about mathematics, and mathematics learning, teaching and assessment.
2.3.5 Sources of teachers’ beliefs

There are varied sources of teachers’ mathematical beliefs. Nemser (1983) cited in Mapolelo (2003) observed that the impact of the teaching experiences student teachers have in primary and secondary schools shape their views on how one should teach and how children learn. These views then become so strong that a preservice programme has hardly any impact. Even if student teachers encounter constructivist approaches during their teacher training period the integration of theory to practice is poor.

The sources of teachers’ mathematical beliefs presented by Nemser (1983) and Raymond (1997) reminds us the importance of the proper enculturation of students into the mathematics culture. It is therefore important that the process of introducing learners to mathematics be done well otherwise the negative effects of poor enculturation stay with the learners for long. This process will in turn become a vicious circle as mathematics learners of today are mathematics teachers of tomorrow.

2.3.6 Changing teachers’ beliefs

Stipek, Givvin, Salmon and MacGyvers (2001) argue that reflection on classroom experiences has been shown to be effective in changing teachers’ beliefs. A study by Cohen and Ball (1990) cited in Stipek et al., (2001), describe a very traditional teacher who was taught to implement an inquiry-oriented fractions lesson. The teacher did so, precisely as he was instructed. Reflecting on his students’ reactions, the teacher was amazed to find that his fifth graders could think and reason in such advanced ways. The authors speculate that if this teacher continued his efforts to implement inquiry-oriented lessons, while engaging in guided reflection, he might ultimately change his beliefs about mathematics teaching and learning.

I would argue, as well, that if teachers have knowledge about children’s early number concept development, that they may reflect differently on classroom practice.
2.4 NUMBER CONCEPT DEVELOPMENT

To emphasize the importance of number concept development, Sharma (2015:277) writes that ‘it is like acquiring the alphabet of the mathematics language with arithmetic facts as its words’. Developing learned concepts of number, beyond the innate concepts, such as the object tracking system (OTS) and the approximate number system (ANS) at an early age is crucial. If teachers of early grade mathematics understood early number concept development, as described by Dehaene (2011) and Carey (2009) they could apply this knowledge to their pedagogy (Henning, 2013).

2.4.1 Number, ‘numberness’, number concepts and number sense

According to the Cambridge dictionary, number is a sign or symbol representing a unit that forms part of the system of counting and calculating but Dehaene (2011:233) defines number as mental constructions whose roots are to be found in the “adaptation of the human brain to the regularities of the universe”. This implies that human beings are not born with number knowledge beyond the OTS and the ANS. - they have to learn and adapt concepts. Humans have to get to understand the ‘numberness’ of a number. Considering that this study is aimed at a description of the culture of early grade mathematics classrooms (specifically standard 1), it will be necessary to delve deeper into the innate and foundational number sense. According to Andrews and Boistrup (2016), applied number sense refers to those core number-related understandings that permeate all mathematical

2.4.2 Innate or preverbal number sense

According to Andrews and Boistrup (2016) innate number sense comprises an understanding of small quantities that allows for comparison by Dehaene (2011) and other cognitive developmental researchers – referred to as ANS. According to Dehaene (2011), it is now well known that children are born with innate number sense. This innate number sense, according to Bobis (1996) cited in Way (2005) is "a well organised conceptual framework of number information that enables a person to understand numbers and number relationships and to solve mathematical problems that are not bound by traditional algorithms". In short, this “number sense is a special intuition that helps us make sense of numbers and mathematics

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3Refer http://dictionary.cambridge.org/dictionary/english/number
(Dehaene, 2011: xiii). When young learners get to school, school mathematics builds on this existing number sense. According to Dehaene (2011:124), the flame of mathematical intuition is only flickering in the child’s mind; it needs to be fortified and sustained before it can illuminate all arithmetic activities.

Dehaene (2011) warns that while young children’s numerical ability is real, they are strictly limited to elementary arithmetic, their abilities for exact calculation do not seem to go beyond the numbers one, two, three and perhaps four. Adding on this, Feigenson et al., cited in Dehaene (2011:45) note that “never can a group of babies under the age of one distinguish four dots from five or even from six”. According to Dehaene (2011), by fourth year, children have mastered the basics of counting and between the ages 4 and 7, children exhibit an intuitive understanding of what calculations mean and how they should best be selected.

In addition to the ANS, children can recognise small sets of up to three and perhaps four. Figure 2.6 is an illustration of the two systems.

![Figure 2.6: Two systems of representing number of objects without counting (Dehaene 2011:258)](image)

The representations of number in Figure 2.6 are then explained by Henning and Ragpot (2015) as follows: the approximate number system (ANS) allows for the non-exact distinction of quantities and it is the foundation on which symbolic knowledge of number will develop. Naturally, human beings and other animals can differentiate between ‘more’ and ‘fewer’ in a set. While object tracking system (OTS) allows for the recognition of one up to three objects in infants. Infants can represent a fine distinction of small numbers up to three.
The approximation of the ANS is not limited to visual arrays but also extends to sounds. Experiments by Feigenson, Dehaene and Spelke (2004), revealed that the system has some limitations: infant numerical discriminations are imprecise and subject to a ratio, numerical discrimination increases with precision over development and numerical discrimination fails when infants are tested with very small numerosities. Core system 2 according to Feigenson, Dehaene and Spelke (2004), is also in some non-human animals, infants and adults. This system is used to keep track of small individual objects (up to 3 objects) and for representing information about their continuous quantitative properties.

According to Feigenson, Dehaene and Spelke (2004:313), the differences shown during the activation of the two systems suggest that large and small numerosities are the province of different systems with different functions: large arrays primarily activate a system for representing sets and comparing their approximate cardinal values. Small arrays primarily activate a system for representing and tracking numerically distinct individuals, which allows for computations of either their continuous quantitative properties or of the number of individuals in the array.

It is therefore important to understand, based on the foregoing discussion, that learners are not empty slates when they enter the classroom. It is upon the innate number sense, discussed earlier in this section, that the foundational number sense is built.

2.4.3 Foundational number sense beyond innate systems

According to Sayers, Andrews and Boistrup (2016), foundational number sense (FoNS) comprises those number-related understandings that require instruction and which typically occur during the first years of school.

A literature review conducted by Sayers, Andrews and Boistrup (2016:374-377) revealed that there are eight components of foundational number sense. Table 2.4 summarises the components.
### Table 2.4: Components of foundational number sense

<table>
<thead>
<tr>
<th>Component</th>
<th>What learners are supposed to demonstrate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number Recognition</td>
<td>Ability to recognise number symbols and know their associated vocabulary and meaning</td>
</tr>
<tr>
<td>Systematic Counting</td>
<td>Count systematically and understand ordinality, count to 20 and back or count upwards and backwards from an arbitrary starting point knowing that each number occupies a fixed position in the sequence of all numbers</td>
</tr>
<tr>
<td>Awareness of the Relationship Between Number and Quantity</td>
<td>Understanding of the relationship between number and quantity. In particular, they understand not only the one-to-one correspondence between a number’s name and the quantity it represents but also that the last number in a count represents the total number of objects. Understanding that eight represents a quantity that is bigger than six but smaller than ten. Magnitude-aware children have moved beyond counting as ‘a memorized list and a mechanical routine, without attaching any sense of numerical magnitudes to the words’</td>
</tr>
<tr>
<td>Quantity discrimination</td>
<td>Understand magnitude and can compare different magnitudes. They deploy language like ‘bigger than’ or ‘smaller than’. Understanding that eight represents a quantity that is bigger than six but smaller than ten. Magnitude-aware children have moved beyond counting as ‘a memorized list and a mechanical routine, without attaching any sense of numerical magnitudes to the words’</td>
</tr>
<tr>
<td>Different representations of number</td>
<td>Understand that numbers can be represented differently and that these ‘act as different points of reference’</td>
</tr>
<tr>
<td>Estimation</td>
<td>Able to estimate, whether it be the size of a set or an object. Estimation involves moving between representations—sometimes the same, sometimes different—of number, for example, placing a number on an empty number line.</td>
</tr>
<tr>
<td>Simple arithmetical operations</td>
<td>Can perform simple arithmetical operations</td>
</tr>
<tr>
<td>Awareness of number patterns</td>
<td>Understand and recognise number patterns and, in particular, can identify a missing number. Such skills reinforce the skills of counting and facilitate later arithmetical operations.</td>
</tr>
</tbody>
</table>

(Sayers, Andrews & Boistrup 2016:374-377)

Table 2.4 shows what foundational number sense awareness children are supposed to demonstrate. Consideration of these components in this study as the observed lessons will show how learners are assisted to have this number sense developed.
2.5 NUMBER CONCEPT DEVELOPMENT

It is important to understand how numerical development takes place in learners for them to be assisted to learn from a teacher with an informed pedagogy and who understands the hierarchical nature of number concept development (NCD). Peucker and Weißhaupt (2013), and Langhorst, Ehlert and Fritz (2013) agree that the development of numerical knowledge can be described as a hierarchical organization of concepts, procedures and the growing number of relations between them. Peucker and Weißhaupt (2013) therefore discuss seven core concepts about the starting point of numerical development. These include: early sensitivity for numerocities, non-verbal mental modes, subitizing, spontaneous focussing on numerocity, proto-quantitative schemata, cardinality of numbers and the ‘part-part-whole’ concept. Some of these concepts are also explained by Langhorst, Ehlert and Fritz (2013) in the development model for the acquisition of numeracy (described below) hence no separate explanation on the seven core concepts are given in this paragraph.

Langhorst, Ehlert and Fritz (2013), and Fritz, Ehlert, and Balzer (2013) present the developmental model for the acquisition of numeracy consisting of five distinguishable levels of ability. The following are the five levels:

- **Level I: Counting**: At this level, children are able to confidently count. They can distinguish small sets and count and enumerate them.

- **Level II: Mental number line**: Based on representations of a mental number line, children develop an understanding of sequence of number. They are able to name the predecessor and the successor of a given number on some kind of mental number line and solve small addition tasks by counting or using the number word sequence

- **Level III Cardinality and decomposability**: The number word line is understood as a sequence of increasing cardinality. Numbers are composite units that represent the specific cardinality of a quantity with the number of its elements. Understanding the connection of number and set in a cardinal number concept, a child is no longer forced to ‘count all’ but ‘counts on’. Another indication of progress is the fact that children can now understand that a number can be divided into parts
• **Level IV Class inclusion and embeddedness:** Children grasp the inclusion principle that each number contains the quantity of the precursory numbers (Piaget & Szeminska 1965 cited in Langhorst, Ehlert, & Fritz 2013). Understanding numbers as compositions or decompositions of other numbers provides a flexible competence that allows for forms of mathematical problem-solving, that are not available to younger children. This is modeled by the part-part-whole schema. At this level, addition and subtraction can be considered as composed of sub-sets and a whole set.

• **Level V Relationality:** Children develop the understanding that the distance between two consecutive numbers is the same: numbers in the number word line increase steadily by 1. Understanding of congruent intervals between the numbers on the number line (relational numbers). Teachers do therefore have a task of understanding this hierarchical nature of numerical development. Jumping to another level without learners having mastered the previous level may have negative effect on the development of the subsequent mathematical concepts. It is however possible to have learners who are at a higher level than others in the same class because of differences in the levels of cognitive development.

Fritz, Ehlert, and Balzer (2013) explain that, with the concept of relationality comes the understanding that the distance between numbers on the number line sequence remains the same. Thus, it is possible to bundle numbers of the same quantity (e.g. 3 x 4). These bundles themselves become countable units in higher order, specifically the tens bundle.

But how are the described concepts acquired by human beings? Carey (2004) answers this question by putting forward three ways. The ways have been summarized in Figure 2.7.
The innate representations are said to be the ones that provide the building blocks for the coming/new concept. One then has to describe the difference between the target concept and the innate representations. Finally, the characterization of the learning mechanism enables one to construct new concepts out of the prior representations.

Carey (2004) then describes the bootstrapping process before explaining how it can be applied to the learning of number words as placeholders for understanding. She explains that,

“Bootstrapping processes make essential use of the human capacity for creating and using external symbols such as words and icons. Bootstrapping capitalizes on our ability to learn sets of symbols and the relations among them directly, independently of any meaning assigned to them in terms of antecedently interpreted mental representations. These external symbols then serve as placeholders, to be filled in with richer and richer meanings. The processes that fill the placeholders create mappings between previously separate systems of representation, drawing on the human capacity for analogical reasoning and inductive inference. The power of the resulting system of concepts derives from the combination and integration of previously distinct representational systems” (Carey 2004:66)

Based on this description of ‘bootstrapping’, Carey (2004) then explains that the child be equipped with the capacity to represent serial order (ordinality in the model of
Fritz et al., 2013). This done, Carey (2004:67) argues that the stage is now set for a series of mappings between representations.

According to Beck (2017), “Carey’s account of bootstrapping explained above has however been heavily criticized; while it purports to explain how important new concepts are learned, many commentators (see Fodor 1975, 1980, 2008, Fodor 2010 and Rey 2014 cited in Beck 2017) complain that it is unclear just what bootstrapping is supposed to be or how it is supposed to work. Others allege that bootstrapping falls prey to the circularity challenge: it cannot explain how new concepts are learned without presupposing that learners already have those very concepts”. Beck (2017) has however explored two interpretations of Carey’s account that promise to answer this challenge in partial defence of the bootstrapping process (see Beck 2017). De Villiers (2015) and Bezuidenhout (2018) explain that bootstrapping is better understood as a component of conceptual change theory.

2.6 EARLY GRADE MATHEMATICS TEACHING

Dehaene (2011) argues that the way learners are taught mathematics, if not handled well, may lead to learners’ struggling in mathematics, not because they have any biological impairment, but likely because they are not taught conceptually. Views about how early grade mathematics is ideally taught may differ, depending on whether the research that is referred to is from the field of pedagogy, developmental cognitive science with mathematical cognition, and neuroscience.

2.6.1 Early grade mathematics teaching in general

On teaching number, Dehaene (2011) puts forward the following in the teaching of number sense;

- Schooling plays a critical role because it helps children draw links between the mechanics of calculation and its meaning
- A good teacher is an ‘alchemist’ who gives a fundamentally modular human trait the semblance of an interactive network.
- We need to ground mathematics knowledge on concrete situations rather than on abstract concepts
On the use of concrete situations, Dehaene (2011:128) notes that “most children are only too pleased to learn mathematics if only one shows them the playful aspects before the abstract symbolism – playing snakes and ladders may be all children need to get a head start in mathematics”.

To realise a suitable mathematical education for children, Langhorst et al. (2013) have generated criteria for pre-school mathematics education. They argue that there has to be a focus on development-oriented and systematic conceptualisation. Early mathematics education should be seen as developmentally oriented and systematically constructed. The aim should be to let children acquire the key concepts gradually\(^4\). They also point out that activities should be integrated in games and daily routines, considering that children interact with their environment through playing and learning processes, the realisation of mathematical education should be oriented towards the child’s environment (Fthenakis et al. 2009 cited in Langhorst et al. 2013). All these efforts are aimed at making learners understand the concepts they are learning.

The key to understanding is the ability to retrieve the information that was stored by the individual. Franke and Grouws (1997) note that an individual who is unable to gain access to a piece of information cannot use it. That’s why they argue that a successful search of one’s mental connections depends on three factors; the types of information that have been connected, how they have been connected (what information is connected to what other information) and the strength of the connections (how clearly the ideas are linked or thought of together). As such, an understanding of mathematics, is based on the number, types, and organisation of connections. The understanding occurs as representations get connected into increasingly structured and cohesive networks (Franke & Grouws 1997). According to Hiebert and Carpenter (1992) cited in Franke and Grouws (1997), the connections that create networks form several kinds of relationships including similarities, differences, and inclusion and subsumption. Franke and Grouws (1997) sum it up by saying that an individual who understands is seen as having multiple connections to a variety of different pieces of information, an intricate web. Often these connections are strong from continued use and the connections must be developed in a way that

\(^4\) See section 2.5 for the hierarchical order of the concepts the learners are expected to acquire in the early years of their learning the number concept.
creates ways of efficiently searching ones mental space. The foregoing discussion on understanding has an implication on repetition as it will allow learners to repeatedly use what they have learnt and eventually master the concepts. The teacher will then ensure that repetition is done in his/her teaching and learning of the concepts. Further, the teacher need to package the lessons in such a way that connections will easily be facilitated.

The teacher has a crucial role in ensuring that learning takes place in the classroom. The teacher as the ‘knowledgeable other’, according to Vygotsky (1978), has to take learners from the ‘zone of actual development’ to the ‘zone of proximal development.’ It is important that the teacher be equipped with the necessary knowledge, content and skills to properly guide learners. This means also that the teacher has to have an understanding of how early number concepts develop so she can adapt her teaching to the developmental phase of children's NCD. The importance of good teacher’s pedagogical content knowledge in eliciting good grounding of mathematical concepts in learners is illustrated by Luneta (2016). Figure 2.8 shows the two ways mathematical concepts can be communicated to the learners by the teacher and learner’s cognitive structure/modules response to the received instructional stimuli.
Luneta (2016:293-294) provides an explanation as follows:

“If the teacher’s content knowledge and instructional skills are effective and provides the appropriate definition and illustrations contextualised to the learners’ ecological experiences and attuned to the learner’s cognitive level, the learner’s concept image is consolidated into conceptual knowledge (solid cognitive structure or ‘core’ cognition, according to (Wellman & Liu, 2007). However, if the teacher’s knowledge base is weak, it results in instructions that further weakens the learners’ concept image (unstable cognitive structures) that might lead to misconceptions and errors (Luneta 2014). Misconceptions and the resulting errors are as a result of weak cognitive structures that the learner forms due to epistemological exposures that are misaligned to the concept definition or correct cognitive module.”

2.6.2 Introducing foundational numeracy

Teaching number recognition

Sharma (2013) writes that numbers are to mathematics what letters of the alphabet are to language. There is some resemblance – metaphorically speaking, but in truly
comparing literacy attainment as similar to achieving numeracy is, to my mind a bit far-fetched. When teaching the alphabetical competence, one assumes that children are already phonemically aware. Yet, what Sharma describes as early numeracy competence is acceptable. Sharma therefore postulates that when teaching numeracy the teacher should ensure that a learner has the ability to integrate the following six key aspects of learning early numeracy:

- Making lexical entries for number (a rich store of number names—can recite number names in order—and knows the difference between number words and non-number words);
- Count meaningfully (one-to-one correspondence + sequencing = conservation of number);
- Recognize and assign a number orally to an observed collection of objects without counting (subitize);
- Represent a collection – a visual cluster of objects up to ten in its written form
- Assign a graphical representation when the name of number is heard (hears s-e-v-e-n and writes 7);
- Decompose and re-compose a collection (cluster into sub-clusters, i.e., large number, up to 10 as a sum of two smaller numbers and vice-versa).

If this can be achieved, the learner is established as an early number ‘knower’.

**Teaching systematic counting**

Cordes and Gelman (2005) define a meaningful verbal counting procedure as one that is consistent with the counting principles of: one-to-one correspondence (each item gets one and only one unique count tag), stable ordering (the count words are consistently used in a stable order), cardinality (the last word in the count represents the cardinality of the set), order irrelevance (the items may be counted in any order), and item-kind irrelevance (there are no restrictions on what counts as a countable entity). Teachers should therefore ensure that learners are assisted to count following the principles so that they are able to count meaningfully.
Clements and Sarama (2009) argue that the capstone of early numerical knowledge is connecting the counting of objects in a collection to the number of objects in that collection. Initially, children may not know how many objects there are in a collection after counting them. If asked how many are there, they typically count again, as if the “how many?” question is a directive to count rather than a request for how many items are in the collection. Children must be assisted to establish that the last number word they say when counting refers to how many items have been counted. This skill is evidence of understanding cardinality.

**Quantity discrimination**

According to Sayers, Andrews and Boistrup (2016), quantity discrimination refers to an awareness of magnitude and of comparisons between different magnitudes. It is therefore important that learners be assisted to use language like ‘bigger than’ or ‘smaller than’ appropriately.

**Teaching different representations of number**

In teaching different representations of number, learners should be assisted to appreciate that there are different representations of numbers. According to Sayers, Andrews and Boistrup (2016), such representations can include a number line; different partitions of a number; the use of fingers and various manipulatives.

Ehlert & Fritz (2013) as well as Radebe (2018) and Ndabezitha (2018) suggest specific programmes for teachers, such as the ‘Meerkat Maths’, in which principles and concepts of number knowledge are emphasised more that facts and procedures.

**Teaching estimation**

Siegler, Fuchs, Jordan, Gersten and Ochsendorf (2015) found that estimation ability predicts future success in learning fractions above and beyond other measures of mathematics proficiency and general cognitive abilities. Clements and Sarama (2009) explain that an estimation is not merely a “guess”—it is at least a mathematically *educated* guess. Estimation is a process of solving a problem that calls for a rough or tentative evaluation of a quantity.
Clements and Sarama (2009) note that there are many types of estimation and present the following common types of estimation; measurement, numerosity estimates and, computational and number line estimation. Clements and Sarama (2009) explain that numerosity estimation often involves procedures similar to measurement and computational estimation procedures. Examples of these are, to estimate the number of people in a theatre; a person might take a sample area, count the people in it, and multiply by an estimate of the number of such areas in the theatre. Early numerosity estimation may involve similar procedures (e.g., try to “picture 10” in a jar then count by tens), or even a straightforward single estimate based on benchmarks (10 “looks like this”; 50 “looks like that”) or merely intuition. On a similar note, Clements and Sarama (2009) explain that number line estimation includes the ability to place numbers on a number line of arbitrary length, given that the ends are labeled (say, 0 to 100).

**Simple arithmetical operations**

Sharma (2013) writes that addition, as combining numbers, is facilitated through strategies of decomposition and re-composition of numbers – much like the fourth level of the Fritz et al. (2013) model would refer to this as the part-part-whole principle. For example, to add 8 and 4 it is much easier to take two from 4 and give it to 8 so that the number combination can easily be seen as: \(8 + 4 = 8 + 2 + 2 = 8 + 2 + 2 = 10 + 2\) equals 12. Decomposition (the breaking of 4 as 2 + 2 and thinking of 10 as 8 + 2) and re-composition (thinking of 10 + 2 as 12) are key strategies for learning addition and subtraction facts. Sharma (2013) points out that the emphasis should be on learning strategies rather than one-to-one counting and games can facilitate the acquisition of learning strategies. Supporting Sharma’s (2013) idea is Zhou (2005) who argues that an understanding that the whole is the greater than its parts and that the parts are less than the whole facilitates children’s comprehension of the meaning of addition and subtraction. Fritz et al. (2013) therefore, argue that to enhance children’s thinking processes, teachers should expose children to the interrelationship between part and whole, and make explicit that mathematical knowledge is internally related and organized. This is emphasised by Henning, Balzer, Ragpot, Herholdt, Elert and Fritz (2018) in the manual for the MARKO-D South Africa interview test, which assesses early NCD and which is based on the Fritz et al. model of NCD.
Zhou (2005) explains how addition and subtraction of numbers with sums or minuends up to 9 are taught in China (see Zhou 2005:265-266). In this example of addition tasks, the emphasis is on the part-part-whole relationships, using concrete manipulatives. The manipulatives are there to assist learners to move from concrete observation to abstraction, in other words mental activity and representation.

The Early Childhood Mathematics Committee in the US (2009) agrees with Sharma (2013) and Zhou (2005) and emphasises that learners should be taken through from simple material (concrete) modelling to advanced levels of applying the facts they have learned in carrying out simple mathematical operations. The Committee on Early Childhood Mathematics (2009:152-153) describes the following three levels in children’s numerical solution methods;

**Level 1:** Direct modeling of all quantities in a situation; used at the first three number/operation levels:

- Counting all: Count out things or fingers for one addend, count out things or fingers for the other addend, and then count all of the things or fingers.
- Take away: Count out things or fingers for the total, take away the known addend number of things or fingers, and then count the things or fingers that are left.

**Level 2:** Counting on: This can be done in first grade (some children can do so earlier): They use embedded number understanding to see the first addend within the total and so see that they do not need to count all of the total, but instead could make a cardinal-to-count shift and count on from the first addend.

- Count on to find the total: On fingers or with objects or with conceptual subitizing, children keep track of how many words to count on so that they stop when they have counted on the second addend number of words and the last word they say is the total: 6 + 3 = ? would be “six, seven, eight, nine, so the total is nine. I counted on 3 more from 6 to make 9.” After learning counting on from the first addend, children learn to count on from the larger addend.

- Count on to find the unknown addend: Children stop counting when they say the total, and the fingers (or other keeping track method) tell the answer (the unknown addend number of words they counted on past the first addend). 6
Level 3: Derived fact methods in which known facts are used to find related facts (mastery by some/many at first grade). For example:

1. Doubles ± 1 is a strategy that uses a related double to find the total of two addends in which one addend is one more or less than the other addend
   \[ (6 + 7 = 6 + 6 + 1 = 12 + 1 = 13) \].

2. Make-a-ten methods are general methods for adding or subtracting to find a teen total by changing a problem into an easier problem involving 10. Children first make a 10 from the first addend and then learn to make a 10 from the larger addend. The following are some examples;
   a. Make a ten to find a total: \[ 8 + 6 \] becomes \[ 10 + 4 \] by separating the 6 into the amount that makes 10 with the 8. Then solving \[ 6 = 2 + ? \] gives the leftover 4 within the 6 to become the ones number in the teen total:
   \[ 8 + 6 = 8 + 2 + 4 = 10 + 4 = 14 \].
   b. Make a ten to find an unknown addend: \[ 14 - 8 = ? \] is \[ 8 + ? = 14 \], so \[ 8 + 2 \] is 10 plus the 4 in 14 makes 14. So \[ 8 + 6 = 14 \]. In this method subtraction requires adding, which is easier than making a ten to find a total. The first step can also be thought of as subtracting the 8 from 10.

Having observed that the development of part-part-whole number sense (thus number concept development [NCD]) of primary school learners as one of their main concerns, Sinnakaudan, Kuldas, Hashim and Ghazali (2016) suggested activities for teaching part-part-whole relationships of numbers to develop numeracy of learners in the first grade. The first activity is about building, modelling and designing numbers. The second activity is a game, finding the missing part. The third activity suggests finding the missing part in storybooks for learners. The fourth activity is also the missing part but in a five-frame or ten-frame (See Sinnakaudan, et al. 2016 for detailed explanation of the activities).

**Number patterns**

In early grade mathematics, number patterns according to Sayers, Andrews and Boistrup (2016) includes the awareness of number patterns and, in particular, being
able to identify a missing number. This therefore means that learners should be afforded opportunities for activities about identifying missing numbers.

### 2.6.3 Teaching how to write numerals

The United States Committee on Early Childhood Mathematics (2009) views learning to write number symbols (numerals in Arabic notation) and number words as a much more difficult task than as reading them, because it requires children to have an accurate mental image of the symbol, which entails left-right orientation, and a motor plan to translate the mental image into the correct sequence of motor actions to form a numeral. The Committee on Early Childhood Mathematics (2009) notes that some numerals are much easier to write than others, the loops in 6 and 9, the curve and straight line in the 2, and the crossovers in the 8 are difficult but can be mastered by children with effort. The easier numerals 1, 3, 4, 5, and 7 can often be mastered earlier. Whenever children do learn to write numerals, learning to write correct and readable numerals is not enough. They must become fluent at writing numerals (i.e., writing numerals must become overlearned) so that writing them as part of a more complex task is not so slow or effortful as to be discouraging when solving several problems. The Committee on Early Childhood Mathematics (2009) also notes that it is common for children at this stage and even later to reverse some numerals (such as 3) because the left-right orientation is difficult for them. Teachers should therefore provide a lot of opportunities and support for the learners to write the numerals. With practise, learners should be able to write the numbers with ease.

### 2.6.4 Remediation and enrichment in early grade mathematics teaching

Langhorst et al. (2013) raise the issue of early intervention for weaker children, there has to be consideration for specific compensatory early intervention. Hellmich (2007) cited in Langhorst et al. (2013) is however quick to point out that fulfilling these requirements concerning suitable mathematical diagnostics and support imposes high demands on the professional knowledge of the teacher and requires appropriate teacher preparation. Teachers also need to have learning support materials that speak to the needs of the children. Chinn (2015) compiled a volume with authors who are leaders in the field of maths learning difficulties. The volume contains chapters by specialists, such as Desoete (2015) and Ansari and Bugden (2015). At the far end of mathematics learning problems is dyscalculia, which affects a small part of the population (5 – 7% in the UK) (Butterworth, 2005).
For effective early intervention, there has to be semiotic mediation within the zone of proximal development (ZPD). In the study of the literature I have extrapolated some components of original Vygotskian theory, one of which I discuss in this section. According to Daniels (2001), the term ‘activity theory’ more immediately captures the notion of tool-mediated, object-oriented activity as the basis for the development of human understanding; it is the cornerstone of Vygotsky’s work. Nardi (1996), cited in Jonassen and Rohrer-Murphy (1999:66) argues that activity cannot be understood without understanding the role of artifacts in everyday existence, especially the way in which artifacts are integrated into social practice. This is why Bartolini Bussi, and Mariotti (2008:754) concluded that an artifact may function as a semiotic mediator. Hardman (2008:68) agrees with them by saying that an individual or group, uses mediational means to act on the object of the activity ‘but’ a central premise of mediation is that a child can accomplish more with assistance than he/she can on his/her own. This is what Vygotsky referred to as mediation within the *zone of proximal development* (ZPD).

Vygotsky (1978) proposes the term, ‘zone of proximal development’ (ZPD) for the (cognitive) distance between the actual developmental level as determined by independent problem solving, and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers (Vygotsky 1978:86). Vygotsky (1978: 86-87) explains that the ZPD refers to “those functions that have not yet matured but are in the process of maturation, functions that will mature in future, but are currently in an embryonic state. These functions could be termed the "buds" or "flowers" of development rather than the "fruits" of development. The actual developmental level characterizes mental development retrospectively, while the ZPD characterizes mental development prospectively”. Henning (2008:18) adds, ‘the potentiality of learning which this definition refers to how much further a learner can go with *the help of a more experienced/learned person* than such a learner would have moved on her/his own.
2.7 CHANGES IN THE EARLY GRADE MATHEMATICS CURRICULUM IN MALAWI SINCE INDEPENDENCE

The early grade mathematics curriculum in Malawi, as has been the case with the whole primary school curriculum in Malawi, has changed three times since independence. In Section 2.2.1, it was noted that, according to Thomas (1996), cited in Staub (2007), culture refers to a broad array of beliefs and activities shared by members of a group. In the case of the current study, it would mean the broad array of beliefs and activities shared by teachers and learners in the mathematics classroom. Ernest (1989) however noted that the institutionalised curriculum embodied in adopted texts, the system of assessment, and so on is one of the sources of mismatch between teachers’ mathematical beliefs and practice (see Section 2.3.4). This section therefore aims at highlighting what constitutes the early grade mathematics curriculum in the three curricula. Focus will be placed on the content about numeracy for the first year of schooling. This will be traced from the early postcolonial period to the current national primary curriculum (NPC).

2.7.1 The 1982 early grade mathematics curriculum

To put the early grade mathematics in context, the entire 1982 primary school curriculum will be discussed. The discussion of the 1982 early grade mathematics curriculum will follow.

Malawi became independent in 1964 after having been under the British colonial government from 1891. Malawi, therefore, inherited the curriculum from the colonial government. According to Chirwa and Naidoo (2014), it became clear that the curricula inherited from the colonial government did not address the needs and the challenges of the independent Malawi. In 1973 the first educational plan (1973-1985) was launched. This plan, according to Kabwira (1995), cited in Chirwa and Naidoo (2014), was to provide guidelines for the development of the education curriculum of the independent Malawi. Following the launching of this first Educational Plan in 1973, a primary curriculum review was then carried out in 1982, with the overall aim of improving the quality of education. In this reviewed curriculum, Agriculture became a common subject to be learnt in both primary and secondary school because the country needed its citizens to have agricultural knowledge as its economy was agriculture-based. The number of subjects on offer in both the primary and secondary school also increased compared to those in the colonial government’s
curricula. The revised curriculum had the following 14 subjects; Agriculture, Chichewa, English, Creative Arts, Social Studies, Arithmetic, Music, Physical Education, Religious Studies, Bible-Knowledge, Needlecraft, Home Economics, Science/Health Education and Life skills.

**An examination of the 1982 early grade mathematics syllabus**

An examination of the 1982 early grade mathematics revealed a lot of important issues worth noting. Firstly, the naming of the subject. It is noted that the name of the subject was Arithmetic (see the extract below. The subject had four aims as presented in the extract from the syllabus in Figure 2.9.

![Aims of the eight year primary school course in Arithmetic](source: MoEC 1982:24)

Looking at the first aim in the extract in Figure 2.9, it is clear that number knowledge acquisition by learners was emphasised.

Secondly, the emphasis was on speed and accuracy. The introduction of the syllabus as seen in the extract in Figure 2.10 shows that teachers were reminded to place emphasis on speed and accuracy in computational skills. This being the case, mental arithmetic was at the order of the day as learners were learning arithmetic. My sense about this is that learning and remembering facts is not a bad thing, as it save space on the child’s working memory.
Figure 2.10: Introduction of the arithmetic syllabus (source: MoEC 1982:24)

In a bid to increase learners’ speed in working on arithmetic operations, teachers were further encouraged to introduce learners to ‘short methods’ of arriving at correct answers. Further, teachers were supposed to give learners adequate practice.

The curriculum was covering the following areas in the early grades; counting, addition and subtraction, tables (multiplication tables), multiplication and division, and money. It should however be noted that division was introduced in standard 2. This whole content was taught in vernacular except for counting where the syllabus stipulated that it should be done in English (using Arabic numerals I suppose). The areas of interest covered in standard 1 can be seen in Figure 2.11.
### Figure 2.11: The standard 1 Arithmetic syllabus (source: MoEC 1982:25)

Lastly, from Figure 2.11 it is notable that children were not given the opportunity to learn the part-part-whole concept in the development of numeracy as the syllabus categorically ‘denied’ teachers the opportunity of developing a number as a separate unit. It is doubtful if learners who went through this curriculum really understood the concept of number, since according to Sinnakaudan, Kuldas, Hashim and Ghazali (2016), the earlier learners understand the part-part-whole relationship, the stronger they may develop number sense and thus the better can be their performance.
2.7.2 The 1991 early grade mathematics curriculum

In this section, I will start by discussing how the 1991 curriculum came to being and the contents of the curriculum. The discussion on the 1991 early grade mathematics curriculum will follow.

There was general dissatisfaction with the curriculum and this led to its review five years after its implementation. Specifically, according to Khomani (2003), the following were the factors that necessitated the review of the 1982 curriculum from 1987; the curriculum was overloaded with subjects of study, there were excessive overlaps in the nature of content across subjects without any deliberate effort to integrate such content and the curriculum was examination-oriented with the greatest stress on cognitive skills rather than on social or practical skills. According to Chirwa and Naidoo (2014), the focus of the resultant curriculum was literacy and numeracy skills and had the following subjects; Agriculture, Chichewa, English, Creative Arts, Social Studies, Mathematics, Music, Physical Education, Religious Studies, Bible-Knowledge, Needlecraft, Home Economics, Science/Health Education and Life skills.

Turning to the 1991 standard 1 curriculum, it is notable that the naming of the subject changed from Arithmetic to Mathematics. The Malawi Institute of Education (MIE) (1991a) argued that it was called Arithmetic because it was one of the 3 R’s i.e. reading, writing and arithmetic. The change of name according to MIE (1991a) came because the new role of mathematics was to develop mathematical abilities applicable in solving everyday problems. The subject had the following six thematic areas; Number and numeration, money, geometric shapes, measurement, rate, ratio and proportion, and graphs. The thematic areas run through all the 8 classes of the primary school. Table 2.5 shows the topics covered in standard 1 in five thematic areas. No content on rate, ratio and proportion was covered in standard 1.
Table 2.5: Topics covered in the 1991 standard 1 mathematics syllabus

<table>
<thead>
<tr>
<th>Thematic area</th>
<th>Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number and numeration</td>
<td>• Sorting, classifying, matching, comparing and ordering objects</td>
</tr>
<tr>
<td></td>
<td>• Counting numbers from 1 to 20</td>
</tr>
<tr>
<td></td>
<td>• Recognising numbers from 1 – 20</td>
</tr>
<tr>
<td></td>
<td>• Writing numbers from 1 to 10</td>
</tr>
<tr>
<td></td>
<td>• Ordering numbers from 0 to 20</td>
</tr>
<tr>
<td></td>
<td>• Adding numbers with sum not exceeding 20</td>
</tr>
<tr>
<td></td>
<td>• Subtracting numbers within the range 0 to 20</td>
</tr>
<tr>
<td>Money</td>
<td>• Recognising 1t, 2t, 5t, 10t and 20t coins</td>
</tr>
<tr>
<td></td>
<td>• Knowing the value of 1t, 2t, 5t, 10t and 20t coins</td>
</tr>
<tr>
<td></td>
<td>• Writing 1t to 20t</td>
</tr>
<tr>
<td></td>
<td>• Adding money with sum not exceeding 20t</td>
</tr>
<tr>
<td></td>
<td>• Subtracting money within the range 1t to 20t</td>
</tr>
<tr>
<td>Geometric shapes</td>
<td>• Recognising everyday shapes (Three dimensional)</td>
</tr>
<tr>
<td></td>
<td>• Sorting out objects</td>
</tr>
<tr>
<td></td>
<td>• Classifying objects</td>
</tr>
<tr>
<td></td>
<td>• Matching objects</td>
</tr>
<tr>
<td>Measurement</td>
<td><strong>Linear measurement</strong></td>
</tr>
<tr>
<td></td>
<td>• Comparing objects according to length and height</td>
</tr>
<tr>
<td></td>
<td>• Sorting out objects according to length and height</td>
</tr>
<tr>
<td></td>
<td>• Describing objects using words like short, shorter, long and longer</td>
</tr>
<tr>
<td></td>
<td><strong>Area</strong></td>
</tr>
<tr>
<td></td>
<td>• Comparing flat surfaces of various objects</td>
</tr>
<tr>
<td></td>
<td>• Describing these flat surfaces using words like smaller and longer</td>
</tr>
<tr>
<td></td>
<td><strong>Capacity</strong></td>
</tr>
<tr>
<td></td>
<td>• Comparing capacities of different containers</td>
</tr>
<tr>
<td></td>
<td>• Describing the containers in terms of which one holds more or less</td>
</tr>
<tr>
<td></td>
<td><strong>Time</strong></td>
</tr>
<tr>
<td></td>
<td>• Relating events to the specific times of the day</td>
</tr>
<tr>
<td>Graphs</td>
<td>• Making physical block graphs</td>
</tr>
</tbody>
</table>

A comparison of this curriculum and the previous one, reveals that something was gained while something was also lost. The work that was lost include introducing learners to number from 21 to 50 (in this curriculum, learners are introduced to numbers from 0 to 20 only), multiplication table of 2, and counting backwards.

The following was, arguably, gained; all content within the following broad areas- geometric shapes, graphs, measurement. This indicates that standard 1 learners had more work to do in the 1991 curriculum than in the 1982 curriculum. This in a way may have been because of the change in the way the subject was looked at. From being called Arithmetic to being called mathematics. MIE attests to the growing
need for mathematics to be applied to solve daily life problems. According to MIE (1991a),

But mathematics forms part and parcel of today’s everyday life. The pupils are faced with problems needing practical mathematical solutions in most of their daily engagements: at the market, grocery shop, in the home when accounting for several domestic undertakings; at the hospital when following medical prescriptions and in many other situation. Because of all these, the recent role of mathematics has hence been to develop skill applicable in solving of such everyday problem” (MIE 1991a:1)

With more work to be done by the learners it was hoped to match with the need for mathematics to assist in solving problems needing mathematics in the society.

According to MIE (1991b: ix), the medium of instruction was vernacular except for counting which was to be done in English. This was also the case with the 1982 early grade mathematics curriculum. MIE (1991b) reveals that problem solving and guided discovery approaches were to be used in the teaching and learning process.

2.7.3 The current (2001) early grade mathematics curriculum

Before discussing the current early grade mathematics curriculum, it will first be situated within the curriculum with the broader national primary curriculum. The discussion on the current early grade primary curriculum will follow.

The current national primary curriculum

The implementation of the current national primary curriculum (NPC) in Malawi started in 2007 with standard 1. (Malawi Institute of Education 2008:6). The curriculum was implemented in the rest of the classes as follows; Standards 2, 5 and 6 in 2008; Standards 3 and 7 in 2009 and standards 4 and 8 in the 2009/2010 academic year (Maganga, Mwale, Mapondera & Saka 2010:1). By 2017, the curriculum had been in use for about 10 years. According to Ministry of Education (2004:14), the NPC is outcomes-based and as such it is focussed on learner achievement. In order for the learners to achieve the outcomes, they must be introduced to new knowledge in the context of their existing knowledge so that they can develop new understandings as learning takes place.
The national primary curriculum has four levels of outcomes: The development outcomes (what the learner is expected to achieve by the end of the primary cycle both in or outside school), primary outcomes (what the learners should know, should be able to do and the desirable attitudes that they should display by the end of the primary cycle for each learning area or subject), assessment standards (indicated the agreed level of achievement during and at the end of each year) and success criteria (learners level of attainment in a given activity). The collective achievement of lower outcomes lead to the achievement of higher outcomes for example, achieving a given set of success criteria leads to the achievement of an assessment standard.

According to MOE (2004:24-25), the curriculum has the following subjects: Chichewa, English, Mathematics (it is referred to Numeracy and mathematics in standards 1 – 4), life skills, social and environmental sciences, expressive arts, agriculture, science and technology, bible knowledge and religious education. Schools do however choose to either teach bible knowledge or religious education. This happens in consultation with the community surrounding the school. For each subject, there are three types of instructional materials; the syllabus, the teachers’ guide and the learners’ book.

Further, Standard 1 learners are exposed to introduction to school life and learning during the first seven weeks of the beginning of each academic year. The aim of this according to MIE (2006) is to support children’s socialization into formal schooling, it introduces learners to school life, the school environment and learning situation so as to promote a smooth transition from home to school. This is against the background that most learners in Malawi do not have access to preschool education. According to the MoEST (2008:5), there were 6,277 Early Childhood Development (ECD) centres as pre-schools and only 30 percent of targeted pre-school children attended ECD centres. The majority of these centres were concentrated in urban and semi-urban areas. The orientation to school life and learning programme consists of 18 units and is based on the following core elements: orientation, promotion of sensory-motor development, and games, plays, songs and dances. Out of the 18 units, four units are on pre-number activities. These include: Copying and tracing objects, shapes, lines and patterns; talking about similarities and differences

5 ‘Standard’ is the term used for ‘grade’
of objects; comparing volumes and sizes of objects; describing surfaces and weights of objects.

**The early grade numeracy and mathematics curriculum in Malawi**

According MOE (2004:18) the numeracy and mathematics curriculum aims at developing learners’ critical awareness of how mathematical relationships are used in social, cultural and economic context. At an early stage, the curriculum is aimed at enabling learners to count and carry out basic mathematical operations. The numeracy and mathematics curriculum has 6 core elements or broad areas. These include: Numbers, operations and relationships; patterns, functions and algebra; space and shape; measurement; data handling, and accounting and business studies. These broad areas cover the whole primary curriculum, what differs is the depth of coverage. Table 2.6 shows the coverage of numeracy and mathematics in standard 1.

**Table 2.6: Topics covered in standard 1 (Source: MIE, 2006)**

<table>
<thead>
<tr>
<th>Core element</th>
<th>Topics</th>
</tr>
</thead>
</table>
| 1. Numbers, operations and relationships | • Counting up to 9  
• Addition of numbers with sums not exceeding 9  
• Subtraction of numbers within the range of 0 to 9 |
| 2. Patterns, functions and algebra | • Patterns |
| 3. Space and shape | • Shapes |
| 4. Measurement | • Time  
• Height and length  
• Capacity |
| 5. Data handling | • Graphs |
| 6. Accounting and business studies | • Money |

It takes the whole of first term and a good part of second term for learners to go through the first core element in Table 2.6 because of the amount of work that is supposed to be covered in this core element. It can be noted that unlike in the 1991 mathematics curriculum, learners are exposed to numbers from 0 to 9 in standard 1. Like in the 1991, ‘times table’ is not part of the current standard 1 curriculum.
The curriculum is taught in local languages was the case with the other two curricula discussed above. The reason for this is because, according to Ministry of Education (2004), “a common local language shall be used as the medium of instruction in standard 1”. Much as local language is supposed to be used, the number words are introduced orally in a local language but very fast linked to the Arabic numerals such that counting is done using Arabic numerals. Table 2.7 shows the local names for numerals from 1 to 9.

**Table 2.7: Chichewa names for Arabic numerals from 1 to 9**

<table>
<thead>
<tr>
<th>Numeral in Arabic notation</th>
<th>Chichewa number word</th>
<th>Corresponding English number word</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Chimodzi</td>
<td>One</td>
</tr>
<tr>
<td>2</td>
<td>Ziwiri</td>
<td>Two</td>
</tr>
<tr>
<td>3</td>
<td>Zitatu</td>
<td>Three</td>
</tr>
<tr>
<td>4</td>
<td>Zinayi</td>
<td>Four</td>
</tr>
<tr>
<td>5</td>
<td>Zisanu</td>
<td>Five</td>
</tr>
<tr>
<td>6</td>
<td>Zisanu ndi chimodzi</td>
<td>Six</td>
</tr>
<tr>
<td>7</td>
<td>Zisanu ndi ziwiri</td>
<td>Seven</td>
</tr>
<tr>
<td>8</td>
<td>Zisanu ndi zitatu</td>
<td>Eight</td>
</tr>
<tr>
<td>9</td>
<td>Zisanu ndi zinayi</td>
<td>Nine</td>
</tr>
</tbody>
</table>

It should, however, be noted that there are many languages and dialects in Malawi. The one used in Table 2.7 is considered to be understood by many people in the country.

Going through how the numbers are introduced in the teachers’ guide reveals that the use of a local name for the numerals ceases at the number 5. No local numeral name is mentioned after having introduced the learners to the number 5 instead, the English number name is used. The number name is however used orally, learners do not write it down. Reading through the preamble of the teachers’ guide for Standard 1 reveals that three major methods are supposed to be used in teaching learners; group work, demonstrations, and games and simulations (see MIE, 2006:ix for details).
2.7.4 Policies affecting the teaching and learning of the current early grade mathematics in Malawi

There are a number of policies that affect the teaching of Numeracy and mathematics in Malawi. The following two policies will be discussed in this section; the curriculum and the language of instruction.

As pointed out in the last section, the teacher is provided with a syllabus, teachers’ guide and a learners’ book. These documents spell out what is supposed to be taught, how the content is supposed to be taught and suggest teaching – learning resources to be used. According to MOE (2004:10), it is assumed that the “teacher shall be knowledgeable, creative, competent facilitator and motivator of the learning process, a role model who promotes good health habits, morally sound, a skills trainer and active classroom researcher who guides all learners to achieve their maximum potential”. This assumption puts a high expectation on the teacher. Having such a teacher however is a desirable thing. Whether the teachers who are handling learners in Malawi suit this description is a question that needs empirical studies.

The debate about the language of instruction to be used has been for a long time in Malawi. According to MOE (2004:11), “a common local language shall be used as medium of instruction…in standard 1”. Indeed, this is what has been happening in the classrooms. The learners’ book is however written in Chichewa while the teachers’ guide is written in English. There has however recently been a policy shift where according to the Education act 2012 article 78, “the medium of instruction in schools and colleges shall be English”. The act however gives powers to the Minister to prescribe the language of instruction in schools. The policy has however not yet been effected in primary schools. The use of either local language or Chichewa has resulted into denying learners from standards 1 to 4 from writing numerals in words. Learners start writing numerals in words when they get to standard 5.

This section has traced the changes in the early grade mathematics curriculum since Malawi became independent. It has been evident that the curriculum has changed three times. The history has assisted in bringing light on why some things are happening the way they are currently in the current early grade mathematics curriculum. Some of the policies affecting the implementation of early grade primary curriculum have also been discussed. The next section will be an investigation into
the development of teacher education in Malawi with the hope to understand how primary mathematics teachers have been prepared over the years.

2.8 HISTORY OF PRIMARY TEACHER EDUCATION IN MALAWI SINCE INDEPENDENCE

In Malawi, preparation of teachers is one of the functions of the MoEST. Primary school teachers are prepared at teacher training colleges while secondary school teachers are prepared at Universities. There are currently 16 teacher training colleges (TTCs) in Malawi, 8 of them are public. Both public and private TTCs use the same primary teacher education curriculum. Other private teacher training colleges, however, introduce other components in the training programme in addition to the official primary teacher education curriculum. Malawi has gone through six modes of training primary school teachers since 1964. Mwanza (2014) reports of the following five modes: two-year programme; a one year teacher training programme, Malawi special teacher education programme (MASTEP), Malawi Integrated In-Service Teacher Education Programme (MIITEP) and the current 1+1 or Initial primary teacher education (IPTE) programme. The sixth model is the open and distance learning which was running concurrently with the IPTE. A description of each of these modes of training will follow.

2.8.1 Two-year teacher training

The two-year teacher training programme, according to Mwanza (2014) and MoEST (2008) was a residential programme resulting into two qualifications; T2 and T3. The junior certificate of education holders graduated with a teacher grade 3 (T3) teaching certificate while Malawi school certificate of education holders graduated with a teacher grade 2 (T2) teaching certificate. Teachers were prepared to teach all the subjects at all levels of the primary education cycle (Standards 1 to 8).

According to MIE (1990), at the end of the second year, students were writing two papers. The first one was on methodology and the second was an academic paper. T2 and T3 wrote the same paper on methods while the academic paper was different. Student teachers were also assessed on block teaching practice. To be awarded the teaching certificate, a student was expected to pass the written papers and in the block teaching practice.
Turning specifically to the preparation of teachers to teach mathematics, according to MIE (1990), generally, the primary teacher mathematics education during the two year programme would enable student teachers to;

- Acquire deeper understanding of mathematical concepts taught in primary schools
- Learn techniques of teaching primary mathematics
- Reinforce and maintain a positive attitude towards mathematics
- Develop critical and logical thinking and apply it in problem-solving
- Relate mathematical concepts in other subjects and in everyday lives
- Develop a desire for continued professional and academic growth in mathematics
- Develop skills which will facilitate permanent numeracy in pupils
- Develop the skill of sequencing mathematical concepts (topics) in a logical order
- Develop skills in using the local environment in teaching mathematics (MIE 1990:1)

It is evident that the course was aimed at preparing the teacher as a professional who was supposed to have a positive attitude towards mathematics, advance in mathematics and equipped with skills to make learners have lasting numeracy skills. Student teachers were exposed to primary school mathematics to acquire a deeper understanding of mathematical concepts taught in primary schools. Further, selected content from secondary education curriculum was also covered with the idea of reinforcing their mathematical ability.

2.8.2 One-year teacher training programme

Kunje, Lewin and Stuart (2003) report that a ‘crash’ one-year in-service initial course was instituted in one college in 1987 to train unqualified but experienced teachers. The one year training programme, according to Mwanza (2014), run from 1987 to 1997. According to MoEST (2008), this programme was a residential programme leading to the award of the same certificates as in the two –year face to face training mode described in 2.8.1. Candidates with junior certificate of education (JCE = two years of secondary education) and those with Malawi school certificate of Education (MSCE = four years of secondary education) were both admitted to the one year
course. They undertook the same course and received the same certificate, but were graded differently as teachers. Those with JCE were graded T3 and those with MSCE were graded T2 on successful completion of the course.

2.8.3 Malawi special teacher education programme (MASTEP)

When it was noted that the 1 year programme described in 2.8.2 was not meeting the demand for teachers, MASTEP was set up in 1989 to train teachers on-the-job through a combination of short residential courses, local seminars, and distance learning methods (Kunje, Lewin & Stuart 2003). According to the Malawi, MoEST (2008), MASTEP was an initiative which offered three year course, integrating residential and distance modes of delivery, aimed at upgrading the large number of untrained teachers serving in the Malawi education system. Further, according to Ministry of Education and culture (MoEC) (nd), MASTEP was designed to help meet a shortfall of primary school teachers in order to improve the quality of education by reducing the teacher – learner ratio. This programme was aimed at producing 4,500 teachers appropriately qualified primary school teachers within three years. This programme, according to Mwanza (2014), ran concurrently with the two year programme described above. The programme emphasized the development of pedagogical skills as they related to problems of the classroom and the use of the environment to supply resources for teaching and learning.

In Malawi, primary school teachers do not specialize in any teaching subject. As such, all student teachers are exposed to the entire content offered by the mode of training. In this mode of training, there were many modules that the teachers went through. The modules on mathematics introduced the student teachers to primary mathematics and were there to equip them on how to teach primary mathematics. This therefore means that the primary teacher education curriculum had to be aligned with the existing primary school curriculum. The introduction in module 12 had the following words;

“In this Module, you will learn how you can teach operations with fractions. These include addition, subtraction and mixed signs with vulgar fractions, and multiplication and division and decimals. After studying the units, you will be in a position to teach operations with fractions at various levels of the primary
school. However, remember to select the appropriate activity for a particular level" (MoEC n.d.: 2).

The introduction presented above demonstrates the emphasis the modules placed on preparing student teachers to teach content at all levels of the 8 class primary education cycle. Much as the primary education cycle is divided into three; infant (standard 1 to 2), junior (standards 3 to 4) and senior (standards 5 to 8), all student teachers are prepared in such a way that they can teach mathematics in all the eight classes.

2.8.4 Malawi integrated in-service teacher education programme (MIITEP)

Malawi integrated in-service teacher education programme (MIITEP) was a successor to the three modes of training described above. The training programme was aimed at addressing the explosion in demand for primary teachers due to the rise in enrolments as a result of the declaration of free primary education in 1994. The MoEST recruited over 22,000 untrained teachers to cope with the increased demand for teachers. Chiziwa (2013) observed that the normal mode of training teachers could not cope with this number. An alternative mode of training the teachers was required. MIITEP was therefore conceived to respond to this situation. It was in 1995 when the Malawi government with the support from World Bank and Gesellschaft fur Technishe Zusammenarbeit (GTZ now GIZ), established the new teachers training programme.

According to Kunje, Lewin and Stuart (2003), MIITEP comprised a total of four months college-based training and 20 months supervised teaching in schools. According to Mwanza (2014), this programme was to run from 1997-2003. It was however phased out in 2005 (MoEST 2008).

According to Kunje, Lewin and Stuart (2003), in MIITEP, student teachers followed a conventional college-based programme in the first phase complete with a minimal teaching practice. Then they returned to schools where they were teaching and while there, they followed a self-study programme based on tasks set by the Malawi national examination board (MANEB). The curriculum used by the student teachers both in the colleges and during the school-based training was based on the student teacher handbooks developed by MIITEP. In schools, the student teachers were
supposed to receive advice and guidance from qualified teachers, and college tutors were supposed to occasionally visit them. The student teachers also had to attend zonal workshops and complete a series of assignments and projects which were sent to the colleges for assessment. The last period in college was a residential block, leading to a final examination.

Kunje, Lewin and Stuart (2003) pointed out that MIITEP materials made it clear that the ambition was to produce teachers who would be more effective in the classroom and adopt new methods of teaching. The intention was that more emphasis would be given to pedagogic strategies that put the child at the centre of learning activities, reduced the amount of recall-based learning in favour of that which focused on higher cognitive levels, and enhanced the achievement of basic skills related to literacy and numeracy.

Further, Kunje, Lewin and Stuart (2003) report that the content of MIITEP training was presented in five student handbooks based on the subjects taught in the primary schools plus Foundation studies. The Foundation studies course covered rather briefly general pedagogic knowledge and skills, knowledge of learners, of educational contexts and educational aims and values, in that order of priority as measured by unit time.

A study of mathematics units of the student handbooks by MIITEP reveals that the objectives are largely concerned with student teachers being able to teach specific curriculum topics and skills (curriculum and pedagogical content knowledge). As such, student teachers were assisted on how they could teach primary mathematics topics in all the 8 classes of the primary education. Kunje, Lewin and Stuart (2003) agree with this observation and report that almost all the mathematics units concentrate on pedagogical content knowledge, here set out as how to teach the primary mathematics. The one exception is a unit on the history of numbers. There are no units on lesson planning or scheming. The zonal seminars are devoted to teaching and learning aids which can be bought or made. Most of the school-based units are expansions of selected topics already covered, but some new concepts are introduced, using formal language; there seems to be much emphasis on definitions and terminology that the teacher should know, and less on how to make things simple for learners. There is nothing on the theory of mathematics education. Kunje,
Lewin and Stuart (2003) continue to report that almost all the unit objectives in the college period are phrased in terms of what the student teacher will know and be able to teach e.g. define subtraction, teach subtraction of numbers with regrouping, define cash account; teach how to enter transactions and balance the account, define and classify geometric shapes; teach modelling, naming and drawing geometric shapes. In the self-study units, the objectives are phrased as: ‘should be able to teach …’

2.8.5 Open and Distance learning (ODL)

The Open and distance learning (ODL) mode of training primary school teachers was birthed as one of the strategies for reducing teacher shortage in primary schools. According to MoEST (2008), one of the strategies of reducing teacher shortage in schools is to “introduce a distance learning mode of IPTE targeted at areas where teacher recruitment and deployment is problematic” (MoEST 2008: 12). However, according to MoEST (2014), this programme was to be phased out in 2015/2016 academic year following the MoEST’s investment in college based teacher training.

According to Webb, Togher, Jere and Jackson (2015), the ODL training mode was a two-and-a-half year programme with the college-based phase limited to a three week induction in a TTC and some ‘in-between-term’ training during vacations. The target of an additional 16,000 ODL trained teachers within three years was reached. The recruitment to the ODL training programme was consequently put on hold in 2015 after having five cohorts (ODL 1 to ODL 5).

2.8.6 Initial primary teacher education (IPTE) or one plus one programme

The one plus one model of training primary school teachers was adopted after the phasing out of the MIITEP in 2005 (MoEST 2008). Unlike in other training programmes discussed above, this programme only admitted students with MSCE with passes in mathematics and two science subjects in addition to English. Webb, Togher, Jere and Jackson (2015) report that IPTE is a two-year pre-service teacher education programme. Year 1 comprises a residential college-based year in a TTC; in year 2, students are placed full-time in nearby primary schools. Anecdotally, the model has become known as the ‘one-plus-one’, one college-based year followed by a school-based placement on successfully passing the end of year examination. In
the first year, ten subjects are taught in each of the three terms and each subject has a syllabus, sets of students’ books and related lecturers’ guides. The following are the ten learning areas (subjects):

1. Foundation Studies
2. English
3. Numeracy and Mathematics:
4. Chichewa
5. Expressive Arts
6. Science and Technology
7. Social and Environmental Studies
8. Life Skills
9. Agriculture
10. Religious Studies

It should however be noted that all these learning areas are basically the ones that are covered in the primary schools except for foundation studies. The focus in year 1 firmly is on theoretical aspects of pedagogy. All students undertake one practical teaching experience at the nearby demonstration school. Indeed in Numeracy and mathematics for example, Webb, Togher, Jere and Jackson (2015) argue that the numeracy course content links well with national primary curriculum and the course is weighted heavily towards the theory of teaching basic mathematical knowledge. Hence the course covers all the necessary content for teaching mathematics in standards 1 to 8 and in some cases tries to give the student teachers a little more depth of the mathematics content.

Webb, Togher, Jere and Jackson (2015) report that on successful completion of year 1, student teacher are paired and placed in groups of 6-10 in teaching practice primary schools. The teaching practice schools are selected in accordance with specific criteria, including the proximity to the TTC and a teacher development centre (TDC), the presence of competent senior school staff and access to suitable accommodation. The expectation is that, with the support of TTC tutors and mentor teachers based at the school, students will continue to develop professionally. It is evident that the school-based year provides student teachers with extensive pedagogical experience.
The materials student teachers use during the school based experience include: ways of teaching handbook, mentors’ guide for term 1, mentors’ guide for term 2, mentors’ guide for term 3, students’ experience journal for term 1, students’ experience journal for term 2 and students’ experience journal for term 3.

Following the changes taking place in the national primary curriculum especially in literacy and languages, an independent review of the IPTE curriculum was undertaken in 2015 on behalf of the Malawi Institute of Education (see Webb, Togher, Jere and Jackson 2015). The study was financed by *Deutsche Gesellschaft für Internationale Zusammenarbeit* (GIZ). The study revealed a lot of weaknesses in the current IPTE curriculum and recommended that a comprehensive reform of the curriculum be undertaken as soon as is feasible because it now appears outdated and does not serve teachers well. The IPTE curriculum is therefore going through a review process since 2015 and implementation of the revised IPTE curriculum is expected to be done in September, 2017.

2.8.7 Current trends in primary teacher education

While preparation of educators for primary teacher education was the preserve of TTCs, current trends reveal that Universities have started offering Bachelor’s degree in primary education. Graduates from these programmes are the ones that are recruited to prepare primary school teachers. Further, the same programmes have assisted in the upgrading of tutors in the TTCs as most of them had Diploma in Education. A case in point is the capacity building programme in primary teacher education at both Bachelors and Masters offered at the University of Malawi, Chancellor College through the Faculty of Education in partnership with the University of Strathclyde in Scotland, UK\(^6\).

2.9 CONCLUSION

This study aims at providing a detailed description of the culture of selected early grade mathematics classrooms in Malawi. This chapter discussed aspects of what such a cultural description could comprise. Through the study of some of the relevant literature I came to the conclusion that a teacher’s beliefs play a crucial role in the establishment of a mathematics classroom culture. I also conclude, from the

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\(^6\) From University of Malawi, Chancellor College website- http://www.chanco.unima.mw/faculty/education
content of this chapter, that there is a hierarchy of management and leadership phenomena, such as curricula, teacher education and national policies that could, arguably, impact the establishment of a solid classroom culture. More than anything, though, the teacher remains the ‘embodied mathematics practitioner’, who co-develops the norms and activities in the way of living of the group of ‘apprenticed’ learners, their materials, their tasks, their rituals and their everyday ‘way of life” (Wolcott 1994) in the apprenticeship of the first year of school.
CHAPTER 3:
RESEARCH DESIGN

3.1 INTRODUCTION
The chapter presents the plan for the study, as well as the reasoning for the way data was collected and analysed. Cheek (2008:761) says that when one converts a research idea into a plan that can then be carried out in practice, one is engaging with a design and asks questions about what could work best to respond to a research question. According to Cheek (2008:761), the process of developing a research design combines three broadly connected and interdependent components: the theoretical, methodological, and ethical considerations relevant to the specific project. This chapter will describe how I planned the project of finding out what the mathematics classroom culture of first grade (Standard 1) classrooms in five Malawian primary schools comprises.

3.2 RESEARCH DESIGN
At the outset of the study, I realised that if I wanted to respond to the research question, I would have to adopt a design that would provide data from everyday classroom life. I also needed to consider the motivation of the study, which was to explore in as much depth as I could, what the source of weak mathematics performance in Malawian schools could be. I knew that I would not be able to generalise findings form a small sample, but at least I would represent real, daily experiences and signs of classroom culture by conducting a study that is informed by principles of ethnography. This would mean that I would be an observer and an investigator of classroom life. This is very different to calculating scores form national or regional test score analysis that place the country’s children, for instance, at the bottom of the SACMEQ ‘listing’.

I thus designed, originally, a case study, with the ‘bounded system’ (Stake 2005; Yin 2013) being ‘standard 1 mathematics classroom culture in schools in and around Zomba City’. The case study was informed by an ethnographic stance, with the
researcher as insider participant, eliciting the emic views of the participants in the various schools (Henning et al. 2004, Chapter 3). As both teacher and education official and community member of the geographical area, I had access to the schools as a local who was looking into the ‘depth’ of classrooms as education cultural sites. I specifically wished to see what classroom culture does to instantiate what research shows about mathematical cognition – thus delving, via the literature, into child development and inserting the context of both urban and rural Malawi. This is, as yet, an unexplored theme. I would approach the theme much like an anthropologist of old, when unknown cultures were explored. Although I cannot describe myself as an experienced education ethnographer such as Harry Wolcott, or Shirley Brice Heath (in Henning 1992), I was familiar enough with the setting and at the same time also sufficiently unfamiliar (Henning 2000). The data would be entirely qualitative, as I was not counting or measuring in any way, except to use numbers as qualifiers.

According to Hammersley (2013:12), qualitative research is a form of social inquiry that tends to adopt flexible and data-driven strategies in the narrower research design, to use relatively unstructured data (although there may be a theoretical lens such as CHAT and literature such as mathematics cognitive development and norms for mathematics classroom culture), to emphasize the essential role of subjectivity (of the participants) in the research process, to study a small number of naturally occurring cases in detail, and to use verbal rather than statistical forms of analysis. Further, according to Ritchie and Lewis (2003), qualitative research is described as a naturalistic (materialistic), interpretative approach concerned with understanding the meanings which people attach to phenomena (actions, decisions, beliefs, values etc.) within their social worlds. I therefore chose to conduct a case study that is informed by ethnographic methods, because I was studying learners and teachers within a specific context, observing them in their natural environment to gain rich, in-depth, detailed understanding of their experiences which was very useful in interpreting the culture of the mathematics classrooms. In the process of observing the learners, I inevitably observed the teachers’ interaction with them.

Case studies are also good if one is interested in providing a ‘thick description’ (Ryle, in Geertz 1973) because according to Rossman and Rallis (2012:130), the strength of case studies is their detail, their complexity, and their use of multiple sources to obtain multiple perspectives. The result is the ‘thickness of description’ that allows
the reader to interpret and decide the applicability of case learnings to another setting.

The ‘thick description’ (Fetterman 2010:125) of (in this instance) the early grade mathematics classrooms culture thus constituted the product of the current inquiry. What happened in the classroom was described and systematically analysed, with interpretation following. Bearing in mind that ethnographically informed research aims at describing and interpreting cultural behaviour, the culture of a mathematics learning environment in a set of schools was the backdrop, or indeed also the full stage of the field study as it unfolded over a year. Thus, if this study describes mathematics classroom life in some primary schools in Malawi, it also interprets such lives according to the understanding and the insight of the author (Henning 1992) as participant observer.

3.3 POPULATION AND SAMPLING
The population from which the sample was drawn comprises learners from primary schools in and around Zomba City. In this study, learners from standard 1, mathematics teachers for standard 1 and head teachers (principals) from five primary schools in Zomba City constituted the sample. Zomba City was purposefully sampled. Educationally, Zomba City is divided into two districts – Zomba urban and Zomba rural. There are 18 primary schools in Zomba Urban and 193 primary schools in Zomba rural. One primary school from Zomba Urban and four primary schools from Zomba rural were purposefully sampled. Purposeful sampling means that the criterion for sampling is the purpose for which the sample is required. Considering that this study is an in-depth look at daily life, I had to focus on schools that were typical for their context (Merriam 2009).

3.4 DATA COLLECTION INSTRUMENTS, SOURCES AND PROCEDURE
The data was mainly collected using lesson observations. Learners in standard 1 classes from the five primary schools in Zomba were observed as they were learning numeracy.
Further, a video camera was used to record all the lessons which I observed. The utterances in the videos were consequently transcribed. This was done to make sure that a close to accurate flow of the lessons was recorded, since the human instrument (the researcher) may leave out some very important elements of the lesson if only taking some fieldnotes.

The main data collection instrument in this study was the researcher - myself. Since observation constituted the major form of data collection, I made fieldnotes to accompany the recordings. Madden (2010:75) points out that an ethnographer is a form of recording device that must always be ‘on’. My role in this study changed. This is so because I am a researcher at a Malawi national curriculum development centre and I frequently visit the schools to monitor curriculum implementation and carry out different studies. I did not enter the schools as an officer from a national curriculum development centre. I entered as a student. This was reflected in the way I presented myself in the schools through the way I negotiated entry to the schools, talked to the participants and the way I dressed. This assisted in making sure that I did not look like an official. Further, a semi-structured interview schedule was in some cases used to interview teachers after the lessons. The semi-structured interview schedule allowed for probing the teachers’ responses as the interview was going on.

The other data collection instrument that was used in the study was a focus group discussion guide (see appendix 5). The guide was to elicit the mathematics culture from the learners’ perspective. The items in the guide were developed in such a way that learners’ voices about mathematics learning would be captured. Before using the focus group guide, the instrument was subjected to validation by ‘critical friends’. Revision of the instrument was made based on the comments that were made.

Furthermore a questionnaire on teachers’ mathematical beliefs (see appendix 6) was used in the study. Section A was crafted so that teachers’ biographic data was collected, section B was aimed at collecting teachers’ beliefs about mathematics, section C, to collect teachers’ beliefs about learning mathematics while section D was aimed at collecting teachers’ beliefs about teaching mathematics. For sections B to D, statements used in a study by Raymond (1997) to represent the teachers’ beliefs were adopted. The statements were put in a table form and provided for
columns for teachers to either strongly disagree, disagree, agree or strongly agree. The questionnaire was then validated by ‘critical friends’ before using them in schools.

The data were collected in three phases over an academic year. Data collection visits were done every term⁷. The number of days spent in the field and at each school is shown in Table 3.1.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Specific activities</th>
<th>Duration of the field work</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Phase 1</strong></td>
<td>1. Setting the scene</td>
<td>5 days (1 day per school)</td>
</tr>
<tr>
<td></td>
<td>2. General observation</td>
<td></td>
</tr>
<tr>
<td><strong>Phase 2</strong></td>
<td>1. Lesson observation</td>
<td>10 days (2 days per school)</td>
</tr>
<tr>
<td></td>
<td>2. General observation</td>
<td></td>
</tr>
<tr>
<td><strong>Phase 3</strong></td>
<td>1. Lesson observation</td>
<td>20 days (4 days per school)</td>
</tr>
<tr>
<td></td>
<td>2. Focus group discussion</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Teacher questionnaire administration</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. General observation</td>
<td></td>
</tr>
</tbody>
</table>

Table 3.1 shows the three phases in which data was collected, the actual activities that took place during each of the three phases and the duration of the phase. At each of the five primary schools, head teachers, standard 1 teachers and standard 1 learners were asked to participate in the study. Head teachers provided data through unstructured in-depth interview aimed at getting the general picture about the school. Standard 1 learners were observed as they were engaging in mathematics⁸. Careful attention was given to what they were doing and speaking during the lessons. Pictures (still) were captured to aid description of the activities. In addition to being observed as they were learning, 6 learners (3 male and 3 female) were asked to participate in a focus group discussion (see appendix 5 for the instrument that was used). The six learners from each of the four schools where focus group discussion were held were purposefully selected. Two learners were below average, two were

⁷In Malawi, there are three terms in an academic year. The first term starts in September and ends in December, the second from January to March and the last term starts in April and ends in July.

⁸ The subject that anchors number concept in standards 1 to 4 in called Numeracy and mathematics but from Standards 5 to 8, it is Mathematics.
average while the remaining two learners were above average. Teacher’s knowledge about the learners was instrumental in the selection.

The teachers were observed as they were teaching. A post-observation interview was, in some cases, conducted with the teachers to clear up some issues that were not clear during the lesson or to find out why the teacher did what she did during the presentation of the lesson. Teachers participating in the study were also asked to complete a questionnaire. The questionnaire was aimed at finding out their beliefs about the nature of mathematics, the nature of mathematics teaching and the nature of mathematics learning (see appendix 6). Three out of the five teachers that participated in the study completed the questionnaire. One teacher returned uncompleted questionnaire and expressed unwillingness to complete it despite her not expressing it when I was giving it to her. The other teacher that failed to complete the questionnaire was not available at a time she was required to complete the data collection tool. She was out of school on official duties for the whole week. This is the same teacher whose two lessons were not observed (note that I was supposed to observe 30 lessons but I ended up observing 28).

Several artefacts (items visually displayed at the school) were collected from the five schools to provide a better understanding of the schools. Examples of artefacts that were collected (or their copies or pictures) include: the school timetable, trophies, classroom rules, work by either teachers or learners pasted on the classroom walls, and displays in the head teachers’ office.

Since short forms (some sentences were not written in full during the observations) were used in collecting notes from the field, the notes were translated so that they were in the form they could easily be understood. This was done the same day because according to Fetterman (2010), the notes should then be translated immediately after either the interview or the observation while the memory is fresh. This ensured that as much information as possible was remembered from the notes.

Analytical memos were also written on a daily basis. According to Mills and Morton (2013:121 - 122), an analytical memo is a short note or piece of writing that seeks to précis and distil one’s emerging thinking and findings about a situation, event, person, or concept. In this case it was on what were observed during the school visits and included ‘scenes’ that were particularly striking and noteworthy. When
writing these memos, “some would rather keep these reflections and developments integrated within one’s fieldnotes, but others prefer to separate out memo’s and label them accordingly” (Mills & Morton 2013:122). In this study, the memos were separate and well filed both electronically and using hard copies.

Of particular importance in any inquiry is the security of the data that is collected. One’s efforts can be useless if the collected information either gets destroyed, lost or stolen. To avoid this phenomenon, every bit of record was digitised and stored securely using multiple sources including Google drive, a cloud-based storage system that helps to keep files secure and one can access the data anywhere as long as there is internet.

3.5 ANALYSIS OF DATA
Creswell (2014:245) argues that data analysis in qualitative research proceeds hand-in-hand with other parts of developing the qualitative study, namely, the data collection and the write-up of findings. While interviews are going on, for example, researchers may be analysing an interview collected earlier, writing memos that may ultimately be included as a narrative in the final report, and organizing the structure of the final report. In this study, data analysis was therefore an ongoing activity during the data collection period. Final formal analysis was however done after the data collection. Qualitative content analysis: a tool for reduced, condensed and grouped content (Henning, van Rensburg & Smit 2004:104) was used in the analysis of the qualitative data that were collected. Before the start of formal analysis, all the videos and interviews that were captured were transcribed and put in electronic form. This assisted in making sure that I easily worked through the data (Madden 2010). According to Mills and Morton (2013:116), the first stage in ethnographic data analysis is always immersion: spending time with one’s research materials through reading and re-reading transcripts, diaries, fieldnotes and artefacts. The importance of this immersion according to Henning, van Rensburg and Smit (2004:104) is that it allows the researcher to get a global impression of the content. I therefore immersed myself in the data that I collected by reading and re-reading to make sure that I was familiar with the whole set of data. I eventually proceeded according to (Madden 2010:150) as follows:
- Coding (detailed coding process is explained towards the end of this section) in order to index the data and show the relationships (or lack of relationship) between various emerging ideas of possible importance in the data
- Arranging the codes in a relational order or hierarchy that shifts from generic to the more specific as the ethnographer works through the analysis
- Accumulating and analysing secondary data in the form of pre-fieldwork background reading and theorising, and the post-fieldwork synthesis of primary and secondary forms of data.

I did not use the terminology as suggested by Creswell (2014), but rather as suggested by Strauss and Corbin (1998).

Creswell (2014:247) has summarised the process above using Figure 3.1 below:

Figure 3.1: An overview of the data analysis according to Creswell (2014:247)
Figure 3.1 shows a summary of Creswell’s analysis model. The coding process described by Henning, van Rensburg and Smit (2004:104) sheds more light on coding and was used during the coding of the data for this study. The process is illustrated in Figure 3.2.

Figure 3.2 provides a step by step process of how I set about coding the text. The generation of codes for the categories that were arrived at was informed by a theoretical framework. More specifically, the work by Engeström (2001), Hardman (2008), Mwanza (2001), and Hardman (2010) based on the CHAT theory, was very crucial in the analysis of the data. The work by the four authors further guided the creation of a code manual or coding scheme (Crabtree & Miller 1999). After the analysis, which is also part of the research report (see chapter 4), interpretation followed (see chapter 5).

3.6 DATA VALIDATION
Creswell (2014:247) argues for validation of the accuracy of the data after analysis. This is in a bid to ensure the trustworthiness of the study and to show that the study is reliable, with a clear ‘chain of evidence’. As such, when the data was put together,
member checking was carried out with head teachers and standard 1 teachers. The form it took was to read the relevant section of the data to the teachers and head teachers. The serious observations made by the participants were incorporated. Data validation was done from 23rd to 28th June 2017.

3.7 THE RESEARCH CONTEXT/SETTING

This study as was carried in five primary school in Zomba City. It is important that the context in which the culture of the early grade mathematics classroom is being lived is understood. A visit was made to all the five primary schools before the classroom observations started. This was done in July 2016, towards the end of the academic year as the schools were about to break for the long holiday. Permission was sought from the District Education managers responsible for the five primary schools. This section provides details about the five primary schools. It should be noted that pseudonyms have been used for all the five schools for ethical reasons. The names used are Phiri, Nyanja, Kamtsinje, Msika and Mchenga.

3.7.1 Brief history of the schools

The location and a brief history of the five primary schools will be given in this section. To begin with, Phiri Primary School is a government co-education full primary school. The school was established about 50 years ago. The school is surrounded by more than twenty villages. The community in the surrounding villages mainly rely on agriculture for their living. Most of them are vegetable growers and they sell their vegetables during market days at the market close to the school. Some members are also tobacco growers. They sell their tobacco to a company called Japan Tobacco Industry (JTI).

The second school is Nyanja Primary school. Nyanja Primary School is right within Zomba city. It was established more than 90 years ago. The school is surrounded by people with mixed social economic status. Some earn more than the average income in Zomba City and they therefore have a relatively higher socio economic status while others are servants (gardeners and housekeepers) of these people. Those with relatively higher socio economic status are either running businesses or have salaried jobs. Many students who attend this school come from parents with

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9 In Malawi, the academic year stretches from September to July the other year. First term runs from September to around mid-December; second term from early January to March or early April while the third term runs from April to July.
low socio economic status, mostly gardeners and house keepers. Most people with relatively higher socio economic status send their children to private primary schools in the city. The school belongs to a church but receives minimal support from it. All the teachers at the school are employed by the government. The head teacher, though employed by the government, is always supposed to be a member of the church that owns the school to ensure that values of the church are upheld. Much as the school belongs to a church, both members and non-members of the church are allowed to enroll at the school.

The third primary school, Kamtsinje Primary School. This is a government co-education primary school. The school is relatively new as it was established less than 20 years ago. Most of the members of the community surrounding the school have houses erected from corrugated iron sheets. Most of them are secondary school dropouts and rely on small scale farming and business.

Msika full primary school is a government co-education primary school. It was established more than 50 years ago. The community surrounding the school are mostly Yao speaking people. They like doing business and some are either maize or groundnut farmers. Most members of the community have little interest in the school. The community is full of social activities negatively affecting the performance of the learners coming from very close to the school. The school is very close to a market. Absenteeism is high during market days since the children either participate in selling items at the market or they are assigned other duties at home while their parents get to the market to sell different items. The school is surrounded by less than 20 villages.

Lastly, Mchenga Primary School is co-run by a religious agency and the government. The school is a co-education full primary school. The school was established about 60 years ago. The school is surrounded by more than 20 villages. Most members of the community are Yao speakers. Members of the community in the surrounding villages mainly rely on agriculture for their living. Most of them cultivate maize and vegetables through irrigation farming and they sell green maize. Most of them are primary school drop outs.
3.7.2 School infrastructure

Phiri primary school has twenty classrooms. All learners at the school learn while in the classrooms, courtesy of JTI which recently built 6 classrooms for the learners and the Save the Children fund which built two classrooms. Before the construction of these classrooms, some learners had their lessons on an open space. The old classrooms are not in a good state and need some maintenance for example the floors, which have a lot of holes. Two of the old classroom blocks are the ones that house standards 1 and 2. The classrooms in these two blocks do not have adequate lighting as it was relatively dark inside especially at the back of the classroom. In addition to the classrooms, JTI also built a head teacher’s office, a staffroom and a teachers’ house as part of corporate responsibility. This is the only school out of the five schools visited that has a staffroom. The staffroom is attached to the head teachers’ office and it has 7 executive office desks with lockable drawers. I have however not seen teachers using the staffroom. One teacher reported that the staffroom is very far from their classes hence they find it difficult to use it. They would rather be either inside or outside their classes. The school has 9 teachers’ houses. Out of these, 8 are habitable. One needs major renovation because it is dilapidated. The school has 34 learners’ toilets (19 for female) and 2 staff toilets (one for female staff).

Nyanja primary school has 19 classrooms. All the classrooms are in good condition but need minor maintenance of windows, doors and painting. The school has double streams from standards 1 to 4. There are single streams from standards 5 to 8. All learners at this school sit on either chairs or in desks. The school makes sure that the desks are maintained so that learners don’t sit on the floor. The resources for maintaining the chairs and desks used mainly come from School Improvement Grants (SIGs) and well-wishers. The school has 2 teachers’ houses only. The school has 4 staff toilets. Two of them are for female teachers. As for learners’ toilet facilities, there are of two types, pit latrines and water closet toilets. There are 6 pit latrines (3 for girls and 3 for boys). There are 10 water closet toilets (5 for girls and 5 for boys).

Kamtsinje primary school has 12 classes housed in 5 blocks. The classes are however not enough for the school hence some learners learn while seated outside the classes under trees and some use a church near the school. The school has
three streams in Standards 1 to 5, there are two streams in standards 6 and 7 and one stream in Standard 8. It becomes difficult when it is raining in that some classes have to be combined despite their having already high enrolments. The school has 4 staff toilets (2 for female teachers and 2 for male teachers). There are 16 toilets for learners (8 for girls and 8 for boys). Some toilets are under construction. The school though new compared with other schools in Zomba City, it is one of the few primary schools with electricity. With support from Mary Meals of Scotland and the supportive community, the schools built some of the classrooms at the school.

Msika primary school has 18 classrooms. Only two of the classrooms were lockable. It is only some standard 8 learners who sit in the desks at this school, the rest sit on the floor. The school has three streams from standards 1 to 7 and two streams in standard 8. The school has a head teachers’ office but it does not have a staffroom. When meeting, the teachers either use chairs and sit in an open ground or use one of the classrooms. There are 18 toilets for learners (10 for girls and 8 for boys) and there are four toilets for teachers (two for female teachers and two for male teachers). The school has only 8 teachers’ houses which are in good condition.

Mchenga primary school has fifteen classrooms. Out of these, seven are in good condition. Three classrooms that houses Standards 2, 3 and 4 are grass thatched. The classroom block is seen in Figure 1.

![Figure 3.3: Standards 2, 3 and 4 classrooms at Mchenga primary school](image)

The classroom block in Figure 3.3 was constructed by members of the community around the school. The inside of the classroom in Figure 3.3 is full of dust as it does not have cement on its floor. The classrooms were however not used during the rainy season.
Though there are inadequate classrooms, all learners at the school learn while in the classrooms. The only challenge is that the classrooms are overcrowded. Only standards 7 and 8 learners learn while seated on a desk while the rest sit on the floor.

The head teachers’ office is relatively new. It was constructed by taking advantage of two classroom blocks that had a gap in between and joined the gap to have the office. The school does not have a staffroom. If staff was to meet, they either use one of the classrooms or the head teachers’ office depending on the size of the teachers meeting. The school has 7 teachers’ houses but most of them are old. The school has 26 learners’ toilets (13 for female) and 2 staff toilets (one for female staff).

3.7.3 School organization and management

The schools have a common organization and management structure as explained below. The management structure of the schools is as shown in Figure 3.4. It should be noted that the head reports to the Primary Education Advisor (PEA) who then reports to the District Education Manager (DEM). There are of course some special cases where the head teacher may report directly to the DEM.

![Figure 3.4: School organisational structure](image)

In addition to the structure shown in Figure 3.4, Msika primary school has an assistant head teacher and all schools have a staff secretary. The secretary is chosen by the teachers. Further, teachers are given responsibilities in committees at
the schools. Some of these different committees include: sanitation, examination, disciplinary, condolence, child protection and sports. On the side of the learners, there is a school prefects' body elected by learners themselves. These prefects are headed by a head boy and a head girl. At classroom level, there are two monitors in most classes, a boy and a girl. These monitors are chosen by the learners themselves. A special case was reported at Mchenga where the standard 1 monitors were chosen by the teacher based on the learners' cleverness.

In addition to the structure shown in Figure 3.4, the schools have governance committees like School Management Committee (SMC), parent teachers association (PTA) and Mother Group (MG). The head teachers have displayed major duties of the committees on the walls of the offices. Figure 3.5 below are the roles of main governing school committees as displayed in one of the head teachers' office.

 FIGURE 3.5: ROLES OF SMC (a), PTA (b) AND MOTHER GROUP (c)

The roles of the SMC, PTA and Mother group in Figure 3.5 above are written in the local language (Chichewa).
3.7.4 Staffing position and school enrolment

The staffing position and the school enrolment is presented in Table 3.2.

Table 3.2: Number of teachers and learners’ enrolment in five schools

<table>
<thead>
<tr>
<th>School</th>
<th>Teachers</th>
<th>Learners</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>Phiri</td>
<td>6</td>
<td>27</td>
</tr>
<tr>
<td>Nyanja</td>
<td>3</td>
<td>19</td>
</tr>
<tr>
<td>Kamtsinje</td>
<td>6</td>
<td>27</td>
</tr>
<tr>
<td>Msika</td>
<td>12</td>
<td>38</td>
</tr>
<tr>
<td>Mchenga</td>
<td>4</td>
<td>19</td>
</tr>
</tbody>
</table>

Table 3.2 reveals that there are more female teachers in the selected primary schools. This is because most of them have their husbands work in Zomba City. Further, for the chosen schools in the rural areas, the current policy on primary school teacher pre-service training is that graduates are requested to teach in the rural areas for not less than five years before they are posted to other schools. The chosen school are rural school that can easily be reached from Zomba City. Many lady teachers in the selected rural schools therefore commute from Zomba City to the school every day.

3.8 TRUSTWORTHINESS

The trustworthiness of ethnographic research, is in contrast to the conventional criteria of internal and external validity, reliability and objectivity (Denzin & Lincoln 1994; Lincoln & Guba 1985). Trustworthiness means that others must have confidence in the findings of this research (Patton 2001). Smyth (2008:563) therefore argues that the trustworthiness of qualitative research depends upon the integrity of data gathering and analysis, the robustness of processes, and the demonstration of thoroughness and a clear chain of evidence – an ‘audit trail’. To ensure trustworthiness of qualitative research, Given and Saumure (2008:895) write that qualitative researchers should ensure that transferability, credibility, dependability,

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10 The figures are correct as of July 2016. Both the enrolments and number of teachers keep on changing because of transfers either in or out of the schools.
and confirmability are evident in their research. The following subsections addresses these issues.

### 3.8.1 Credibility

According to Trochim (2006), credibility criteria involve establishing that the results of the research are believable from the viewpoint of the participants in the research. Given and Saumure (2008:895) argue that a credible qualitative research requires accurately and richly described processes of research of the phenomenon in question. In my effort to conform to these, I used a variety of data collection methods and sources for triangulation purposes. Almost all the lessons that were observed were video recorded to accurately capture the lessons, reducing bias in turn. A detailed research report was produced; an audit trail from filed notes is also available and a detailed description of the research process and outcomes was provided to participants of the study. After compiling the data, member checking was done with the teachers and head teachers because Thomas (2017:23) write that proponents of member checks maintain that such checks enhance the credibility or validity of the research findings.

### 3.8.2 Transferability

Trochim (2006) defines transferability as the degree to which the results of qualitative research can be generalized or transferred to other contexts or settings. He (Trochim 2006) however cautions that from a qualitative perspective, transferability is primarily the responsibility of the one doing the generalizing. He therefore posits that a thorough job of describing the research context and the assumptions that were central to the research can enhance the transferability of the study. Shenton (2004) adds that sufficient thick description of the phenomenon under investigation is provided to allow readers to have a proper understanding of it, thereby enabling them to compare the instances of the phenomenon described in the research report with those that they have seen emerge in their situations. A rich description of the study, participants and the context have therefore been made in this study to allow for transferability. The findings of this study were also compared to the work of other scholars who have carried out similar studies in primary schools in Malawi.
3.8.3 Dependability

Given and Saumure (2008:896) write that for dependability of qualitative research, the researcher lays out his or her procedure and research instruments in such a way that others can attempt to collect data in similar conditions. Trochim (2006) adds that dependability emphasizes the need for the researcher to account for the ever-changing context within which research occurs. As such, the present study among other issues, described and justified the changing conditions that affected the participants in the design of the study. The research also accounted for this ever-changing research context by adopting necessary strategies during the execution of the study. For example, the absence of teachers during the study due to reasons beyond their control led to the making of fresh appointments for lesson observations.

In order to address the dependability issue more directly, Shenton (2004:71) advises that the processes within the study should be reported in detail, thereby enabling a future researcher to repeat the work, if not necessarily to gain the same results. This is essentially what Merriam (2009) calls is ‘audit trail’. Merriam (2009:223) argues that an audit trail in a qualitative study describes in detail how data were collected, how categories were derived, and how decisions were made throughout the inquiry. That is why, in the present study, a detailed description of the research process, methods, giving a full description of individual participants and the context is available and the raw data is available for viewing.

3.8.4 Confirmability

Trochim (2006) defines confirmability as the degree to which the results could be confirmed or corroborated by others. Thus, Shenton (2004:72) advises that ‘steps must be taken to help ensure as far as possible that the work’s findings are the result of the experiences and ideas of the informants, rather than the characteristics and preferences of the researcher’. The present study therefore conducted member check with the participants of the study and detailed description of how the data was gathered and processed during the course of the study has been provided (audit trail). The connections between data and the researcher’s interpretations has also clearly been provided in the discussion chapter.
3.9 ETHICAL CONSIDERATIONS

According to the University of Johannesburg (2015:11), ethical conduct involves conducting research that shows a fundamental respect for human dignity, implying that the freedom of choice, voluntary participation, and self-determination of participants must be respected. Ethical clearance was therefore sought from the Faculty Academic Ethics Committee (FAEC) (see appendix 14).

Further, letters were written to the District Education Managers (DEM) of Zomba urban (see appendix 13) and rural (see appendix 11) seeking permission to collect data from the five selected primary schools in Zomba city. The permission from the DEMs (see appendices 12 and 13) were used to gain entry into the primary schools and verbal consent was sought from the head teachers (principals) and written consent was sought from standard 1 teachers (including their consent to have their lessons video recorded (see appendix 10). Both the head teachers and teachers were provided with the details of the study and their role in the study was clearly defined for them. The participation of the teachers and the head teachers in this study was entirely voluntary as such they were told that they were free to discontinue from participating in the study. The information collected from the study was and will be treated with confidentiality and the participants’ identities are not disclosed in any of the products of this study. Pseudonyms were used where the participants’ name was required. When the study is finally concluded, the key findings of the study will be given to the schools where the study was carried out and the DEMs’ offices.

3.10 CONCLUSION

This chapter has provided a description of the research process and the setting of the ethnographically-oriented inquiry. I argue that the depth of the description of the setting can be regarded as part of the data. In addition, I described how I planned for the study to be optimally trustworthy. The following chapter, chapter 4, discusses the empirical data that emanated from the application of the research process described in this chapter.
4.1 INTRODUCTION
This chapter presents the collected data and the ensuing process of analysis. The way the collection and analysis proceeded is captured, aiming to provide a ‘thick description’, albeit not as an ethnographic narrative, but rather a systematic analysis of an ‘ethnographic case’. In the data collection and analysis I kept in mind that at the nexus of a mathematics classroom culture (MCC) is, ideally, a culture of learning of mathematics and of teaching mathematics. In such a classroom culture, the participants are the teacher, the children and all the artefacts and mediational tools that may be used, as well as the classroom processes (or ‘rituals’ and patterns of action. The chapter is introduced with a gaze on the teachers - the adults who plan and execute learning opportunities and who design the life in the classroom and who also are accountable for a strong culture of learning in the mathematics classroom.

4.2 THE TEACHERS IN THE STUDY
This section is aimed at introducing the standard 1 mathematics teachers that participated in this study. There were five of them. Each teacher will be described separately, and a summary of main issues pertaining to the teachers are thereafter presented in Table 4.1. Pseudonyms are used for the teachers

Teacher Xenia – The standard one teacher from Kamtsinje primary school
Teacher Yvone – The standard one teacher from Phiri primary school
Teacher Zola – The standard one teacher from Nyanja primary school
Teacher Alice – The standard one teacher from Msika primary school
Teacher Betty - The standard one teacher from Mchenga primary school
4.2.1 Teacher Xenia:

Teacher Xenia is female and she is 48 years old. She has Malawi School Certificate of Education (MSCE) as her highest academic qualification and a T2 (the qualification classification when one completes pre-service teacher education having entered the training an MSCE) teaching professional qualification. She is at grade PT3. This is the second grade in the primary teaching career after the entry grade which is PT4. She has been teaching since 1996. She has been teaching numeracy and mathematics since she started teaching. Teacher Xenia has been teaching learners in standard 1 for 15 years. She started teaching at the current primary school in 2009. Much as continuing professional development is essential for teachers’ professional growth, the teacher revealed that she has never received any in-service training on mathematics since she started teaching.

The standard 1 class at Kamtsinje primary school was split into three classes but was later integrated into two classes. In the 2015/2016 academic year, the teacher had 152 learners (70 girls and 82 boys) in her class, while in the 2016/2017 academic year, there were 121 learners (56 girls and 65 boys). When teaching mathematics, the teacher uses Chichewa as many learners are Chichewa speakers at the school.

Something special about Xenia is her passion for teaching as seen from the way she handles her class, the way she teaches and the plans she has for the learners. When I interviewed her during the last term of the 2015/2016 academic year, this is what she had to say;

‘I am looking forward to acquiring additional skills from friends in private schools to better teach learners during the next academic year’ (July, 2016).
4.2.2 Teacher Yvone:

Yvone is female and is 34 years old. She has Malawi School Certificate of Education (MSCE) as her highest education qualification. Her professional qualification is a T2 teaching certificate obtained from one of the teacher training colleges in Malawi. Despite her 9 years’ experience in teaching, she is at the entry grade of the primary school teaching, grade PT4. She has been teaching numeracy and mathematics the whole period that she has been a primary school teacher. Out of the 9 years that she has been teaching in primary schools, 7 years has been spent on teaching Standard 1.

The teacher is well known for her teaching skills especially in languages. As such, she is currently a key teacher of the zone where she is (a zone is comprised of about 13 to 15 schools). She therefore moves from one school to another offering support to other teachers in the teaching of languages. Observing her teach reveals that she uses the skills she has in the teaching of languages when teaching mathematics. The teacher has been attending mathematics in-service training sessions organised by Save the Children under Numeracy Boost project which is implemented in some zones in Zomba City, her zone being one of them. When the teacher was asked more about Numeracy boost, this is what she had to say:

‘Numeracy boost is a Save the Children project. It targets the teaching of mathematics in standards 1 to 4. We used to attend frequent training sessions. But last year it was once. This year too, we have attended once. During the training, we cover a number of areas, some of them include; Introduction of numbers, addition of numbers, subtraction of numbers and multiplication of numbers’ (21st September 2016).

Initially, there were 60 learners in her class, 33 girls and 27 boys. The number however increased because two classes were combined because of the blown off roofs of the classes that were used by standard one learners. At the time of the study, there were 138 learners (63 girls and 75 boys) in her class where she was co-teaching with a colleague. The language of instruction in her class was Chichewa. This is so because almost all learners in her class were Chichewa speakers.
4.2.3 Teacher Zola:
Zola is female and is 26 years old. She has Malawi School Certificate of Education (MSCE) as her highest education qualification. Her professional qualification is a T2 teaching certificate recently obtained from one of the teacher training colleges in Malawi. She has just started teaching mathematics this class this year (January, 2017). The one who was previously teaching mathematics in this class has been posted away from the district, following her husband. Since she has just joined the teaching force, she is at grade PT4 and she has never attended any in-service training workshop on mathematics.

Teacher Z has 75 learners (40 girls and 35 boys) in her class. The teacher uses Chichewa in teaching learners in the class. Almost all learners in this class are Chichewa speakers.

This was the only teacher who after accepting to have her lessons video recorded, she later changed her mind. She told me to never video record the rest of the lessons. Her decision was not negotiated, and I had to abide by what she said. Three of the four lessons I observed her teach were therefore not video recorded.

4.2.4 Teacher Alice:
Alice is also a female member of staff. She is 36 years old. She has the Malawi School Certificate of Education (MSCE) and a T2 teaching professional qualification. She has been teaching since 2008. She has been teaching standard 1 learners at the current school since May 2016 when she joined the school. She has, however, been teaching mathematics for three years. The teacher has never attended any in-service course for mathematics since she started teaching.

In 2015/2016 academic year, the teachers’ class had 80 learners (40 girls and 40 boys). Initially, they were 100 but 20 dropped out. In the 2016/2017 academic year, her class has 91 learners (44 girls and 47 boys). She felt that the big number of drop outs in the 2015/2016 academic year could have been as a result of community’s view on education. Emphasis is put on Madrassa where most learners go in the afternoon. Most learners in her class speak Chichewa and the teacher therefore uses Chichewa in teaching them.
4.2.5 Teacher Betty:

Betty is female and is 29 years old. She has a Malawi School Certificate of Education Certificate. She started teaching in April 2016. She has been teaching Standard 1 since April 2016. She has never gone through any in-service training workshop for mathematics since she started teaching.

The teacher said that much as the language spoken by most learners in the area is Chiyao, the teacher uses Chichewa in teaching Numeracy and mathematics because the learners understand Chichewa.

In the 2015/2016 academic year, the teachers’ class had 128 learners and out of these, 87 were girls while 41 were boys. In the 2016/2017 academic year, the teacher is responsible for teaching 74 learners (37 girls and 37 boys).

The information about the teacher’s described above has been summarized in Table 4.1.

Table 4.1: Summary of teacher characteristics

<table>
<thead>
<tr>
<th>Teacher</th>
<th>Sex</th>
<th>Age (yrs)</th>
<th>Teaching experience (yrs)</th>
<th>Experience teaching mathematics (yrs)</th>
<th>Attended in-service training workshop on mathematics</th>
<th>Number of learners in class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xenia</td>
<td>F</td>
<td>48</td>
<td>21</td>
<td>21</td>
<td>No</td>
<td>121</td>
</tr>
<tr>
<td>Yvonne</td>
<td>F</td>
<td>34</td>
<td>9</td>
<td>9</td>
<td>Yes</td>
<td>138</td>
</tr>
<tr>
<td>Zola</td>
<td>F</td>
<td>26</td>
<td>1/12</td>
<td>1/12</td>
<td>No</td>
<td>75</td>
</tr>
<tr>
<td>Alice</td>
<td>F</td>
<td>36</td>
<td>9</td>
<td>3</td>
<td>No</td>
<td>166</td>
</tr>
<tr>
<td>Betty</td>
<td>F</td>
<td>29</td>
<td>1</td>
<td>1</td>
<td>No</td>
<td>74</td>
</tr>
</tbody>
</table>

Only one teacher had attended an in-service training workshop on mathematics. All of them have large numbers of learners in their classes, the smallest number being 75 learners and the highest being 166 learners. Though not shown in the table, all five teacher have MSCE as their highest academic qualification. The teachers’ teaching experience and experience in teaching mathematics varies from one month to 21 years.
4.3 INVENTORY OF MATHEMATICS LESSONS

In total, 28 lessons were observed. Twenty five of them were video recorded. The lessons were all transcribed, including the three that were audio-recorded. The 28 lessons can be grouped into five categories. These include; pre-number work (one lesson was observed), introducing and writing numerals (12 lessons), addition of numbers (12 lessons), subtraction of numbers (2 lessons) and writing missing numbers (1 lesson). Introduction and writing of numerals have been placed into one category because in some cases, as it can be seen in Appendix 1, a numeral was introduced, and the writing of the numeral was done in the same lesson. Many lessons were either about introducing and writing numerals, and addition of numerals. An analysis of the observed lessons revealed that they followed a particular pattern.

4.4 EPISODES FROM EARLY GRADE MATHEMATICS CLASSROOM LIFE

The results from the analysis of 28 lessons that were observed are presented in this sub-section. The first step into the analysis was to watch all the videos and read all the lesson transcripts several times. The idea was to identify episodes in the lessons. This process yielded eight consistent episodes across the five classes. These episodes were evident in almost all the lessons that were observed and the sequence remained the same:

1. Setting the scene
2. Recap of previous work
3. New content introduced
4. Whole class discussion
5. Group discussion/work
6. Individual work
7. Concluding activities
8. Take-home assignment (homework)

When this pattern was identified, the videos and the lesson transcripts were again watched and the transcripts read to determine what exactly happened in each of the learning episodes. Nineteen (19) areas (see Table 4.2, first column) were identified
in the episodes with varying frequency. Two were, however removed because they appeared only once over the eight episodes. Seventeen areas remained and are the ones that will therefore be presented and further explored. Table 4.2 was generated to keep track of the occurrences of the 19 areas in the episodes in all the 28 lessons that were observed. The five teachers in the study are represented by letters. The letters in Table 4.2 therefore shows the presence of a particular area in an episode.
### Table 4.2: Analysis of episodes in early grade mathematics classrooms

<table>
<thead>
<tr>
<th>Area</th>
<th>Episode</th>
<th>Setting the scene</th>
<th>Recap of previous work</th>
<th>New content introduced</th>
<th>Whole class discussion/Whole class discussion/work</th>
<th>Group discussion/work</th>
<th>Individual work</th>
<th>Concluding activities</th>
<th>Take home assignment</th>
</tr>
</thead>
</table>
| 1. Reflection of Numeracy and mathematics curriculum                | yy zy yz zy yyyy zy yyyy zy yyyy zy yyyy
<table>
<thead>
<tr>
<th>Area</th>
<th>Episode</th>
<th>Setting the scene</th>
<th>Recap of previous work</th>
<th>New content introduced</th>
<th>Whole class discussion/work</th>
<th>Group discussion/work</th>
<th>Individually work</th>
<th>Concluding activities</th>
<th>Take home assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.</td>
<td>Artefacts e.g. learner or teacher created work on walls, learners’ notebooks</td>
<td>a</td>
<td>y</td>
<td>xxxa</td>
<td>xx yyy a</td>
<td>xxxxxx yyy zzz aa bbb</td>
<td>xx zz aa</td>
<td>x</td>
<td>y</td>
</tr>
<tr>
<td>9.</td>
<td>Seminal learning events</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>10.</td>
<td>Rituals</td>
<td>xx y</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>11.</td>
<td>Individual attention</td>
<td>x z</td>
<td>z aa</td>
<td></td>
<td></td>
<td>xxxxxx yyy zzz aaaa bbb</td>
<td>xx</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>Prize giving</td>
<td>z</td>
<td>z a</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>Greeting &amp; maths introduced</td>
<td>xxxxy yyy zzzzz aaa bbbbbb</td>
<td></td>
<td></td>
<td></td>
<td>xxxxxx yyy zzz aaaa bbb</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td>Checking for correctness/seeking confirmation from learners</td>
<td>a</td>
<td>xxx aaaa b</td>
<td>X</td>
<td>x y zz aaa bbbbbb</td>
<td>zz</td>
<td>x z</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Area</td>
<td>Episode</td>
<td>Setting the scene</td>
<td>Recap of previous work</td>
<td>New content introduced</td>
<td>Whole class discussion</td>
<td>Group discussion/work</td>
<td>Individual work</td>
<td>Concluding activities</td>
<td>Take home assignment</td>
</tr>
<tr>
<td>----------------------------------------</td>
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<td>----------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>15. Perceptual training (see, hear &amp; write)</td>
<td></td>
<td>x y z a</td>
<td></td>
<td>y zzz aaa</td>
<td>z</td>
<td></td>
<td>a</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16. Peer support (maths specific)</td>
<td></td>
<td>xx aaa</td>
<td></td>
<td>y zz aaa b</td>
<td>b</td>
<td>zz</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17. Motivating learners</td>
<td></td>
<td>x aa</td>
<td>x x y y z z a a b b b b</td>
<td>x y y z z z a a b b b b</td>
<td>x b</td>
<td>z</td>
<td>x z z z a b b b</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The letters in the cells of Table 4.2 represent the presence of an area in that particular episode. For example, the presence of three ‘y’s for the area of ‘singing in setting the scene’ episode denotes that there was singing to set the scene of the lesson in three lessons taught by Yvone. The rest of this section is therefore spent on providing a description of the 17 areas within the 8 episodes. The episodes will be described in the order that they are appearing in Table 4.2.

4.4.1 Setting the scene

Setting the scene is about preparing learners for the lesson about to be presented. The teachers in this study ‘announced’ the topic to set the scene. When setting the scene, there was a reflection of Numeracy and mathematics curriculum in 9 lessons. Opportunity for learning was provided for in 6 lessons. There were two major areas that were evident in many lessons. These include; singing, and greeting and mathematics introduced.

Singing was evident in 11 lessons as a way of setting the scene. Different songs were sang, the titles of the songs that were sang are as seen in the box below;

<table>
<thead>
<tr>
<th>Song Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tiwerenge manambala’</td>
<td>(Reciting numbers)</td>
</tr>
<tr>
<td>Masamu masamu’</td>
<td>(mathematics)</td>
</tr>
<tr>
<td>Kuwerenga kwa manambala’</td>
<td>(Counting)</td>
</tr>
<tr>
<td>Chitimbe chitimbe’</td>
<td>(Name of a local tree)</td>
</tr>
</tbody>
</table>

These songs and others have been documented. Full versions of the songs can therefore be seen in appendix 2. Listening to the songs, some of them were related to the days’ work while some were not. An example of a lesson in which there was a song that was sang related to the days’ work is presented below;

1. **Teacher** – Good morning?
2. **Learners** – Good morning.
3. **Teacher** – Now it is time for mathematics. What time is it for?
4. **Learners** - mathematics
5. **Teacher**- Let’s start with singing a song- Tiwerenge (Let’s count)
6. **Learners**- Manambala (numbers) (learners responded). 1,2,3,…10 (singing and counting up to 10 while clapping hands)  

(Lesson 7, 21st September, 2016)
The song in the extract of lesson 7 above talks about counting. Learners counted hand claps up to 10. In lesson 7 above, Yvone was teaching the numeral 2. An example of a situation in which a song that was sang was not related to the days’ work is shown below:

1. **Teacher** – It is time for mathematics (teacher starts a song). *Masamu masamu* (mathematics, mathematics)
2. **Learners** – *Sitingawasiye masamu* (We will not stop doing mathematics, learners responded) (some words are missing in the song. See appendix 2 for a full version of the song)

   (Lesson 17, 29th September 2016)

In the extract of lesson 17 above, Alice was teaching about 0 but the song is basically saying that mathematics is good and that the learners cannot drop it, and the teaching of 0 and encouraging learners not do drop mathematics (as sang in the song in lesson 17) are not related.

The explanation above has shown us that some teachers used songs during the introduction of a lesson. It was however observed that the songs that the teachers sang with the learners were either related or not related to the days’ work.

The second major area in setting the scene is introducing the name of the subject to be learnt and greeting the learners. This was evident in 24 out of the 28 lessons. In most cases, the greeting started, followed by the introduction of the name of the subject to be learnt. In some cases, only the subject name was introduced. This was usually the case when the mathematics teacher was the same teacher who was teaching the learners the subject that preceded mathematics. The introduction of the subject name was to warn the learners about the switch from the subject they were learning to another subject, in this case, mathematics. Consider the two examples below:

1. **Teacher** – Good morning everybody?
2. **Learner** – Good morning teacher
3. **Teacher** – It is time for mathematics (Teacher started the *Masamu masamu* song). Yesterday, I gave you a homework. How many did it.

   (Lesson 21, 1st February, 2017)
In the extract from lesson 21 above, Alice is taking up a lesson from another teacher who was teaching a different subject. She is talking to these learners for the first time today. Hence she has started by greeting the learners and then introduced the subject she is going to teach. A different scenario is however presented in the extract below.

1. **Teacher** – It’s now time for mathematics. Let us now be in our groups. What type of mathematics are we learning?
2. **Learners** – Addition
3. **Teacher** – We should stop eating in class (Some learners were eating while the teacher was speaking). I have cards in my hands. I want some people to come in front here. (Five learners were called in front of the classroom and the teacher gave a number card to each one of them. A number was written on each one of them. Numbers 1 to 5). Raise the number cards (The teacher told the learners). What cards are they having?
4. **Learners** – Number cards  

(Lesson 27, 19th January 2017)

In the extract from lesson 27 above, the teacher did not greet the learners because she has been teaching them another subject. At this point, she just wants to switch from the subject she was teaching to another subject, mathematics.

After the greeting and the introduction of the subject to be taught/learnt, some teachers were involved in general classroom management and conduct. This was evident in 5 lessons. The general classroom management and conduct mainly involved the following;

- Stopping learners from making noise
- Asking learners to put their notebooks in their bags to get ready for mathematics
- Putting the learners in groups (See lesson 27, on number 1 in the extract above).

In some cases, learners were in group for the whole period. When there was general discussion for the whole class, the learners who were facing the back of the classroom were asked to turn so that they were able to see the front of the classroom (This will further be explained in the area of group discussion/work). The extract from lesson 27 above is an example where a teacher was involved in the general classroom
management during the setting of the scene. The teacher made learners to be in groups and stopped some learners from eating in class.

Apart from the language of instruction used and the songs sang, the following were some of the tools that were seen to be used during the setting of the scene; chalkboard, chalk, number cards, fingers and hands (used in clapping as the learners were counting the hand claps).

There were artefacts evident in the setting of the scene episode in one lesson by Alice. The artefact included learner created work. This was homework that learners were supposed to write. Some learners wrote the homework.

Learners were seen to be motivated by the teacher during the setting of the scene in 3 lessons. Motivation of learners basically included saying a positive remark to the learners after saying something correctly or clapping hands for them. The extract below shows an example.

| 3. **Teacher** – It is time for mathematics (Teacher started the *Masamu masamu* song).  
Yesterday, I gave you a homework. How many did it. |
<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4. <strong>Learners</strong> – (9 learners raised their hands)</td>
</tr>
<tr>
<td>5. <strong>Teacher</strong> – How about others? You forgot?</td>
</tr>
<tr>
<td>6. <strong>Learners</strong> – Yes</td>
</tr>
<tr>
<td>7. <strong>Teacher</strong> – No, you should not forget. Make sure you do the homework soon after eating. I will mark their work and I will also give them a gift. These are good children. Clap hands once for them</td>
</tr>
<tr>
<td>8. <strong>Learners</strong> – clap</td>
</tr>
</tbody>
</table>

(Lesson 21, 1st February, 2017)

We are seeing that learners who did the homework had a hand clapped for them. Those who did not do the homework were encouraged to be doing the homework soon after taking their lunch in the afternoon. It was interesting to note that after this statement, the number of learners who wrote the homework increased the following day.
After setting the scene, the teachers took learners through the recap of the previous lesson. What happened during the recap of previous work will therefore be explored.

### 4.4.2 Recap of previous work

Principles of pedagogy has it that learners should be taken from known to unknown. It was therefore observed that there was recapitulation of the work covered in the previous lessons in 22 lessons out of the 28 lessons that were observed. Previous work was based on the work in the national curriculum hence the recap of the previous work was a reflection of the work in the numeracy and mathematics curriculum.

There were a number of learning opportunities provided during the recap of previous work as the teachers were briefly going through the work they covered during the previous lesson. During the recap, the teachers were also involved in teaching the learners. This was evident in 16 lessons.

The recap of previous work was mainly done through question and answer. Learners were asked questions based on what they covered during the previous lessons. During the question and answer sessions, it was observed that teachers checked for correctness or sought confirmation from learners in 8 lessons. What was actually happening was that the teacher could ask a question for the learners to answer. When the learner gives a response, the teacher could ask the whole class as to whether that was true. An extract from one of the lessons is provided below to show what was happening.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3. <strong>Teacher</strong> – Now I want you to count up to 9 using fingers</td>
<td></td>
</tr>
<tr>
<td>4. <strong>Learners</strong> – 1,2,3,4,5,6,7,8,9 (Counted learners using their fingers)</td>
<td></td>
</tr>
<tr>
<td>5. <strong>Teacher</strong> – Somebody should come to write 8 on the chalkboard (said this five times)</td>
<td></td>
</tr>
<tr>
<td>6. <strong>Learners</strong> – (learner wrote)</td>
<td></td>
</tr>
<tr>
<td>7. <strong>Teacher</strong> – Has she got it right?</td>
<td></td>
</tr>
<tr>
<td>8. <strong>Learners</strong> – Yes</td>
<td></td>
</tr>
<tr>
<td>9. <strong>Teacher</strong> – Ok. I want another person to come and write 6. A beautiful one.</td>
<td></td>
</tr>
<tr>
<td>10. <strong>Learner</strong> – Wrote 6 very well.</td>
<td></td>
</tr>
<tr>
<td>11. <strong>Teacher</strong> – Has he got it right?</td>
<td></td>
</tr>
<tr>
<td>12. <strong>Learners</strong> – Yes</td>
<td></td>
</tr>
<tr>
<td>13. <strong>Teacher</strong> – Let us clap hands once for him.</td>
<td></td>
</tr>
<tr>
<td>14. <strong>Learners</strong> – Clap!</td>
<td></td>
</tr>
<tr>
<td>15. <strong>Teacher</strong> - Good. May somebody come and write 9 on the chalkboard</td>
<td>(Lesson 3, 27th January, 2017)</td>
</tr>
</tbody>
</table>
In the extract from Lesson 3, the teacher was introducing addition of numbers with the sum not exceeding 9. She therefore had to take learners through all the numbers that she had taught them. She had to ask learners to write numerals on the chalkboard without following any order. When the learner had written the numeral, the teacher had to ask learners to confirm the correctness of the numeral that had been written. She started with the numeral 8 followed by 6 and continued with other numerals before getting to addition.

When it was confirmed that the learner had given a correct answer, the teachers were motivating the learners through either asking other learners to clap hands for the learner or through speaking positive words to the learners. In one lesson, a teacher was seen to give a prize to a learner after giving a correct response. When clapping hands, sometimes the teacher could ask the learners to clap hands a given number of times. A look at entries 13 and 14 in the extract from lesson 3 above demonstrates this. Learners were told to clap hands once which they did.

There were situations where learners were supposed to write an answer on the chalkboard. When they failed to get it right, individual attention followed until the learner was assisted to get the right answer. Individual attention was seen in two lessons during the recap of previous work. Considering the numbers in the classroom, not all learners got individual attention. An interesting scenario happened one day during the recap of previous work in lesson 12 taught by Zola on 3rd October 2016. The following is what happened.
This story is about a situation where the recap of the previous activity revealed that some learners do not know how to write 2. Instead of continuing with the planned introduction of 3, the teacher had to let the learners practice writing 2.

There were some situations where the teacher asked other learners to assist fellow learners (peer support). This happened in 5 lessons during the recap of the previous work.

Apart from using the question and answer approach to looking at the previous work, some teachers could just speak in passing what they covered during the previous lesson. The extract of lesson 15 exemplifies the situation.
In the excerpt from Lesson 15 above, the teacher reminded the learners that they had already learnt how to add numbers horizontally in the previous lesson and did not go into the details but went straight to the days’ content.

Several tools and artefacts were used during the recap of previous work. The following are the tools and artefacts that were observed to be used during the recap of the previous work. Tools and artefacts included the chalkboard, fingers, singing, number cards books, leaves, notebooks, stones and pencils. There were also clay and a number chart.

Specific to recap of lessons on writing numerals, it was observed that the teacher involved learners in perceptual training. In this case, learners were told to write by looking at how the teacher wrote a numeral in the air. The teacher was writing the numeral in the air while saying some words. The numbers covered in standard 1 and what was said to accompany the writing of the numbers is presented in Table 4.3.

<table>
<thead>
<tr>
<th></th>
<th>Teacher – It is now time for mathematics. It is time for what?</th>
<th>Learners – mathematics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Teacher – We will continue adding numbers up to 9. Up to what?</td>
<td>Learners – 9</td>
</tr>
<tr>
<td></td>
<td>Teacher – Last time we were adding numbers horizontally, we will today add numbers vertically. (Teacher wrote the problem below on the chalkboard)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>+ 4</td>
</tr>
<tr>
<td></td>
<td>___</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Read this problem</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Learners – 5 plus 4 equals</td>
<td></td>
</tr>
</tbody>
</table>

(Lesson 15, 9th February, 2017).
Table 4.3: Writing mechanics/modelling of numerals from 0 to 9

<table>
<thead>
<tr>
<th>Numeral</th>
<th>Words spoken as she writes</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Doo! (a sound made as the teacher wrote a full stop marking the beginning of the writing of the numeral) zungulira (go round)</td>
</tr>
<tr>
<td>1</td>
<td>Doo! tsika (go down)</td>
</tr>
<tr>
<td>2</td>
<td>Doo! zungulira pang’ono, (make a short corner) tsika (go down), gona (sleep)</td>
</tr>
<tr>
<td>3</td>
<td>Doo!, chimimba (stomach), chimimba (Stomach)</td>
</tr>
<tr>
<td>4</td>
<td>Doo!, tsika (go down), gona (sleep), dula (cut)</td>
</tr>
<tr>
<td>5</td>
<td>Doo!, gona, tsika (go down), chimimba</td>
</tr>
<tr>
<td>6</td>
<td>Doo!, kamwezi (like a moon), chipinda m’munsi (create a room down)</td>
</tr>
<tr>
<td>7</td>
<td>Doo!, gona (sleep), tsika (go down)</td>
</tr>
<tr>
<td>8</td>
<td>Doo!, zungulira pamwamba (go round at the top), zungulira pansi (go round at the bottom)</td>
</tr>
<tr>
<td>9</td>
<td>Doo!, tsika (go down), kwelanso (go up again), chimimba</td>
</tr>
</tbody>
</table>

Table 4.3 shows the words that were said when writing numbers 0 to 9. The words said were generally there to give direction in which the writing would flow to have the numeral written. The learners then followed exactly how the teacher was doing it. This practice was observed in three lessons. Learners were now ‘ready’ for the content of the day.

4.4.3 New content introduced

The introduction of the content of the day, referred to a new topic and was different to the topic of the previous lesson. In 25 of the 28 lessons new content was introduced. It was only in 3 lessons where there was coherence with a previous lesson. In one of these, lesson, Zola was revising what the learners had covered during the week while in two lessons, Zola and Alice had to cover the work that was covered during the previous lessons (see vignettes in recap of previous work and whole class discussion). The new content was basically from the curriculum materials hence there was reflection of Numeracy and mathematics curriculum in the introduction of new content. As the content was being introduced, learning opportunities were provided to the learners and there was teaching involved.

It was only Xenia who checked for confirmation (what this involves has been explained in the episode, recap of previous work in the last sub section) from the learners when the new content was being introduced. She was also the only one engaged in ‘small talk’ during the introduction of new content. During this time, a learner fell ill and was
involved in a dialogue with the learner and had to take her to the other teacher who was co-teaching with her to find a way of taking the learner back to her home.

Only Zola (in lesson 13) introduced the new content by singing a song. The song was about addition of numbers. The title of the song that was sang was ‘Tiwonketse manambala’ (adding numbers), another version of ‘Tiwerenge manambala’ (reciting numbers or counting song). The lesson was on adding numbers with the sum not exceeding 9.

Tool-use was also observed in the introduction of new content. It was in 10 lessons where tools were used to introduce new content. The following extract from lesson one observed on 19th September 2016 demonstrates how the tools were used in the introduction of the new content.

3. Teacher - Now it is time for mathematics. Today we will start learning numbers. We will start with the first number which is called 1. We will see how many objects are found in 1. What is this? (Holding a stick in her hand).
4. Learner – A stick (all learners shouting at once)
5. Teacher – How many sticks are here?
6. Learner - One
7. Teacher – Ok. One thing is one. (Repeated three times). Look at what I have in my hands. What is it?
8. Learners – a duster (learners shouted at once)
9. Teacher- How many dusters are here? (showing one duster to learners)
10. Learners – one
11. Teacher- In mathematics, what is this?
12. Learners - 1
13. Teacher- This show that if there is one object we say ‘one’. Look at this. What is it?
14. Learner – a stone (Shouted all learners)
15. Teacher- How many stones do I have?
16. Learners- one (learners shouted)
17. Teacher – (The teacher showed a bean seed to the learners). How many bean seeds do I have?
18. Learner – One (The whole class responded – responded more than four times because the teacher asked them four times)

(Lesson 1, 19th September, 2016)

In the excerpt from lesson 1 above, the teacher was introducing the number 1. Several objects were taken to the class to establish the quantity aspect in 1. The tools were
used to simplify the acquisition of the concepts by the learners. The tools used were mostly those that are locally found. The diagrams below shows some of the tools that were used during the introduction of new content in addition to what is in lesson 1 shown above.

Figure 4.1: Some tools that teachers used when introducing new content

The left side of Figure 4.1 is showing bottle tops placed in a bow while the right hand side of Figure 4.1 is showing bottle tops, maize seeds and bean seeds. All the tools seen above are locally found.

After the introduction of the new content. The teacher then moved into the systematic teaching of the new concept to ensure that learners acquire it. This was in most cases done through the whole class discussion.

4.4.4 Whole class discussion

The whole class discussion was done in such a way that all learners in the classroom were given an opportunity to participate in the lesson, even when this was logistically impossible to achieve. The whole class discussion was evident in 25 out of the 28 lessons that were observed.

The whole class discussion was based on the numeracy and mathematics curriculum. Hence all the 25 lessons where the whole class discussion was observed reflected the numeracy and mathematics curriculum. The central issue being discussed is reflected in the summary of the lessons observed (see Appendix 1). During these whole class
discussions, there were several learning opportunities. In fact, these opportunities were observed in 24 of the 25 lessons that had whole class discussions. The excerpt below shows some of them.

43. **Teacher** – (The teacher wrote the figure below with missing numbers). Today we will write missing numbers including the number that we have been learning, the number 7. Now we will write the missing numbers. Let us read through the numbers that are here.

![Number Line](image)

44. **Learners** – (Learners read together with the teacher and completed the missing numbers on the number line).
45. **Teacher** – let us read the numbers together
46. **Learner** – 0, 1, 2, 3, 4, 5, 6, 7
47. **Teacher** – Let us read again
48. **Learner** - 0, 1, 2, 3, 4, 5, 6, 7 (Learners read while the teacher was pointing at each of the numbers)
49. **Teacher** – Ok. These numbers have started from 0. Now I will erase some numbers. (The teacher erased what was written in the missing boxes). Who can come and write what is missing here? (Pointing at the first blank box)
50. **Learner** – (Learner went and wrote 2)
51. **Teacher** – Has he got it right?
52. **Learners** – Yes
53. **Teacher** – Let us clap hands once for him
54. **Learners** – clap!

(Lesson 22, 2<sup>nd</sup> February 2017)

Some of the forms in which learning opportunities were given to learners were,

- Learners orally responding to questions that guided the discussion during the whole class discussion for example in lesson 22, entries 46 to 48 above.
Learners writing on the chalkboard what the teacher wanted them to write e.g. writing a numeral like in lesson 22, entries 49 to 52 above.

These learning opportunities provided some chance for learners to engage with the content that was being taught. It is during these whole class discussions where teachers did much of the teaching of mathematical concepts. This was evident in 24 out of the 25 lessons where whole class discussion was observed.

Before moving onto the other areas that were covered during the whole class discussion, it would be necessary to look at what was taught and how it was taught during the whole class discussion to have a better understanding of what was happening in the classrooms. A summary of the lessons observed (see Appendix 1) during the study shows that one lesson was on pre-number work: 12 lessons were on introducing and writing numerals, 12 lessons were on addition of numbers, 2 lessons were on subtraction of numbers and 1 lesson was on writing missing numbers. Out of the 28 lessons, it was only in four pairs of lessons where what was taught was seen to be repeated. These pairs of lessons include; lessons 5 and 6, lessons 11 and 12, lessons 13 and 14, and lessons 20 and 21. The teachers’ original plans for the lessons 11 and 12, and 20 and 21 were not to make one lesson a repeat of the other. The teachers were ready to move on to another topic but the non-performance of the learners forced them to repeat the lessons. Apart from the pairs of lessons described above, it is clear that a concept is generally handled in one day. The next day is planned for another concept. Of particular interest are lessons on introducing and writing numerals, addition of numbers and subtraction of numbers. There were lessons in which a numeral was introduced and learners were expected to write it in the same lesson. After doing this, when learners came to school the following day, they were to look at a different numeral. Lessons 1, 2 and 7 are examples of such lessons. In these lessons, learners were exposed to the following activities:

1. Introducing the numeral by showing them a variety of objects corresponding to the numeral being introduced on that day
2. Recognising the symbol for the numeral
3. Writing the symbol for the numeral
These three activities were the only activities that learners engaged with as far the introduction of numbers in early grade classes that were observed is concerned. After going through these three activities in either a day or two days, learners were now moved to the next numeral. Lesson 7 has been put in Appendix 3 to give an idea of what was happening. It was therefore not surprising that some teachers were forced to repeat a lesson after noting the non-performance of the learners because learners were rushed through the concepts, leaving many who had not mastered the concepts in turn.

Turning to learners’ experiences on addition/subtraction, learners went through the following activities:

1. Introducing addition/subtraction of numbers using objects
2. Writing addition/subtraction sentences
3. Completing addition/subtraction sentences horizontally
4. Adding/subtracting numbers vertically

This whole work for addition could be done in three or four lessons and a further 3 or 4 lessons for subtraction. When performing addition, ‘count all’ was practiced in all addition problems observed during the study when learners were given two numbers to add (see lesson 13 in Appendix 4 for an example).

Singing was part and parcel of the whole class discussion in some lessons. This was evident in 10 lessons. Four out the five teachers were seen to incorporate singing during the whole class discussion. It was mostly Yvone and Zola who did this in most of their lessons (4 lessons for Yvone and 4 lessons for Alice). Apart from being part of the lesson to reinforce what was being taught, sometimes the songs were also used to control noise during the whole class discussion. The following extracts are examples of the two situations just described. The first one is the one where a song was used to reinforce what learners were learning or what they had been learning. In the excerpt below, Yvone was introducing numeral 3. She started the song within the time she was discussing with students to assist them to know the quantity and the symbol for the numeral 2. The title of the song was ‘pamchenga’ (on the sand). Entries 44 to 54 shows how the song progressed in the lesson to reinforce what the teacher was teaching.
On the other hand, excerpt below is showing a situation where songs were used for controlling noise in the classroom.

17. Teacher – (the teacher showed a bean to the learners). How many bean seeds do I have?
18. Learners – One (the whole class responded – responded more than four times)
19. Teacher – Now I will put objects in your groups (the teacher distributed objects to all the groups. Led the learners into singing a song *(Wolongolola alibe Yesu Satana aliza mkonono mtima mwawo* (Those who are making noise do not have Jesus and Satan is snoring in their hearts) as she was distributing the resources since many learners were making noise).
   I have placed objects in your groups. When I show you an object, a leader in your groups should hold a similar object up. Then we will all say ‘one’. Let us raise the object I have raised. (moved to all groups to ensure that they had raised the right object). What is it?
20. Learners - a stone
21. Teacher- How many stones are there?
22. Learners – One

(Lesson 1, 19th September 2016)
The teacher started the song ‘wolongolola’ (those who make noise) when she noted that the learners were making a lot of noise as she was distributing the resources that she wanted learners to use in their groups.

Since it was during the whole class discussion when the actual teaching was conducted, a lot of resources were seen being used in 19 lessons. The tools or resources that were seen to be used during the whole class discussion included bean seeds, stones, bottle tops, number cards, the chalkboard, maize seeds, notebooks, text books (only in some classes), slate, songs, leaves, small sticks.

As was seen in the recap where tools were used, it is also evident here that most resources used are those which are locally available.

A number of artefacts were created during the whole class discussion. These were evident in 6 out of the 25 lessons where whole class discussion was evident. The following are some of the artefacts that were used in the lessons. They were either created during or before the lessons.

There was a seminal learning event that happened during one of the lessons conducted by Xenia. The following vignette is a story narrating the event.

It was a day when Xenia was teaching addition of numbers with sum not exceeding 9. There was 112 learners in the classroom. There came a moment where the teacher was teaching the addition of 6 and 0 vertically. The teacher took the learners through the whole process of adding but she deliberately wrote a reflection of 6 instead of writing the real 6 as the answer. She then asked learners if she had written a 6 correctly. There were mixed answers. Some learners said that the teacher had correctly written 6 while some said that 6 was wrongly written by the teacher. The teacher then asked the learners to raise up their hands if they thought 6 was wrongly written. Only about 15 learners raised their hands, the rest raised when the teacher asked those who thought that 6 was correctly written to raise their hands. The teacher then invited one of the learners who said that the 6 was wrongly written to get in front of the class to write a proper 6 on the chalkboard. The learner who was a boy, successfully wrote 6. The teacher also invited another learner, a girl to write 6. She also correctly wrote 6. The teacher then asked learners to choose between what she wrote and what other learners wrote. It was observed that only 17 learners were in favour of the learners while the rest were in favour of the teacher. The teacher then revealed that those who were in favour of her had all failed. She told the learners that the ones who had written a correct 6 were the learners. She then went through some writing sessions to give learners practice in writing 6. She started with having the learners write 6 in the air, then on the floor with a piece of chalk. During this period, it was evident that most learners indeed had problems with writing 6. See figure 4.3 below for examples. Thereafter, she continued with the lesson on addition.
The writing of 6 by some learners can be seen in Figure 4.3.

Figure 4.2: The writing of 6

Figure 4.2 is an example of wrong writing of 6 that was evident in the class. An interesting case was, however seen where a learner correctly wrote 6 and wrote a number word for the numeral. The number word was however written the way the numeral sounds in English.

Figure 4.3: The ‘number word’ and the symbol for 6 written on the floor
What was interesting with the learner who wrote this was that he was not taught to write this. This was his own imagination of how the number word for 6 is supposed to be written.

During the whole class discussion, there were instances where learners were expected to respond to questions. Those who failed to answer the questions were provided with individual support in some lessons. This was evident in 3 lessons, one by Zola and 2 by Alice. This in most cases was about assisting the learner to do a required activity the right way, for example, writing a numeral on the chalkboard or in the air. Examples of such situations are shown below.

| 60. Teacher- | (Teacher chose four learners to write on the chalkboard. One learner struggled to write but the teacher assisted him). What number have we written? |
| 61. Learner - 2 |
| 62. Teacher- | Now everybody should get a notebook and a pen and write 2 | (Lesson 7, 21\textsuperscript{st} September, 2016) |

| 23. Teacher – | (The teacher observed that one learner was not able to write 7 in the air. The teacher then provided support to the learner. I also saw more than two learners who were not able to write 7 in the air but the teacher did not see them.) |
| 24. Teacher – | Ok, you, stand up (pointed at one of the learners who failed to write 7 in the air. He was refusing to stand up but eventually stood up). |
| 25. Learner – | (the learner failed to write 7 in the air) |
| 26. Teacher – | Can somebody assist him to write 7 in the air |
| 27. Learner – | (A girl demonstrated how to write 7) |
| 28. Teacher – | Now write 7 in the air (The learner still failed to write). He will write together with me (held his hand to write but could not write 7 in the air on his own. Ok he will write on the chalkboard. (The teacher held his hand once and then she then just asked him to write after the teacher. He was eventually able to write 7.) Clap hands for him. |
| 29. Learners – | Clap clap clap | (Lesson 21. 1\textsuperscript{st} February, 2017) |
In the two excerpts above, (Lessons 7 and 21), the teachers were observed to be providing individual support during the whole class discussion. As was observed in lesson 21 entry 23, there were some learners who failed to write 7 in the air but the teacher did not see them. There were 96 learners in this class.

There was peer support observed during whole class discussion. In some cases, some teachers were observed to be asking other learners to assist those who failed to carry out an instruction the way it was supposed to be. Or in some cases, learners were seen to support each other without being told by the teacher. This was seen in 7 lessons. An example of a situation where a teacher asked another learner to assist the one who failed was observed in lesson 21 above, entries 25 to 27. On the other hand the extract below is presenting an example where learners were seen to be supporting each other.

<table>
<thead>
<tr>
<th>56. Learner – (As the learners were writing 2, a learner close to where I sat was seen to be assisting another learner to write 2 since he was failing to write).</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Lesson 11, 27th September, 2016)</td>
</tr>
</tbody>
</table>

Learners’ achievement was in most cases not going unnoticed. There were varied ways of motivating learners after they gave correct answers or correctly performed an activity. This was observed in 16 of the lessons where there was whole class discussion. This was done as discussed during the episode ‘recap of previous activities’.

The whole class discussion in some cases involved question and answer. In such cases, the teacher could ask questions to the learners to stimulate their thinking and learners were encouraged to raise their hand if they know the answer. When the teacher has recognised them, learners were encouraged to say the answer while standing. When an answer was said, other learners were asked for correctness (see explanation given in the recap of previous activity). Checking for correctness was evident in 12 out of the 25 lessons where the whole class discussion was held. When it was certified that the learner had given the right answer, many teachers made sure that the learners were motivated (see recap of previous work for explanation on ways of motivating learners in the class). This was seen in 16 classes. Some teachers went to the extent of giving prizes to the learners as observed in 2 lessons.
As was the case during the recap of previous lessons on writing numerals, it was also observed during the whole class discussion that some teachers involved learners in perceptual training. This was evident in 7 out of the 25 lessons where whole class discussion was conducted. The practice was similar to the one described in the recap of previous work episode.

Having engaged learners in whole class discussion, some teachers could go straight to asking learners to do individual work. There were however some teachers who made sure that learners discuss in groups before individual work. It is important to provide what happened during group discussion.

4.4.5 Group discussion/work
Mathematics activities were observed to have been assigned to groups in 9 lessons. During these lessons, learners were put in groups. The sizes of the groups ranged from 6 learners to more than 15 learners per group. Some groups were really big like the ones observed at Nyanja primary school. In these groups, there were leaders who were in charge of them. Leaders were selected by the teacher based on their ability. Among the responsibilities of the group leaders as observed during the lesson observations include: to receive resources used in the group, take lead in the activity, take the resources used in the group back to the teacher, control the noise in the group. The groups in most cases were seen as just seating arrangements. There was no real discussion heard during group work. In most cases, it was the group leader who was doing the activities while other learners were just watching. In some cases, the other
learners were not even aware of what was happening in the activity that was supposed to be done by all the group members. A case in point is seen in the extract below.

It was observed that some learners were not following what was happening in the groups as can be seen in entry 19 of lesson 16 above. It appears that the answers were given by the leaders of the groups without really the groups discussing.

An observation of the activities that were done in the groups showed that they were reflecting the numeracy and mathematics curriculum. This was evident in all the 9 lessons where there was group work. The groups provided learning opportunities in all the 9 lessons where group work was observed. Much as the aim was to provide opportunities for learning to all members of the group, the large sizes of some groups denied learning opportunities of some learners during the group activity as some did not know what was happening in the group as explained above.

Some teachers were observed teaching during the group work as they moved around the groups. This was the time when one teacher also noted that some learners were not following what was happening in the group. The teaching was evident in 8 out of the 9
lessons that had learners engaged in group work. In some cases, a group leader was supposed to report what was discussed in the groups. An interesting story happened where the group leaders gave an answer different from the ones given by the learners in the groups. The following story describes the details of what happened.

35. **Teacher** – This means that $2 - 1 = 1$
   (Saw a monitor slightly whipping another learner who was making noise. He used a stick). (The teacher wrote this mathematical statement $7 - 0 =$). Let us read this (Pointing at the statement)

36. **Learners** – 7 minus 0 equals

37. **Teacher** – Ok. I want you to count 7 objects. (Pause) Have you counted?

38. **Learners** – Yes

39. **Teacher** – remove 0 from the 7 objects. (Pause). Have you removed 0?

40. **Learners** – yes

41. **Teacher** – Now count what is remaining after removing 0 (pause). How many have counted? Raise your hands

42. **Learners** – (about 70% of the learners raised their hands).

43. **Teacher** – (Teacher went to individual learners so that they should whisper the answer they have found to her. The following were the answers the learners whispered to the teacher; 4, 5, 6, 7 and 9. The teacher then asked the learners to raise hands according to the responses they had found. 36 learners found 4, 13 learners found 5, 10 learners found 6, more than 50 learners found 7 and 10 learners found 9. Interestingly, the answer that the leader of the group provided was different from the answers some members of the group gave out as reflected in the hands that were raised). Let’s now see the real answer. Look here. We will count together.

44. **Learners** – 1, 2, 3, …..7 (The teacher counting up to 7 together with the learners)

45. **Teacher** – We have counted 7 objects. We should now remove 0 objects. Since nothing is removed, it will remain like that. Let us count.

46. **Learners** – 1, 2, 3, …..7

47. **Teacher** – This means that those who found 7 have got it right. Let us clap hands for them.

48. **Learners** – clap! Clap!

49. **Teacher** – For those who found 9. Remember that when we are subtracting, the number does not go up. (The teacher wrote this mathematical statement $8 - 4 =$). Now I
range 0 to 9. There were 108 learners in this class on this day. The lesson flow from entries 35 to 49 shows a situation where the teacher was teaching subtracting a number by 0. It was evident that some learners did not understand the concept of 0 as they were still subtracting a number from 7. Further, there were some learners who did not understand the concept of subtraction such that $7 - 0$ yielded a number greater than 7. The teacher then tried to bring them into understanding that when 0 is subtracted from a number. We end up with the same number.

As the teacher was moving around teaching the learners in groups, checking for correctness was observed in 2 lessons, all by Zola. It was in one of these two lessons where perceptual training was observed to be happening. In a different lesson by a different teacher, Betty, a learner, one of the group leaders was observed to have assisted another learner in the same group.

A number of tools were used during the group work discussion. The tools used during this episode are however the same as that which were used during the whole class discussion. No special tools are therefore presented in this section.

After either whole class discussion or group work, the lesson transitioned to individual work.

4.4.6 Individual work

Individual work happened when learners were asked to do a mathematical activity individually. The activities included but were not limited to the following: writing numerals, writing plus or equal sign symbols, working out addition statements, working out subtraction statements, drawing a given number of objects. Individual work was observed in 25 out of the 28 lessons that were observed. An observation of the activities that learners were involved in clearly indicated that they reflected the Numeracy and mathematics curriculum. This was evident in all the 25 lessons where individual work was observed. In most cases, learners were using their notebooks in writing individual work. As they were writing, it was an opportunity for the learners to reinforce what was taught. This was evident in all the 25 lessons where individual work was performed. Teaching was observed in 23 lessons as the teachers were going around the classroom marking learners work. This was seen where learners did not get a correct answer or a
correct way of carrying out the activity. This also entailed the individual attention which was observed in 21 out of the 25 lessons where individual work was observed. The marking was done as soon as some learners finished writing the work. In some classes, learners were asked to do the activities fast for them to have their work marked. The following extracts exemplifies such situations.

35. **Teacher** - (The teacher erased the answers to the questions). Write these problems. Those who will write fast will be the ones whose work will be marked. (The teacher then sat down as the learners were writing. One learner finished earlier than others and raised his notebook). Put down your notebook and wait for your friends to finish (Teacher talking to the student). Make sure you write the word *Masamu* on top before writing the answers and today’s date (The teacher then started marking the learners’ work. Did this for 8 minutes). Ok. Those who have got these problems right, what is 3 + 1?

36. **Learners** – 4

(Lesson 10, 10th January, 2017)

40. **Teacher** – Clap hands for him (and was given a sweet). Everybody should get his/her notebook. We have one question. Write it fast. I want to start marking now. Those who will not write will be punished. Fast, write very fast! (the teacher wrote 5 + 3 = )

41. **Learners** – Madam, I have finished (Shouted one of the fast writers)

(Lesson 13, 6th February 2017)

108. **Teacher** – No. Make sure you write the word ‘Masamu’ before writing the exercise

109. **Learners** – Should we also write the date?

110. **Teacher** – Yes. Now write very fast. Don’t draw the chicken (Teacher moved around looking at what the learners were doing. She also marked learners work) (Then after marking). 1st picture 2 + 2 = 4. Those who failed, write the way I have written here. Bring my books (continued marking until many learners had their notebooks marked. Provided help to many learners who had problems with writing the addition problem)

(Lesson 27, 19th January 2017)
A look at extracts from lessons 10, 13 and 27 above in entries 35, 40 and 110 respectively, shows examples of situations where learners were told to write fast. It was observed that in most cases, those who wrote slowly did not have their work marked during the lesson. The following extract exemplifies the situation.

171. Teacher – Now I want you to draw the six leaves in your notebooks. I want to see those who will draw very fast. Draw better leaves than mine. Remember to write the word Masamu and todays date before drawing the leaves. (Teacher moved around marking learners’ work after 4 minutes when some learners were through with drawing the six leaves). When you are done with the writing, put your notebooks on your head. (After 5 minutes of marking) We will finish later. I will mark your work later. How many objects were we looking at today?

172. Learners – 6 (Learners responded on top of their voice).

(Lesson 19, 23rd January, 2017)

The extract above from lesson 19 shows that the learners were told to write fast and those who did not finish were told that their work would be marked later (see entry 171). This therefore left many learners with their work not marked during the lesson.

There was peer support during two lessons by Zola. In these lessons, some learners who failed to get the correct answers to a problem were asked to choose a person to assist them. The following is an example of such a situation;

44. Teacher – (The teacher then moved around to mark learners work. Marked 19 learners’ work and then sat down on her chair and marked 8 more notebooks

45. Learners – (One learner whose work was marked but failed was asked to find somebody who could assist him to work out the answer to the questions. He did identify somebody and went to him to be assisted. Then the class became very noisy and the class monitor was given a stick to control his friends. He managed to stop other learners from making noise)

(Lesson 16, 10th February, 2017)
In the extracts from lesson 16 above, entry 45, Zola was observed to have asked a learner to be helped by another learner. It was pleasing to note that the learner was indeed assisted.

There were a number of tools that were used during the individual work. All of them have been documented under the whole class discussion episode. What is presented below is however diagrams of some of the tools the learners used.

![Image of tools used during individual work]

**Figure 4.4: Some of the tools learners used when carrying out individual work**

The learner on the left of Figure 4.4 is carrying some grass that were cut short and a hole made so that a rope could get through to have a bow shaped object that he is carrying in his hands. While on the right are small plastic pipes cut short and put as seen in the figure.

On the other hand there were few artefacts that were generated during the individual work. This was evident in 17 lessons. These artefacts mainly included learners' notebooks as learners used them in writing exercises that they were given. Figure 4.5 is an example.
Figure 4.5: Learners’ marked work in note books

Figure 4.5 is one of the learners’ notebooks. It can be noted that learners were encouraged to write the day’s date and the word ‘Masamu’ (mathematics) before writing the exercise.

A point worth mentioning at this stage is what happened to those who did not get the answers correct. It was observed that corrections were made in a whole class discussion mode and the learners who failed were told to copy what was written. In some cases, the teacher was also marking this copied work. An extract of lesson 28 below exemplifies this situation.
69. **Teacher** – Ok, this shows that if we add 1 to 3, we get 4 that is
\[ 3 + 1 = 4 \]
Now everyone should get his/her notebook and write these problems. (The teacher wrote the following problems) 2 + 0 = and 1 + 2 = . Listen. Write the word ‘masamu’ (mathematics) before writing your work. (The teacher distributed counters (bottle tops) in groups and asked the learners to be lending the counters to each other as some learners did not have counters. Learners did the work individually). Those who have finished should raise their notebooks (The teacher marked the learners’ work while the learners were in their groups). Look here (Invited two learners, a boy and a girl). How many people are here? We use these people in front here to find the answer. Let us count

70. **Learners** – 1 2
71. **Teacher** – let us count again
72. **Learner** – 1 2
73. **Teacher** – what should we add
74. **Learner** – Two
75. **Teacher** – No, What are we supposed to add here?
76. **Learners** – zero
77. **Teacher** – Are we going to add anything?
78. **Learner** – No
79. **Teacher** – Then let us count these people again to see how many they are
80. **Learners** – 1 2 (Counted the learners together with the teacher)
81. **Teacher** – This means the answer is what?
82. **Learners** - 2
83. **Teacher** – Ok, the other problem) 1 + 2 = Can one person come here. What number will this person represent?
84. **Learner** – 1
85. **Teacher** – Thank you. (Then took 2 other children). How many are here? (Pointing at the two children).
86. **Learners** – 1, 2
87. **Teacher** – Let us now put them together. How many are they now?
88. **Learner** – 1,2 ,3 (Counted the learners together with the teacher)
89. **Teacher** – That means that 1 + 2 = 3. Those who have failed should write again. (Those who had failed were busy writing, copying what the teacher wrote on the chalkboard and the teacher marked their work, after she was through she called for her counters). Give me my counters.

(Lesson 28, 20th January 2017)

In extract of lesson 28, the teacher moves to assigning individual work to learners in entry 69. Then when she had marked work for most learners who were through, the teacher uses a whole class discussion mode to find the answers to the two questions in entries 70 to 88. It is in entry 89 where we see the teacher asking learners who failed to find the answers to the questions to copy what the teacher wrote on the chalkboard and she marked their work.
When marking and correction of the work that was done individually was over, the teacher then concluded the lessons in many ways.

4.4.7 Concluding activities

Twenty out of the 28 lessons that were observed were concluded. All the 20 lesson reflected the numeracy and mathematics curriculum. Learning opportunities were provided to the learners because of the nature of the concluding activities in 19 lessons. An extract below demonstrates an example where learning opportunity was provided to the learners.

171. **Teacher** – ... I will mark your work later. How many objects were we looking at today?
172. **Learners** – 6 (Learners responded on top of their voice).
173. **Teacher** – How many objects
174. **Learners** – 6
175. **Teacher** – Ok. If we have 5 leaves and we have added one leaf, how many leaves will there be altogether?
176. **Learners** – 6
177. **Teacher** – How many?
178. **Learners** – 6
179. **Teacher** – What if we have 5 stones and we have added one stone. How many stones will there be?
180. **Learners** – 6 (responded learners)
181. **Teacher** – If I have 5 books. Let’s count
182. **Learners** - 1,2,3,4,5
183. **Teacher** – And if I add one more book, how many books will there be?
184. **Learners** - 6
185. **Teacher** – Now let us count these leaves.
186. **Learners** – 1,2,3,4,5
187. **Teacher** – If I add one more leaf, how many leaves are there altogether?
188. **Learners** - 6
189. **Teacher** – Hands up. Clap hands twice
190. **Learners** – Clap clap
191. **Teacher** – Anybody with a question?
192. **Learners** – No

(Lesson 19, 23rd January, 2017)
In the extract from lesson 19 above, Alice was introducing 6. What is seen in this extract is a conclusion of her lesson. It can be seen that the teacher was in a way involved in teaching and the learners were further given opportunity to learn.

As the lessons were being concluded, teachers were seen teaching the learners in 16 lessons. The extract above demonstrates this. In some cases, teachers sang songs with learners as a way of concluding a lesson. This was seen in 10 lessons. The songs that were sang were in most cases a reflection of the content that was covered. The songs sang have been documented in the episode on whole class discussion. An example of a situation with a song as a concluding activity can be seen in the extract below.

| 64. Teacher – | What number have you written? |
| 65. Learner – | 0 (Responded the learners) |
| 66. Teacher – | (Then the teacher started a song). *Tiwerenge* |
| 67. Learners - | *Manambala* |
| 68. Teacher – | *Tiwerenge* |
| 69. Learner – | *Manambala* |
| 70. Teacher – | Kuwerenga (The teacher had set of numbers in her hands – flashed a paper with three 1’s) |
| 71. Learners – | 1 1 1 |
| 72. Teacher – | Kuwerenga (She flashed a paper with three 3’s) |
| 73. Learner – | 3 3 3 |
| 74. Teacher – | Kuwerenga (The teacher flashed a paper with three 2’s) |
| 75. Learners - | 2 2 2 |
| 76. Teacher – | Kuwerenga (The teacher flashed a paper with three 0’s) |
| 77. Learner – | 0 0 0 |

(Lesson 18, 30th September, 2016)

In the extract of lesson 18 above, Alice was teaching how to write 0. It is in entries 66 to 77 where the teacher is singing the song with the learners. Learners are further given opportunity to look at all the numbers they have covered by this day (Numbers from 0 to 3).
It was only in two lessons where individual attention was observed to take place during the concluding activities. These were situations where learners were asked to write a numeral but they failed hence the teacher gave individual attention to them.

It was in 2 lessons where teachers were observed to seek confirmation from other learners during the episode. This was because a question and answer approach was used in some cases during the conclusion. When learners got the right answers, motivation followed in 8 lessons (motivation has been explained earlier on in this section – see episode on recap of previous work).

Some teachers provided opportunities for leaners to work on mathematics activities at home. This was done after the conclusion but before switching to another subject.

4.4.8 Take home assignment

From the 28 lessons that were observed, it was in 11 lessons where teachers were seen to give home work to learners. Further, it was 4 out of five teachers that gave out homework to learners. Take home assignment was generally based on the work that was covered during the lesson. As such, homework reflected the Numeracy and mathematics curriculum. The following extracts from lessons exemplifies this.

66. Teacher- (When marking was through) everybody should pack his/her notebook. We will sing a song – sang the song alone and then sang it together with the learners). When we go home, everybody should write the number 2. Tell the people you stay with that you want to write 2. Tomorrow we will learn 3.

(Lesson 7, 21st September, 2016)

89. Teacher – When you go home, draw 4 boxes and put objects as we did here and write the number corresponding to the number of objects in the box. Write the numbers below the boxes.

(Lesson 17, 29th September)

193. Teacher – I will now give you homework. Pluck six leaves and count them in front of your mother. You should also draw six eggs. I will look at what you will have drawn tomorrow. This is the end of the time for mathematics.

(Lesson 19, 23rd January, 2017)
Since learners were supposed to work on the homework, learning opportunity was therefore provided to them to reinforce what was covered in the lesson. As the take home assignment was being given to the learners, the teachers explained clearly what they expected the learners to do on the assignment. This means that there was to a small extent teaching involved.

When carrying out the take home assignment, tools were involved. The tools used were in most cases not different from what were used during either the whole class discussion or the group work activities. No special tool is therefore presented in this sub-section.

Some assignments involved generation of artefacts for example

<table>
<thead>
<tr>
<th>193. Teacher – I will now give you homework. Pluck six leaves and count them in front of your mother. You should also draw six eggs. I will look at what you will have drawn tomorrow. This is the end of the time for mathematics.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Lesson 19, 23rd January, 2017)</td>
</tr>
</tbody>
</table>

| 55. Teacher – It is slightly bent. 1 should be straight. Let us clap hands for these two. (Learners clapped hands). Now when you get home, everybody should mould 1 with clay. What are you going to mould? |
| 56. Learner – One |
| 57. Teacher - Tomorrow, everybody should come back with and show me the 1 that you will mould with clay. Are you going to mould it for me? |
| 58. Learner – Yes |
| 59. Teacher – Ok. So bring 1 moulded with clay. Thank you so much. This is the end of the mathematics lesson. |
| (Lesson 1, 19th September, 2016) |

In the extracts of both lessons 1 and 19 above, artefacts were generated. In lesson 1, 1 moulded with clay was to be made by the learners while in lesson 19, learners drew eggs in their notebooks.

A study of Table 4.2 reveals that for Teachers Y and A, giving assignments is one of the rituals in their classes. This is so because out of the 6 lessons that were observed in
Alice’s class, it was in 5 of them where learners were given take home exercise. Out of 4 lessons that were observed in Yvone’s class, it was in 3 of them where learners were given homework. This means that after almost every Numeracy and mathematics lesson, learners were expecting to have a take home assignment. It was however sad that not all learners were doing the assignments. For example the extracts below show figures of learners who did the take home assignments for Alice;

5. Teacher – Those who did the homework I gave you, raise your hands
6. Learners – (23 learners raised their hands)
7. Teacher – Some of you forgot to write 7. Put down your hands. These will be given good. I will mark their work during the time of marking. Yesterday. We wrote a number. What was the number that we wrote?

(Lesson 22, 2nd February, 2017)

It can be observed that out of the 91 learners who were part of lesson 20, only 9 learners did the homework as seen in the extract from lesson 21 above entry 4. Further, out of 96 learners who were part of lesson 21, only 23 learners did the home work as seen in the extract from lesson 22 above, entry 6.

This is why Xenia, after seeing this problem, introduced prize giving. Those who worked on the assignment were either promised or given a prize. This was in a bid to encourage other learners to also be carrying out the assignments. For example, in Lesson 1, Xenia asked the learners to mould 1 with clay. When she was beginning to teach during lesson 2, she asked those who moulded 1. Only 1 learner moulded 1 and the learner was given a prize.

For written work, the marking of the assignment was done during the time the days’ work was being marked. Learners who wrote the assignment were told to open where the answers to the assignment were written. The following extract is an evidence of such a practice.

5. Teacher – Those who did the homework I gave you, raise your hands
6. Learners – (23 learners raised their hands)
7. Teacher – Some of you forgot to write 7. Put down your hands. These will be given good. I will mark their work during the time of marking. Yesterday. We wrote a number. What was the number that we wrote?

(Lesson 22, 2nd February, 2017)
The episodic early grade mathematics life has been explained. It is now important to understand the type of learners that went through these episodes.

4.5 CHILDREN’S MATHEMATICAL ‘LIFE-WORLDS’
This section presents the details of the children’s everyday life in the mathematics classrooms where they were being introduced to numeracy.

4.5.1 Who are the Standard 1 learners in the five schools?
I received permission to conduct focus group interviews with 24 children (12 were male and 12 were female). It is worth noting that it was not possible to conduct a focus group discussion at one school due to reasons beyond my control. This is why 24 learners are mentioned instead of 30 learners. The average age of the learners was 7. Figure 4.6 below shows the distribution of the ages of the learners to give an idea of the spread of the learners’ ages.

![Distribution of learners’ age in the focus groups](image)

Figure 4.6: Distribution of learners’ age in the focus groups

4.5.2 What were the learners’ general feelings about school?
Learners who participated in the focus groups were asked how they feel when they come to school in the morning.
Table 4.4: Learners feelings when they come to school in the morning

<table>
<thead>
<tr>
<th>Feeling</th>
<th>Frequency</th>
<th>Percentage (N=24)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Happy</td>
<td>15</td>
<td>62.5</td>
</tr>
<tr>
<td>Good</td>
<td>6</td>
<td>25.0</td>
</tr>
<tr>
<td>Very good</td>
<td>2</td>
<td>8.3</td>
</tr>
<tr>
<td>Proud</td>
<td>1</td>
<td>4.2</td>
</tr>
</tbody>
</table>

Table 4.4 reveals that all learners have a positive outlook about schooling since all of them were either feeling happy, good, very good or proud about coming to school in the morning.

4.5.3 What are the subjects that learners like most at school?

Learners were asked to mention the subject they like very much. Table 4.5 shows their responses.

Table 4.5: The subject learners like very much

<table>
<thead>
<tr>
<th>Subject</th>
<th>Frequency</th>
<th>Percentage (N=24)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chichewa</td>
<td>8</td>
<td>33.3</td>
</tr>
<tr>
<td>English</td>
<td>7</td>
<td>29.2</td>
</tr>
<tr>
<td>Expressive arts</td>
<td>4</td>
<td>16.7</td>
</tr>
<tr>
<td>Mathematics</td>
<td>3</td>
<td>12.5</td>
</tr>
<tr>
<td>Religious education</td>
<td>2</td>
<td>8.3</td>
</tr>
</tbody>
</table>

It is noteworthy that already at the beginning of their school career most children do not ‘like’ mathematics. The learners were also given an opportunity to mention the second subject that they like. Results are documented in Table 4.6 below.
Table 4.6: Another subject learners like

<table>
<thead>
<tr>
<th>Subject</th>
<th>Frequency</th>
<th>Percentage (N=24)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chichewa</td>
<td>6</td>
<td>25.0</td>
</tr>
<tr>
<td>English</td>
<td>5</td>
<td>20.8</td>
</tr>
<tr>
<td>Mathematics</td>
<td>5</td>
<td>20.8</td>
</tr>
<tr>
<td>Religious education</td>
<td>1</td>
<td>4.2</td>
</tr>
<tr>
<td>Bible knowledge</td>
<td>1</td>
<td>4.2</td>
</tr>
</tbody>
</table>

Table 4.6 shows the second choice of the subject learners like. It can be noted that the right column does not add up to 100% because some learners (25%) did not have another subject which they liked. Unlike in Table 4.5 above, Table 4.6 shows more learners liking mathematics as their second choice. A combination of Table 4.5 and 4.6 shows that about 33% of the learners that participated in the focus group discussion like mathematics with varied degree of liking of course.

It was interesting to find out why the learners like the subjects they said they liked most. The reasons learners gave for their liking the subjects are presented in Table 4.7 below.

Table 4.7: Reasons for liking a subject most

<table>
<thead>
<tr>
<th>Subject</th>
<th>Reasons for liking the subject most</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chichewa</td>
<td>• I want to learn Chichewa and be able to read</td>
</tr>
<tr>
<td></td>
<td>• Because we read</td>
</tr>
<tr>
<td></td>
<td>• Because it makes me happy</td>
</tr>
<tr>
<td></td>
<td>• Because I like writing</td>
</tr>
<tr>
<td></td>
<td>• Because I want to learn to read</td>
</tr>
<tr>
<td>Expressive arts</td>
<td>• Because I want to learn English</td>
</tr>
<tr>
<td></td>
<td>• Because we read</td>
</tr>
<tr>
<td></td>
<td>• Because we sing</td>
</tr>
<tr>
<td>English</td>
<td>• Because of reading</td>
</tr>
<tr>
<td></td>
<td>• Because I like singing songs</td>
</tr>
<tr>
<td></td>
<td>• I like reading</td>
</tr>
<tr>
<td></td>
<td>• Because we learn and write</td>
</tr>
<tr>
<td>Mathematics</td>
<td>• I like mathematics because I get right answers when I have been given an exercise</td>
</tr>
<tr>
<td></td>
<td>• It makes me happy and I am pleased with it</td>
</tr>
<tr>
<td></td>
<td>• Because I like reciting numbers</td>
</tr>
</tbody>
</table>
The reasons have been written the way the learners expressed them. Some learners were however not able to say why they liked the subject they said they like.

**4.5.4 What makes learners happy when learning mathematics?**

Learners were asked to explain what makes them happy when learning mathematics. There were two main triggers of their happiness. Table 4.8 below is the results.

<table>
<thead>
<tr>
<th>What makes learners happy</th>
<th>Frequency</th>
<th>Percentage (N=24)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Writing mathematics</td>
<td>11</td>
<td>45.8</td>
</tr>
<tr>
<td>Reading numbers</td>
<td>5</td>
<td>20.8</td>
</tr>
<tr>
<td>Counting</td>
<td>1</td>
<td>4.2</td>
</tr>
<tr>
<td>Touching a mathematics book</td>
<td>1</td>
<td>4.2</td>
</tr>
</tbody>
</table>

Table 4.8 above shows what made learners feel happy during mathematics lessons. Writing mathematics is basically about writing exercises the teacher gives the learners during the lessons. It appears that 11 out of the 24 learners were triggered by this aspect. It can be noted that the percentage does not add up to 100% because some learners did not respond to this question. They were not able to say anything that makes them happy during mathematics lessons. It was also necessary to find out what made them worried during mathematics lessons. The next subsection will give out the details.
4.5.5 What makes learners worried when learning mathematics?

Learners were asked to explain what makes them worried when they are learning mathematics. Table 4.9 below is a display of the results.

Table 4.9: Triggers of worry during mathematics lessons

<table>
<thead>
<tr>
<th>What makes learners worried</th>
<th>Frequency</th>
<th>Percentage (N=24)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nothing</td>
<td>7</td>
<td>29.2</td>
</tr>
<tr>
<td>Counting</td>
<td>1</td>
<td>4.2</td>
</tr>
<tr>
<td>Subtraction of numbers</td>
<td>1</td>
<td>4.2</td>
</tr>
<tr>
<td>Reading numbers</td>
<td>1</td>
<td>4.2</td>
</tr>
</tbody>
</table>

Table 4.9 shows what makes learners worried when they are learning mathematics. Only 10 learners responded to this question. The assumption is that those who were quiet did not have anything that made them worried during the learning of mathematics. Seven (29.2%) of the learners came outright that there is nothing that makes them worried when they are learning mathematics.

4.5.6 What are the learners’ expectations of what is supposed to happen in mathematics classes?

Learners were asked about what they would like to be happening in a mathematics class. The responses were summarized and are presented here below in Table 4.10.

Table 4.10: What learners would like to be happening in a mathematics class

<table>
<thead>
<tr>
<th>Activity</th>
<th>Frequency</th>
<th>Percentage (N=24)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Should be writing</td>
<td>10</td>
<td>41.7</td>
</tr>
<tr>
<td>Should be counting</td>
<td>2</td>
<td>8.3</td>
</tr>
<tr>
<td>Should be reading numbers</td>
<td>2</td>
<td>8.3</td>
</tr>
<tr>
<td>Teacher should be writing on chalkboard</td>
<td>2</td>
<td>8.3</td>
</tr>
</tbody>
</table>
It can be seen from the table that 10 out of 24 learners would like to be writing in the classroom. Some learners went to specify the purpose for the writing and they had this to say;

‘we should write so that we should be marked’ (a Standard 1 learner from Msika primary school)

‘we should be writing so that we should not fail examinations’ (a learner from Msika primary school).

When asked as to what other learners in the classroom should be doing, the learners had varied answers. Table 4.11 is a display of the responses they gave.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Frequency</th>
<th>Percentage (N=24)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Writing mathematics exercises</td>
<td>9</td>
<td>37.5</td>
</tr>
<tr>
<td>Should be learning</td>
<td>4</td>
<td>16.7</td>
</tr>
<tr>
<td>Should be able to read</td>
<td>2</td>
<td>8.3</td>
</tr>
<tr>
<td>Should be listening</td>
<td>3</td>
<td>12.5</td>
</tr>
<tr>
<td>Should read numbers</td>
<td>1</td>
<td>4.2</td>
</tr>
<tr>
<td>Should be bringing counters</td>
<td>1</td>
<td>4.2</td>
</tr>
<tr>
<td>Should not be producing abusive language</td>
<td>1</td>
<td>4.2</td>
</tr>
</tbody>
</table>

It is interesting to note that 9 out of the 24 learners said exactly what they also said as to what they would want to happen in the mathematics classroom – writing mathematics.

4.5.7 What resources do learners use when learning mathematics?

Learners were asked to mention the resources that they use when learning mathematics. Twenty two (22) learners responded to this question. Figure 4.7 below displays the responses they gave out during the focus group discussion.
It is evident from Figure 4.7 that the learners mostly use bottle tops when learning mathematics. Learners explained that the resources they mentioned were very helpful in that they made them get the correct answers to the exercises their teachers gave them. Hence they are assisted by the resources to solve well. All the resources in Figure 4.7 except one (pencils) are locally found. Observation of the resources used in the classroom agrees with what the learners explained as the resources they use when learning mathematics.

4.5.8 Who are the learners’ best friends in the mathematics class?

Learners were asked to name their best friends in the mathematics class. Only one mentioned the names. It should however be noted that some learners were not able to say why the people they mentioned were their best friends. For the 9 learners who were able to explain, they pointed out the following two reasons why the people they mentioned were their best friends:

Five learners said that their friends assist them. Some of the learners even specified the type of assistance they get from their friends. They talked of being assisted with
counting. One learner also described his friend as a person who does well in class and hence he assists him. The remaining 4 learners said that they chat with their friends.

4.5.9 How do learners engage with mathematics in everyday life?

It was important to find out whether mathematics is confined to the mathematics classroom. Learners were therefore asked as to whether they think about mathematics at home. They were also asked as to whether they count things on their way to and back from school. Responses to these questions are presented below.

When learners were asked as to whether they thought about mathematics at home, ten of them indicated that they thought about mathematics at home while 3 said they didn’t. The rest did not say anything on this question. Those who thought about mathematics at home were asked about the situations in which they thought about mathematics. Table 4.12 displays their responses.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Frequency</th>
<th>Percentage (N=24)</th>
</tr>
</thead>
<tbody>
<tr>
<td>When playing e.g. games like football and netball</td>
<td>6</td>
<td>25.0</td>
</tr>
<tr>
<td>When sent to grocery e.g. to buy cooking oil</td>
<td>2</td>
<td>8.3</td>
</tr>
<tr>
<td>When performing subtraction at home</td>
<td>1</td>
<td>4.2</td>
</tr>
<tr>
<td>When eating e.g. when eating nsima (pap)</td>
<td>1</td>
<td>4.2</td>
</tr>
</tbody>
</table>

Table 4.12 shows that learners engage themselves with mathematics at home in several situations. The major one being when they are generally playing at home including playing ball games.

When learners were asked as to whether they counted things on their way to and back from school, 13 of them indicated that they counted while 5 did not count (It was only learners from three schools that responded to this question. Learners from the other school were not provided opportunity to respond to this question because they were tired and it became difficult to get response from them, hence the discussion was
curtailed. This applies to the rest of the responses thereafter). The thirteen learners who indicated that they counted objects were asked to mention what they counted. One learner was not able to mention what she counted. Table 4.14 displays the responses from the remaining 12 learners.

Table 4.13: What learners counted on their way to and back from school

<table>
<thead>
<tr>
<th>Activity</th>
<th>Frequency</th>
<th>Percentage (N=24)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plants e.g. trees, maize and pigeon peas</td>
<td>5</td>
<td>20.8</td>
</tr>
<tr>
<td>Birds</td>
<td>2</td>
<td>8.3</td>
</tr>
<tr>
<td>Planks on a bridge</td>
<td>1</td>
<td>4.2</td>
</tr>
<tr>
<td>Posters</td>
<td>1</td>
<td>4.2</td>
</tr>
<tr>
<td>Bicycles</td>
<td>1</td>
<td>4.2</td>
</tr>
<tr>
<td>Shoes</td>
<td>1</td>
<td>4.2</td>
</tr>
<tr>
<td>People</td>
<td>1</td>
<td>4.2</td>
</tr>
</tbody>
</table>

Table 4.13 displays what the learners were counting on their way to and back from school. Table 4.13 reveals that 5 learners out of 13 were counting plants. An interesting response was where a learner said that he counted planks on the bridge. These are bridges where they lay planks on big logs of trees to make a river passable. These type of bridges are a common feature in most rural parts of Malawi. The learner who mentioned of counting bicycles came from an area where there are a lot of bicycles. These bicycles are used as a major form of transport as bicycle taxis.

4.5.10 How do learners feel about learning on the school ground?

Learners were asked as to how they would feel if their teacher did a mathematics class outside. It was found that out of 18 learners who were given an opportunity to respond to this question, 15 learners said that they would feel happy. These learners were therefore asked why they would feel happy working outside. Out of the 15 learners who said that they would feel happy, 13 responded to why they would feel happy. Table 4.14 displays their responses.
Table 4.14: Why learners would feel happy about working outside their classes

<table>
<thead>
<tr>
<th>Activity</th>
<th>Frequency</th>
<th>Percentage (N=18)</th>
</tr>
</thead>
<tbody>
<tr>
<td>We will be practicing writing</td>
<td>4</td>
<td>22.2</td>
</tr>
<tr>
<td>Nobody will copy what I will be writing</td>
<td>2</td>
<td>11.1</td>
</tr>
<tr>
<td>Being outside makes me feel happy</td>
<td>2</td>
<td>11.1</td>
</tr>
<tr>
<td>We will be reading</td>
<td>2</td>
<td>11.1</td>
</tr>
<tr>
<td>Will find chance to move around and play</td>
<td>2</td>
<td>11.1</td>
</tr>
<tr>
<td>The writing looks beautiful outside</td>
<td>1</td>
<td>5.6</td>
</tr>
</tbody>
</table>

Table 4.14 displays why learners would feel happy working outside their classes. It is evident from the table that 4 learners felt that being outside will afford them an opportunity to practice writing. An interesting response is where two learners are mindful about the privacy of their written work. They feel the wide area before them outside their classroom would afford them privacy unlike their classroom which are overcrowded.

The results presented in this section speak a lot to how standard 1 learners relate with mathematics. A discussion of these results in the next chapter reveals the role of these learners’ practices in the formulation of the mathematics classroom culture, the way of life of the mathematics classroom.

4.6 MATHEMATICS CLASSROOM CULTURE: ENABLED AND CONSTRAINED

This section presents the possible enablers of learning as well as possible challenges to learning related to the routines and the patterns of activity in the classrooms and also the bigger community of the schools. This is based on the understanding that there are a number of issues that affect the development of the mathematics culture both inside and outside the classroom.
The field notes and interview transcripts from the unstructured interviews with the teachers were read several times and issues that were considered to be possible enablers of learning and those that were considered possible challenges to learning were isolated. The notes and the interview transcripts were therefore coded with these two themes in mind. A lot of issues were identified and consequently written down. Both the enablers of learning and the challenges to learning were categorised. I therefore begin by presenting the possible enablers to learning as revealed by the study.

### 4.6.1 Possible enablers of learning

In total there were 7 categories of possible enablers of learning and 8 categories of possible challenges to learning. Table 4.15 below shows the details for the categories of possible enablers of learning.

**Table 4.15: Possible enablers of learning**

<table>
<thead>
<tr>
<th>Possible enablers</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher support (PEA supervision)</td>
<td>Professional support provided to teachers</td>
</tr>
<tr>
<td>Teacher support (School based CPD and Numeracy boost)</td>
<td></td>
</tr>
<tr>
<td>Teacher desire to grow professionally – additional skills-Pvt schools</td>
<td></td>
</tr>
<tr>
<td>Teacher support to mathematics teachers</td>
<td></td>
</tr>
<tr>
<td>Teacher signing in time book</td>
<td>Presence of good school discipline</td>
</tr>
<tr>
<td>Teacher signing in time book</td>
<td></td>
</tr>
<tr>
<td>Teacher signing in the time book</td>
<td></td>
</tr>
<tr>
<td>School rules for learners</td>
<td></td>
</tr>
<tr>
<td>Seeking permission when getting out of the school surrounding</td>
<td></td>
</tr>
<tr>
<td>Signing in time book</td>
<td></td>
</tr>
<tr>
<td>Signing in time book</td>
<td></td>
</tr>
<tr>
<td>Class leaders (Criteria for selection and roles)</td>
<td></td>
</tr>
<tr>
<td>Class leaders</td>
<td></td>
</tr>
<tr>
<td>Class leaders</td>
<td></td>
</tr>
<tr>
<td>Classroom rules</td>
<td></td>
</tr>
<tr>
<td>School rules</td>
<td></td>
</tr>
<tr>
<td>Special feeding programme (street kids)</td>
<td></td>
</tr>
<tr>
<td>Learners motivated during assembly</td>
<td>Presence of extrinsic teacher and learner motivation</td>
</tr>
<tr>
<td>End of year activities (Learner motivation and feedback)</td>
<td></td>
</tr>
<tr>
<td>Teacher supported (verbal encouragement and resources)</td>
<td></td>
</tr>
<tr>
<td>End of year closing arrangements (Gift presentation)</td>
<td></td>
</tr>
<tr>
<td>Teacher motivated by community (gifts)</td>
<td></td>
</tr>
<tr>
<td>School committee presents gifts to teachers</td>
<td></td>
</tr>
<tr>
<td>Possible enablers</td>
<td>Category</td>
</tr>
<tr>
<td>---------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Community participation</td>
<td>Community organised support towards school activities</td>
</tr>
<tr>
<td>Community participation – cash collection</td>
<td></td>
</tr>
<tr>
<td>Community participation – learners given letters inviting parents to school</td>
<td></td>
</tr>
<tr>
<td>Community participation – built temporary shelter</td>
<td></td>
</tr>
<tr>
<td>School community linkages</td>
<td></td>
</tr>
<tr>
<td>Adequate learners books</td>
<td>The nature of teaching and learning resources and methods used</td>
</tr>
<tr>
<td>Teaching resources used</td>
<td></td>
</tr>
<tr>
<td>Teaching resources</td>
<td></td>
</tr>
<tr>
<td>Teaching resources – real objects</td>
<td></td>
</tr>
<tr>
<td>Teaching methods used</td>
<td></td>
</tr>
<tr>
<td>Teaching methods used</td>
<td></td>
</tr>
<tr>
<td>Approaches for teaching Chichewa applied in mathematics</td>
<td></td>
</tr>
<tr>
<td>Use of tools versus stories in teaching addition and subtraction</td>
<td></td>
</tr>
<tr>
<td>Financing of resources at the school</td>
<td></td>
</tr>
<tr>
<td>Continuous assessment (One note book used the whole year)</td>
<td>Curriculum compliance</td>
</tr>
<tr>
<td>Curriculum compliance</td>
<td></td>
</tr>
<tr>
<td>Hands clapped a given # of times during assembly</td>
<td>Learners’ application of mathematics outside the classroom</td>
</tr>
<tr>
<td>Games during end of year (Fish fish &amp; fly)</td>
<td></td>
</tr>
<tr>
<td>Games during end of year (Fish fish &amp; fly)</td>
<td></td>
</tr>
<tr>
<td>Games during end of year (Fish fish &amp; soccer)</td>
<td></td>
</tr>
</tbody>
</table>

As can be observed from Table 4.15 there were 7 categories into which codes awarded to utterances and observations were collapsed. These are; professional support provided to teachers, presence of good school discipline, presence of extrinsic teacher and learner motivation, community organised support towards school activities, the nature of teaching and learning resources and methods used, curriculum compliance and learners’ application of mathematics outside the classroom. Out of these, 6 will be explained thoroughly. As for curriculum compliance, which will not be thoroughly explained, suffice to write that an observation of all the 28 lessons (see appendix 1 for content of the lessons) indicated that teachers adhered to the stipulated national primary curriculum as presented in the mathematics syllabus, teachers’ guide and learners’ books. This was evident in the content that the teachers taught and the methods that they used since a comparison of the content taught and what is the curriculum materials was made during the observation period.
Professional support provided to teachers

There was some evidence of professional teacher support in three out of the five primary schools. Teacher support took three forms. These include; continuous professional development, provision of resources and support from Primary Education Advisor (PEA). In all the schools, teachers were given some resources for use during the teaching of mathematics. The resources included; the mathematics syllabus, the teachers’ guide and in some cases, charts and pentel markers. Continuous professional development was evident at one school. At this school, mathematics teachers in the early grade classes went through in-service training sessions by an international non-governmental organisation (Save the Children) under a project called Numeracy Boost. A teacher at this school had this to say,

‘Numeracy boost is a Save the Children project. It targets the teaching of mathematics in standard 1 to 4. We used to attend frequent training sessions. But last year it was once. This year too, we have attended once. During the training, we cover a number of areas, some of them include; Introduction of numbers, addition of numbers, subtraction of numbers and multiplication of numbers.’ (Standard 1 teacher at Phiri, 21st September 2016)

During an unstructured interview with the head teacher (principal) of the school where the project is being implemented, the head mentioned that the school also organises school based continuous professional development support sessions. This however did not come out during the discussion with the teacher. Much as a look on the walls showed the days when these sessions were supposed to be done as seen in Figure 4.8 below.
Figure 4.8: Continuous professional development programme at Phiri School

Figure 4.8 above displays the continuous development programme 2015/2016 academic year at Phiri primary school displayed in the head teachers’ office.

The last aspect of teacher support was the support provided by the Primary Education Advisors (PEAs). I met with the PEA at two of the schools where the study was conducted. In one case, the PEA targeted all teachers while in another case, the PEA only targeted the standard 1 teacher who was teaching Chichewa at the time of the study to monitor how the National reading Programme was going.

An interesting case was heard at one of the schools where the teacher showed her desire to grow professionally by networking with teachers in private schools to acquire more information on how to handle the teaching of some mathematical concepts.

Presence of good school discipline

Much as there were many learners loitering around during the last week of the academic year, subsequent visits to the schools revealed that the schools generally had good discipline. This applied to both teachers and learners. The discipline was evident in the way learners conducted themselves during the lesson times. When you get to the schools, if by chance no chorus responses were made, one could think that the children are not at the school. There was no loitering around of learners during lesson times in all the five schools. This discipline was also evident in the morning as the teachers were reporting for duties. Except for days when there was bad weather, teachers were seen to get to the school before the start of the lessons. In all the schools, a check in system was instituted. All teachers were asked to sign in the time they arrived at the school. A time book was used for that purpose. Teachers were also supposed to check out when
they are leaving the school. This was however not fully done. A look at one of the time books revealed that the time for leaving the school was mostly blank.

Getting to the classes, it was evident that there were disciplined learners. In each of the five classes that were visited, there were class monitors that were chosen. The number of monitors chosen varied from class to class. In some classes, there were only two monitors while in some, there were more than two monitors. There appeared to be convergence on how the monitors were chosen. In these five schools, monitors were chosen based on their academic ability and attendance to classes. When teachers were asked as to what the roles of the monitors were, some teachers had this to say during the unstructured interviews I had with them;

| R   | Ok. I have noted that there are leaders in your class? |
| T   | Yes.                                                  |
| R   | How many are they?                                   |
| T   | There are three leaders. Two boys and one girl.      |
| R   | what are their roles?                                |
| T   | Their roles include:                                 |
|     | • Distribution of books/slates                       |
|     | • Controlling noise                                  |
|     | • Reporting any eventuality in class e.g. accidents  |
|     | • Drawing drinking water for the class (a bucket is placed outside the classroom) |
|     | • Guide other learners during lessons                |
| R   | Thank you. Who selected them?                        |
| T   | It was done by myself?                               |
| R   | What criteria did you use in selecting them?         |
| T   | I chose those who are intelligent and older than their friends. |
| R   | Do you have rules in your class (I did not see a copy of the rules in the classroom) |
| T   | Yes                                                  |
| R   | What are they?                                       |
| T   | They are;                                             |
|     | • Observance of punctuality                           |
|     | • No noise                                            |
|     | • No fighting                                         |
|     | • No theft                                            |
|     | • No kusinana (pinching)                              |
| R   | Thank you                                            |

(Post lesson interview with standard 1 teacher, 27th September, 2016)
R Ok. Do you have leaders in your class?
T Not yet. The learners are under observation. We will have leaders during the fourth week.
R Who is responsible for selecting the leaders?
T I will do it myself.
R What criteria will you use in selecting the leaders?
T I will base on good attendance and performance. Those who usually get answers to my questions correct.
R Fine. How many will they be?
T They will be four (2 boys and 2 girls)
R What will be their roles?
T They will be monitoring their friends, controlling noise and ensuring that there is discipline in the classroom and ensuring that their friends are inside the classrooms not outside playing.
R Thank you so much.

(Post lesson interview with standard 1 teacher, 23rd September, 2016)

In the extracts of the two interviews above, R stands for the researcher while T stands for the teacher. In the interview extracts, a number of roles played by the class leaders are mentioned. The criteria for selection is also mentioned. The leaders were seen to be doing most of these roles mentioned above during the time lessons were being observed. It can also be seen from the interview held on 27th September that the class has some unwritten rules. This was also true with other classes where lessons were observed. It was only at one school where classroom rules were displayed in the classroom as shown in Figure 4.9.
Figure 4.9: Classroom rules in one of the classes

Figure 4.9 shows classroom rules in one of the classrooms. Since the rules are in Chichewa, the following is a translation of the rules in order of their appearance.

1. Don’t make noise
2. We should be standing when responding to questions
3. Don’t eat your food inside the classroom
4. Don’t use foul language on your friend
5. We should tell the teacher when our friends offend us.
6. Write the work you have been given to write
7. Come to school early
8. A recovered lost object should be given to the teacher

In addition to the classroom rules, the schools did also have school rules. These rules were mostly hang in head teachers’ office and mostly communicated to learners during the morning assemblies. An example of the school rules can be seen in Figure 4.10 below.
Figure 4.10 shows the school rules displayed in the head teachers’ office at one of the schools where the study was carried out. As pointed out earlier, access to the written school rules by learners is limited hence the rules are usually spelt out during the morning assemblies. Learners were communicated bits and pieces of the rules every time and again.

**Presence of extrinsic teacher and learner motivation**

Teacher extrinsic motivation constituted the gifts the members of the community gave to the teachers at the end of the term. This was narrated by head teachers of two of the schools that were visited during an informal discussion with them. The prizes were said to be mostly in form of cash. The amount of cash was however not disclosed. The other way by which the teachers are motivated according to one head teacher was through verbal encouragement and providing them with the resources they need for teaching. One head teacher had this to say during an unstructured interview with him during one of the visits,

‘*The school provides the following support to the numeracy and mathematics teachers:*
- Teaching and learning materials like – curriculum books
- Assist them in preparing teaching and learning resources
- Assist them in resolving errors observed during lesson observation sessions and lesson plan checkup (teachers are expected to show the lesson plans that they have prepared to either the school head or the section heads.)

(Field notes, July 2016)

As for learner motivation, this constituted of presentation of gifts to them and verbally encouraging them to work hard during assembly. As the gifts, this was reported by head teachers from three schools. It was reported that learners who do well at the end of either the year or the term are given gifts. The presented gifts comprised mainly of writing materials like notebooks and pens.

**Community organised support towards school activities**

The community in the school under study were seen to be involved in the school activities. The major activity that the school was seen to be engaged in was in trying to sort out the challenges relating to shortage of classrooms. The community managed to build grass and wooden poled structures as seen in Figures 4.11 and 4.12 below. In figure 4.11, the following field notes give more details on what transpired for the community to build the shelter.

One day the wind blew over the school leaving some teachers’ houses and classroom blocks without roofs. The teacher’s house was worked on. One teacher however said that it may take time for the roofs of the classrooms to be brought back because of the high cost involved in carrying out the task. The community had to make a temporary shelter which cost about K50, 000 (an equivalence of US$68 at US$1 to MWK733). It was on the day of visit being used by the two standard 3 classes.

(Field notes, 9th January, 2017)
Figure 4.11: Grass and wood classrooms (far left) and blown off classroom (inset)

The school block inserted in Figure 4.11 above are the ones referred to in the field notes to have had their roof blown off. The white coloured classrooms seen in Figure 4.11 above were constructed by a tobacco company doing its agricultural activities in the area as cooperate social responsibility. It's the same company that also built a head teacher office and staffroom at the school.

Figure 4.12: Community built structure at one of the schools
The structure seen in Figure 4.12 was however not used during the rainy season because the water could get into the classroom making the classroom inhabitable.

Apart from parents’ material contribution to the schools, extra financial resources used in the construction of the temporary classrooms do come from school development fund that the learners contribute every term. The school committee members are the ones responsible for the collection of the funds. The presence of these committee members was seen in two schools that were visited much as all the five schools have the same practice on this issue.

At another school, learners were given letters for their parents to come to school the following day to discuss several issues including parents’ support to children’s learning and construction of classes.

**The nature of teaching and learning resources and methods used**

The teaching resources used during the teaching of mathematics were mostly seen to be locally available, they were resources that learners were used to in their daily life. Example of such resources have been documented in Section 4.4.4 when we were looking at the resources the teachers used in different episodes of the mathematics lessons. This was evident in all the five schools. A Standard 1 teacher at Nyanja primary school had this to say on the resources, ‘I use real objects, pictures and other objects in teaching numbers. In standard 1, you need to use real objects and learners should also use real objects’.

The use of songs was also common among the standard 1 teachers. The use of songs has however been explained thoroughly in sections 4.4.1 and 4.4.4. The following conversation with a standard 1 teacher at Phiri primary school revealed something about the use of songs,

<table>
<thead>
<tr>
<th>R</th>
<th>I noted that you used songs during the introduction and within the lesson. Can you tell me about the songs where do you get them? Who teaches you?</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>In introduction, we usually use songs related to the lesson. Some songs are written in the introduction to school life and learning book. Further, in EGRA, we have a session when we learn songs.</td>
</tr>
</tbody>
</table>

(Post lesson interview with standard 1 teacher, 21st September 2016)
EGRA is an acronym standing for Early Grade Reading Activity. However currently EGRA has transformed into the National Reading Programme (NRP). From the response given in the interview extract above, it is clear that some teachers apply what they have learnt in one subject to another subject like it is in this case. The same teacher was also seen to use other approaches that she uses when teaching Chichewa during mathematics lessons. I asked the teacher about the approach she used which was not common to mathematics but because of my basic knowledge about what is happening in NRP, I was able to see the transfer of knowledge from Chichewa teaching to mathematics teaching. This is what the teacher had to say when I asked her,

“The skills that I learnt in teaching Chichewa I also apply in teaching mathematics. This is my creativity. Nobody taught me how to do this’

(Post lesson interview with standard 1 teacher, 21st September, 2016)

In terms of curriculum materials, learners’ books to be specific, it was at one school where the teacher indicated that she had adequate books for the learners.

As for the type of methods used during the teaching and learning of mathematics, all the five teachers in the five schools indicated that they use learner centred methods. For example two of the five teachers had this to say, ‘when teaching Numeracy and mathematics, I use question and answer, discussion, explanation, practical and group work’, ‘some of the methods I use when teaching Numeracy and mathematics include: group work, individual exercises, pair work, observation, question and answer, discussion, mental sums and peer assessment’. A look at the lessons that were presented agreed with what the teachers said. All of them were indeed using learner centered methods when their lessons were observed.

**Learners’ application of mathematics outside the classroom**

An observation of the learners outside classroom revealed that there were a number of activities that took place outside their classrooms that had a bearing on their learning of mathematics. The first case was when they were attending morning assemblies. Learners were asked by the teacher on duty in all the five schools to clap hands a given number of times. Mentioning the number name each time they were clapping hands.
Further, during break or at the end of the year when they were through with writing their examinations, some learners were seen to be involved in several games. Some of the games they were involved in include ‘fish fish’ and ‘fly’. The following is a description of the two games;

I will begin with a description of ‘fish fish’. This game uses a rope. Two people will turn the rope while one or more people jump in the middle. This game is often accompanied by either singing to help the players stay in rhythm or counting as far as they can get while jumping. The one who gets very far with counting wins the game. The person jumping needs to ensure that the rope does not touch him/her when either getting in or while inside jumping or when getting out.

Turning to the other game, fly, in this game, players play by either stacking bricks up or filling a bottle with sand or soil. To win, you need to have the biggest number of times of either filling the bottle with sand or stacking the bricks. At each moment, three people can play the game. Two people on each of the two ends while one person is in the middle. The two throw a ball at each other and always looking for an opportunity for hitting the person in the middle with a ball. If the person is hit with a ball, his turn is lost and another person gets in. If instead of being hit with the ball, the person catches the ball with his/her hands, s/he throws the ball very far away. While one person goes to fetch the ball, the person in the middle fills and empties the bottle with sand/soil as fast as s/he can while keeping track of the number of times the bottle has been filled (It works the same with stacking and unstacking of bricks).

And yet at another school, there is a street kid programme. The following are the details of the programme according to an unstructured interview with the head teacher of the school,

The school has a special feeding programme for street kids. Street kids from the City are encouraged to go back to school. When they get to the school, food is prepared and provided to them every day. It is however only lunch that is provided to them. The policy is that if they have missed the classes, they cannot partake of the lunch. The goal of the programme is to bring street kids back to school. The programme is run by a committee and there are currently 18 street kids. The kids are supported as far as they can go with their studies. Some learners still get to the streets after learning but some stop going there. Apart from lunch, the kids are also given uniform, blankets, soap, learning materials like notebooks and pens, bags and games.

(Field notes, July 2016)
This special feeding programme therefore makes the learners attend lessons hence have access to the learning of mathematics.

Having looked at the possible enablers to learning, it is important to understand the possible challenges to learning met by the learners in the study.

4.6.2 Possible challenges to learning

As explained in the introduction of this section (4.6), Table 4.16 displays the resultant categories of the possible challenges to learning.

*Table 4.16: Possible challenges to learning*

<table>
<thead>
<tr>
<th>Possible challenges</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learners’ failure to write some numerals e.g. 5, 6, and 9</td>
<td>Learners’ failure to perform mathematical tasks</td>
</tr>
<tr>
<td>Have learners with learning difficulty</td>
<td></td>
</tr>
<tr>
<td>Learners having problems with writing some numbers like 5 and 6</td>
<td></td>
</tr>
<tr>
<td>Learning having problems with arranging numbers in descending order</td>
<td></td>
</tr>
<tr>
<td>Learner having problem with transferring the concrete to abstract</td>
<td></td>
</tr>
<tr>
<td>Learners failing to write the numeral 6</td>
<td></td>
</tr>
<tr>
<td>Learners have problems with completing missing numbers</td>
<td></td>
</tr>
<tr>
<td>Learners have problems with writing numbers in descending order</td>
<td></td>
</tr>
<tr>
<td>Ordering numbers – descending order</td>
<td></td>
</tr>
<tr>
<td>Learners writing problems with numbers like 2 and 5</td>
<td></td>
</tr>
<tr>
<td>Learners’ writing problems e.g. numbers like 3 and 0</td>
<td></td>
</tr>
<tr>
<td>Learners having problems with writing numbers like 2, 3, 5 and 6</td>
<td></td>
</tr>
<tr>
<td>Learners having problems with writing numbers like 2, 5 and 6</td>
<td></td>
</tr>
<tr>
<td>Confusion between addition and subtraction</td>
<td></td>
</tr>
<tr>
<td>Overcrowding of learners in class</td>
<td>Overcrowding of learners in class</td>
</tr>
<tr>
<td>Big class-individual attention difficult</td>
<td></td>
</tr>
<tr>
<td>Overcrowding</td>
<td></td>
</tr>
<tr>
<td>Assessment results not good because of large class</td>
<td></td>
</tr>
<tr>
<td>Big number of learners in Class</td>
<td></td>
</tr>
<tr>
<td>Large class</td>
<td></td>
</tr>
<tr>
<td>Lack of books</td>
<td>Inadequate/lack of teaching and learning resources</td>
</tr>
<tr>
<td>Inadequate learners books</td>
<td></td>
</tr>
<tr>
<td>Unavailability of subject specific resources</td>
<td></td>
</tr>
<tr>
<td>Learners not bringing counters to the classroom</td>
<td></td>
</tr>
<tr>
<td>Learners contribution to their learning</td>
<td></td>
</tr>
<tr>
<td>Inadequate learners book</td>
<td></td>
</tr>
<tr>
<td>Inadequate learners’ books 152 learners versus less than 20 LBs</td>
<td></td>
</tr>
<tr>
<td>Inadequate learners’ books (1 book for 3 learners)</td>
<td></td>
</tr>
<tr>
<td>No learners’ books</td>
<td></td>
</tr>
<tr>
<td>Absenteeism</td>
<td>Poor/Erratic learner classroom attendance</td>
</tr>
<tr>
<td>High absenteeism</td>
<td></td>
</tr>
<tr>
<td>Frequent transfers</td>
<td></td>
</tr>
<tr>
<td>High absenteeism</td>
<td></td>
</tr>
<tr>
<td>Learner absenteeism</td>
<td></td>
</tr>
<tr>
<td>Possible challenges</td>
<td>Category</td>
</tr>
<tr>
<td>------------------------------------------------------------------------------------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td>Absenteeism of learners</td>
<td></td>
</tr>
<tr>
<td>Absenteeism</td>
<td></td>
</tr>
<tr>
<td>Absenteeism</td>
<td></td>
</tr>
<tr>
<td>Inadequacy of classrooms</td>
<td>Inadequate number of classrooms</td>
</tr>
<tr>
<td>Shortage of classrooms</td>
<td></td>
</tr>
<tr>
<td>Some learners under-aged – not ready to learn</td>
<td>Policy direction</td>
</tr>
<tr>
<td>Extension of learning time</td>
<td></td>
</tr>
<tr>
<td>Too much freedom</td>
<td></td>
</tr>
<tr>
<td>Teaching of mathematics in Chichewa</td>
<td></td>
</tr>
<tr>
<td>Learners are not taught how to write number words</td>
<td>Poor time management</td>
</tr>
<tr>
<td>Late reporting of learners for school</td>
<td></td>
</tr>
<tr>
<td>Late reporting of learners</td>
<td></td>
</tr>
<tr>
<td>Late finishing of assembly</td>
<td></td>
</tr>
<tr>
<td>Loss of learning time due to staff meeting during lesson time 7:28 – 8:00</td>
<td></td>
</tr>
<tr>
<td>Loss of learning time due to porridge (7:30 – 7:45am)</td>
<td></td>
</tr>
<tr>
<td>Loss of learning time due to school feeding programme</td>
<td></td>
</tr>
<tr>
<td>Assembly done during time for lessons from 7:30am</td>
<td></td>
</tr>
<tr>
<td>Late starting of assembly – 7:35 am</td>
<td></td>
</tr>
<tr>
<td>Late start of lessons</td>
<td></td>
</tr>
<tr>
<td>Learning environment</td>
<td>Unfavourable learning environment</td>
</tr>
<tr>
<td>Learning environment – Classroom</td>
<td></td>
</tr>
<tr>
<td>Mathematics print rich – absent</td>
<td></td>
</tr>
<tr>
<td>Room not mathematics print rich (Explains why so)</td>
<td></td>
</tr>
<tr>
<td>Room not mathematics print rich</td>
<td></td>
</tr>
<tr>
<td>Classroom wall bare</td>
<td></td>
</tr>
</tbody>
</table>

Table 4.16 shows the 8 categories of data that were combined from codes shown in this table and which pertain to possible challenges to learning. The first category (learners’ failure to perform mathematical tasks) will however not be explained in this sub section as it is felt that it is not a challenge but a result of challenges. It will therefore be 7 categories that will be explained.
**Overcrowding of learners in class**

A look at the enrolment of the classes under observation showed high enrolments. Table 4.17 shows the information.

*Table 4.17: Enrolment of learners in standard 1 in the five schools*

<table>
<thead>
<tr>
<th>Name of school</th>
<th>Enrolment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kamtsinje</td>
<td>121</td>
</tr>
<tr>
<td>Phiri</td>
<td>76</td>
</tr>
<tr>
<td>Nyanja</td>
<td>77</td>
</tr>
<tr>
<td>Msika</td>
<td>166</td>
</tr>
<tr>
<td>Mchenga</td>
<td>74</td>
</tr>
</tbody>
</table>

Table 4.17 shows that the enrolment of learners in standard 1 classes that were observed had more than 70 learners in each of the classes. The situation was worse at Msika and Kamtsinje Primary schools. The overcrowding of learners caused the teacher to either have a lot of groups in the classroom or have groups with many learners during group activities. Some teachers had this to say on the sizes of the classes,

“I have a big class which makes it difficult for me to have effective individual attention. It is very difficult to do individual help” (Standard 1 teacher at Kamtsinje primary school);

“The large class I have is another big challenge. It limits how I can support the learners. I know what to do in the classroom but I cannot because of the large number of children in the class”. (Standard 1 teacher at Phiri Primary school, 9th January, 2017)

The statements by the two teachers presented above give a picture of the challenge the teachers have with the large classes. It appears that they know what they are supposed to do with the learners to elicit learning but the large class militates against their effective delivery of the lessons. That’s why on a different day, the standard 1 teacher from Kamtsinje primary school pointed out that she administered an assessment the
previous day. She however said that she was not impressed with the learners’ performance and she had this to say, “I think the size of the class is really affecting me. I cannot effectively provide individual attention”

**Inadequate/lack of teaching and learning resources**

It was only at Nyanja primary school where the major learning resource, the learners’ book was said to be adequate for the learners. Learners however, had limited access to the books because there was no day when learners were seen to use the books during the time the lessons were being observed. The rest of the schools either had few learners’ books or they did not have. Specifically, a teacher at Phiri primary school indicated that she had never seen a mathematics learners’ book at the school, the standard 1 mathematics teacher at Kamtsinje primary school indicated that she only had 15 learners books against more than 100 learners she had in the class, the mathematics teacher at Msika primary school reported that she had 1 learners’ book for every 3 learners while the mathematics teacher at Mchenga primary school reported that she only had 25 learners’ book for her more than 100 learners. The figures mentioned by the teachers give a picture of the situation on the availability of learning resources in the classrooms where this study was carried out.

Further, mention was made of the absence of subject specific teaching and learning resources apart from the curriculum materials. Indeed a visit to all the schools showed that there was no teaching and learning resources specifically designed for teaching mathematics in the infant classes.

The other issue that came out was the failure of the learners to bring counters to the classroom. Some teachers pointed out that despite their telling learners to be bringing counters to the classrooms, very few learners were actually bringing them making the work of the teachers difficult when it came to instances where counters were supposed to be used. In some cases, some learners were seen to be without the necessary writing materials during individual work. Since these children are still young, this was therefore attributed to lack of parental support. A teacher at Phiri primary school had this to say, ‘parents provide inadequate support to learners. Some learners come to
school without notebooks and pencils. When the learners lose their writing materials, especially pencils, most parents do not buy for them’.

**Poor/Erratic learner classroom attendance**

The other critical challenge to learning pointed out by standard 1 teachers and also observed during the lesson observations was the poor learners’ classroom attendance. There were high absenteeism noted in all the five classes under study. Table 4.18 displays the results across the six lessons that were observed in the five classes at the five schools.

*Table 4.18: Standard 1 learners’ class absenteeism*

<table>
<thead>
<tr>
<th>Name of School</th>
<th>Class enrolment</th>
<th>Absenteeism during lessons</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1&lt;sup&gt;st&lt;/sup&gt;</td>
</tr>
<tr>
<td>Kamtsinje</td>
<td>121</td>
<td>16</td>
</tr>
<tr>
<td>Phiri</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nyanja</td>
<td>77</td>
<td>0</td>
</tr>
<tr>
<td>Msika</td>
<td>166</td>
<td>0</td>
</tr>
<tr>
<td>Mchenga</td>
<td>74</td>
<td>6</td>
</tr>
</tbody>
</table>

Table 4.18 reveals that there were high cases of absenteeism in the schools that were studied. Absenteeism was more pronounced at Msika and Mchenga primary schools. As for Phiri primary school, some details are not available hence the grey areas against the school. There were however only four lessons that were observed from this school. Though the class enrolment was not provided, looking at the following classroom attendance gives an idea that the school was not spared from the issue of absenteeism. There were 41 learners during the 1<sup>st</sup> lesson that was observed, 72 learners during the 2<sup>nd</sup> lesson and 76 learners during the 3<sup>rd</sup> lesson. Observation and discussion with teachers revealed that there were many causes of absenteeism. These causes can be classified into the following four categories; economic reasons, weather related, spiritual related and school related.
Economic reasons included reasons such as learners going to the market or staying at home with siblings while parents go to the market on market days or to the garden during farming season. A standard 1 mathematics teacher from Phiri primary school had this to say on this category of reasons for absenteeism, ‘Learner absenteeism is also very high. The cause is mainly because of farm activities. Either the learners accompany their parents to the farms or they are told to stay at home with their siblings.’ Further, absenteeism was also seen to be high during market days. The following memo exemplifies the situation.

It’s a market day. The market is very close to the school and it is noisy. Many learners are absent today. I am told that it is because it is a market day. Learners are either told to keep the house as their parents get to the market or they are told to join them to assist in selling the items. (Field notes, 23rd January 2017)

On reasons associated with weather, it was reported and observed that learners’ attendance in the classes was low whenever it was either raining or very cold. The following memo from field notebook provides an example of such a situation.

I arrived at the school at 7:15 am. The school had not yet gone for the morning assembly. Few minutes after I arrived, rains started falling. It was raining heavily. The assembly did not take place. The rains fell until 7:55 am when it stopped. Many lessons started late because of the rains as many teachers and learners came to the school late. The classes had few learners when lessons were starting and many learners joined the classes after the rains. Some did not even bother to come after the rains (Field notes, 24th January, 2017)
The third category of causes of absenteeism, spiritual reason, was evident in two primary schools. A memo recorded in my field notes on one of the days provides an example of this category of the cause of absenteeism.

The learners in the classroom observed were fewer than actual number of the learners in the classroom. I was told that absenteeism is high on Fridays. Learners are told by their parents that they should not attend lessons in fear of them failing to go to the mosque. I was informed that this phenomenon started after the extension in the time the learners are supposed to be in school (Field notes, 20th January, 2017).

The last category of the causes of absenteeism, school related reasons, was evident at one school. At this school, learners either came and were sent back or they did not come to school in fear of being asked the school development fund. The following memo recorded on 17th January provides an example of such a situation.

The standard 1 class had 22 learners only because most of the learners were sent back to get school fund which is MK150 (an equivalence of US$0.2 at US$1 to MWK733) (field notes, 17th January, 2017)

In fact the high figures of absenteeism for Mchenga revealed in Table 4.18 was mainly due to this reason. Many learners did not come back when they were sent back to collect the school development fund from their parents at home.

**Inadequate number of classrooms**

All the five schools except one had problems with availability of classrooms. The classrooms were not adequate for the school enrolment. The inadequacy of classrooms led to the combining of classes that were supposed to be split to ensure a smaller number of learners in the classrooms. At two of the schools, learners were seen to be learning under a tree and at another school, learners were seen to be learning while in a church that was near the school. In all these cases, the school administration made sure that infant class learners were learning while in classrooms though there was overcrowding in the classrooms. As a way of trying to sort out the problem, one school
resorted to having an overlapping system. Details can be seen in the memo from field notebook below.

Due to shortage of classrooms, I learnt that learners from standards 4 to 6 came to school later than other classes. Standard 4 is split into two classes. One class came in the morning and another one late in the morning. They start their lessons at 9:30 and leave the school at 3:30 pm. This was considered to be one of the solutions because the school does not have adequate classrooms (Field notes, 31st January, 2017)

In some cases, temporary sheds were made from grass and wooden poles as seen in Figure 4.12 above to deal with classroom shortage.

**Policy direction**

There were a number of policy issues that were noted in the study as being possible challenges to learning. The first one is the teaching of mathematics in Chichewa from standard 1 to standard 4. Considering that the number words for the numerals in Chichewa are big compared to the vocabulary that they had acquired, learners were therefore not exposed to written number words. One teacher pointed out that this has a negative effect on the learners’ performance when they get to standard 5 as they start writing number names for big numerals and yet another teacher said this, ‘the teaching of mathematics in Chichewa has an effect of learners not understanding some mathematical terminologies like add, subtract and multiply’ (Standard 1 Numeracy and mathematics teacher, July, 2016)

The second policy issue is the increase of learning time by one hour. Initially, standard 1 learners were leaving the school for home at 11:00 am but starting from September 2016, standard 1 learners leave school for home at 12:00 pm. One teacher had the following observation on this policy change, ‘I feel this will have a negative effect on the learning of standard 1 learners since they get tired easily’.

Lastly, too much freedom for learners. With the advent of human rights movement, learners are supposed to be neither beaten nor sent back home when they have not fulfilled the requirement of the school. One teacher had this to say on this,
'It appears we have too much freedom for the learners. In the past, we used to send back the learners who had not brought writing materials with them. Many learners don’t bring pencils nowadays when coming to school. We cannot send them back though. When they want to write, they have to wait for their colleagues. (Post lesson observation interview with standard 1 mathematics teacher, 9th January, 2017)

**Poor time management**

Both learners and school staff were seen to manage time poorly in some schools. This was evident in four of the five schools under study. The poor management of time led to the loss of learning time. This was manifested in the following ways,

Firstly, the late reporting of learners to school. In some schools, learners were seen to report for classes late. They were getting there when their friends had already started learning.

Secondly, late starting and/or finishing of morning assembly. In two of the schools, morning assembly was seen to start around 7:30 and finishing at 8:00 am. This meant that the assembly started at a time when the lessons were supposed to begin. This therefore led to the loss of learning time as both the first and second periods of the timetable were affected.

Thirdly, loss of learning time due to staff meeting. This was evident at two schools where school staff had a staff meeting at a time when the lessons were supposed to start and ended the meeting during the second period of the timetable.

Lastly, it was also evident at two schools that some classes had to start their lessons late due to school feeding programme. At these schools, learners are given porridge before they start lessons. Unfortunately, it was observed especially at one school that learners consistently started their first lesson late due to the fact that they were supposed to take their porridge.
Unfavourable learning environment

For the learning environment to be unfavourable, there are a number of factors. The ones observed during the current study were classroom walls without mathematics print and classrooms without desks.

Standard 1 learners were sitting on the floor in three out of the five schools under study. The floor was in most cases dusty leaving the learners with dirty clothes. The following memo gives more information on the same.

Learners at this school sit on the floor leading to their getting back home dirty. The few available furniture is for the standard 8 learners (Field notes, July, 2016)

The second situation is the absence of mathematics print on the walls. A visit to the five schools showed the absence of either teacher created or learner created mathematics related work placed on walls leaving the wall bare in three out of the five schools. In the remaining two schools, few mathematics print was spotted and was mainly teacher created. The absence of the mathematics print in some schools was defended by one of the teachers at the school. This is what she had to say,

‘Learners do tear off the charts placed on the walls hence you may not find anything on the wall. Further, the room is not lockable and it is used for prayer service on Sunday’ (Standard 1 teacher at Kamtsinje primary school).

Related to this, another teacher had this to say,

‘I used to place charts on walls in the classroom but I removed them because it is examinations time and students used to remove them from the classroom by tearing them off’ (Standard 1 teacher at Msika Primary school).

An observation of the windows for the standard 1 mathematics classes at Msika primary school also showed that the windows have big spaces where one can easily get the items from the walls.
An isolated case was observed at one of the schools where a teacher was observed to have mistreated learners. An extract from the lesson where this happened gives the details of the incident.

```
1. Teacher – Class, look here (teacher wrote 7 + 0 = on the chalkboard) read this.
2. Learners – 7 plus 0 equals
3. Teacher – Ok. Find the answer
4. Learner – madam, madam (shouted one learner)
5. Teacher – Ok. You have called me. If you will fail, I will beat you.
6. Learners – (Learner did not respond, he was therefore slapped by the teacher).
```

(10th February, 2017)

The extract above shows an extrovert learner being frightened and silenced by a teacher during one of the mathematics lessons.

The possible enablers of learning and challenges to learning have been explained in this subsection. A number of issues have been raised. The issues will be discussed in the next chapter.

Much as the teachers are working within a system with the possible challenges mentioned in this subsection. These teachers do also have beliefs about mathematics teaching and learning that may have an effect on the mathematics classroom culture. These beliefs are therefore explored.

### 4.7 TEACHERS’ BELIEFS ABOUT MATHEMATICS TEACHING AND LEARNING

Literature revealed that mathematics classroom culture is also influenced by teachers’ beliefs about mathematics, mathematics learning and teaching. A questionnaire was therefore formulated to capture the teachers’ beliefs. The questionnaire comprised of a Likert scale. In the questionnaire, teachers were asked to indicate their views on a set of statements about the nature of mathematics and their beliefs about mathematics teaching and learning. They were asked to strongly disagree, disagree, agree or strongly agree to the statements. Three out of the 5 teachers completed the
questionnaire. The teachers’ responses were put together (see appendices 7 to 9). For comparison sake, ‘each teachers’ beliefs about the nature of mathematics, mathematics teaching and mathematics learning were categorised on a 5-level scale as one of the following: traditional, primarily traditional, an even mix of traditional and non-traditional, primarily non-traditional, and non-traditional’ (Raymond, 1997:556). The data analysis presented in this section was based on the composite score from the series of questions that represented each of the five elements of the five level scale. The responses to the statements were combined to create a belief measurement scale. The first step to the analysis of the data was to code the responses as follows:

1 - strongly disagree
2 - disagree,
3 - agree
4 - strongly agree

The following sub sections therefore provides details of the results.

4.7.1 Teachers’ beliefs about mathematics

To understand the teacher’s beliefs about the nature of, teachers were requested to respond to 13 items. These items were distributed as follows; 2 items represented traditional beliefs (referring broadly to pre-constructivist views of the nature of mathematics, 2 items represented primarily traditional beliefs, 2 items represented an even mix of traditional and non-traditional beliefs, 3 items represented primarily non-traditional beliefs, and 4 items represented non-traditional beliefs. Table 4.19 below is a summary of the results. The scale range in the table is basically showing the possible total scores that the respondents could get. For example for non-traditional beliefs, with 4 items, the respondent could score a total of 4 if she strongly agreed (see the codes in introduction of 4.7) to the statements and she could score a total of 16 she strongly agreed to all the 4 statements. The closer the total score for the respondent to the higher figure, the higher the level of agreement with the statements, the more the property described present in the teacher.
Table 4.19: Teachers’ beliefs about the nature of mathematics

<table>
<thead>
<tr>
<th>Scale</th>
<th>Scale range</th>
<th>Summative Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Xenia</td>
</tr>
<tr>
<td>Traditional</td>
<td>2 - 8</td>
<td>5</td>
</tr>
<tr>
<td>Primarily traditional</td>
<td>2 - 8</td>
<td>4</td>
</tr>
<tr>
<td>Even mix of traditional and non-traditional</td>
<td>2 - 8</td>
<td>6</td>
</tr>
<tr>
<td>Primarily non-traditional</td>
<td>3 - 12</td>
<td>7</td>
</tr>
<tr>
<td>Non – traditional</td>
<td>4 - 16</td>
<td>8</td>
</tr>
</tbody>
</table>

Table 4.19 shows the summative scores for the five scales of the teachers’ beliefs about the nature of mathematics. The overall score was formulated by adding either the median or the mode of the individual statement scores in each of the five scales. Considering how far their scores are from the maximum score, the table shows that all the three teachers exhibit some traditional/conventional beliefs about the nature of mathematics and more of the mixture between the traditional and non-traditional beliefs. Alice and Betty also exhibit more of the primarily traditional beliefs about the nature of mathematics.

4.7.2 Teachers’ beliefs about learning mathematics

Exploring teacher’s beliefs about learning mathematics involved asking teachers to respond to a set of 35 items. These items were distributed as follows; 8 items represented traditional beliefs (referring largely to pre-constructivist ways of seeing mathematics pedagogy), 6 items represented primarily traditional beliefs, 8 items represented an even mix of traditional and non-traditional beliefs, 5 items represented primarily non-traditional beliefs, and 8 items represented non-traditional beliefs. Table 4.20 below displays the results.

Table 4.20: Teachers’ beliefs about learning mathematics

<table>
<thead>
<tr>
<th>Scale</th>
<th>Scale range</th>
<th>Summative Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Xenia</td>
</tr>
<tr>
<td>Traditional</td>
<td>8 - 32</td>
<td>21</td>
</tr>
<tr>
<td>Primarily traditional</td>
<td>6 - 24</td>
<td>17</td>
</tr>
<tr>
<td>Even mix of traditional and non-traditional</td>
<td>8 - 32</td>
<td>32</td>
</tr>
<tr>
<td>Primarily non-traditional</td>
<td>5 - 20</td>
<td>18</td>
</tr>
<tr>
<td>Non traditional</td>
<td>8 -32</td>
<td>25</td>
</tr>
</tbody>
</table>
Table 4.20 shows summative scores for the scale on teachers’ beliefs about learning mathematics. Table 4.20 reveals that Xenia has an even mix of traditional and non-traditional beliefs about learning mathematics. For Alice, she appears to hold both primarily non-traditional and non-traditional beliefs while Betty possess an even mix of traditional and non-traditional, and primarily traditional beliefs about learning mathematics.

4.7.3 Teachers’ beliefs about teaching mathematics

To explore teacher’s beliefs about teaching mathematics, teachers were asked to strongly disagree, disagree, agree or strongly agree to 37 statements. These statements were distributed as follows; 9 items represented traditional beliefs, 5 items represented primarily traditional beliefs, 8 items represented an even mix of traditional and non-traditional beliefs, 8 items represented primarily non-traditional beliefs, and 10 items represented non-traditional beliefs. Table 4.21 below displays the results.

Table 4.21: Teachers’ beliefs about teaching mathematics

<table>
<thead>
<tr>
<th>Scale</th>
<th>Scale range</th>
<th>Summative Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Xenia</td>
</tr>
<tr>
<td>Traditional</td>
<td>9 - 36</td>
<td>20</td>
</tr>
<tr>
<td>Primarily traditional</td>
<td>5 - 20</td>
<td>9</td>
</tr>
<tr>
<td>Even mix of traditional and non-</td>
<td>8 - 32</td>
<td>24</td>
</tr>
<tr>
<td>traditional</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primarily non traditional</td>
<td>5 - 20</td>
<td>17</td>
</tr>
<tr>
<td>Non traditional</td>
<td>10 - 40</td>
<td>32</td>
</tr>
</tbody>
</table>

Table 4.21 above shows the summative scores for each of the five scales on the teachers’ beliefs about mathematics teaching. Considering the difference between the actual score and the total score for the scale, the table reveals that the three teachers have a primarily non-traditional beliefs about teaching mathematics. Indeed the overall score supports the teachers having primarily non-traditional beliefs about teaching.

4.8 CONCLUSION

This chapter has provided some insights into the process and the product of the data gathering and management, as well as the process of analysis. The chapter was
amplified with excerpts from 'raw' data and organized according to Table 4.2. Towards the end of the process of analysis the chapter culminated in several themes, which I labeled according to the inductive process of data coding and grouping. In Chapter 5 these themes will be extracted and interpreted, utilizing the criteria of a mathematics classroom culture and the activity system analysis (ASA) tool, which arose from third generation activity theory (AT), and which was formulated by Engeström (1987, 2001, 2015). It will be evident in the conclusion of the last chapter, that extreme poverty as observed in this study affects teachers, their work, children’s learning, including the number concept development (NCD) of the Standard 1 children in the study.
CHAPTER 5:
DISCUSSION AND CONCLUSION

5.1 INTRODUCTION
This chapter presents a discussion of the data of the study. The analytical framework in this study comprises an integrated, hybrid analytical framework (Figure 5.1), with the research question, “What is the culture of early grade mathematics classes”?

![Figure 5.1: The epistemological integration of the hybrid analytical framework](image)

At the centre of this analytical framework is the learning child engaging with the culture of a mathematics classroom. The child is a ‘subject’ in the activity system (see Figure 5.2) in which she is learning numeracy (the ‘activity’), aiming at the numeracy (numerical competence) as ‘object’ and overall mathematics learning outcome. The activity will have elements of the norms of mathematics classrooms as described by Cobb et al. (2001), and Cobb and Yackel (1998) (see Section 2.2 in chapter 2). The
activity system (of classroom culture) has been operationalized in Figure 5.2, based on the data that was presented in chapter 4.

Figure 5.2: The operationalized activity system of mathematics classrooms
In this system, the learners are the ‘subject’ of the activity and they are engaging in mathematics classroom life (the ‘activity’ in the system) in order for them to learn numeracy (the ‘object’ of the activity system). The teaching of mathematics is mediated by several ‘tools’ like the curriculum materials, games and songs and by the teacher herself as someone who has beliefs and knowledge. Within the mathematics classroom system, there are behavioural ‘rules’ and regulations like standing up when answering questions, seeking permission when they want to go outside and following teachers’ instructions generally. Learners are assigned roles during the lesson (‘division of labour’ in the system) some of the learners are made to be either group or classroom leaders with functions assigned to them. The teacher is the locus of power in the activity system’s ‘division of labour’. The activity is taking place within a ‘community’, including the children and the teacher as well as the school management team and the governing body. It is evident from the operationalized system that there is contestation and ‘puzzles’ in all of the components of the ‘systems gaze’ (Wardekker 2008 cited in cited in Henning, Petker & Petersen 2015:3).

5.2 ACTIVITY SYSTEM ANALYSIS (ASA) OF MATHEMATICS CLASSROOM CULTURE

In reflecting on the result of the analysis as set out in Figure 5.2, I interpret the ASA outcome according to the aspects of classroom culture as set out in Chapter 2. I group the discussion according to the main aspects of classroom culture, beginning with a reference to Wolcott (1994), who describes a study with ethnographic characteristics as ‘the way of life of an identifiable group of people.’ ‘Way of life’ suggests regular ways of doing, of using tools, of interacting with the community according to the norms of behavior, and the processes that are typically followed according to work-allocation. For this purpose, I extracted aspects of socio-mathematical norms which reflect the shared ways of doing in a mathematics class and the mathematic norms, which I would describe as those norms that reflect shared mathematical activity. I would argue that these norms are the ones that situate learners in a classroom, where they learn to be
practicing as ‘apprentices’ of the teacher as mathematics practitioner, whom they could emulate. The teacher would display, as every mathematics teacher would, mathematics behavior, including the behavior of the pedagogy of mathematics as propounded by Ball, Hill and Bass (2005), Hill, Blunk, Charalambous, Lewis, Phelps, Sleep and Ball (2008).

My interpretation of the notion of mathematical classroom culture would thus follow the authors whose work on MCC I have discussed in Chapter 2. To this end, I will first tabulate the intersect of the main findings of the study with the norms of MCC as propounded by Cobb et al. (2001) and Cobb and Yackel (1998).

**Table 5.1: Findings of the study and the norms of mathematics classroom culture**

<table>
<thead>
<tr>
<th>Findings of the study: Eight themes</th>
<th>Criteria for fostering mathematics classroom culture</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Shared purpose</td>
</tr>
<tr>
<td></td>
<td>Shared ways of reasoning with tools and symbols</td>
</tr>
<tr>
<td></td>
<td>Shared forms of mathematical argumentation</td>
</tr>
<tr>
<td>T1. Teachers are overburdened and receive limited support</td>
<td>There was little opportunity to enact these norms</td>
</tr>
<tr>
<td>T2. The fast-paced curriculum inhibits evolvement of MCC</td>
<td>There was little time - and with the logistical challenges of large classes and short lessons, the ‘shared’ culture did not manifest as intended. In its place there arose a culture of management of classroom behavior control.</td>
</tr>
<tr>
<td>T3. Enculturation into MCC is rigid with controlled, episodic lesson format</td>
<td>The ‘culture of learning’ that was inherited, was aspiring to share the purpose of learning early numeracy. There was little time for shared reasoning practices. The practices were stringently based on oral interaction.</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>T4. Children’s spontaneous mathematics experiences</td>
<td>When the children were away from school, they showed their spontaneous attraction to numeracy. Their curiosity and free talk during their extended routes on the way home became a ‘sub-culture’ of spontaneous mathematical application.</td>
</tr>
<tr>
<td>T5. Juxtaposition of MCC - constrained and enabled</td>
<td>The MCC that was evolving in the classes was enabled by joint, espoused purpose, but constrained by logistics and possibly also by teacher beliefs about mathematics learning.</td>
</tr>
<tr>
<td>T6. Teachers' beliefs about learning mathematics</td>
<td>For ‘survival’, the teachers relied on (fossilized?) beliefs about how to teach, control behavior and follow a rigid template of pedagogy</td>
</tr>
<tr>
<td>T7. MCC isolated</td>
<td>The lessons are demarcated for 30 minutes. Most children do not</td>
</tr>
</tbody>
</table>
In the discussion of MCC in Chapter 2, it was evident that authors agree on the function of the teacher as leader (elder) in the cultural group and she is expected to set the tone for the ‘apprentices’ in her class. However, in this study, it was evident that the teachers are not fully agentive, having to adhere to a prescriptive curriculum and reverting to their apprenticeship of observation (Lortie 1975) and teaching in a ‘default’, ritualistic manner. A teacher as the ‘knowledgeable other’ in the classroom is a key person in the development of a classroom culture (Vygotsky 1978). Following Table 5.1, I now discuss the themes that have emanated from the data according to the ASA tool (Engeström 1987, 2001). I begin by an interpretation of the ‘activity’ of the system – the young children’s engagement with mathematics learning (numeracy specifically) in the system where they are enculturated in MCC. Thereafter I briefly present my interpretation of what each component of the system has yielded through the lens of CHAT.

5.2.1 The activity of learning numeracy is compromised

Informed by a number of the eight themes, it was evident that the activity of engaging with classroom culture (thus learning) is compromised by a number of practices. One of these is the pacing of a lesson, which is crucial for number concept development (NCD). The lessons that were observed (Table 4.2) during the study, revealed how the pacing was done strictly for curriculum coverage and not so much for learning. To me it simply appeared as a ritual to be completed in the culture of the classroom. According to MIE (2012), teachers are supposed to spend more than two lessons on introducing
learners to a new number concept (Ministry of Education, 2004). Although I do not agree with spending time on the numeracy concepts of ‘one’ and ‘two’, I do think that the teachers did not approach this in an innovative way, as suggested by Fritz et al. (2013). The activities that were suggested in the teachers’ guide were not adhered to. Langhorst et al. (2013) argue that early mathematics education should aim at letting children acquire the key concepts gradually. The data has not yielded evidence that the teachers worked in a contemplative way as reflective practitioners.

The study also revealed that the mathematics lessons had a distinct pattern. The lessons were characterised by eight identifiable major learning episodes (see Section 4.4. This was more like a rigid custom of how the lessons were supposed to be flowing. The study showed that teachers used questions. Questions were, however, not used as invitations for discussion; questions in mathematics are considered to be a type of mathematics talk and that comprises revoicing, repeating, eliciting students’ reasoning and adding on (Chapin & O’Connor 2007). It is through such talk that gaps in the learners’ understanding can be revealed (see also Levine & Bailargeon 2016). Learners’ involvement in the mathematics lessons was limited because of the large number of children in the classrooms. The use of questions was seen to be in line with the observation by Mehan (1979), who argues that classroom discourse, where the whole class is involved, teacher-student behaviour is organized into interactional sequences that has initiation-reply-evaluation (IRE) components. In this sequence, a teacher asks a question, a student is then selected to respond, and the teacher evaluates the student’s response. A modification of Mehan’s observation was made in the current study in that other learners also participated in the evaluation of the response. I have termed this modification as the culture of corroboration.

The teaching of numerals took place in 12 lessons out of the 28 lessons that were observed (see Section 4.3). When introducing learners to numerals, teachers took learners through the following three activities;

1. Introducing the numeral by showing them a variety of objects corresponding to the numeral being introduced on that day
2. Recognising the symbol (the digit – the Arabic notation) for the numeral
3. Writing the symbol for the numeral

This, however, may not be adequate for children who encounter written representations for the first time. Much as teachers adhered to some steps outlined in the teachers’ guide (MIE 2012), the time teachers spent on solidifying the foundations for early numeracy was less than what is stipulated in the teachers’ guide. My sense of this was that it indicated a mechanical, fast-paced teaching. (This ‘rushing through’, I have phrased as a culture of ‘changu changu’ – fast-fast). It is therefore unlikely that most learners could cope with such a tempo. Further, according to MIE (2012), when introducing numerals from 0 to 5, learners are expected to go through an activity on tracing” the symbols – or practicing the writing of each symbol (and here I do not include the writing of the verbal/linguistic version).

The culture of ‘changu changu’ was also evident during the time when learners were given an opportunity to practice what they learnt in class individually. Teachers attempted to assess learners' written work but in most cases some learners did not have their work checked. Those who fell culprit of this were usually the ones who wrote slowly, since learners were encouraged to write fast when given individual work. Considering that learners work at different paces depending on their cognitive functioning, including their working memory and executive functions (Bezuidenhout, 2018), those who worked slowly were at a disadvantage as their work was continually not assessed in this lack of ‘continuous assessment’ practice. To support the importance of feedback to learners, meta-analytic results by Fyfe and Brown (2017) indicated that feedback had positive effects for learners who work slowly. In the present study, one may not conclude that learners who wrote slowly had limited knowledge. Chances are that there may indeed be learners with some mathematics learning difficulties (MLD) who may have benefited from teacher feedback. The absence of feedback to some learners during the performance of their work means that there is limited scaffolding for such learners.
(Scaffolding) comes out of sociocultural theory, [and] is based on the idea that a task otherwise outside of a student’s ZPD can become accessible if it is carefully structured. For concepts completely new to students, the learning requires more structure or assistance, including the use of tools like manipulatives or more assistance from peers. As students become more comfortable with the content, the scaffolds are removed and the student becomes more independent (Van de Walle, Karp, & Bay-Williams 2010:23).

In the observation in this study, the scaffolds were, however, largely absent for those learners had to cope on their own.

Fritz et al. (2013) gives a detailed theoretical base on how learners acquire early number concepts, while Sharma (2013) discusses agreed-upon concepts that are always supposed to be covered when teaching numeracy.

Relatedly, when teaching additive relationships, teachers were observed teaching additive relationships (addition and subtraction) in 14 lessons out of the 28 lessons that were observed (see Section 4.3). In learning additive relationships, learners were taken through the following activities;

1. Introducing addition/subtraction of numbers using objects
2. Writing addition/subtraction sentences
3. Completing addition/subtraction sentences horizontally
4. Adding/subtracting numbers vertically

Addition was taught in three or four lessons and three or four lessons for subtraction. On the contrary, according to the teachers’ guide, more time is supposed to be spent on these activities. Table 5.2 shows the details.
Table 5.2: Time allocation of activities on additive relationships

<table>
<thead>
<tr>
<th>Activity</th>
<th>Number of lessons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Addition of numbers with sums not exceeding 5</td>
<td>12</td>
</tr>
<tr>
<td>Subtraction of numbers within the range of 0 to 5</td>
<td>14</td>
</tr>
<tr>
<td>Addition of numbers with sums not exceeding 9</td>
<td>12</td>
</tr>
<tr>
<td>Subtraction of numbers within the range of 0 to 9</td>
<td>12</td>
</tr>
</tbody>
</table>

(MIE 2012)

Take home assignment was provided to learners in 11 out of the 28 lessons that were observed. An observation of the lessons revealed that it was mainly in Yvonne’s and Alice’s classes where homework was seen to be a ritual. The take home assignments were based on the work that they covered during the lesson (see Section 4.4.8 for examples). The findings in this study are contrary to what Ministry of Education Science and Technology (MoEST) (2017) found where 2.9 percent of the learners indicated that they did not receive homework, meaning that 97.1% of the learners received homework. The absence of homework in most mathematics classrooms in the schools under study denied learners the organised opportunity to engage with mathematics at home.

The study revealed that there was loss of learning time due to late finishing of morning assembly, staff meetings, the school feeding programme and learners reporting for classes late. Since what is to be learnt on a specific day is well structured on a time table, the loss in time has consequences.
According to the timetable in Figure 5.3, learners are supposed to start lessons at 07:30 and finish at 12:00 with two breaks of 15 minutes each.

The lessons that were observed did not provide adequate opportunities for learners to explore the mathematical concepts in any depth. The following are some of the examples supporting this; learners were not given a lot of time to explore the numbers apart from the basics that they were introduced to.

5.2.2 The subject: Learners are compromised

It has been discussed earlier on that there were large numbers of learners in their classes. Considering that the learners in the classrooms were young (an average of 6 years according to government requirement), the large class size poses challenges in meeting the needs of each one of them. The recommended teacher-learner ratio in Malawi, according to MoEST (2008) is 1:60. All five schools that participated in the study therefore had teacher-learner ratios higher than the recommended. Studies by Chirwa (2013) and Lowe (2008) have reported on overcrowding of classes. Secondary schools have a ratio of 1:40. What is surprising is that learners who are older and can do independent studying have a smaller teacher learner ratio than learners who need the teacher more. I argue that the opposite could have been the case. It is also disturbing to have a uniform teacher learner ratio in primary school.

Malawi has grappled with learner teacher learner ratio since 1994 when it introduced free primary education. By 2001, the situation had not improved: According to Ministry
of Education Sports and Culture (2001:18), “efforts shall be made to reduce the current pupil - qualified teacher ratio to 60:1 across all primary standards by 2012. The national teacher: pupil ratios in Standard 1 shall reduce from 134:1 in 1997 to 80:1 in 2007 and 60:1 in 2012”. Whilst MoEST (2014:31) reports that student to qualified teacher ratio improved from 70:1 to 46:1 from 2009 to 2012 in secondary schools, the student to qualified teacher ratio increased from 90:1 to 95:1 from 2008 to 2012 in primary schools (MoEST 2014:24). This means that more has to be done in the primary sector especially the early grades to make the learner qualified teacher ratio manageable to teachers who are currently overburdened. This is crucial because in a recent study by Mulera, Ndala and Nyirongo (2017), one of the key factors (predictors) driving pupil performance in reading and mathematics in SACMEQ III in Malawi was found to be learner-teacher ratio. If learner teacher ratio is an issue for standard 6 learners, what more with standard 1 learners whose learner teacher ratio is usually bigger than that in standard 6 due to drop outs.

This study revealed that there were inadequate classrooms at 4 of the five schools where the study was carried out. The absence of adequate classrooms led to having overcrowded classes in some schools as explained earlier on where adequate classrooms could have solved the problem. This is so because at Phiri primary school for example, there were two teachers in the standard 1 classroom that was under study. Meaning that the congestion could have been avoided if there were adequate number of classrooms at the school. The issues discussed on overcrowding therefore also apply to cases where there were inadequate classrooms at the school. The need for more classrooms is therefore supposed to be met to assist in decreasing the sizes of standard 1 classes in some of the schools under study. The Malawi government acknowledges that the class space started to be an issue since 1994 and according to the Republic of Malawi (2013:14), “after almost twenty years since the introduction of free primary education, the sub-sector has not fully overcome these challenges”.

I further found that learners generally have a positive outlook to schooling as reflected by their feelings when they come to school (see Section 4.5.2). Much as they had a positive outlook to schooling, the study showed that most learners did not like
mathematics much. I have termed this as the culture of 'lack of interest in mathematics'. The subjects they liked most were the languages (see Section 4.5.3). This is an important finding because it may be difficult for a learner to perform well in a subject in which she is not engaging. Teachers have a challenge to ensure that learners develop interest in mathematics.

The study also showed that some learners engaged with mathematics after school (see Section 4.5.9). These results show that learners take an initiative to use mathematics outside the classroom and give themselves opportunities to continue practicing what they learnt in class. This is essential because mathematics is supposed to assist learners in solving everyday life problems (MIE 2012: ix). The use and application of mathematics by learners outside school is therefore a positive development. Taylor and Mathews (2014:109) argue that parents have opportunities to engage learners in informal mathematics in daily life. Some of these are, noticing patterns in their surroundings, telling time, setting a table, shopping, cooking, and using measuring. This is, however, a challenge in most families in Malawi because according to Lowe (2008:213), Malawi is at a stage where many adults have had little or no education. This lack of education can make meaningful support to children difficult.

Learners expressed that they felt happy about learning informally. The statements made by the learners may be worth taking seriously, considering that none of the 28 lessons observed during the study were conducted outside and yet the classes are overcrowded. The children said they enjoyed learning informally outside the (overcrowded) classrooms. The value of having mathematics lessons outside the classroom is well documented Taylor (2014:61).

**5.2.3 The tools are underutilized**

In Section 4.4.4, I showed that the tools that were used during the lessons were mostly those that were locally available. The teachers were very resourceful. The use of tools is very important in teaching elementary mathematics as it assists learners to move from concrete objects to abstract concepts and relationships (Sharma 2013). Rosli, Goldsby and Capraro (2015) emphasise this too, as do Fritz and Ehlert (2013) and many other authors.
The use of tools specifically designed for mathematics teaching was non-existent in all the five primary schools. In an effort to ensure that learners understand the concepts they are learning, Fthenakis et al. (2009), cited in Langhorst et al. (2013) argue that activities should be integrated in games and daily routines considering that children interact with their environment through playing and learning processes, the realisation of mathematical education should be oriented towards the child’s environment. In fact one of the major methods advocated in standard 1 mathematics teachers’ guides is the use of games and simulations (MIE 2006.ix; MIE 2012:x). There was however no lesson during the period of study where games and simulations were seen to be used during the mathematics lessons. The lessons were in most cases too formal which I argue that it is not healthy for learners who are just being introduced to mathematics.

In three of the schools there were few resources. At one school there were not even any books. Where there were learners’ books there was very little time to use them. For example, it was only at one school (Mchenga primary school) where learners were seen to use books. One book was shared by more than 5 learners. I see this ‘way of life’ as severely constrained for forming number concepts. Lowe (2008:190) found similar trends in schools that were studied in Malawi:

“In fact, in none of my observations did I actually see textbooks in use, except in the hands of the teacher; Patricia used five books in a class of 120, and that was hardly effective!) On enquiry I discovered that there was a critical shortage of books in several cases, so the problems were written on the board. In all primary schools there is a severe lack of resources, and little furniture to cope with very large classes, particularly at Standards 1 and 2”.

The absence of learners’ books seems to be a general problem in primary schools in Malawi. According to MoEST (2016:47), pupil textbook ratio for standard 1 and 2 mathematics books in good condition is 0. Meaning that learners in both standards 1 and 2 do not have access to mathematics learners’ books. This is contrary to the national education policy. According to Government of republic of Malawi (2013:5) the national education policy will ensure that teaching and learning materials are available to all learners. In planning to ensure that resources are available in schools and in
further saying that the 'number of textbooks available in primary schools contributes to quality performance of learners' MoEST (2016:46), the Malawi government appreciates the role textbooks play in the learning of learners. More therefore has to be done to match this realisation with reality on the ground. In three of the five schools, children sat on the floor in classes where the walls were devoid of any diagrams or print of any kind.

5.2.4 The rules require stringent adherence

The study revealed that there was a culture of 'mathematics curriculum compliance and coverage'. It was noted that the teachers did not deviate from the stipulated content in the national primary curriculum for numeracy and mathematics. All the lessons that were observed were actually derived directly from the curriculum. Teachers did not show any innovative way to implement the curriculum. This however meant that learners were not exposed to the new ways of early mathematics learning as explained by Fritz et al. (2013).

5.2.5 The community is overly structured and the teacher is overburdened

I found that only one mathematics teacher attended in-service training workshops on mathematics teaching. This teacher did so in a project of an international NGO. This means that if it was not for the organisation, she could also have not attended any in-service training workshop. A worst case was seen where a teacher had 21 years’ experience in teaching mathematics but had never attended any in-service training workshop on mathematics. Such a teacher may hold onto old beliefs about mathematics teaching which may not apply now. Attending in-service training workshops, which are currently non-existent, would assist in giving such a teacher current ways of teaching mathematics. Further, a recent study by Kutaka et al. (2016) linked professional development of teachers to changes in the quality of instructional practices and a positive effect on the achievement of learners who were taught by the teacher who went through this professional development.

The absence of continuous professional development for mathematics teachers speaks to the little support provided to the mathematics teachers while the big learner – teacher ratios in the classes puts a heavy load on the teachers. Much as these teachers are not fully supported and have big loads of work, observing them teach revealed how
passionate and hardworking they were to ensure that learners learn in their classrooms. The discussion of their lessons in the next section provides more information.

Regarding the ‘community’ in the classroom what showed up very strongly was that teachers’ beliefs about the nature of mathematics, mathematics learning and mathematics teaching were powerful indicators of how they teach and what constitutes their PCK (Shulman 1987). The teachers have primarily traditional beliefs about the nature of mathematics, an even mix of traditional and nontraditional beliefs about learning mathematics and primarily nontraditional beliefs about mathematics teaching. The teachers’ beliefs about mathematics teaching may have been influenced by the nature of the current national curriculum and the orientation teachers went through. According to MIE (2012: vii), the current national curriculum is ‘outcomes based’, the teaching and learning process is achievement oriented, activity based and learner centered. This, I argue, may have influenced the teachers’ beliefs about teaching mathematics. However, observing the teachers, elements of traditional beliefs about teaching were evident. This agrees with the findings by Raymond (1997:574) who found that,

“traditional beliefs about the nature of mathematics have the potential to perpetuate mathematics teaching that is more traditional, even when teachers hold nontraditional beliefs about mathematics pedagogy”.

It should also be pointed out that much as their view about the nature of mathematics may have influenced their practice, the environment in their classrooms, with very high numbers of learners and no learners’ books may also have played a role in influencing their practice.

5.2.6 The work of the ‘activity’ is shared hierarchically

Contrary to the findings that emphasised limitations and challenges, the way the classes were organised with group leaders was a sign of practical wisdom of the teachers. In a few cases, group leaders also assisted (scaffolded) other learners in the group. It was, nevertheless, mainly the group leader who was working out the answers to problems posed by the teachers. This left other learners idle, just watching what was happening and in some worst cases, some learners were not even aware of what was happening
in the groups (see Section 4.4.4 for an example of such a situation). Considering that the learners are just starting school, the teachers have a great role to play in ensuring that group activity elicit learning in the learners. Suzanne, Chapin, O’Connor & Anderson (2003:17) propose that discussion, either in small groups or with the whole class, can play a critical part in helping students improve their ability to reason logically and the three talk formats (whole-class discussion, small-group discussion, and partner talk) have been found to be particularly helpful in maximizing opportunities for mathematical learning by all learners. Suzanne et al. (2003:19) propose how these should be conducted:

- The teacher typically gives students a question to discuss among themselves, in groups of three to six
- Learners need help becoming familiar and comfortable with the rules for small-group discussion, since multiple conversations occur
- The teacher circulates as groups discuss and doesn’t control the discussions, but observes and interjects

In such large classes it is hard to manage these procedures. Much as Suzanne et al. (2003) advocate for a size of 3 to 6 learners per group, this was not practical in most classes in this study. The case of Msika primary school standard 1 class this would mean having about 28 groups to attend to.

**5.2.7 The object is not realized while the outcome is not reached**

A study of all the issues raised in Sections 5.2.1 to 5.2.6 show that the object of the learning activity (children to learn numeracy) is not probable for most learners. Further, since learners are not learning mathematics, the outcome (to be numerate) is therefore not reached for most learners.

**5.3 TENSIONS/CONTRADICTIONS IN THE ACTIVITY SYSTEM**

The activity in the *activity system* of classroom culture in standard 1 (and likely in other classes in the early grades) has been discussed in the previous sections of this chapter. A summary of the activity system has been presented in Figure 5.2. To make further sense of what constituted the classroom culture - interpreted as an activity system - the
data was interpreted in terms of ‘contradictions’ in the components of the system (Mwanza 2001), keeping in mind that the ASA tool is a heuristic, and therefore, only a ‘gaze’ to make sense of a system. It is not intended as a classification of empirical reality. According to Kuuti (1995), activity theory uses the term contradiction to indicate ill-fitting elements in a system.

Engeström (1999b) posits that the internal tensions and contradictions of such a system are the driving force of change and development. He proposes two types of tensions:

*Primary contradictions:*

A primary contradiction arises within a single component of the activity system (Farrelly 2012:54). Several sources of primary contradictions were identified in the elements of the activity system analysis of this study. Two contradictions were found in the learners as the subjects of the activity system. Firstly, the different profiles of the children as individuals in development in a specific sociocultural and historical setting – one of the contributions of Lev Vygostky was that he argued for such a view (Bronfenbrenner 1979) was observed. Second, the large number of children together in one space is in itself a ‘puzzle’ for an educational analyst.

In a focus group discussion that was held with learners, it was evident that most of them ‘did not like’ mathematics when asked to rate school subjects. It was also evident during observations that there was high absenteeism and late arrival at school. One of the five teachers had this to say on absenteeism and late-coming of learners,

> ‘The other crucial issues in this class are absenteeism and late reporting for classes. Absenteeism is very much pronounced on Fridays. On late reporting, some learners get to school around 9 am. (A standard 1 teacher at Mchenga primary school, 20th January 2017)

These issues were prevalent in all of the schools. Though remedial lessons are encouraged in the national curriculum (Malawi Institute of Education, 2012), there was no sign of any learning support in addition to classroom help.
The number of learners per class was identified as second area of contradiction. The enrolments of learners in each of the five schools that were visited during the study are displayed in Table 4.17. Two of the five teachers made serious comments on this large class size (see Section 4.6.2). One teacher came out clear that she knows what to teach and how to teach and assess but she is defeated by such large classes. It is very clear that learners have limited, if any, individual time with their teacher. At the same time, it is also difficult to know the actual development of each of the learners in such a class. The only assessment a teacher has in such a large class will be the learning outcome scores as evident in pencil and paper assessments.

The often-referenced notion of ‘proximal learning’ (Vygotsky 1978: 86-87), or ‘the zone of proximal development’ (ZPD) refers to those cognitive functions that have not yet matured but are in the process of maturation, thus functions that will mature in future, but are currently in an embryonic state. These functions could be termed the ‘buds’ or ‘flowers’ of development rather than the ‘fruits’ of development. The actual developmental level characterizes mental development retrospectively, while the zone of proximal development characterizes mental development prospectively.’ Henning (2008:18) makes an observation on ZPD, when she points out that,

the potentiality of learning which this definition refers to depends on the recognition of how much further a learner can go with the help of a more experienced/learned person than such a learner would have moved on her/his own. Also, how consistent is this help? This person scaffolds and judges potential for conceptual (and other forms of learning) movement by systematically lifting the bar and remaining engaged with the learner.

The ‘knowledgeable other’ in the instances of the five teachers in this study have little chance to scaffold learners’ advancement of individuals and has to rely on group instruction and thus also assumptions about learners’ understanding, based on such an assumption.

There are also contradictions in the teacher as subject in the system of her mathematics classroom. Central to the teacher is the knowledge about early number concept development as revealed by their practice. There is a contradiction between the teacher
as subject and the achievement of the object (children’s learning and engagement). This has to do with the knowledge that teachers had on early number concept development of children. From the observation analysis it was evident that the teachers were not actually teaching concepts, but mostly facts. For example, in all of the five classes that were observed, learners were not exposed to the part-part whole relationship of numbers and this relationship provides a good foundation for additive relationships. Teachers’ knowledge was not above what was written in the national curriculum (see a discussion under secondary contradiction on the subsystem subject – tool and object in the next section). Only one teacher in the study was said to have gone through mathematics related continuous professional development sessions. It is common knowledge that teachers teach content knowledge that they have been exposed to. Teachers’ limited content knowledge on number concept and the absence of continuous professional development may negatively affect learners’ acquisition of number concepts.

There was also tension in the language of instruction. Teachers are asked to use the language commonly used in the area where the school is while the instructional material that guides the teachers in teaching is in English and the learners’ books were written in Chichewa, the lingua franca. This means, therefore, that learners were not exposed to number words in the national text as the local number words used were beyond the level of the language that the learners were exposed to by the time they were learning numeracy. An example of a number word for ‘7’ in Chichewa is zisanu ndi ziwiri (seven –literally, five and two). Translation from English to the local Malawian language during teaching may also lead to inconsistency among teachers.

Secondary contradictions:
A secondary contradiction is a tension that arises within a relationship between two elements of the activity system, such as ‘subject’ and ‘tool’, ‘subject’ and ‘community’ or ‘community’ and ‘rules’ as they interact (Farrelly 2012:54-55). In determining the prevalent secondary contradictions, the activity system ‘the mathematics Standard 1 classroom’ was decomposed into sub-systems. Its decomposition was guided by Mwanza (2001).
The following contradictions were found in four ‘sub-systems’ of the activity;

1. **Tools used for learning (the object)**

Contradictions in two of the tools used by the subject were evident. The first tool was the learners’ books. Four of the five schools did not have adequate books. The second was the knowledge tool of the teachers. Even though the current Malawi national curriculum spells points out that, “the teacher shall be knowledgeable, creative, a competent facilitator and motivator of the learning process, a role model who promotes good health habits, is morally sound, a skills trainer and an active classroom researcher who guides all learners to achieve their maximum potential” (Malawi, Ministry of education 2009:11), the teachers in this study were not exemplary of such knowledgeable practitioners.

2. **Rules and regulations**

In the observed lessons it was evident that the teachers had limited knowledge of early number concept development. The lessons were very basic, teaching counting and sequencing of numbers and not much more. A further observation on the curriculum materials is that resources that are designed specifically for teaching mathematics are not clear in the curriculum, as a result, learners are encouraged to bring with them learning resources as they get to school. Unfortunately, an observation of the lessons at the five schools under study showed that most learners came to school without the resources.

3. **Division of work roles**

The third sub-system in which a contradiction was identified was in the ‘division of labour’. Each class that was observed had both class leaders and group leaders (when learners were working in groups). Since the classes had high enrolments, the class leaders had to assist the teachers in making sure that there is order in the classrooms by controlling noise and class work. The classes were well-managed but the class leaders’ attention was divided between learning and controlling the functioning of the activity system, which, in some cases meant that more than 100 seven year-olds had to be organized.
4. Tool management by the activity system community

The fourth sub-system where a contraction was identified is captured in this utterance of one of the teachers.

*Learners do tear off the charts placed on the walls hence you may not find anything on the wall. Further, the room is not lockable and it is used for prayer services on Sunday*” (Standard 1 teacher at Kamtsinje primary school).

Related to this, another teacher had this to say,

*I used to place charts on walls in the classroom but I removed them because it is examinations time and students used to remove them from the classroom by tearing them off*” (Standard 1 teacher at Msika Primary school.

The contradictions that I have described highlighted the puzzle of how to nurture a ‘way of life’ that can honour mathematics classrooms in the early grades.

5.4 FOSTERING MATHEMATICS CLASSROOM CULTURE IN LARGE CLASSES: THE CHALLENGE

When considering an alternative culture for large classes of young learners who have to lay foundations for their future learning of mathematics, one realises that the norms proposed by theorists in this field cannot apply in the conditions of the classes where I tried to see how these norms were enacted. The criteria for fostering a mathematics classroom culture as set out in Table 5.1 are simply not applicable. The eight themes that emanated from the analysis in Chapter 4, and the ASA interpretation in Section 5.2 and 5.3 provide observational and descriptive evidential warrant that the MCC is not conducive to laying foundations for early NCD. The study thus ended on a bifocal note: On the one hand the objects set out in Chapter 1 were achieved.

1. I found out what constitutes the culture of standard/grade 1 numeracy and mathematics classrooms in the sampled schools;
2. I explored possible enablers of learning as well as possible challenges to learning, related to the routines and the patterns of activity in the classrooms and also the bigger community of the schools;

3. I explored the utility of cultural historical and activity theory (CHAT) as an educational-anthropological lens for classroom culture studies study.

4. Additionally, I used models of mathematics classroom culture norms as criteria for judging whether the classes that I had observed had an enabling culture or a ‘disturbing’ culture.

The other side of the bifocal note is that although the objectives of the study were achieved, the findings show that there are limitations to the study. The three periods of observation may simply not have been enough, even though they were spread over a year. My description of the classroom culture may have been too narrow. The very size of the pupil population in each class may also have made it nearly impossible to get to the bottom of what drives such a culture of strict rituals and patterns. Nevertheless, despite these limitations I suggest, knowing how hard it will be to implement the recommendations, a few possibilities to inject more dynamism into the teaching of mathematics in these conditions.

5.5 RECOMMENDATIONS

The suggestions which I forward are from the view of a ‘quasi’ educational ethnographer who is also a mathematics teacher and an educational bureaucrat. I realise that to convert the large classes of early learning to MCC spaces is something that looks like an insurmountable challenge. Nevertheless, I tentatively do make suggestions.

5.5.1 Recommendations for future practice

The study revealed a number of issues worth considering in future as far as practice is concerned.

**School level recommendations**

- Standard 1 teachers should not rush learners through the content they are supposed to learn. More time should be provided to learners to practice the content.
• Standard 1 teachers should use games as prescribed in the teachers’ guides. Innovative ways of making mathematics appealing to learners should be explored and used in the classes.
• Standard 1 teachers should explore the use of mathematics specific resources like 5 frame and 10 frame to aid the teaching of numerals and additive relationships.
• Standard 1 teachers should use small group discussion in such a way that most learners should benefit from it.
• Standard 1 teachers should ensure that learners are frequently provided with homework to provide learners with opportunities to engage with mathematics after school.

Policy level recommendations

• The Malawi Institute of Education should consider revising the standard 1 mathematics curriculum to align it with the current theories of early number concept development.
• The Institute should ensure that pre-service teachers are equipped with early number concept development theories during their training.
• The ministry of education science and technology should provide adequate teaching and learning resources like learners’ books to all schools.
• The ministry of education science and technology should ensure that the learner teacher ratio in early grade classes is reduced to allow for effective learning.
• The ministry of education science and technology in collaboration with Malawi Institute of Education should establish a sustainable continuous professional development model for teachers.
• The Ministry of education science and technology should cause that the teaching of early grade mathematics be done in both local language and English (There should be code switching. Unlike the present state where it
is done in local language making learners miss some crucial elements of mathematical concept acquisition).

5.5.2 Recommendations for future research
The following are recommendations for future research:

- A follow up large scale study be carried out on mathematics classroom culture of early grade classes.
- An exploration of how to create and sustain a continuing professional development among early grade mathematics teachers.
- How to effectively use small group discussion in early grade classrooms to elicit learning.

5.6 CONTRIBUTION OF THE STUDY
The study has produced an ethnographically informed thesis in which the ‘puzzles’ of classroom culture has been described in a ‘thick description’. As a document, like the one of Henning (1992), early grade mathematics learning in Malawi has been discussed. The strength of the study thus lies in the spread of the sampled population at the time it was conducted, my study is a first ethnographically-based study of standard 1 MCC. Unlike studies that measure outcome and output or small case studies, this thesis has yielded an academic output that spans five schools, five teachers and more than 400 children in different parts of the Zomba City area. It is therefore possible that the study gives a glimpse of what happens elsewhere in the country and could partly explain why the regional assessments of standard 6 learners show that out of 14 countries in Africa, Malawian learners’ performance is the weakest. To address this, I should undertake to write a policy brief for the MIE. These should include, among others:

- Policy briefs on the revealed mathematics classroom culture. Special focus will be made on the issues that may negatively affect early number concept development.
• Taking advantage of the nature of my institution (Malawi Institute of Education (MIE), which is a national curriculum development centre), I will work with the Department of school and teacher development (One of the departments at MIE) to provide small scale orientation and training programme to teachers on pre-number, early number concept development, additive relationships and multiplicative relationships. Ideas from Fritz et al (2013) and meerkat mathematics will be useful during these trainings.

• Run small scale early number concept development interventions for learners who have shown signs of MLD. Initial focus will be on standard 2 learners at the school within Malawi Institute of Education campus.

The results of this study, having revealed some serious gaps in the way early mathematics learning is done, may contribute in developing interest among mathematics educators and researchers. Early mathematics education and research may begin to be given special attention. This may lead to the exploration and provision of context specific approaches to early mathematics learning.

The study has and will produce several research outputs inform of conference proceeding and journal articles. This has and will contribute to knowledge about early mathematics learning in Malawi. This literature will be vital to early mathematics educators and researchers.

5.7 CONCLUSIONS

The aim of this study was to provide a detailed (“thick”) description of the culture of selected standard 1 mathematics classrooms in five primary schools in Malawi at three different points in the school year. This was meant to assist in giving a better understanding of learners’ learning of early mathematics in the primary schools in a bid to tease out what may be contributors to the poor achievement of learners in Mathematics both at national and international level.

The study has shown what constitutes the culture of the early grade mathematics classes in the sampled classes. The major culture that was unearthed was the limited
exploration of mathematical concepts arising from the gaps in the way the curriculum materials were packaged. This has serious implications on the way learners are enculturated into mathematics. Addressing the issue will go a long way in the preparation of learners for higher level mathematics whose good performance is based on good grounding of learners at an early age.

The study also explored possible enablers of learning as well as possible challenges to learning, related to the routines and the patterns of activity in the classrooms and also the bigger community of the schools. It is worth noting that most of the challenges to learning that have been unearthed in this study were also found by other researchers (Chirwa 2013; Lowe 2008). Commitment to working on the challenges to learning will be of paramount importance because the curriculum may be revised to align it with early numeracy development theories for example, but if the classes will remain overcrowded and learners will not be provided with the needed teaching and learning resources, no meaningful change will occur.

Drawing from the numerical concept development theory, standard 1 teachers are supposed to be conversant with the early numerical concept development to ensure that they ably assist learners to have a firm grasp of numerical concepts. Further, drawing from Vygotsky’s (1979) concept of zone of proximal development, the study revealed how difficult it was to take learners from the zone of actual development to the zone of proximal development because of the large numbers of learners in the classrooms. The teachers in the five schools are however doing a great job despite their knowledge and resource limitation.

The use of the activity theory in identifying contradictions/tensions in the activity system was phenomenal and can be applied in several education settings. The identified contradictions in the study will be a springboard towards transformation if taken positively. The issues raised will actually provide a platform for relooking at the activity system to ensure that transformative learning takes place.

Overall, the way of life of the mathematics classroom studied is not conducive to learning. It is therefore not surprising that learners’ achievement in mathematics is poor. For early number concept development to be effective, there is need for space, tools,
time which are not adequate in the schools that were studied. This rendered the schools not conducive for proper enculturation of learners to the mathematics world.


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# APPENDICES

## Appendix 1: Summary of standard 1 mathematics lessons observed

<table>
<thead>
<tr>
<th>Lesson #</th>
<th>Date observed</th>
<th>School</th>
<th>Topic/main activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>19th Sept, 2016</td>
<td>Kamtsinje</td>
<td>Introducing 1 and writing 1</td>
</tr>
<tr>
<td>2</td>
<td>20th Sept, 2016</td>
<td>Kamtsinje</td>
<td>Introducing 2 and writing 2</td>
</tr>
<tr>
<td>3</td>
<td>27th Jan, 2017</td>
<td>Kamtsinje</td>
<td>Adding numbers horizontally (sum ≤ 9)</td>
</tr>
<tr>
<td>4</td>
<td>30th Jan, 2017</td>
<td>Kamtsinje</td>
<td>Adding numbers vertically (sum ≤ 9)</td>
</tr>
<tr>
<td>5</td>
<td>1st Jan, 2017</td>
<td>Kamtsinje</td>
<td>Subtracting numbers horizontally (Range - 0 to 9)</td>
</tr>
<tr>
<td>6</td>
<td>1st Feb, 2017</td>
<td>Kamtsinje</td>
<td>Subtracting numbers horizontally (Range - 0 to 9)</td>
</tr>
<tr>
<td>7</td>
<td>21st Sept, 2016</td>
<td>Phiri</td>
<td>Introducing 2 and writing 2</td>
</tr>
<tr>
<td>8</td>
<td>22nd Sept, 2016</td>
<td>Phiri</td>
<td>Introducing 3</td>
</tr>
<tr>
<td>9</td>
<td>9th Jan, 2017</td>
<td>Phiri</td>
<td>Adding numbers vertically (sum ≤ 5)</td>
</tr>
<tr>
<td>10</td>
<td>10th Jan, 2017</td>
<td>Phiri</td>
<td>Adding numbers horizontally (sum ≤ 5)</td>
</tr>
<tr>
<td>11</td>
<td>27th Sept, 2016</td>
<td>Nyanja</td>
<td>Writing 2</td>
</tr>
<tr>
<td>12</td>
<td>3rd Oct, 2016</td>
<td>Nyanja</td>
<td>Writing 2</td>
</tr>
<tr>
<td>13</td>
<td>6th Feb, 2017</td>
<td>Nyanja</td>
<td>Adding numbers horizontally (sum ≤ 9)</td>
</tr>
<tr>
<td>14</td>
<td>7th Feb, 2017</td>
<td>Nyanja</td>
<td>Adding numbers horizontally (sum ≤ 9)</td>
</tr>
<tr>
<td>15</td>
<td>9th Feb, 2017</td>
<td>Nyanja</td>
<td>Adding numbers vertically (sum ≤ 9)</td>
</tr>
<tr>
<td>16</td>
<td>10th Feb, 2017</td>
<td>Nyanja</td>
<td>Adding numbers (Sum ≤ 9), revision</td>
</tr>
<tr>
<td>17</td>
<td>29th Sept, 2016</td>
<td>Msika</td>
<td>Introducing 0</td>
</tr>
<tr>
<td>18</td>
<td>30th Sept, 2016</td>
<td>Msika</td>
<td>Writing 0</td>
</tr>
<tr>
<td>19</td>
<td>23rd Jan, 2017</td>
<td>Msika</td>
<td>Introducing 6</td>
</tr>
<tr>
<td>20</td>
<td>1st Jan, 2017</td>
<td>Msika</td>
<td>Counting up to 7 and writing 7</td>
</tr>
<tr>
<td>21</td>
<td>1st Feb, 2017</td>
<td>Msika</td>
<td>Writing 7</td>
</tr>
<tr>
<td>22</td>
<td>2nd Feb, 2017</td>
<td>Msika</td>
<td>Writing missing numbers (Range: 0 to 7)</td>
</tr>
<tr>
<td>23</td>
<td>23rd Sept, 2016</td>
<td>Mchenga</td>
<td>Comparing objects</td>
</tr>
<tr>
<td>24</td>
<td>26th Sept, 2016</td>
<td>Mchenga</td>
<td>Introducing 1</td>
</tr>
<tr>
<td>25</td>
<td>17th Jan, 2017</td>
<td>Mchenga</td>
<td>Introducing plus sign</td>
</tr>
<tr>
<td>26</td>
<td>18th Jan, 2017</td>
<td>Mchenga</td>
<td>Introducing the ‘equals’ sign</td>
</tr>
<tr>
<td>27</td>
<td>19th Jan, 2017</td>
<td>Mchenga</td>
<td>Introducing addition</td>
</tr>
<tr>
<td>28</td>
<td>20th Jan, 2017</td>
<td>Mchenga</td>
<td>Adding numbers horizontally (sum ≤ 5)</td>
</tr>
</tbody>
</table>

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11 Teacher wanted to introduce 3 but spent the whole lesson on writing 2 because many learners failed to write 2 when they were asked to write 2 on the chalkboard.

12 Teacher continued with the writing 7 in this lesson (lesson 21) because many learners had problems with writing 7 in lesson 20.
Appendix 2: Lyrics of songs sang during early grade mathematics lessons

Song 1: Tiwerenge manambala’ (Reciting numbers)
Teacher  Tiwerenge
Learners  Manambala
Teacher  Tiwerenge
Learners  Manambala,
tiphunzire kuwerenga manambala
tiphunzire kuwerenga manambala
Teacher  Werenga!
Learners  One two three
Teacher  Werenga
Learners  One two three

Note: The numbers recited are the ones determined by the teacher. Sometimes the reciting of numbers went up to the number 10

Song 2: Tiwonkhetsa manambala (Let us add numbers)
Teacher  Tiwonkhetsa
Learners  Manambala
Teacher  Tiwonkhetsa
Learners  Manambala,
tiphunzire kuwonkhetsa manambala
tiphunzire kuwonkhetsa manambala

Note: Song 2 is a variant of song 1.

Song 3: Masamu masamu’ (mathematics mathematics)
Teacher  Masamu masamu
Learners  Masamu ndi abwino
Teacher  Masamu masamu
Learners  Masamu ndi abwino
Sitingawasiye masamu
Masamu ndi abwino
**Song 4: ‘Kuwerenga kwa manambala’ (Counting)**
Teacher: Kuwerenga kwa manambala  
Learners: Kuli pano pano  
Teacher: Kuwerenga kwa manambala  
Learners: Bwerani mudzawone

**Song 5: Pamchenga**
Teacher: Pamchenga  
Learners: Pamchenga timatero powerenga  
Teacher: Pamchenga  
Learners: Pamchenga timatero powerenga  
Teacher: Uyu ndani  
Learners: One  
Teacher: Uyu ndani?  
Learners: Two  
**Note:** This song can continue until the teacher reaches the desired number of numerals that she/he wants learners to read.

**Song 6: ‘Chitimbe chitimbe’ (Local name of a certain fruit bearing tree)**
Teacher: *Chitimbe eee yaye chalakatika*  
Learners: *Chitimbe eee yaye chalakatika*  
Teacher: *Chitimbe eee yaye chalakatika*  
Learners: *Chitimbe eee yaye chalakatika*  
Teacher: Chitimbe  
Learners: Chalakatika  
Teacher: Chitimbe  
Learners: chalakatika  
Teacher: Chitimbe  
Learners: Chalakatika
Teacher Chitimbe
Learners Chalakatika
Teacher: *Chitimbe eee yaye chalakatika*
Learners *Chitimbe eee yaye chalakatika*
Teacher: *Chitimbe eee yaye chalakatika*
Learners *Chitimbe eee yaye chalakatika*
Teacher: *Chitimbe eee yaye chalakatika*
Learners *Chitimbe eee yaye chalakatika*
Teacher Chitimbe
Learners Chalakatika
Teacher Chitimbe
Learners Chalakatika
Teacher Werenga
Learners one
Teacher Werenga
Learners Two

**Note:** The learners were dancing as they were responding to this song while changing their body positions. The reading of the numbers went on until the number that they had so far covered was reached.

**Song 7: Ichi ndi chiyani?**

Teacher Ichi ndichiyani ananu
Learners One one
Teacher Bwerezani kawiri
Learners One one
Teacher Ichi ndichiyani ananu
Learners two two
Teacher Bwerezani kawiri
Learners two two

**Note:** This song continued until the teacher reached the desired number of numerals that she/he wanted learners to read.
Appendix 3: Lesson 7 transcript

STANDARD 1 NUMERACY AND MATHEMATICS CLASS AT PHIRI PRIMARY SCHOOL

Date: 21st September 2016

Starting time: 8:19am

1. Teacher – Good morning?
2. Learner – Good morning.
3. Teacher – Now it is time for mathematics. What time is it for?
4. Learners - mathematics
5. Teacher - Let’s start with singing a song- Tiwerenge
6. Learners- Manambala (learners responded). 1,2,3,…10 (singing and counting up to 10 while clapping hands)
7. Teacher – (Teacher wrote Manambala (meaning numbers) on the chalkboard). We are continuing to learn numbers. What are we going to learn?
8. Learner –Numbers (learners shouted)
9. Teacher –(She placed a chart on the board) How many trees are here (Pointing at the trees on the chart).
10. Learners – One (learners shouted)
11. Teacher- Look here (pointing at a candle on the chart). What is this?
12. Learner – a candle (all learners shouted)
13. Teacher –How many candles are here?
14. Learner – One (learners shouted)
15. Teacher- Look here (pointing at a banana). What is this?
16. Learner –a banana (shouted learners)
17. Teacher –How many bananas are here?
18. Learners – One (one learner shouted)
19. Teacher- How about this (pointing at a pistle)
20. Learner –a pistle
21. Teacher –How many are here
22. Learners - One
23. Teacher- How about this (pointing at a bloom)
24. Learner –Bloom (all learners shouted)
25. Teacher –Is it used for sweeping inside a house or outside?
26. Learners – Inside (shouted learners)
27. Teacher- How many blooms are here?
28. Learner – one
29. Teacher –What is this? (pointing at an onion)
30. Learners - Onion
31. Teacher- How many onions are here?
32. Learner –one (learners shouted)
33. **Teacher** – If there is one object, we say One (writes 1 on the chalkboard). (Held a card with 1 in her hands). What number is this?

34. **Learners** – One (one learner answered)

35. **Teacher** – Say sure (to the learner who responded correctly) we are proud of you. Yesterday we learnt something (she hangs a chart on the blackboard). Let’s look at this picture (pointing at a fish). What is this?

36. **Learner** – Fish (all learners shouted)

37. **Teacher** – How many fish are here?

38. **Learners** – One

39. **Teacher** – (repeated part of 35 above, 36 and 37 with the following; pen, cup, mango, flower, leaf and eye)

40. **Teacher** – What number is represented by two things?

41. **Learners** – 2

42. **Teacher** – Two, what is it?

43. **Learners** – 2 (middle row), 2 (girls only), 2 (boys only)

44. **Teacher** – (Held a card with 2). This number is 2 (Said three times)

45. **Learner** – 2 (repeated more than 5 times) (said whole class, back row, front row, boys only, girls only)

46. **Teacher** – Who can point at 2 on the chart and speak out as you point?

47. **Learners** – 2 (a learners said while pointing at 2)

48. **Teacher** – Who else can point at 2 and say its name

49. **Learner** – 2 (a learners said while pointing at 2)

50. **Teacher** – Let’s give him Mandela wave

51. **Teacher** – (Started singing a song) Tiwerenge (let us count)

52. **Learner** – manambala (numbers)

53. **Teacher** – Now we will learn how to write 2. What are we going to learn to write?

54. **Learner** – 2 (all learners responded)

55. **Teacher** – I will write….

56. **Teacher** – I want somebody to write 2 on the chalkboard (A learner was selected and went in front to write 2 on the chalkboard). Make sure that it is clear

57. **Learner** – (Learner writes on the chalkboard)

58. **Teacher** – What number have our friends written?

59. **Learners** – 2 (all learners shouted)

60. **Teacher** – (Teacher chose four learners to write on the chalkboard. One learner struggled to write but the teacher assisted him). What number have we written?

61. **Learner** – 2

62. **Teacher** – Now everybody should get a notebook and a pen and write 2

63. **Learner** – Madam, I want to go out and a get a notebook and a pen (One learner shouted while some learners were busy writing)

64. **Teacher** – Go. Everybody should be keeping his/her own writing materials

65. **Learners** – (Some learners wrote a reflection of 2. The teacher guided them as she moved from one person to the other during marking)
66. **Teacher** - (When marking was through) everybody should pack his/her notebook. We will sing a song – sang the song alone and then sang it together with the learners). When we go home, everybody should write the number 2. Tell the people you stay with that you want to write 2. Tomorrow we will learn 3.

**End of the lesson**
Appendix 4: Lesson 13 transcript

STANDARD 1 NUMERACY AND MATHEMATICS CLASS AT NYANJA PRIMARY SCHOOL

Date: 6th February 2017

Topic: Kuwonkhetsa nambala mpaka 9 (Adding numbers up 9)

Starting time: 10:15 am

67. Teacher – Good morning children? It is time for mathematics. It is time for what?
68. Learner – mathematics
69. Teacher – (Teacher writes 1 + 1 = on the chalkboard). Who can say the answer to this question?
70. Learners – 1 + 1 = 2
71. Teacher – Good. Today, we will learn addition of numbers up to 9. (Started the song ‘Tiwonkhetse’ a related version of the song ‘Tiwerenge’ As the learners sang the song, they also counted up to 10. Ok we are adding numbers with sum not exceeding 9. (The teacher wrote 5 + 1 = ). What have I written on the chalkboard?
72. Learner – five plus one equals
73. Teacher – Yes. How will we find the answer? What number will we start counting?
74. Learners – 5
75. Teacher – Ok. Everybody should have counters. Let’s us count 5 objects.
76. Learner – 1,2,3,4,5 (Learners counted together with the teacher)
77. Teacher – How many are we adding to 5?
78. Learners – 1
79. Teacher – How many are they altogether
80. Learner – 1,2,3,4,5,6 (Leaners counting the objects together with the teacher)
81. Learners - 6
82. Teacher – who can come and write 6 on the chalkboard?
83. Learners – (Learner wrote)
84. Teacher – has she got it right?
85. Learner – Yes
86. Teacher – What do we do we do with those who get answers right?
87. Learners – we give them sweets
88. Teacher – (Teacher writes 5 + 2 = on the chalkboard). Who can read what I have written?
89. Learner – Five kuphatikiza 2 zikhala (Five plus 2 equals)
90. Teacher – Good. Solve this problem in your groups. (There are 4 groups in the classroom and they are fixed. The arrangement of the classroom is in such a way that leaners are always in groups. The groups are given names of animals ie. Lion, leopard, giraffe. When done, a member from each of the groups were invited to work out the answer to the problem). Who can come to write 7 on the chalkboard.
91. **Learners** – learner wrote - *gona sika* (the learner said these words as she was writing the digit 7)

92. **Teacher** – (The teacher wrote $5 + 3 = $ on the chalkboard). Let us read this together (Pointing at the mathematical statement on the blackboard)

93. **Learner** – Five plus 3 equals

94. **Teacher** – A minute. What is the answer?

95. **Learners** – 8 (Answered one learner)

96. **Teacher** – Has he got it right?

97. **Learner** – Yes

98. **Teacher** – Come and write 8 on the chalkboard

99. **Learners** – (Learner wrote)

100. **Teacher** – (Teacher wrote $5 + 4 = $ on the chalkboard). Let’s read this together.

101. **Learner** – Five plus 4 equals

102. **Teacher** – Now, everybody find the answer to this problem individually. What is the answer?

103. **Learners** – 9 (Answered one learner)

104. **Teacher** – Come an write 9 on the chalkboard

105. **Learner** – (Learner wrote the 9)

106. **Teacher** – Clap hands for him (And was given a sweet). Everybody should get his/her notebook. We have one question. Write it fast. I want to start marking now. Those who will not write will be punished. Fast, write very fast! (the teacher wrote $5 + 3 = $

107. **Learners** – Madam, I have finished (Shouted one of the fast writers)

108. **Teacher** – Ok. Those who will get correct answer to the problem will receive a sweet. (Learners had their notebooks marked those who got the correct answer had their notebooks retained by the teacher). Make sure that you write subject and date before writing the problem. (After some time of marking, though not everybody had his/her work marked. The lesson was over). It is now time up. I told you to write fast. Here are those who got the answers to the question correct. (They were only 16 and the teacher called them their names and gave them back their notebooks). Clap hands for them

109. **Learner** – Clap! Clap! Clap!

**End of lesson 10:45 am**
Appendix 5: Focus group discussion guide

University of Johannesburg
Faculty of Education, Childhood Education Department

Focus group discussion guide

Instructions

1. Ensure that the class teacher is always present when discussing with the learners
2. Ensure that the place where the discussion will be conducted is free from disruptions
3. Take note of the learners’ sex and age before the beginning of the discussion
4. Ensure that all the selected learners participate in the discussion
5. Confirm with the school that parental consent is in order

Guiding questions

1. Tell me how you feel when you come to school in the morning.
2. Let us talk about school. Is there a subject you like very much? Which one?
3. What other subjects do you like?
4. So let’s now talk about mathematics: What makes you happy when learning mathematics?
5. What makes you worried when you are learning mathematics?
6. What would you like to happen in the mathematics class? What should your teacher do?
7. What about the other children. What would you like them to do in the maths lessons?

8. Would you please tell me about the resources that you use when you are learning mathematics? (Probes—What are they? How do you use them? Do you like them? Do they assist you to understand what the teacher is teaching you?)

9. Who is your best friend in the mathematics class? Why do you say so?

10. Do you think of mathematics at home? When?

11. Do you count things on the way to and back from school—like trees or stones?

12. How would you feel if your teacher did the mathematics class outside?

13. How big is your school?

14. How far is your home from the school?

15. How long does it take you to walk to school?

16. How high is the roof of your house?

17. Can you tell me any shape that you know.

18. Which shape do you like best—for instance a circle?

19. Can anyone tell me what a rectangle is?

20. What else would you like to say about mathematics?

Thank you very much for your responses
Appendix 6: Teacher questionnaire

University of Johannesburg
Faculty of Education, Childhood Education Department

Teachers’ questionnaire on mathematical beliefs

Instructions
6. Do not write your name on this instrument
7. Please answer all questions
8. Be free to ask if you need clarification on any item

Section A: Teachers’ biographical data
1. Zone: ________________________  School: ______________________________
2. Standard:   __________
3. No. of learners:      Male  _______   Female  _______
4. Sex of teacher:  □ Male   □ Female   Age: ______________________
5. Number of years teaching mathematics in infant section   _____________
6. Number of years teaching this standard     _____________
7. Total years teaching        _____________
8. What mode of training did you go through? (Tick one)
   □ One year teacher training
   □ One plus one (IPTE)
   □ Two year teacher training
   □ Malawi Integrated In-service Teacher Education Programme (MIITEP)
   □ Open and Distance Learning (ODL)
   □ Malawi Special Teacher Education Programme (MASTEP)
   □ Other _____________________(specify)

This questionnaire is mainly based on the work of Raymond (1997)
9. What is your highest academic qualification? (Tick one)
   - □ Junior Certificate of Education
   - □ Malawi School Certificate of Education
   - □ Diploma in Education

10. What is the status of your employment?
    - □ Permanent
    - □ Month-to-month
    - □ Temporary
    - □ Student Teacher
    - □ Volunteer

11. What kind of in-service training did you receive on the teaching and learning of mathematics?
    - □ School based
    - □ Zonal based
    - □ None

12. How many in-service training sessions on mathematics teaching and learning have you attended this academic year? (Tick one)
    - □ None
    - □ One
    - □ Two
    - □ Three
    - □ More than three sessions

13. How many in-service training sessions on mathematics teaching and learning did you attended last academic year? (Tick one)
    - □ None
    - □ One
    - □ Two
    - □ Three
More than three sessions

14. What role does the community surrounding this school play in learners’ mathematics learning?

__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________

Section B: Teachers’ beliefs about mathematics

In this section, you are asked to indicate your views on a set of statements. You can strongly disagree; you can disagree; you can agree; or you can strongly agree.

<table>
<thead>
<tr>
<th>Item description</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
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</thead>
<tbody>
<tr>
<td>1. Mathematics is an unrelated collection of facts, rules, and skills.</td>
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<td>2. Mathematics is fixed, predictable, absolute, certain, and applicable.</td>
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<td>3. Mathematics is primarily an unrelated collection of facts, rules, and skills.</td>
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<td>4. Mathematics is primarily fixed, predictable, absolute, certain, and applicable.</td>
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<td>5. Mathematics is a static but unified body of knowledge with interconnecting structures.</td>
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<td>6. Mathematics is equally both fixed and dynamic, both predictable and surprising, both absolute and relative, both doubtful and certain, and both applicable and aesthetic.</td>
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<tr>
<td>7. Mathematics is primarily a static but unified body of knowledge.</td>
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<td>9. Mathematics is primarily surprising, relative, doubtful, and aesthetic.</td>
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<td>10. Mathematics is dynamic, problem driven, and</td>
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Section C: Teachers’ beliefs about learning mathematics

In this section, you are asked to indicate your views on a set of statements. You can strongly disagree; you can disagree; you can agree; or you can strongly agree.

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<tr>
<td>1. Students passively receive knowledge from the teacher.</td>
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<td>2. Students learn mathematics by working individually.</td>
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<td>3. Students engage in repeated practice for mastery of skills.</td>
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<td>4. There is only one way to learn mathematics.</td>
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<td>5. Memorization and mastery of algorithms signify learning.</td>
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<td>6. Student learns mathematics solely from the textbook and worksheets.</td>
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<td>7. Many students are just not able to learn mathematics.</td>
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<td>8. Students’ learning of mathematics depends solely on the teacher.</td>
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<td>9. Students primarily engage in practice for mastery of skills.</td>
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<td>10. Memorization and mastery of algorithms provide primary evidence of learning.</td>
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<td>11. The teacher is more responsible for learning than continually expanding.</td>
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<td>12. Mathematics can be surprising, relative, doubtful, and aesthetic.</td>
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<td>13. Mathematics is a way of seeing the world we are living in.</td>
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<td>14. Mathematics is a useful discipline/science that can be applied to society and life.</td>
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<td>12. Mathematics is learned primarily from the textbook and worksheets.</td>
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<td>13. Students work individually except perhaps to work on homework.</td>
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<td>14. Students are primarily passive learners, raising questions on occasion.</td>
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<td>15. Students should learn mathematics through both problem solving and textbook work.</td>
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<td>16. Students should both understand and master skills and algorithms.</td>
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<td>17. Students should do equal amounts of individual and group work.</td>
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<td>18. There is more than one way to learn mathematics.</td>
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<td>19. Most students can learn mathematics.</td>
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<td>20. Learning mathematics is equally the responsibility of students and teachers.</td>
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<td>21. Trying hard is as likely to aid mathematics learning as is being naturally good.</td>
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<td>22. Repeated practice is as likely to help in the learning of mathematics as is having insights as a result of explorations.</td>
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<td>24. Students primarily learn mathematics from working with other students.</td>
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<td>25. Learning is evidenced more through ability to explain understanding than through expert memorization and performance of algorithms.</td>
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<td>26. Students are more responsible for their own learning than the teacher.</td>
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<td>Item description</td>
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<td>27. Students learn mathematics primarily as active learners.</td>
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<td>28. The students' role is that of autonomous explorer.</td>
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<td>29. Students learn mathematics only through problem-solving activities.</td>
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<td>30. Students learn mathematics without textbook or paper-and-pencil activities.</td>
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<td>31. Students learn mathematics through cooperative group interactions.</td>
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<td>32. Students are active mathematics learners.</td>
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<td>33. All students can learn mathematics.</td>
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<td>34. Each student learns mathematics in his or her own way.</td>
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<td>35. Students like learning using objects and scenarios from the natural world, such as stones, leaves, rocks, sand and water</td>
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**Section D: Teachers’ beliefs about teaching mathematics**

In this section, you are asked to indicate your views on a set of statements. You can strongly disagree; you can disagree; you can agree; or you can strongly agree.

<table>
<thead>
<tr>
<th>Item description</th>
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<th>Disagree</th>
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<tbody>
<tr>
<td>1. My role is to lecture and to dispense mathematical knowledge.</td>
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<td>2. My role is to assign individual seatwork.</td>
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<td>3. I seek &quot;right answers&quot; and I am not concerned with explanations.</td>
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<td>4. I approach mathematical topics individually, a day at a time.</td>
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<td>5. I emphasize mastery and memorization of skills</td>
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<td><strong>Item description</strong></td>
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<td>and facts.</td>
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<td>6. I instruct solely from the textbook.</td>
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<td>7. Lessons are planned and implemented explicitly without deviation.</td>
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<td>8. I assess students solely through end of term/year examinations.</td>
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<td>9. Lessons and activities follow the same pattern daily.</td>
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<td>10. I primarily dispense knowledge.</td>
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<td>11. I primarily value right answers over process.</td>
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<td>12. I emphasize memorization over understanding.</td>
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<td>13. I primarily (but not exclusively) teach from the textbook.</td>
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<td>14. I include a limited number of opportunities for problem solving.</td>
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<td>15. I include a variety of mathematical tasks in lessons.</td>
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<td>16. I equally value product and process.</td>
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<tr>
<td>17. I equally emphasize memorization and understanding.</td>
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<tr>
<td>18. I spend equal time as a dispenser of knowledge and as a facilitator.</td>
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<tr>
<td>19. Lesson plans are followed explicitly at times and flexibly at others.</td>
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<tr>
<td>20. I have students work in groups and individually in equal amounts.</td>
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<tr>
<td>21. I use textbook and problem-solving activities equally.</td>
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</tr>
<tr>
<td>22. I help students both enjoy mathematics and see it as useful.</td>
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<tr>
<td>Item description</td>
<td>Strongly Disagree</td>
<td>Disagree</td>
<td>Agree</td>
<td>Strongly Agree</td>
</tr>
<tr>
<td>---------------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>23. I primarily facilitate and guide, with little lecturing and direct instruction.</td>
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<tr>
<td>24. I value process somewhat more than product.</td>
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<tr>
<td>25. I emphasize understanding over memorization.</td>
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<tr>
<td>26. I make problem solving an integral part of class.</td>
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<tr>
<td>27. I use the textbook in a limited way.</td>
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<tr>
<td>28. My role is to guide learning and pose challenging questions.</td>
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<tr>
<td>29. My role is to promote knowledge sharing.</td>
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<tr>
<td>30. I clearly value process over product.</td>
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</tr>
<tr>
<td>31. I do not follow the textbook when teaching.</td>
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</tr>
<tr>
<td>32. I only provide problem-solving, manipulative-driven activities.</td>
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</tr>
<tr>
<td>33. I do not plan explicit, inflexible lessons.</td>
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<tr>
<td>34. I have students work in cooperative groups at all times.</td>
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<tr>
<td>35. I promote students’ autonomy.</td>
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<tr>
<td>36. I help students to like and value mathematics.</td>
<td></td>
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</tr>
<tr>
<td>37. I use objects and scenarios from the natural world, such as stones, leaves, rocks, sand and water</td>
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</tr>
</tbody>
</table>

Thank you so much for your time
### Appendix 7: Teachers’ beliefs about mathematics

<table>
<thead>
<tr>
<th>Item description</th>
<th>Teacher X</th>
<th>Teacher A</th>
<th>Teacher B</th>
<th>Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>14. Mathematics is an unrelated collection of facts, rules, and skills.</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>15. Mathematics is fixed, predictable, absolute, certain, and applicable.</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>16. Mathematics is primarily an unrelated collection of facts, rules, and skills.</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>17. Mathematics is primarily fixed, predictable, absolute, certain, and applicable.</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>18. Mathematics is a static but unified body of knowledge with interconnecting structures.</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>19. Mathematics is equally both fixed and dynamic, both predictable and surprising, both absolute and relative, both doubtful and certain, and both applicable and aesthetic.</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>20. Mathematics is primarily a static but unified body of knowledge.</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>21. Mathematics involves problem solving.</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>22. Mathematics is primarily surprising, relative, doubtful, and aesthetic.</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>23. Mathematics is dynamic, problem driven, and continually expanding.</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>24. Mathematics can be surprising, relative, doubtful, and aesthetic.</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>25. Mathematics is a way of seeing the world we are living in.</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>26. Mathematics is a useful discipline/science that can be applied to society and life.</td>
<td>1</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

Note that where there was no mode, median was used.
Appendix 8: Teachers’ beliefs about learning mathematics

<table>
<thead>
<tr>
<th>Item description</th>
<th>Teacher X</th>
<th>Teacher A</th>
<th>Teacher B</th>
<th>Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>36. Students passively receive knowledge from the teacher.</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>37. Students learn mathematics by working individually.</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>38. Students engage in repeated practice for mastery of skills.</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>39. There is only one way to learn mathematics.</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>40. Memorization and mastery of algorithms signify learning.</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>41. Student learns mathematics solely from the textbook and worksheets.</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>42. Many students are just not able to learn mathematics.</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>43. Students’ learning of mathematics depends solely on the teacher.</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>44. Students primarily engage in practice for mastery of skills.</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>45. Memorization and mastery of algorithms provide primary evidence of learning.</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>46. The teacher is more responsible for learning than the student.</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>47. Mathematics is learned primarily from the textbook and worksheets.</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>48. Students work individually except perhaps to work on homework.</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>49. Students are primarily passive learners, raising questions on occasion.</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>50. Students should learn mathematics through both problem solving and textbook work.</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>51. Students should both understand and master skills and algorithms.</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>52. Students should do equal amounts of individual and group work.</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>53. There is more than one way to learn mathematics.</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>54. Most students can learn mathematics.</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>55. Learning mathematics is equally the responsibility of students and teachers.</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>56. Trying hard is as likely to aid mathematics learning as is being naturally good.</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>57. Repeated practice is as likely to help in the learning of mathematics as is having insights as a result of explorations.</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>58. Students primarily learn mathematics through problem-solving tasks.</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>59. Students primarily learn mathematics from working with other students.</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>60. Learning is evidenced more through ability to explain understanding than through expert memorization and performance of algorithms.</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>61. Students are more responsible for their own learning than the teacher.</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>62. Students learn mathematics primarily as active learners.</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>63. The students’ role is that of autonomous explorer.</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Item description</td>
<td>Teacher X</td>
<td>Teacher A</td>
<td>Teacher B</td>
<td>Mode</td>
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<tr>
<td>---------------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>64. Students learn mathematics only through problem-solving activities.</td>
<td>3</td>
<td>3</td>
<td>2</td>
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</tr>
<tr>
<td>65. Students learn mathematics without textbook or paper-and-pencil activities.</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>66. Students learn mathematics through cooperative group interactions.</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>67. Students are active mathematics learners.</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>68. All students can learn mathematics.</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>69. Each student learns mathematics in his or her own way.</td>
<td>3</td>
<td>4</td>
<td>3</td>
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</tr>
<tr>
<td>70. Students like learning using objects and scenarios from the natural world, such as stones, leaves, rocks, sand and water</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>
### Appendix 9: Teachers’ beliefs about teaching mathematics

<table>
<thead>
<tr>
<th>Item description</th>
<th>Teacher X</th>
<th>Teacher A</th>
<th>Teacher B</th>
<th>Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>38. My role is to lecture and to dispense mathematical knowledge.</td>
<td>3</td>
<td>3</td>
<td>3</td>
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</tr>
<tr>
<td>39. My role is to assign individual seatwork.</td>
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<td>2</td>
<td>3</td>
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</tr>
<tr>
<td>40. I seek &quot;right answers&quot; and I am not concerned with explanations.</td>
<td>2</td>
<td>2</td>
<td>1</td>
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</tr>
<tr>
<td>41. I approach mathematical topics individually, a day at a time.</td>
<td>2</td>
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<td>3</td>
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</tr>
<tr>
<td>42. I emphasize mastery and memorization of skills and facts.</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>43. I instruct solely from the textbook.</td>
<td>2</td>
<td>3</td>
<td>2</td>
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</tr>
<tr>
<td>44. Lessons are planned and implemented explicitly without deviation.</td>
<td>3</td>
<td>3</td>
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</tr>
<tr>
<td>45. I assess students solely through end of term/year examinations.</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>46. Lessons and activities follow the same pattern daily.</td>
<td>1</td>
<td>2</td>
<td>3</td>
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</tr>
<tr>
<td>47. I primarily dispense knowledge.</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>48. I primarily value right answers over process.</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>49. I emphasize memorization over understanding.</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>50. I primarily (but not exclusively) teach from the textbook.</td>
<td>2</td>
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</tr>
<tr>
<td>51. I include a limited number of opportunities for problem solving.</td>
<td>3</td>
<td>2</td>
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</tr>
<tr>
<td>52. I include a variety of mathematical tasks in lessons.</td>
<td>4</td>
<td>3</td>
<td>3</td>
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</tr>
<tr>
<td>53. I equally value product and process.</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>54. I equally emphasize memorization and understanding.</td>
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<td>55. I spend equal time as a dispenser of knowledge and as a facilitator.</td>
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<tr>
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<td>3</td>
<td>3</td>
</tr>
<tr>
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<td>65. My role is to guide learning and pose challenging questions.</td>
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<tr>
<td>66. My role is to promote knowledge sharing.</td>
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<td>3</td>
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<td>3</td>
</tr>
<tr>
<td>Item description</td>
<td>Teacher X</td>
<td>Teacher A</td>
<td>Teacher B</td>
<td>Mode</td>
</tr>
<tr>
<td>---------------------------------------------------------------------------------</td>
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<td>------</td>
</tr>
<tr>
<td>67. I clearly value process over product.</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>68. I do not follow the textbook when teaching.</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>69. I only provide problem-solving, manipulative-driven activities.</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>70. I do not plan explicit, inflexible lessons.</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>71. I have students work in cooperative groups at all times.</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>72. I promote students’ autonomy.</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>73. I help students to like and value mathematics.</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>74. I use objects and scenarios from the natural world, such as stones, leaves, rocks, sand and water</td>
<td>4</td>
<td>3</td>
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<td>4</td>
</tr>
</tbody>
</table>
Appendix 10: Consent form for teachers

Faculty of Education - Research Project Information
AN EXPLORATION OF MATHEMATICS CLASSROOM CULTURE IN SELECTED EARLY GRADE MATHEMATICS CLASSROOMS IN MALAWI

Background to the study including the nature of the research
1. Tiounge Waddington Saka, am doing research on the culture of early grade mathematics classes. My view is that ethnographically informed research comprises the process of systematic observation across time in order to identify practices and signs of "the way of life of an identifiable group of people"(Wolcott. 1994). I wish to learn what happens in early grade mathematics classes on a regular basis and at different times of the school year. I am inviting you to participate in this research study in which I hope to show and interpret the events and processes in classes in five different schools and then, in giving a 'thick description' of them, conclude that there is a pattern of regularities that may mirror and interpret learners' competence in maths. Studies show that a good grasp of early mathematical concepts is a good predictor of subsequent mathematics achievement and in this study, I want to extract descriptors of classrooms that can be described as 'classroom culture' (Henning, 1991), a component of which is the type of conversations that happen in the classrooms (Venkat, 2013; Graven, 2015).

Intention of the project
Research associated with this project attempts to:
provide a description of the culture of early grade mathematics classes in five primary schools in Malawi. This will assist in giving a better understanding of learners’ learning of numeracy and mathematics in the primary schools in this specific context and may also give an exploratory account of who pedagogical rituals and patterns structure learning opportunities.

Procedures involved in the research
Dear teachers and learners, in this study, you are expected to prepare for the mathematics lessons as you normally do and I will observe your lessons as a 'friendly outsider'. Depending on the lesson, I may interview you after the lesson, just to understand what I may not have understood during the lesson. The observation time will be determined by the class timetable to ensure that everything runs as normal as they are supposed to. I will observe six of your mathematics lessons at three different points in the school year. Bearing in mind that it is difficult to capture everything that is going on during the lesson using pen and paper, your lesson will also be video recorded to complement what I will take note during the lesson observation.

Potential Risks
It is unlikely that there will be any harm or discomfort associated with your participation in this study. This is so because your participation will be within the normal duties that you carry out. If there will be need for post observation interviews, this will be done after lessons to ensure that there is no loss to the teaching time. If you are willing I may have a look at your lesson preparation and other available documents.

Potential Benefits
The findings of this study will contribute to the promotion of the quality of education in our country, Malawi. In the detailed description of your classroom activity, we may, together, find ways to improve the cultural practice of mathematics teaching, especially when I have collated the data from all five schools and share that with you when I do 'member checking' to ensure that I have captured your classroom 'way of life' reliably.

Informed consent
We recognize that participants are not capable of consent unless “informed”. We have, therefore, disclosed the nature of the research, the aims, the duration, the risks and benefits, the nature of interventions throughout the study, compensations where appropriate, researcher details, and details of the ethical review process. Where appropriate, communities, employers, departments and other instances are also part of the informed consent process.

Faculty of Education Research Ethics Committee, University of Johannesburg, Updated February 2016
Please report any instance of unethical research practice to geere@uj.ac.za or 011 559 3016

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Confidentiality

Every effort will be made to protect (guarantee) your confidentiality and privacy. I will not use your name or any information that would allow you to be identified. In addition, all data collected will be anonymous and only the researchers will have access to the data that will be securely stored for no longer than 2 years after publication of research reports, or papers. Thereafter, all collected data will be destroyed. You must, however, be aware that there is always the risk of group or cohort identification in research reports, but your personal identity will always remain confidential. You must also be aware that if information you have provided is requested by legal authorities I may be required to comply.

Participation and Withdrawal

Your participation in this study is voluntary. You may withdraw your consent to participate in the project at any time during the project. If you decide to withdraw, there will be no consequences to you. Your decision whether or not to be part of the study will not affect your continuing access to any services that might be part of this study.

Future interest and Feedback

You may contact me (see below) at any time during or after the study for additional information, or if you have questions related to the findings of the study. You may indicate your need to see the findings of the research in the attached consent form.

Tionge Weddington Saka 063 536 7923 Prof Elizabeth Henning 011 5595102

31 May 2018
Informed Consent/Assent Form

Project Title:
AN EXPLORATION OF MATHEMATICS CLASSROOM CULTURE IN SELECTED EARLY GRADE MATHEMATICS CLASSROOMS IN MALAWI

Investigator:
Tionge Weddington Saka, University of Johannesburg, Childhood Education Department, P.O. Box 524, Johannesburg 2006. Cell: +276 3536 7923

Date:
31 May 2018

Please mark the appropriate checkboxes. I hereby:

☐ Agree to be involved in the above research project as a participant.
☐ Agree to be involved in the above research project as an observer to protect the rights of:
  ☐ Children younger than 18 years of age;
  ☐ Children younger than 18 years of age that might be vulnerable*; and/or
  ☐ Children younger than 18 years of age who are part of a child-headed family.
☐ Agree that my child. __________________________ may participate in the above research project.
☐ Agree that my staff may be involved in the above research project as participants.

☐ I have read the research information sheet pertaining to this research project (or had it explained to me) and I understand the nature of the research and my role in it. I have had the opportunity to ask questions about my involvement in this study. I understand that my personal details (and any identifying data) will be kept strictly confidential. I understand that I may withdraw my consent and participation in this study at any time with no penalty.

☐ Please allow me to review the report prior to publication. I supply my details below for this purpose:
☐ Please allow me to review the report after publication. I supply my details below for this purpose:
☐ I would like to retain a copy of this signed document as proof of the contractual agreement between myself and the researcher

Name: ____________________________________________________________
Phone or Cell number: ________________________________________________
e-mail address: ______________________________________________________

Signature: __________________________________________________________

If applicable:
☐ I willingly provide my consent/assent for using audio recording of my/the participant’s contributions.
☐ I willingly provide my consent/assent for using video recording of my/the participant’s contributions.
☐ I willingly provide my consent/assent for the use of photographs in this study.

Signature (and date): ________________________________________________

Signature of person taking the consent (and date): _________________________

Faculty of Education Research Ethics Committee, University of Johannesburg, Updated February 2016
Please report any instance of unethical research practice to geoff@uj.ac.za or 011 559 3016
Appendix 11: Request for permission to carry out study in Zomba Rural schools

Department of Research, Evaluation and Policy Studies
Malawi Institute of Education
P.O. Box 50
DOMASI
30th June, 2016
E-mail: tione4@gmail.com
Cell: +265 888 362 850/+276 3536 7923

The District Education Manager (Zomba Rural)
P. O Box 311
ZOMBA

Dear Sir,

REQUEST FOR PERMISSION TO CONDUCT A STUDY IN FOUR PRIMARY SCHOOLS IN YOUR DISTRICT

My name is Tionge Weddington Saka. I am working with the Malawi Institute of Education as a Senior Research Officer in the Department of Research, Evaluation and Policy Studies. I am currently studying at the University of Johannesburg, South Africa. I hereby seek permission to access four primary schools in your district in order for me to collect data for my PhD thesis. I plan to collect the data in three phases – as the schools are closing for the third term in July (2015/2016 academic year) and during the first and second term of the 2016/2017 academic year.

In this study, I would like to learn how learners are assisted to learn the number concept. This study will therefore assist in unearthing the learners’ learning of the number concept which is very crucial for their subsequent achievement in mathematics.

During the study, Standards 1 and 2 classes will be targeted. In these classes, interviews will be conducted with the teachers and lesson observations will be made as the learners will be learning Numeracy and Mathematics and any other learning area. The head teacher will also be interviewed.

The participation of the teachers and the head teachers in this study will be entirely voluntary. The information collected from the study will be treated with confidentiality and the participants’ identities will not be disclosed in any of the products of this study. The teachers will be allowed to withdraw from the study at any time if they wish to do so. When the study is finally concluded, I hope to provide you with a summary of the key findings.

Yours faithfully,

Tionge Weddington Saka
Appendix 12: Permission from the District Education Manager for the Zomba Rural

Ref: /DEM/ADMIN/08/7
DATE: 27/06/2016

FROM
THE DISTRICT EDUCATION MANAGER,
BOX 311,
ZOMBA.

TO:
WHOM IT MAY CONCERN

The bearer of the letter is TIONGE WEDDINGTON SAKA who is carrying out a research. So this is to introduce him to you so that you can work with him.

Please assist him accordingly.

Lastly we thank you for your usual assistance
Yours Faithfully,

[Signature]

Ellen Lokoma (Mrs Mittochi) CPEA
FOR: THE DISTRICT EDUCATION MANAGER ZOMBA RURAL
Appendix 13: Permission from the District Education Manager for the Zomba Urban

Department of Research, Evaluation and Policy Studies
Malawi Institute of Education
P.O. Box 50
DOMASI
30th June, 2016
E-mail: tionge4@gmail.com
Cell: +265 888 362 850/+276 3536 7923

The District Education Manager (Zomba Urban)
P. O Box 311
ZOMBA

Dear Sir,

REQUEST FOR PERMISSION TO CONDUCT A STUDY IN ONE PRIMARY SCHOOL IN YOUR DISTRICT

My name is Tione Weddington Saka. I am working with the Malawi Institute of Education as a Senior Research Officer in the Department of Research, Evaluation and Policy Studies. I am currently studying at the University of Johannesurg, South Africa. I hereby seek permission to access one primary school in your district in order for me to collect data for my PhD thesis. I plan to collect the data in three phases - as the schools are closing for the third term in July (2015/2016 academic year) and during the first and second term of the 2016/2017 academic year.

In this study, I would like to learn how learners are assisted to learn the number concept. This study will therefore assist in unearthing the learners’ learning of the number concept which is very crucial for their subsequent achievement in mathematics.

During the study, Standards 1 and 2 classes will be targeted. In these classes, interviews will be conducted with the teachers and lesson observations will be made as the learners will be learning Numeracy and Mathematics and any other learning area. The head teacher will also be interviewed.

The participation of the teachers and the head teacher in this study will be entirely voluntary. The information collected from the study will be treated with confidentiality and the participants’ identities will not be disclosed in any of the products of this study. The teachers and head teacher will be allowed to withdraw from the study at any time if they wish to do so. When the study is finally concluded, I hope to provide you with a summary of the key findings.

Yours faithfully,

Tione Weddington Saka
Appendix 14: Ethical approval from the University of Johannesburg

ETHICS CLEARANCE

Dear TW Saka

Ethical Clearance Number: 2016-094

An ethnographic study of early grade mathematics classes in five primary schools in Malawi

Ethical clearance for this study is granted subject to the following conditions:

- If there are major revisions to the research proposal based on recommendations from the Faculty Higher Degrees Committee, a new application for ethical clearance must be submitted.
- If the research question changes significantly so as to alter the nature of the study, it remains the duty of the student to submit a new application.
- It remains the student’s responsibility to ensure that all ethical forms and documents related to the research are kept in a safe and secure facility and are available on demand.
- Please quote the reference number above in all future communications and documents.

The Faculty of Education Research Ethics Committee has decided to

☐ Grant ethical clearance for the proposed research.
☐ Provisionally grant ethical clearance for the proposed research
☐ Recommend revision and resubmission of the ethical clearance documents

Sincerely,

[Signature]

Prof Geoffrey Lautenbach
Chair: FACULTY OF EDUCATION RESEARCH ETHICS COMMITTEE
3 February 2017