

**PARENTAL INVOLVEMENT IN CHILDREN'S MATHEMATICS LEARNING: A
CASE OF A RURAL COMMUNITY, GHANA**

by

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Abstract

Although emergent literature and anecdotal experience indicate the importance of parental involvement in their children's mathematics learning, there is still a void in literature with regard to involvement of parents with low formal education in their children's mathematics learning in culturally diverse contexts. In an attempt to address this void, a study that employed socio cultural learning and social constructivist theories investigated how parents with low formal education are involved in their children's mathematics learning in a rural Community, Ghana. Data was collected from six parents with low formal education, their 8-9 year old children as well as the children's class teachers through semi-structured individual face to face interviews and home visit observations.

Analysis of the data corpus revealed that 1) parents' mentorship and engagement in local business transactions, were used as learning and evaluation contexts for a child's mathematics competence; 2) parents perceived giving and receiving correct change as a key indicator of one's moral standing and mediated children's mathematics accordingly; 3) parents, teachers and children consider mathematics as a hallmark of future success; 4) parents' belief that increasing time spent on academic activities improved children's success, within the examination culture of the context; 5) teachers see low formal education as a handicap of parental involvement in children's mathematics learning; 6) children typically corroborate their parents' perceived ways of supporting their mathematics learning.

These findings are significant and offer insight into how parents with low formal education from a different cultural context are involved in their older children's mathematics learning. The study adds to the literature on the topic of parental involvement from a non-western context.

Preface

This thesis is original, unpublished, independent work by the author, K. Yaro. Dr. Ann Anderson provided suggestions in terms of methodology and approaches to data analysis for this study. The results reported in Chapter 4 were covered by the Behavioural Research Ethics Board at the University of British Columbia (ethics certificate number H14-00358).

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Chapter One: Introduction

The growing need for parental involvement in children's mathematics education (Anderson, Anderson, & Shapiro, 2005) is occasioned by its impact on children's mathematics achievement across grade levels (Cheung & Pomerantz, 2014; Cai, 2003, Sonnenschein & Galindo, 2014; Skwarchuk, Sowinski & LeFevre, 2014). For instance, the linkage between parental involvement and academic success of children at middle school level is evident in Cai's, (2003) study with middle class Chinese and American families (parents and children). Cai (2003) noted that parental roles such as mathematics content advisor, motivator, monitor, and mathematics counsellor were found to be statistically significant predictors of 6th and 7th grade children's mathematics achievement (Cai, 2003). Similar discoveries were made in Cheung & Pomerantz's (2014) study with 7th and 8th grade children and their parents from diverse socio-cultural backgrounds. Likewise, the academic success and parental involvement in early literacy development is well established in current research, such as Sonnenschein & Galindo's (2014) study with black and Latino kindergarten children. Thus, regardless of grade level, ethnicity and race, parental involvement is an important factor where children's mathematics learning is concerned. Apart from what is known about the significance of parental involvement in children's mathematics learning, relatively little is understood concerning the actual home practices and various parental roles that support children's mathematics learning. More specifically, there remains a dearth of such research at the middle school level, and from developing countries, such as Ghana (Etsey, 2005). The latter takes on importance when we recognize that parental involvement does not occur in isolation, but in a community and within particular cultural contexts (Hill & Taylor, 2004). In other words, parents from different cultures may have various ways of

supporting their children's mathematics learning. For instance, interactions between parents and children during shared story book reading is a way of supporting early literacy development (Lynch et al, 2008) although this practice tends to be a socio-cultural practice associated with Caucasian middle class parents (Lynch et al, 2008, Anderson, 1997). However, ways in which parents in different cultures, such as those in rural communities in Ghana, may support their children's mathematics learning still remains unknown.

1.1 Problem Statement and Research Questions

In attempts to investigate parental involvement in children's mathematics learning, researchers, over the years, have focused on ways in which educators get parents involved in their children's mathematics learning. For instance in the UK, there are well documented intervention programs like IMPACT and "Math Year 2000 Scotland" (Muir, 2012) which delineate ways some parents have engaged in their children's mathematics education. Findings from these projects do not only acknowledge the mathematical skills parents acquired but also indicated parents felt more confident being involved in school activities and valued being an integral part of their child's mathematics learning. Indeed, the success of the above mentioned interventions seemed to rest on two main factors. First, there were previous studies that realised the potential that parents in those communities have in terms of contributing positively to their children's mathematical education and the nature of assistance parents might need in order to get involved in mathematics learning of their children effectively (Muir, 2012). Secondly, the success of these interventions was also based on a high level of parental involvement in communities under study (Muir, 2012). However, for many jurisdictions, including contexts such as rural Ghana, without first knowing the nature

of mathematical learning support parents are involved in with their children at home, it appears too soon to implement any form of intervention program.

Hence it appears that much of the research in the area of parental involvement in children's mathematics learning have focused on euro-centric communities and particularly with middle class families (eg; Anderson, 1997, Lynch et al 2008, Phillip, Norris & Anderson, 2008). Moreover, these studies have dwelt much on parental involvement in children's early mathematics learning. Consequently, this has created a research void in the area of parental involvement in children's (7-9 years olds) mathematics learning and most importantly with non-mainstream parents in different cultures. In an attempt to engender the involvement of non-mainstream parents such as those with low or no formal education, much more research is needed. Indeed it appears that more often than not, educators' discussions on parental involvement in their children's mathematics learning have focused on parents with formal education thereby side lining contributions parents with low or no formal education could make towards their children's mathematics learning. Thus, in response to the growing need for parental involvement in mathematics learning (Lynch et al, 2008) and also premised on the fact that regardless of their economic status and level of formal education parents could contribute to their children's mathematics learning (Anderson, 1997, Goldman & Booker, 2009), we need to learn more about the involvement of parents from diverse backgrounds in contexts throughout the world. Thus, the current study is focused on parental involvement and children's mathematics education in rural basic schools in Ghana (the researcher's birth country) and is guided by the following research questions:

1. *How are parents with a low level of formal education involved in their children's mathematics education?*
2. *How might parental involvement be interpreted in relation to local sociocultural practices?*
3. *How do teachers, the parents with low formal education, and the children perceive parental involvement in children's mathematics education?*

1.2 Significance of the Study

This research revealed the contributions of non-mainstream parents (parents with low formal education in rural Ghana) towards their children's mathematics learning. Thus, this study adds insights gained from parents with low formal education to the growing body of knowledge in the area of parental involvement in children's mathematics learning. In addition, the study serves to inform teachers, curriculum developers and researchers, of non-mainstream parents' contributions to, and the opportunities they create for, children's mathematics learning in home settings.

More specifically, since similar studies have paid more attention to parental involvement in preschool mathematics (Anderson, 1999; 1997; Anderson et al 2005, Lynch et al, 2008), this study focused on parental involvement in mathematics education of children beyond early years (8-9 years old) and serves as baseline data for further studies in the area of parental involvement in mathematics education of children in the intermediate-school level (e.g. Grs 4 & 5 in Canada). Most importantly, informed by parents with low level formal education from a different cultural context, the study's findings informs us about

differing cultural perspectives and experiences children may bring to our mathematics classrooms based on parent-child involvement in the home. This is especially significant for mathematics education in light of the increasing global migration whereby countries, such as Canada, serve a diverse population of citizens, immigrants and refugees from different cultural backgrounds.

1.3 Organization of the Thesis

In the remaining chapters, I share the process I followed in seeking answers to the current study's research questions. Chapter Two opens with a review of studies on parental involvement in children's mathematics learning to help us understand what has already been done in the field and what more we need to know. Parental involvement in children's mathematics learning intervention programs are also discussed to give the reader a sense of some specific parental involvement intervention projects and how they were carried out across the globe. Theoretical perspectives are then presented for readers to understand the theories that informed the current study. Specifically Vygotsky's (1978) social constructivist theory and Rogoff's (1990) socio-cultural theory of learning are elaborated. A discussion of base line competencies in different cultural contexts follows to enable us to understand the cultural differences in understanding of mathematics competencies. This serves to help readers to draw their own interpretations (differences or otherwise) of rural parents' perceptions of mathematics learning and how that influences their ways of involvement. Chapter Three discusses the case study design and introduces the participants of the study. More so, detailed data collection methods and analysis procedures are also discussed. In addition, I discuss the credibility and limitations of the study. In Chapter Four, I present key

findings from the study under each research question. Framed under each research question, Chapter Five provides space to situate and discuss the findings (Chapter Four) within the context of the theoretical perspectives (Chapter Two), and also connect the findings to the current literature. Implications for future research and practices are discussed.

Chapter Two: Literature Review

Available literature on parental involvement in children's mathematics learning appears to focus on home practices and parent-child interaction in home settings, largely among mainstream parents. (Anderson, 2010; Lynch, Anderson, Anderson, & Shapiro, 2008). Moreover, these studies have documented particular home practices, such as parents reading to their children, as a way of developing early years mathematics competencies in middle class homes. However, it appears less attention has been given to how parents with low or no formal education (non-mainstream) support their children's mathematics learning and how the home environment affords such non-mainstream parents to participate with or involve their children in mathematics learning.

To understand the roles of families/parents in children's mathematics learning, current research on parent-child home interactions and mathematics learning is reviewed to give readers insights into home activities/interactions in different cultures and how they support mathematics learning across grade levels. This review culminates with a description of some specific parental intervention programs to inform readers about various programs that have been implemented in different countries to engender parental participation in children's mathematics learning. The inter-play between two theoretical perspectives (i.e. social constructivist theory (Vygotsky, 1978) and socio-cultural theory of learning (Vygotsky, 1978; Rogoff, 1994; 1990) are discussed to tease out how these two theories complement one another. This then leads into a discussion on base line mathematics competencies in different socio cultural contexts to help readers understand how different cultures perceive competence and how this may influence parental involvement in children's mathematics learning. The chapter ends with a brief description of Ghana's education system

and mathematics learning to elucidate the context of the current study.

2.1 Role of Families/Parents in Children's Mathematics Learning

Parents are integral and usually a primary part of the social context that influences children's educational outcomes (Hoover-Dempsey et al, 1997). As a result, researchers have developed different types of frameworks, models and activities to engender effective partnership between school and families. Prominent among them is the School, Family and Community Partnership framework developed by Epstein, Coates, Salinas, Sanders & Simon (1997) in which the researchers employed a theory of *over-lapping spheres of influence* as well as review of research works over a period of time in education and families in elementary, middle, and high schools to explain the shared responsibilities of home, school, and community in children's learning and development. The theory of *over-lapping spheres of influence* acknowledges the three main social contexts within which the child's development takes place – the family, the school, and the community (Epstein et al, 1997). Although each of these social contexts or institutions has different roles or activities to perform, they also have those they carried out jointly to the benefit of the child's learning. Premised on this, Epstein et al, (1997) outlined six types of involvement that define broadly key activities or roles of families, school and community within the partnership framework. The six types of involvement identified by Epstein et al (1997) include: 1) *type 1*: parenting, 2) *type 2*: communicating between teachers and families, 3) *type 3*: families volunteering in schools, 4) *type 4*: families supporting children's learning at home, 5) *type 5*: families participating in decision making and, 6) *type 6*: collaborating among families, school, and the community. Each "involvement type" is characterised by certain activities families and

schools engage in to ensure effective partnership. Even though, the partnership framework is not subject specific, I argue it relates to parental involvement in children's mathematics learning in many ways.

2.1.1 Type 1: Parenting

This mode of involvement helps families to establish conducive home environments to support their children as students. Epstein et al, (1997) suggested that schools should increase families' understanding of their children as students. In doing so, schools are expected to furnish parents with information on children's health, safety and home conditions that support the child's learning at each grade level. Specific to mathematics, schools have to make sure parents are well informed about their children's mathematics progress (weaknesses and strength) and offer suggestions for parents to assist their children at home. On the other hand, parents should be willing to share with the school concerns for their children's progress in mathematics. This in turn would promote exchange of information between schools and families about their care and concerns for children's mathematics learning.

2.1.2 Type 2: Communicating

This type of involvement consists of school-to-home and home-to-school communications about school and classroom programs as well as children's progress (Epstein et al, 1997). Just as in any subject including mathematics, communication increases the understanding of the collaboration between families and teachers with regards to children's general learning. Activities such as phone calls, parents-teachers association meetings (PTAs), parents attending school events and parents informal visits to schools to

inquire about their children's learning are all avenues by which families and schools engage in effective communication to share ideas about children's mathematics learning.

2.1.3 Type 3: Volunteering

This refers to parents and community taking an active part in school activities through voluntary services rendered to support children's overall well-being in schools. Since children's learning is a shared responsibility between families and schools, schools create activities that enable families to give their time and talent to support schools, teachers and children. This may include in or out of school events such as participating in mathematics fairs, helping teachers to supervise children at playgrounds and so on. All activities are geared towards enhancing the child's performance and creating an enabling learning environment.

2.1.4 Type 4: Learning at home

This refers to activities aimed at improving family involvement in children's learning activities at home. These include families providing direct academic support at home based on information and ideas they receive from the school concerning their children's academic work. Therefore, in this case, family support is mainly meant to assist children with their homework and other curriculum related activities (Epstein et al, 1997). Such activities increase family discussions about academic work. This is applicable to all subject areas including mathematics where parents or families are expected to guide and assist their children with mathematics homework.

2.1.5 Type 5: Decision Making

As stipulated within the partnership framework, parents are expected to actively participate in decision making on issues that affect their children's learning. Family representations on school boards, PTAs, or other organisations that ensure that parents' voices are heard. Such participation is indeed necessary in ensuring parental support in their children's mathematics learning. This gives families the opportunity to share their ideas about school policies and specific programs that would enhance children's mathematics learning.

2.1.6 Type 6: Collaborating with Community

This type of involvement consists of activities geared toward integration of the resources within the community such as economic, materials, human resources, and social support to enhance home and school activities (Epstein et al, 1997) to ensure success of the child's general learning including mathematics. For instance activities for parents may include workshops organised to educate parents on available resources within the community and information sessions about community services in which children can get involved. To sum up, Type 6 recognizes that parents, educators, and children serve as agents of the partnership programs. In other words, without them there would be no partnership. In this sense, they all work together to ensure smooth running of both school and family partnership programs.

However, it appears to me Epstein et al (1997) framework of school, family, and community partnerships there seems to be a strong emphasis on what the school can tell the families about how to support their children and less about what families are currently doing

and how schools might draw on that knowledge to strengthen home-school partnerships. Again, in this framework, it is unclear, how parents from non-mainstream cultures would view such school-associated roles and whether language and sociocultural perspectives might impact their participation.

Apart from Epstein's partnership framework, some scholars have also described or categorised roles parents play specifically in their children's mathematics learning. From a systematic literature review on parent involvement, educational policies, mathematics education reform, and cross national studies, scholars have identified five parental roles in middle school students' learning of mathematics (Cai et al. 1999; Cai, 2003). These include: motivator, monitor, resource provider, mathematics content adviser, and mathematics learning counsellor (Cai et al. 1999; Cai, 2003). They added that parents acting as motivators, monitors, and resource providers are roles by which parents provide emotional and resource support for their children's mathematics learning. Cai's, (2003) empirical study with middle class parents indicated these parents enact the above listed roles but they do so differently across families. However, since Cai's (2003) study focused on mainstream parents and their middle school children's mathematics learning (sixth, seventh, and eighth-graders), it is still unclear whether non-mainstream parents such as those with low formal education play similar or different roles as identified in Cai et al (1999) study.

Both Epstein et al's (1997) framework for family-school partnership and Cai et al's (1999) roles for parental involvement outline activities for parents to get involved in their children's learning. However, Cai et al (1999) focused their study on parental roles in children's mathematics learning while Epstein et al (1997) framework looks broadly at activities of families, community and schools in ensuring effective collaboration between

them and children's general educational achievement. In addition, Cai et al (1999) acknowledge the role of affect in children's mathematics learning and hence, parents are seen as key players in counselling and motivating their children to become successful in their mathematics learning. However, Epstein et al (1997) paid less attention to affect and its impact on children's learning. Nonetheless, both studies validate the important role of parents/families in the child's learning.

In conclusion, the inconsistencies in roles and different types of frameworks proposed by researchers give credence to the difficulty of having a single model or prescribed roles for parental involvement across cultural contexts and age groups. To address such inconsistencies in order to understand parental roles or ways of involvement in different contexts, I posit that it is worth considering factors such as age, mainstream/non-mainstream, and varying socio-cultural context in which parents are involved. Specifically, in the area of mathematics education, it will deepen and broaden our understanding of the support (or lack thereof) children receive at home. Prior to the current study, I taught mathematics to middle school children in rural Ghana. Taking into consideration that many parents in rural Ghana have no or a low level of formal education, it appears well suited as a cultural context in which to explore such phenomenon.

2.2 Parent-Child Home Interactions and Mathematics Learning

Researchers have argued that "home" is the first accessible resource for developing children's mathematics competencies. In other words, a child's mathematics learning starts within the home. In this regard, children participate in legitimate mathematical activities at home (Anderson and Gold, 2006), whereby much of the children's mathematics learning is

implicit in unstructured interactions in daily cultural activities such as play and household chores (Beningno & Ellis, 2008). Such informal home activities are potentially rich for developing children's mathematics concepts. Given that parents and other caregivers are an immediate part of the social context of the child (Hill and Taylor, 2004), they are positioned as a prime source of engaging children in those informal home activities and interactions with the potential to enhance children's mathematics learning. For instance, as part of a larger study of "The Primes Project", Goldman and Booker, (2009) worked with six families (parents and their middle school years children) from diverse socio-economic backgrounds to develop observational case studies. The researchers videotaped the families in their homes, workplaces, schools, and outings over several years to understand mathematics at home and at school in order to help parents recognize possible connections, and to develop materials and activities that could help create linkages. Goldman & Booker (2009) concluded that parent child dyads engaged creatively in solving mathematics related problems through daily practices. However, most parents in the study did not recognize mathematics in their problem solving and hence did not readily connect such daily home practices with school mathematics. Despite, the absence of such recognition of home-school connections, the study provides evidence of parents engaging their children in middle school mathematically embedded routine home activities. Anderson's (1997) study is another study that investigates the sort of parent-child mathematical interactions that ensue at home. The researcher worked with middle-class parents and their 4-year-old children in the study. Each family chose to engage with their pre-school child in 4 separate 15-minute periods over 2 days to share multilink blocks, a child's book, blank paper, and preschool worksheets with their child at home. Each 15-minute session was audiotaped. The researcher concluded that even though

the parents were neither mathematics educators nor teachers they still engaged their young children (4-6 year olds) in activities and conversations that stimulate mathematical thinking, with counting being the most prevalent. The study's findings were consistent with Lynch et al's (2008) study in which parents engaged with their pre-school age children from diverse cultural groups in western Canada. Lynch et al's (2008) research findings suggests positive association between parent -child interactions in shared story book reading and children's early literacy achievement. Similar, in Anderson, Anderson & Shapiro's (2005) study in which culturally diverse parents and their 4-year old children were videotaped as they read Mr. McMouse (Lionni, 1992) and Swimmy (Lionni, 1963) cited in Anderson et al (2005), the researchers noted that shared book reading holds considerable potential for parents to draw attention to mathematical vocabulary and concepts to their children. Despite the prospects of shared book reading in development of early mathematical concepts as noted above, the phenomena (i.e. shared book reading) is not universal but rather more common with middle-class Caucasian parents (Anderson, Anderson, Friedrich & Kim, 2010).

Apart from parents and other caregivers, siblings also play important roles in engaging younger ones in interactions and activities at home that may led to development of literacy and numeracy skills. For example, Gregory (2004) researched through observations and interviews with eight families from lower socio-economic background, each with an older child in year 4 or 5 (i.e. aged 9–11) and a younger child in the nursery or infants (i.e. aged 4–7) in homes of the Bangladeshi London. The researcher concluded that the older child 1) provides a model, demonstrating what the younger sibling should do, 2) checks up on past learning and directly instructs the younger siblings, and 3) provides alternatives if the younger child is in difficulty (p. 104). Thus, siblings, in this study, provide guidance and

facilitate the learning of the younger child through interactions and activities, not unlike parents in other studies. A question, which remains unanswered in Gregory's (2004) study, however is the role parents may play in ensuring older children support their younger siblings' learning in this way.

Thus, we are gaining convergent evidence that parent-child mathematical interactions and varied parental involvement in children's mathematics learning occurs in homes, across diverse cultures. What remains understudied is the nature of such interactions within particular cultural contexts, or within families who are not middle class, or with parents who are not well educated.

2.3 Parental Involvement Intervention Programs

In mathematics education, we find multiple examples of parent-related programs and interventions specifically designed to facilitate (or increase) parental involvement in their children's mathematics learning. A review of literature in which these programs are considered broadens our understanding about specific programs designed mostly in developed countries. Prominent among these programs include: The IMPACT project, The Math Year 2000 (Merttens & Vass, 1993) and The Math Club (Muir, 2011). Brief highlights of these programs are provided to enable reflection and discussion with respect to ways by which they engender involvement among parents, and more specifically to determine whether such initiatives are relevant for non-mainstream parents outside the contexts in which they were developed.

The IMPACT project was introduced in London in 1985 to involve parents from diverse socio-economic backgrounds and their children sharing regular mathematics

activities together with the core goals of empowering parents and transforming school practices. The program involved primary students taking home mathematics homework designed by the teacher to fit into the work being done in the classroom. In other words, any activity to be done at home should have some connection with the program and on-going class work. In the IMPACT projects, mathematical games and problem solving mathematics are given to children to practice at home with their parents and meetings are held to discuss the progress of children as well as program. To continue keeping track of the general progress of the program, parents and children were given some time to report back their progress on assigned activities twice every year. In short, the IMPACT project was well structured and coordinated. Findings from the project indicate that parents who formed part of the project felt more confident being involved in school activities and valued being an integral part of their child's education.

Similarly, the "Math Year 2000 Scotland" program was a government sponsored program to improve the numeracy skills in Scottish schools and help everyone do basic arithmetic (Merttens & Vass, 1993). The programme was premised on the fact that parents possess inherent potential to help their children's mathematics learning. To promote mathematics education, many activities and events were organized across the country (Scotland) stressing the value and fun of numeracy in order to reverse the trend of "math phobia" among children and parents and instead create positive attitudes towards mathematics learning. Books were issued to parents and childcares to help primary school children learn mathematics better (Merttens & Vass, 1993). Fun activities such as mathematics games (e.g. simple addition like adding digits of phone numbers) were recommended for play at home. According to the author, this programme made children

appreciate the fun nature of mathematics while increasing their numeracy skills.

Similar to Math Year 2000 Scotland is “The Maths Club” project, a parental involvement intervention programme which was introduced to two public high schools at different times in Australia. The project was introduced to a second school in 2010 to equip parents with mathematics content in order to assist their children’s mathematics learning at home (Muir, 2011). Eighteen parents from diverse socio-cultural backgrounds who had children in classes, ranging from kindergarten to high school attend these sessions. In the first introductory session, parents filled an “Anticipation guide” by indicating agreed or disagreed to statements regarding the attitude towards mathematics. Based on the responses from parents, the researcher (Muir) discussed each statement and organised a series of activities to counteract those “myths” with regards to mathematics. Subsequent sessions were aimed at addressing areas of “need” including algorithms, tables, mental computations and fractions (Muir, 2011). Each session consisted of designed hands on activities, and games related to the mathematical needs of parents. Information and resources such as follow-up readings and web links were made available to parent participants. For instance, activities on fractions with parents included the use of a digital camera to take photographs in the environment that could stimulate discussions about fractions not being a mere numerical representation of numerator and denominator (Muir, 2011). In conclusion, parents developed positive attitudes towards mathematics, acquired mathematics content knowledge to assist their children’s mathematics learning and were keen to see the programme continue (Muir, 2011).

The parent intervention programs discussed above, seem to be successful interventions, but it appears there is no evidence as to who actually benefited from the

programs. The backgrounds of parents who participated remains unclear, as do the scalability of such programs. More so, they occur in developed country contexts and thus may not be transferrable to developing countries. Hence, there is the need for a needs assessment or knowledge of culture before thinking of intervention programs. In other words, the need for further research in cultural contexts to better understand what parents actually do before we prescribe programs for them.

2.4 Theoretical Perspectives

The current study is informed by social constructivist theory (Vygotsky, 1978) complemented by the socio-cultural theory of learning (Vygotsky, 1978; Rogoff, 1994; 1990). Vygotsky (1978) argued that children learn through social interactions - initially with parents or other care-givers, family members and peers, and later through teachers and other knowledgeable adults. Hence, the role of parents as mediators of children's knowledge is important for educators and researchers to understand (Anderson, Anderson & Shapiro, 2005). Vygotsky, therefore, concluded that educators must not only focus attention on the child's interaction with the external world, but also pay closer attention to the immediate social world in which the child is located. Hence, social constructivism recognises the role of family members, parents and others through which children learn cognitive and communicative skills of their culture, which ultimately form the basis of all learning (Hodson & Hodson, 2003).

Moreover, Rogoff (1994), views learning as socio-culturally mediated, whereby the individual's learning processes and the socio-cultural activities cannot be detached. These socio-cultural activities are carried out with other members of the society. The social

interaction with a more competent member of society is the means by which cultural knowledge is transmitted and acquired and that all learning first takes place on an interpersonal level between participants before it is internalized on an intrapersonal level within the individual self (Gregory, 2001). Home is one immediate setting or context which provides the child with opportunities to acquire skills to participate in activities of life through the support of others (White and Siegel, 1984). However, home supports varies depending on different cultural practices (Rogoff, 1990). Thus, socio-cultural activities have traditions that vary across contexts and groups (Anderson, 1997). This implies that although socio cultural activities and interactions may differ from home to home, each cultural environment is capable of providing learning tools from which parents could draw to enhance mathematical learning of children irrespective of their educational backgrounds. Such socio-cultural interactions are in many cases not universal but rather culturally and context specific. For example, one is most likely to observe sharp differences in socio-cultural interactions between traditional African families and Western families. More specifically to mathematics learning, Anderson (1997) argued that mathematics is seen as social practice embedded in, and influenced by, particular social and cultural practices. Based on this, interactions and engagements between parents and their children are socio-culturally situated.

2.4.1 Inter-Play between Socio-Cultural Theory and Social Constructivist Theory

The extent of interplay between social constructivist theory (Vygotsky, 1978) and socio-cultural theory of learning (Vygotsky, 1978; Rogoff, 1994; 1990) is worth discussing. This would allow us to recognize how the two theories complement one another. Rogoff

(1990) for instance, argued that active novices advance their skills and understanding through participation with more skilled partners in culturally organized activities (p. 39). Rogoff (1990) used the term *apprenticeship* to describe such interaction between more skilled and novice partners as they engage in culturally relevant activities. Such social interaction with a more competent member in the society is the means by which cultural knowledge is transmitted and acquired (Vygotsky, 1978). Hence, parents and more competent community members play important roles in creating opportunities to ensure that children grasp the necessary cultural skills needed to survive in that cultural context. In other words, mathematics is embedded in routine cultural practices and other life activities of people (D' Ambrosio, 2014). For this reason parents see the need to engage children in activities that support their mathematics learning in order to help make their children more functional in their daily lives.

Rogoff (1990) identified common characteristics of apprenticeship, including the role of skilled partners in sub-dividing goals into manageable units for easy absorption by a novice in problem solving situations. This resonates with my personal experience in some Ghanaian rural communities like Bonwire, a cloth weaving community, where rural parents or grandparents teach their children or grand-children how to weave kente (a prestigious hand woven ceremonial cloth). Parents or grand-parents break down tasks involved in weaving into several “teachable” tasks according to the age, ability and prior weaving experiences of child. Although parents or grandparents may not be aware of the theoretical implications of breaking down such tasks for children, they may still see themselves as being capable of employing relevant strategies to ensure children acquire needed skills. Similarly, Vygotsky (1978) theorized such processes as *scaffolding*. Wells (1999) identified three

important features that give educational scaffolding its particular character: 1) the essentially dialogic nature of the discourse in which knowledge is co-constructed; 2) the significance of the kind of activity in which knowing is embedded and 3) the role of artefacts that mediate knowing (p.127). The first characteristic is in semblance with what Rogoff (1990) termed as *intersubjectivity*. Rogoff (1990) pointed out that by its nature, “communication presumes intersubjectivity- where there is a common focus of attention and some shared presuppositions that form the ground for communication” (p. 71). This in turn, provides the basis for “meaningful” communication or interactions and at the same time supports the extension of children’s understanding to new information and activities (Vygotsky, 1978). This implies that since parents have unique knowledge about their children’s behaviour and the cultural context (Peressini, 1998), they may be able to engage them in interactions or provide opportunities to support their children’s mathematics learning that others may not.

As argued earlier, mathematics is viewed as social practice embedded in, and influenced by particular socio-cultural practices (Anderson, 1997). It is therefore likely that how parents are involved in children’s mathematics learning may differ across cultures. Such theoretical underpinnings led the researcher to inquire about ways parents in rural Ghanaian socio-cultural context are involved in their children’s mathematics learning.

2.5 Base Line Mathematics Competencies in Different Socio cultural Contexts

For us to better understand how parents in rural Ghana are involved in their children’s mathematics learning, it is worth providing insights into the nature of contexts in which children’s mathematics curriculum (primary 1-6) and its tenets are enacted. Again, this would enable us to better understand differences or otherwise of rural parents’ perceptions of

children's mathematics and how that may or may not influence their involvement in their children's mathematics learning. Understanding various socio-cultural perspectives of mathematics competencies would help us to better conceptualise or situate the current study.

Mathematics competencies may be viewed from an institutional and organisational perspective as well as sociocultural perspectives. Even though there might be some universally agreed upon baseline competencies such as an ability to add and divide, I view baseline competencies to be context dependent as well as socio-culturally defined. For the case of Ghana, the mathematics syllabus (primary 1-6) emphasizes mathematical knowledge and skills that should help the young person to develop basic numeracy competence to be able to function effectively in society. In addition, the mathematics teaching syllabus pays attention to developing primary 1-6 children's knowledge and competencies in the use of numbers, reading and interpreting numeral data, reasoning logically, solving problems involving calculations and mathematical reasoning, as well as communicating effectively with other people using accurate mathematical data and interpretations" (Curriculum Research and Development Division [CRDD], 2007 p. 2).] Various educational organizations, assessment institutions, and educational stakeholders appear to have varying bench marks for assessing mathematical competencies and hence, it will be difficult to pinpoint a universal criterion on which children's mathematical competencies should be measured. Therefore, I argue that the baseline definition of competency in mathematics is largely dependent on the socio-cultural context within which the phrase is understood and used. Furthermore, socio cultural "ways of knowing" and communities' perceptions about what is considered "knowledge" and "competence" may vary from one culture to another. Some cultures may find "competence or knowing" intertwined with societal norms and

values while other cultures may view these as distinct (Rogoff, 1990). For instance in Tajitsu and Ireland's (1998) work entitled "Rethinking Columbus", they describe a knowledgeable typical Amazonian elder as one who

... "has memorized hundreds of sacred songs and stories; plays several musical instruments; and knows the habit and habitat of hundreds of forest animals, birds, and insects, as well as the medicinal uses of local plants. He can guide his sons in building a two-story tall house using only axes, machetes, and materials from the forest. He is an expert agronomist. He speaks several languages fluently; knows precisely how he is related to several hundred of his closest kin; and has acquired sufficient wisdom to share his home peacefully with in-laws, cousins, children, and grandchildren. Female elders are comparably learned and accomplished" (p. 112).

On the other hand, Gutstein (2007b) described such knowledge as "community knowledge or cultural knowledge" (p. 110), which could also refer to what people already know due to their interaction in various sociocultural settings or communities. Students bring to school such related components of knowledge and culture (Gutstein, 2007b). Similar ways of interpreting competence is that of the Kipsigis (Kenyan) parents who see competence as including responsible participation in family and social life (Super & Harkness, 1983). From another perspective cited in Rogoff (1990), Ugandans view competence as both knowing what to do and doing the *socially appropriate* things. I argue that what is deemed appropriate is in itself concealed within knowing what is considered morally appropriate within a particular society or cultural context. Consistent with this argument on competence, some scholars of "African ways of knowing" have also tied learner competencies to socio-cultural contexts (Nashon & Madera, 2013; Madera et al. 1996) Therefore, it is timely for researchers to look into ways parents and other people from different cultures understand and interpret competencies in mathematics and how this might influence their involvement in children's

mathematics learning in culturally situated contexts.

2.6 Ghana's Education System and Children's Mathematics

To help readers understand the context in which the current study was carried out I now describe the Education system as it pertains to Ghana. Basic education in Ghana starts from kindergarten (age four) for two years and continues for another six years of primary school. After two years of Kindergarten, the student at age six starts primary one and continues till primary six at age eleven. At the primary school, in order for a child to graduate from one class to another, he or she must have passed the internal end-of-term examinations conducted by the class teacher. To demonstrate preparedness to take on the academic task of the next class, the child must have maintained a minimum average score of 44% in all subjects with premium placed on mathematics, natural science and English language. Six years of primary school education, is followed by three years of Junior High School (JHS) till the child is fifteen years. This ends the child's education at the basic school level. JHS candidates who sit for the nationwide examination (Basic Education Certificate Examination) are graded based on performance in the external examination (objective and written) and continuous (internal) assessment marks provided by the candidates' schools. A nine-point scale is used in grading the candidates with Grade 1 denoting the highest performance in a nationwide examination that is conducted by the West African Examination Council (WAEC), which consist of five West Africa member states (Ghana, Liberia, Sierra- Leone, Gambia and Nigeria). For a JHS graduate to qualify for admission to senior high school (SHS), he/she must have passed all core subjects including mathematics, English Language, Integrated Science, Social Studies, and Religious and Moral Education and any two

additional subjects with a minimum average grade of 6 in each of subjects mentioned. At the Senior high school (SHS), students may choose from different streams of General Education with electives in General Arts, Business, Technical, Vocational and Agricultural education options for entry into the tertiary institutions or the job market. Therefore, mathematics as a subject in the Ghanaian curriculum remains paramount at all levels of the country's public education system and there are clear-cut guidelines or criteria that define mathematical competency.

As a consequence, the Ministry of Education (MoE), in conjunction with other agencies such as the Japan International Co-operation Agency (JICA) and Canada International Development Agency (CIDA), has been making efforts to improve the quality of education in Ghana with particular focus on mathematics. For example, in 1995, the MoE introduced the Free Compulsory Universal Basic Education (FCUBE) programme, to improve the quality and access to education in Ghana. However, a national Criterion Reference Test (CRT) conducted in 2010 established that only 5.5% and 1.8% of primary six students, who took this test nationwide obtained mastery scores of 60% and 55% for English Language and Mathematics respectively. The percentages fell below the minimum percentage of 60 set by Ghana Education Service (GES). In addition, the 2010 Basic Education Certificate Examination (i.e. a nationwide final examination organised for students in the JHS level) indicated that in Cape Coast Metropolis, 49.43% of the students passed Mathematics, which was a drop compared to the previous years' percentages of 66.5% and 55.3%, documented in 2009 and 2008, respectively. Despite efforts by government and non-governmental organisations to enhance mathematics education in Ghana, there appears to be a decline in performance of children in mathematics.

Therefore, it is important at this time, to explore ways other primary stakeholders such as parents may be involved in their children's mathematics learning. Etsey (2005) found that in the high-achieving schools, middle class parents from culturally diverse backgrounds interacted more with their children's teachers than the parents of students from low achieving schools in the Shama sub-metro schools, Ghana. However, Etsey's work neither reported the nature of such interactions among parents and students in the high achieving schools nor the causes of such a communication gap between parents and children's teachers in low-achieving schools. Moreover, Etsey did not situate his research in any particular subject area. Therefore, it is worthwhile to conduct a study to foreground the issue of parental involvement in mathematics education and more specifically among parents from diverse sociocultural backgrounds with low formal education. The current study will target parents who dropped out of school at the primary school level due to poor academics (and not for fees) or parents with no formal education at all. It is assumed that most of these parents within this category may lack very basic mathematics literacy. Therefore, to investigate how these parents with very low or no formal education help their children to develop mathematical competencies affords educators an opportunity to better understand how such parental involvement might impact school mathematics outcomes.

In the next chapter, I describe vividly the processes of my research which include; methodology, data sources, data collection and data analysis. In addition I describe my participants, the context of the study and my insider role, as a past teacher in the community.

Chapter Three: Methodology

This study sought to explore parental involvement in their children's mathematics learning. More specifically, the study sought to understand how parents with low formal education engage with their children and mathematics. Through interviews and observations, I researched Ghanaian parents and their (8-9) year old children, as well as their children's teachers to explore how parents in a rural Ghanaian context support their children's mathematics learning. Thus the study was guided by the following research questions:

- 1. How are parents with low formal education involved in their children's mathematics learning?*
- 2. How might parental involvement be interpreted in relation to local sociocultural practices?*
- 3. How do teachers, the parents with low formal education, and the children perceive parental involvement in children's mathematics education?*

In order to comprehensively address the above questions, a case study research design, as discussed in the next section, was deemed appropriate. The research context and participants of the study are then described, to assist readers unfamiliar with Ghana and the community in which this case study took place. Data sources and data analysis procedures are explained in detail to prepare the reader for the following chapter in which the results are reported.

3.1 The Research Design: Case Study

In order to describe the nature of parents' involvement in their children's mathematics learning in a rural community in Ghana, a case study design (Yin, 2003; Merriam, 1998; Stake 1995) was used. Thus, the case of this study was bounded by parents with low formal education and their primary four children (aged 8-9 years) in rural South-Western part of Ghana. However, it is worth to specify the study is a case of six families in the community with each family as unit of analysis contributing to the broader case. The choice of the research design (case study) was inspired by other case study research into parent mediation of children's mathematics learning prior to school. For instance Anderson (2007) employed a case study of parents from a culturally diverse metropolitan area within British Columbia, Canada. This case study of parents and their preschool children uncovered how shared book reading holds considerable potential to draw attention to mathematical vocabulary and concepts. Moreover, other case studies into parent-child interactions (e.g., Rogoff, Ellis, & Gardner, 1984,) often in clinical contexts, indicate parents support their children's mathematics learning notwithstanding parents' educational and socioeconomic background. The context in which parents do so, influences mathematics support they give to their children at home (Anderson, 1997, p. 486). Premised on this, I posited parents with low formal education in a rural Ghanaian context were involved in their children's mathematics learning. However, it was unclear as to the ways such a category of parents were involved. As a result, employing a case study design enabled me to work much closer with a limited number of participants and delve deeper to unravel ways by which parents with low level of education in the rural community, support their children's mathematics learning. More so, the small number of families (six) provided more time for home visits and observations as

well as detailed interactions with parents and children. As such, this study's findings, on the one hand, would be limited to the rural community where the study was carried out.

However, in spite of geographical localization and limited sample size of the study, "thick descriptions" (Stake, 1995, p. 102) of the cases involved in this study allow "readers to derive their own meanings" (p.103), based on detailed documentation of participants' views and descriptions of parents engagements with their children at home. Specifically, the use of case study design affords deeper understanding of the contemporary phenomenon within its real-life context (Yin, 2003).

3.2 Study Context and Participants

Ghana is a predominantly rural country with about 49% of the population living in rural areas where economic and social opportunities are much lower as compared to urban areas [Ghana Statistical Service (GSS), 2012]. In Ghanaian context, urban and rural definitions come from the GSS, which defines a rural area as a town/community with a population less than 5,000 (GSS, 2012). In most cases, people living in rural areas lack availability of basic amenities such as water, sanitation and health facilities coupled with a poverty rate per capita of 25% as compared to 5% in urban areas [Ghana Food and Agriculture Organisation (FAO), 2012; GSS, 2012]. The above description of rural areas in the Ghanaian context perfectly fits the community where this study was carried out. The study was carried out in a rural community in South-Western part of Ghana with a population of 1,500 (GSS, 2012), far less than an urban population of 5,000. The settlement in the rural community under study is nucleated in nature where people live very close to one another (less than a minute walk to next door neighbours in most cases). Growing up in a similar

context, I recall my mother use to send me to collect salt from the next door neighbour for soup anytime she forgot to buy salt from the market and neighbours also do similar. Such is the case of neighbour proximity in the rural community this study was carried out. The community is homogenous in terms of socio-cultural and economic background and primarily a low-income community with most of its residents being peasant farmers. As such, it provided a suitable context in which to study the ways in which parents with low formal education, as is the case for many peasant farmers in rural communities in Ghana, support their children's mathematics. Noticeably, all six parents who voluntarily participated were biological parents of the children participants. Moreover, the context of the research assisted in defining what was meant by "low formal education" in that, for this study parents who dropped out from primary school due to poor academics (and not for fees) or parents with no formal education at all were targeted. In so doing, it was believed that most parents within such a category in rural areas would likely possess only basic mathematics literacy (i.e. limited knowledge of school mathematics). Thus, research with such a sample provided important insight into how parents' low or no formal education background impacts the support they provide for their children's mathematics learning.

Participants were drawn from two basic schools in a rural community in South-Western Ghana. The selected schools were the only basic schools in the community and were therefore used, since multiple cases often provide more compelling and robust evidence (Yin, 2002). In addition, the use of multiple cases was to ensure external validity (Merriam, 1998). Hence, the detailed descriptions of the multiple cases involved provided a base of information for readers to make comparisons with other cases in similar contexts or relate to their own situations.

The average number of students in each primary four class of the two basic schools in the community was 35 at the time of the study and with an average age range between eight to nine years. Each class had one class teacher who taught all subjects including mathematics. Fourteen respondents, comprising of three parents with low formal education and their 8-9 year old children as well as the children's class teacher from each of the two basic schools were selected. Parents with low formal education were purposefully selected by the help of teachers and head teachers (school principals) who had background information of parents as part of their children's bio data at the schools. This category of parents in the targeted population were deemed capable of giving information in response to the research questions. The six families seemed to have no obvious connections and their houses were located at least 18 minutes walking distance apart due to the dispersed nature of the rural settlement.

The process of recruitment began with seeking official approval from the education directorate, which oversees the two schools in the community the study took place. After I obtained permission to access the schools from the directorate, I then sought consent of two schools' principals. Upon receiving consent from the schools, the two classroom teachers (one from each primary four class) of the two participating schools were contacted and informed consent was sought. In turn, the teachers coordinated the distribution of consent forms to parents and children. Based on parents' bio data of students in each primary 4 class, the teachers from the participating schools identified ten and nine students respectively from homes where parent(s) have low formal education. At this juncture, I chose to contact all parents of the identified students. This was followed by home visits to all identified parents where I explained details of the research to them and their children. In both cases, teachers

and families (parents-children) were allowed two weeks to decide and respond to the consent form (either agree or disagree to participate in the study).

Obtaining data from parents and their children as well as their class teachers respectively ensured the accessibility of information from a variety of sources for triangulation purposes, thereby enhancing the credibility of the study (Stake 1995; Merriam 1998; Yin 2003). For instance, data from parents, where they shared their daily experiences and thoughts, directly spoke to how they support their children's mathematics learning at home. Interviews with the teachers offered insights into teachers' perceptions on what parents do to support their children's mathematics education and indirectly revealed how apparent the parent support was to them. Children also provided first-hand information with regards to what their parents do to support their mathematics learning both at home and at school, which in turn served as corroboration or elaboration of parents' perceptions. Teachers and children data in some cases corroborated parents' data to establish a chain of evidence on parents' contribution to their children's mathematics learning.

3.2.1 Family Participants

Given the case study methodology employed, it is important to provide background of the parent and child in each of the families, which constituted the individual cases. The names and identities (IDs) used here are pseudonyms and do not reflect the actual identities of the study participants.

“Alison, Parent One (P1) and Monica, Learner One (L1)”

Alison (P1) is a single mother of three children including Monica (L1). Alison (P1) was a baker at the time of the study. She dropped out of school in primary five. Monica (L1),

the youngest daughter was nine at the time of the study. Monica's (L1) teacher Mark (T1) described her as a high achieving student. Monica (L1) liked to play oware (local game) with friends after school and learned hand sewing from her mother. Her favourite subjects are mathematics and science. Alison (P1) indicated that she helps her daughter with mathematics homework but sometimes relies on neighbours for help.

“Susan, Parent two (P2) and Jenn, Learner 2 (L2)”

Susan (P2) is a mother of three including Jenn (L2). Susan (P2) was a cook for a boarding school. She shared that she dropped out of school in primary six and learned a trade because she was too weak in almost all the subjects and found it worthwhile to learn a trade instead. Jenn (L2), the second youngest daughter was nine at the time of the study. Jenn's teacher Mark (T1) described her as a slow learner. She likes to help her elder sister in the kitchen after school and also likes to play ludo with her mother after homework is done. She shared that mathematics and science are her favourite school subjects. Susan sometimes calls in a neighbour to assist Jenn (L2) any time she experiences difficulty with mathematics homework.

“Paulina, Parent three (P3) and Ben, Learner three (L3)”

Paulina (P3) is the mother of Ben (L3) and a single mother of three children. She was a petty trader or a small scale retailer at the time of the study. She dropped out of school in primary four. She shared that she was the oldest in her class but weak in subjects including mathematics. She stopped schooling because she could not stand being ridiculed by her younger classmates. Ben (L3), the youngest was ten at the time of the study. He liked playing soccer after school. Mathematics and information communication technology (ICT) are his

favourite school subjects. His teacher Mark (T1) described him as an average student. Often, the elder sister and mother assist him with his mathematics homework. Paulina (P3) shared that she engages her son Ben (L3) in her trading activities during weekends.

“John, Parent four (P4) and Sammy, Learner four (L4)”

John (P4) is the father of Sammy (L4) and four other children. John (P4) dropped out of school in primary six. He was a security guard at the time of the study. He shared that he was an average student during his schooling days and enjoyed mathematics. Sammy (L4), second youngest was nine years at the time of the study. His teacher Dan (T2) described him as a high achieving student. After school hours, Sammy (L4) helps out in his Aunt’s shop, by stacking items into the shelves. John (P4) helps his son with his mathematic homework after work.

“Mercy, Parent five (P5) and Zimba, Learner five (L5)”

Mercy (P5) is a mother of three including Zimba (L5). Mercy (P5) shared that she attended school up to primary two but lost interest in schooling. She was a housewife at the time of the study. Zimba (L5), the second youngest was nine at the time of the study. Zimba’s teacher Dan (T2) described him as a “struggling student”. He likes to play dame (local chess game) after school but prefers to work in the garden during weekends. Zimba’s favourite subjects are mathematics and Religious and moral education. Mercy (P5) shared that she calls in neighbouring friends to help Zimba (L5) with mathematics homework in case his older sibling is not at home.

“Vic, Parent six (P6) and Sandy, Learner six (L6)”

Vic (P6) is a mother of two children. Vic shared that she dropped out of school in primary three because she had to take care of her sick mother. She recounted her love for mathematics during her school days. She was a second-hand cloth seller at the time of the study. Sandy (L6), the youngest, was nine at the time of the study. Her teacher Dan (T2) described her as an average learner. She likes to listen to stories. Vic (P6) involves Sandy (L6) her trading activities during weekends. Mathematics and English language are Sandy’s favourite school subjects. P6 supervises her daughter to do her mathematics homework before going to bed.

Table 1: Summary of Parent, Child and Teacher Connections, their Gender and Ages

Parent name	Parent gender	Child name	Child gender/age	Teacher name
Alison (P1)	Mother	Monica (L1)	Daughter/9 yrs	Mark (T1)
Susan (P2)	Mother	Jenn (L2)	Daughter/9yrs	Mark (T1)
Paulina (P3)	Mother	Ben (L3)	Son/10 yrs	Mark (T1)
John (P4)	Father	Sammy (L4)	Son/9yrs	Dan (T2)
Mercy (P5)	Mother	Zimba (L5)	Son/9yrs	Dan (T2)
Vic (P6)	Mother	Sandy (L6)	Daughter/9yrs	Dan (T2)

3.2.2 Teacher Participants

“Mark, Teacher One (T1) and Dan, Teacher Two (T2)”

Both Mark (T1) and Dan (T2) are professional teachers with Bachelor of Education degrees. Mark (T1) had about twenty years teaching experience but had taught for ten years at the current school (study site) at the time of the study but had only three years in primary four class. Dan (T2) on the other hand had taught for fifteen years but had had five years of experience at his current school (second study site) specifically in primary four class.

3.2.3 The Researcher

I had taught mathematics for seven years in both middle and high schools in rural community along the coast of Ghana before enrolling in the graduate program. During my years of teaching, I was actively involved in the activities of the Mathematics Teachers Association of Ghana. The association meets annually to discuss current trends in mathematics teaching and learning as well as ways to improve students' performance. Each annual meeting I attended had a session on ways parents could support their children's mathematics learning. The discussion on this important topic had always sparked an intense debate among teachers who constituted the attendees of the conference. While almost all teachers (attendees) thought parents play a significant role in their children's mathematics learning, they also doubted the specific roles a parent could play. As a rural school teacher, I reflected on the majority of children whose parents had very low or no formal education and began to ponder on how this category of parents may/could support their children's mathematics learning and what could be my role as a teacher to get all parents irrespective of their educational background involved in their children's mathematics learning. Hence, the opportunity to explore parental involvement in children's mathematics learning and focusing on parents with low or no formal education stems from these earlier inquiries. Based on these past experiences and reflections, it seemed important to include parents' voices as the focus, alongside teachers' and children's perceptions, so that a more complete picture of the involvement of parents with low education was attained.

3.3 Data Collection Methods

Data was collected through separate interviews with parents with low formal education, their children and their children's teachers over a three month period as well as eight weeks of home visits (observations) including days I visited homes to interview either a child or a parent. Interviews were conducted in places convenient to the participants. Mostly, families (parents and their children) preferred being interviewed in their homes while teachers preferred their offices in their respective schools. This made participants more comfortable and relaxed to share information freely (Boyce, & Neale, 2006). Before interviewing participants, I piloted the interview protocol with a teacher, a child and a parent from in a nearby village. Each of these pilot participants were interviewed separately and helped address ambiguities, bias and blind spots in light of the culture of the people. As a result, parents' and children's semi-structured interview questions were rephrased, and thus enhanced the reliability of the instruments (Yin, 2002). However, this did not significantly change the interview questions originally designed in consultation with my committee members.

Some challenges also emerged during the pilot testing of the interview protocols with respect to obtaining a commonly acceptable translation of the interview questions into the local language (Fante). I had not anticipated this but in order to allow participants (in the pilot as well as the current study) to freely share their thoughts, I suspended the pilot and devoted more time to obtaining an appropriate, locally approved translation of questions for parents and children. Fante is my first language and hence communication with the participants was not an issue. I initially translated all the interview questions to the local language and then found a teacher of the language who also did the same. Afterwards, the

teacher and I met to cross check our translations and agreed on an acceptable Fante version (See Appendix B, and Appendix D for parents' and children's Fante versions of interview protocols respectively) of the questions then cross checked against the English version of the questions (original interview questions). This was to ensure the translation of interview questions from the local language did not unnecessarily alter the original English version (see Appendix A and Appendix C for parents and children's English versions of interview protocols respectively). This was a major step in achieving validity of the instrument. However, teachers in the study opted to be interviewed in English, hence no translations were needed and the original English version of the interview protocol (See Appendix E) was used for the teachers.

Even though scripted semi-structured interviews were used to keep participants in focus with respect to the research questions, there were certain instances I probed further for more information, explanation or description. For instance, a parent, who answered "there is the need for their children to learn mathematics", was probed further to explain why they thought mathematics is important to their children. Again, teachers who responded that "parents need to assist children at home to learn mathematics" were asked to describe the form of support or assistance they thought parents could offer. These probes and others were essential in obtaining more detailed and rich data from the participants. Detailed one-time 30-45 minutes interviews with teachers and parents and 20-25 minutes with children were conducted. However, in three instances, I made follow-ups after replaying participants audio recorded interviews and noticed some responses needed clarifications or expansion. In such instances, time and place were again arranged to the convenience of the participants. The order of the interviews were based on each participant's availability. For instance, in most

cases, a child and parent were interviewed on different dates or at different times on the same day depending on each person's schedule. All interviews (including pilot interviews) were audio-recorded and password protected digital files were made.

In addition, home observations were used to collect first-hand information about the kind of interactions and activities parents engaged their primary four children in at home. The observations took place over eight consecutive weeks and they occurred every other day at different times in each home. At least, a minimum of two hours was spent on each home visit with families and not less than five visits to each home. Some of the visits were in family gardens and stores located outside the house as this gave me better insights into what activities parents engage or allow children to participate after school. Such visits to gardens, stores and in some cases, children's play grounds enabled me to develop a certain degree of friendship with children and parents. This relationship was very helpful in all interviews that followed as children and families were very comfortable to share information with me and welcomed me any time I proposed a home visit. It is worth to note that some observations (home visits) were made prior to interview of parents and then more observations thereafter. A research diary was used to keep all observation notes while a digital camera was used to photograph some activities I observed children doing themselves or with their parents.

3.4 Data Sources

The verbatim interview transcripts of parents', their children and teachers were the primary sources of data. In addition, field notes taken during interviews and home visits (observations) as well as photographs of children engaged in various activities after school all became part of the data corpus.

3.5 Data Analysis

The first step of the analysis process was transcription of the interview data. Audiotapes of one-to-one individual interviews with parents, children, and teachers were transcribed. The process of transcription began with multiple listening to audiotaped interviews to familiarise myself with participants' comments and responses more generally before transcribing verbatim. All parents' interviews were completely transcribed, followed by children's interviews and teachers' interviews were transcribed last. This allowed me to focus on each group of participants and make relevant notes in response to the research questions while transcribing, without knowledge of the other participants (as was the case for the parents) or with knowledge of others in the background (as in the case of the children & teachers). All transcriptions were done in their entirety. This allowed me to trace common patterns or nuances in each transcribed data set. During the transcription, when needed, I altered the normal audio play to a slower pace to allow careful listening and to ensure I captured every audible comment.

As noted earlier, parents and children interviews were conducted in the local language (Fante), hence samples of interviews from these participants were given to a colleague who is also a native speaker of the language to independently transcribe certain portions (about 10-20 minutes) of each of interviews selected to English. The portions of the interviews were carefully chosen making sure it contained chunks of participants' voices other than the researcher. In Sandy's (L6) transcripts for example, when our mutual transcriptions were compared, we initially agreed on the English meaning of 80% of the phrases and upon deliberations, we were able to increase agreement to 95% overall. Again, in Susan's (P2) transcript, we readily agreed on the meaning of 77% of the phrasing, which in

later discussion rose to 86% agreement. Such inter-rater agreement on translations was carried out to ensure that the data accurately represented the views of the participants thereby enhancing the validity and authenticity of the data.

3.6 Themes and Case Analysis

Parents', children's and teachers' interview data sets as well as observational notes from home visits were examined for common patterns and possible nuances. However, pilot interviews did not form part of the data corpus, hence, were not analysed. In each data set, transcribed interviews were compared and grouped into descriptive categories (i.e. common themes). Tables were then used as organisational tools to organise themes derived from the data corpus and all relevant transcript excerpts from parents, their children and their children's teachers matched under each theme. The field notes from home observations were also categorised under relevant themes as further evidence. This was done for each of three research questions. Through triangulation I searched for areas of convergence, divergence, and nuances in the data under each theme (Mathison, 1988) in relation to the research question, which enabled generation of new and substantive knowledge (Khan & VanWynsberghe, 2008). This triangulation process was important in the analysis process. For instance, when all of the excerpts from parents, children, were matched under themes in research question one, I easily noticed commonalities and differences as to how those themes played out in the data sets within and across cases as opposed to focusing on individual data. Similar strategies were applied to the other research questions in this study.

Since researchers cannot free themselves of their theoretical and epistemological commitments, and data are not coded in an epistemological vacuum (Braun & Clarke, 2006,

p. 12) some of the themes in this study had come to mind during my interactions with the participants and were later confirmed during the repeated listening of the audio-taped interviews and careful reviewing of the interview transcripts. Moreover, repeated listening of audio-taped interviews and re-reading of participants transcripts allowed me to delve deeper into the data to look for “new” themes that had not surfaced in that moment of interaction with participants. Consistency of phrases, statements and words in the data corpus that provided clues in answering the research questions were noted and categorised. It is worth to note here that all six families (either parent or child) and teachers did not necessarily have to mention aspects of statements, phrase or a word for a theme to be named. Also, the insights and reflections I had in the bus, shops, at home and school during the study tended to inform further discoveries and themes during formal analysis. Initial phrases describing the possible themes were constructed and readjusted several times until stability in the meanings of the commonalities and patterns within the participants’ responses stabilised. Using this constant-comparative method, these themes were used to further cull the remaining data.

3.7 Credibility and Limitations

Credibility is a key constituent of measuring the validity of a qualitative study. According to Merriam (1998), credibility of a qualitative research is judged against the question “How congruent are the findings with reality?” Lincoln and Guba (1989) argue that ensuring credibility is one of the most important factors in establishing trustworthiness of a study. With regard to this particular study, all four of Guba and Lincoln’s (1989) criteria for ensuring credibility in qualitative study have been adhered to which include: different

sources of data (triangulation), debriefing, member checking, and thick description of the phenomenon and context.

Triangulation

Different data collection methods such as semi-structured interviews and home visits (observations) were used in this study. Since each data collection method has its own pros and cons, using different data collection methods, according to Guba and Lincoln (1989), in effect compensated for their individual limitations and exploited their respective benefits. For example visiting homes to observe engagements between parents and their children provided further insights into what parents actually do with their children at home after school instead of depending solely on what parents told me they do with their children at home. Also, another level of triangulation was ensured by collecting data from different sources (i.e. parents, children and teachers). When considering the ways in which parents with low formal education support their children's mathematics learning, hearing from all three groups added to the strength and credibility of the study's findings.

Debriefing

Throughout the research process, discussions were frequently held with the research supervisory committee on matters relating to interview protocols, preliminary coding scheme and other relevant issues that formed the bedrock of the interpretative process and reporting of the study's findings. Such discussions were very fruitful as it broadened my scope since the research committee brought to bear their experiences and perceptions. In effect, such debriefing provided alternative approaches for consideration versus relying just on my own personal judgements. This was instrumental in reducing inherent biases.

Member Checks

Checks relating to the accuracy of the data, at any point of the research are important. Guba and Lincoln (1989) described this criterion of qualitative research as the most important in ensuring that the researcher can bolster the study's credibility. In the current study, since interviews with parents and children participants were conducted in the local language (Fante), I made sure the English transcripts of the interviews represented what the participants actually said or meant, as described earlier. In addition, to member check, after transcription I returned to the participants (families) with my colleague who read and interpreted them to the parents and children in the local language for confirmation and disconfirmation. In doing so, I argue such member checking increased this study's credibility and clarity.

Thick description of the phenomenon and context.

Another effort towards building credibility, which is evident in this current study, is the thick description of the participants, context and their relationship with the overall research question in this study. Without this insight, it is difficult for the reader of the final account to determine the extent to which the overall findings "ring true" (Shenton, 2004, p. 7). Having provided the above check list of credibility in this study, as a researcher, I also acknowledge that interpretation of the participants' views stem from my understandings.

3.8 Summary

This chapter outlined the methodological process of the research, which included the research design, description of the participants, data collection techniques, data sources and

data analysis process used to explore parental involvement in children's (8-9 years) mathematics learning in a rural community in South-western part of Ghana.

A case study design (Yin, 2003) was used to explore the issue of parental involvement in their children's mathematics learning with a focus on parents with low formal education. Participants in this study were purposely selected. Six families (cases) within a broader case (a single community) provided detailed information from different individual cases, which contributed to our understanding of the larger case of parents with low formal education in rural Ghana and their support for their children's mathematics.

The aim of the analysis process was to make sense of the data corpus. As this was an interpretive study, as researcher, I made judgements and decisions through the themes that were constructed from the data sets and during the interview process. In the analysis process, I needed to consider the consistencies, nuances within and across cases taking into cognisance the study's research questions.

In the next chapter, I thematically present the results and interpretively analyse them.

Chapter Four: Results

This chapter presents findings from the analysis of data on children's mathematics learning and parental involvement. The findings are presented thematically for easy elaboration. These themes were analysed from the parents', students' and teachers' interview data as well as from home visit observation data on parental involvement in children's mathematics learning in a rural community in Ghana. The themes are supported by representative verbatim excerpts from the data sets.

The study's analysis and findings are an attempt to answer the following guiding research questions:

- 1) How are parents with low formal education involved in their children's mathematics learning?
- 2) How might parental involvement be interpreted in relation to local sociocultural practices?
- 3) How do teachers, the parents with low formal education, and the children perceive parental involvement in children's mathematics education?

4.1 Findings for Research Question 1

To address my first research question: "how are parents with low formal education involved in their children's mathematics education?" I searched through the data corpus by comparing and sorting out points that appeared to be responses to the question. This led to drafting and refining of five key themes that characterized answers to the question. The themes that were constructed were validated through triangulation with data from the

different kinds that included parents, children and teachers as well as the observational data derived from the home visits where I observed interactions between each parent and their child. The analysis revealed six themes: 1) Parents with low formal education use local business transactions to teach their children mathematics; 2) Parents support their children's mathematics learning by actively engaging and interacting with their school mathematics performance; 3) Parents' high propensity for mathematics as a hallmark of future success is the basis for motivating their children to learn mathematics; 4) Parents play local games with their children to assess and enhance mathematics learning; 5) Parents support their children's mathematics learning by providing financial support and school supplies; and 6) Parents supervise and assist children with their mathematics homework:

Parents with low formal education use local business transactions to teach their children mathematics

All the study's participating parents (n=6) shared that they engage their children in mathematics learning through sending them on errands to do daily purchases within their vicinity. For instance, both Alison (P1) and Susan (P2) shared that they teach their primary four daughters "correct change" when they send them on these shopping or selling errands. Even though the concept of "correct change" seems to have mathematics implied (i.e. subtraction and addition), Alison (P1) seems to be aware of the general mathematics connections of what she guides her child through on a daily basis although she was not sure of the explicit connections between what she does with her child and the primary four mathematics curriculum. This is to say, she could not relate what she does with her child to any specific primary four mathematics topic(s). Alison (P1) further explained that whenever

her daughter Monica (L1) returns from the seller with “doubtful change” she sends her back to confirm the price of the item so that she could do the calculations with her daughter to figure out “if the change adds up to the money she used for the purchase” or if she returned with any excess change. Monica (L1), daughter of Alison (P1) confirmed this in a separate interview but could not immediately give any specific memorable incident to illustrate it. She however confirmed that her mother supports her to know how much change she is expected to bring home anytime she is sent on errands when she said;

Monica (L1): They send me on errands. When my mother helps me to calculate for correct change anytime she sends me to buy items along the road. It helps me to know the appropriate change to receive.

Even though it was not explicitly mentioned in my interview with Susan (P2), Jenn (L2) (Susan’s daughter) recalled a day her mother sent her back to a shop to collect “correct change” after coming home with less change than she was expected.

Jenn (L2): When my mother sends me and I do not bring home correct change, she tells me the appropriate change to collect and sends me back to the seller for it.

Again, Vic (P6) also seems to do similar although it was not specifically indicated in Vic’s interview however, her daughter Sandy (L6) recounted it. Paulina (P3), a petty trader indicated she uses her trading activities to teach her child some financial transactions, which she believes helps him to learn mathematics needed to carry out daily business transactions but could not tell how such activities directly relate to her child’s school mathematics.

Paulina (P3): He [Ben (L3)] helps me to sell during weekends. I sometimes help him to give appropriate change to my customers. For example, if a customer purchases an item worth 2.70 with a Gh 10.0 note, I guide him to return to the customer an appropriate change of Gh 7.30. As I said I dropped out of school so I am not sure how this can help him what he learns at school.

This was not too surprising to me since I could sense during the interview that Paulina (P3) had little idea about the specifics of her son's Ben (L3) mathematics curriculum and seemed to think that what is taught in class might be different from what she teaches her child at home. However, it was clear from Paulina's interview that her prime interest in teaching her child "correct change" is to enable him to carry out local daily transactions efficiently. This appears to be in addition to Vic's (P6) agreement about Sandy's (L6) involvement in her (Vic's) clothing business. Hence both parents (Paulina and Vic) do teach their children about "correct change" in daily local business transactions using their own trading activities, which differ from what Alison (P1) and Susan (P2) do. They use daily errands (buying items) to achieve a similar goal as Paulina (P3) and Vic (P6). Not only does P6 teach her daughter the concept of "correct change" using her own cloth trading activities, she also involves the daughter in practical ways to understand the concept of profit and loss in business through her trading activities. This was reflected in Vic's expression.

Vic (P6): "I let her count the clothes I sell in tens and writes them down. Also, she writes the quantity of clothes sold and how much profits gotten from each of them."

In the case of John (P4), he did not actually say how he uses local transactions to teach his son Sammy (L4) mathematics at home but during home visits, I observed on three occasions John allowed his son Sammy to help his aunt who operates a small shop in the locality. Even though John was silent on how this could contribute to his son's mathematics learning, Sammy pointed out that his aunt does teach him how much "change" to give to customers when they purchase items. I found it interesting that John (P4), the father of Sammy (L4) seemed to be unaware of such mathematical learning experience his son goes

through on a daily basis any time he visited his Aunt's store after school.

The fifth parent Mercy (P5), shared that she helped her son with mathematics learning by posing problem solving questions at bed time about local transactions. This is different from what other parents did even though in all cases all the parents aimed at achieving similar results. In the case of Mercy (P5), she helped Zimba (L5) to learn mathematics at home as conveyed in the excerpts below;

“I did not complete primary education so, in the evening, when we are retiring to bed, I ask simple mathematics questions to help him learn”

Mercy (P5) shared an example of how she does this:

“...how much will you have if you spent fifth cedis (Gh 50) from one hundred (Gh 100)? If he's able to tell the correct answer, I ask another question to see how well he understands mathematics”

In all, some of the parents namely; Alison (P1), Susan (P2) and Paulina (P3) indicated that the prime motive of teaching their children mathematics using local business transactions (mostly limited to buying and selling items) is to enable them to acquire “knowledge that will help them run daily errands” and also to assist them in their trading activities after school.” Alison (P1) and Susan (P2) further explained that most of such mathematics learning at home only arises when they send their children on errands or when the children are assisting them with their trading activities after school and that, such activities are “usually unstructured and come up spontaneously”. This suggested that parents with low informal education who participated in this study attach great importance to mathematics learning which in my view is largely about financial literacy. Hence, they capitalise on every available opportunity to teach their children some form of mathematics

with the prime focus on financial literacy. To these parents, financial literacy seems to equate to mathematical literacy. Moreover, they did not explicitly see this as teaching mathematics for school but more for real life contexts as conveyed in earlier comments by parents who were unsure of how it fits in school mathematics.

Parents support their children's mathematics learning by actively engaging and interacting with their school mathematics performance

This theme was common across data sets from the six parents. Two of the parent participants, Susan (P2) and John (P4) noted they pay more attention to their children's mathematics performance during school visits. Susan (P2) does so because her previous visits to the school revealed her daughter "was not good at math" and she became more interested in enquiring more about her daughter's progress in mathematics to see how best she could help her improve. Likewise, John indicated that he checks on his child's academic performance in all the subjects but "pays particular attention to his mathematics performance" because of the importance he attaches to the subject. While some parents only attend the formal Parents-Teachers' Association (PTA) meetings, others make additional informal visits to the school. Indeed, this was confirmed by Jenn's (L2) teacher Mark (T1) who affirmed that Susan (P2) "is very much concern about the general academic progress of her child and often comes to school". The teacher added without being specific to any of the parents that: "some parents do pay frequent visits" to him to find out more about their children's general academic progress. This is especially after their "children have been advised to repeat a grade for non-performance". This makes some parents to become more

concerned when they realize the implication of their child's lack of progress. Similarly, Dan (T2) expressed that he "won't say most of the parents visit to enquire about their children's mathematics learning". Although, some of the parents come to school to inquire about the progress of their children, he cited Alison (P1) and Vic (P6) and as "good examples" of parents who often visit the school to inquire about their children's performance. This was further confirmed by their children (Monica and Sandy) who appreciated the benefits of their parents' visits to inquire about their mathematics progress. Acknowledging the value of the parental visits, Mark (T1) for example noted that he helps parents identify their children's mathematics weaknesses any time they visit. Similar sentiments were shared by the second teacher Dan (T2):

"Once in a while some parents pop in to find out the general performance of their children". He however noted that "any time the parents come they do not ask for specific subject; they instead ask about the general performance of their children".

The above statement seems to indicate that parents with low formal education show interest and support for their children's general learning including mathematics. However, some seem to show more interest in instances when their children's mathematics performance appears not encouraging.

Parents' high propensity for mathematics as a hallmark of future success is the basis for motivating their children to learn mathematics

Motivation was explicitly expressed by Alison (P1) and Susan (P2). However, the same is implied in interview conversations with children from the other parents. The children

in the study had indicated being encouraged and supported to work harder in mathematics so they may have a successful future. For instance, Alison seems to motivate her daughter by passing encouraging comments such “good work done” which she claims has yielded good results.

“She likes to be encouraged especially in her mathematics learning and anytime she get encouraged for “good work done she turns to do better the next time”.

Likewise, Susan (P2) shared,

“[By] inspecting my child’s home work, and asking what she learned in school motivates my child to work hard in mathematics.”

Even though, some of the parents did not explicitly share about how they motivate their children to learn mathematics and the positive influence of such motivation in the children’s learning, some of the children in the study revealed how they get encouraged by the kind of support they receive from their parents. For instance, Jenn (L2) shared that she feels “good and encouraged” to work harder when her mother rewards her with “a bottle of drink” for good performance in mathematics exams. Also, Sammy (L4) thinks he is encouraged to learn mathematics anytime his parents express love and subsequently his father buys him “a new mathematics textbook”. Similarly, Sandy (L6) for instance indicated that calculating profits for her mother on cloths sold, an informal activity, makes her “like mathematics”, However, Zimba (L5) considers his mother’s concern by regularly asking him questions about the mathematics he learns in class “helps him retain and recall facts during examination”. Hence, it appears that parents with low formal education in this study do value and motivate their children in general. Also, children in this study were able to specify positive reinforcements they receive from parents. This seems to make them, feel loved and

more motivated to learn mathematics.

Parents assess and enhance their children's mathematics learning by playing local games with them.

This theme was common across most (n=4) parents' interview data with additional compliment from one of the children. Even though expressed differently by the participants, there was a convergence of opinion that the parents Alison (P1), Susan (P2), John (P4), and Mercy (P5) do place value and importance on playing local games as a way of enhancing their children's mathematical learning. Although, in some cases parents and children do not play the games together, they nonetheless support their children's mathematics learning by providing material resources and opportunities (time and space) to play the games such as *ludo* and *oware* (traditional games) with their peers. For instance, Alison (P1) and Susan (P2) shared that they play *ludo* and *oware* with their daughters for fun as well as helping them build their "counting skills". Likewise, John (P4) shared that he was very much aware of "educative games like Oware and Dame (Ghanaian version of chess)", he does not have such games at home. Therefore, the son is interested in playing soccer with his friends after school. During the interview, I could sense that John (P4) would have liked his son to have and play the mathematical games but unfortunately he does not have the funds to purchase them. On the one hand, Mercy (P5) shared that she does not play games with her son (Zimba). On the other, Zimba revealed that although he and the mother do not currently play games together, he remembers vividly playing Dame with the mother, which in his words was "very enjoyable". But, Zimba (L5) suspect the reason for the mother not playing with

him anymore is because of her suspicion that he could “easily forget what he learns at school” if he plays at home instead of studying. It is possible that the mother might have had a different reason for not playing the game with her son any more, for I speculate that it could be as a result of her busy work schedule.

Evidence from the data seems to suggest some parents in this study do engage their children in local mathematics games at home while others provide the resources or chance for their children to play such games. However, some parents were unaware of the mathematics connection per se or at least did not articulate the mathematical nature of the games as others did.

Parents support their children’s mathematics learning by providing financial support and school supplies.

This theme cuts across parents’, teachers’ and children’s data sets. Alison (P1) and John (P4) shared that they bought almost all the textbooks including mathematics books for their daughters as recommended by their class teachers. Sammy (L4) concurred with his father’s (John) statement. Similarly, Susan (P2) shared that she buys exercise books and pens for her son so he “can practice more at home”. Paulina (P3) reckons her inability to teach her son mathematics that is in the school recommended textbook but she ensures that the son gets all the needed mathematics textbooks.

Paulina (P3): I buy mathematics textbooks so that my next door neighbour can guide my son to learn after school.

Although Mercy (P5) did not share how she supports her son with school supplies and funds, her son (Zimba) did say that his elder brother “buys mathematics and science books” for him.

The above synthesis of parents and children’s data clearly indicates parents’ involvement in their children’s mathematics learning by providing learning resources including school supplies even if they could not guide their children to use such resources. Moreover, knowledge of others who could help is another resource they draw upon to support their children’s mathematics learning.

Teachers affirmed these parents’ and children’s testimonies from selected schools indicated the kind of financial support and school supplies parents in his class provide their children. Mark (T1) noted that most parents in general could not go “beyond providing the basic support for their children such as hiring a mathematics tutor to teach their children at home”. He added that he “thinks parental help is mostly providing financial assistance, feeding and buying of relevant books for the kids” but he acknowledged such support from parents by adding that “hungry child cannot learn mathematics”. Mark (T1) also considers this to be “all about the teacher and parent relationship for the parent to understand why there is the need for the child to get certain things to learn at home”. From this analysis, it is clear that parents and teachers appreciate the fact that parents are of pivotal importance in providing all the necessary support including financial assistance and school supplies for their children in order to enhance their mathematics learning. In the same vein as Mark (T1), Dan (T2) expressed that even though some of the parents do have low formal education they still see the value of supporting their children’s mathematics learning since they continue to

“buy teaching/learning materials like charts, exercise books and math textbooks just to support what is learnt or being learnt at school”.

Parents supervise and assist children with their mathematics homework:

This theme was most prominent in the parents’ data sets. The supervisory role of parents in enhancing their children’s mathematics learning seems to run through all six family’s (parent-child) data sets. In some cases parents did not mention this but it was evident in their children’s data corpus.

All parents except John (P4) mostly rely on the academic strengths of either siblings, or other members in the community/neighbours. It still remains parent’s own responsibility of ensuring that children get the needed supervision and assistance in their mathematics learning by seeking help for mathematics homework, when they might have difficulty offering the needed guidance. In this regard, both Alison (P1) and Susan (P2) indicated supervising their daughters’ mathematics learning at home by getting further support from siblings and neighbours. Both parents shared as in the following excerpts:

Alison (P1): As I have told you, I cannot help with very difficult math problems. I call someone down the road to help her with math homework.

Susan (P2): I get the elder sister to help her anytime she comes home with mathematics. She also teaches her in the evenings.

Both Alison and Susan seem to rely on additional support to theirs for their children’s mathematics learning at home. While P1 requests such support from neighbours, P2 does similarly through her child’s sibling. In both cases, parents indicated they ensure their

children get needed supervision and assistance. In contrast, Paulina (P3), Mercy P5 and Vic P6 find it hard offering any form of support for homework in mathematics because they dropped out of school at lower primary level and therefore had very limited knowledge of formal school mathematics. This is the reason Paulina (P3) and P6 explicitly expressed that they always seek the needed help for their children from either the children's siblings or other members in the community.

Paulina (P3): I want my child to do well in mathematics. Sometimes I let the elder sister help him with his homework and make sure he learns after school hours and also phone my friend to help her with difficult math problems.

Vic (P6): I always ask her about mathematics homework and makes sure she does it before she goes out to play or watch television. I tell her to contact her nephew who is in primary 6 for assistance. There is also one man behind this house whom I sometimes call to help her with school homework.

Even though Mercy (P5) did not indicate her supervisory role at home when it comes to her son's mathematics homework, in a separate conversation, her son Zimba (L5) did say that his mother ensures he gets the needed mathematics support from people in the neighbourhood. Sandy (L6) expressed similar sentiments about her mother.

To the contrary, John (P4) was the only participant who acknowledged being able to help with his son's mathematics all by himself. This was confirmed by his son (Sammy) when he said his father sees to it that he does his homework and checks to see if he has done the right thing especially in mathematics and also guides him to solve more mathematics problems from the textbook that his father (John) bought for him.

In summary, from the data sets, it appears parents with low formal education in this study do support their children's mathematics learning in a variety of ways that include

financial and non-financial support. Specifically, evidence from the study suggest that parent participants do use local business transactions (mostly buying and selling) to teach their children mathematics and with more emphasis on financial literacy and this is done differently across families. While others do this through their errands, other parents create learning opportunities for their children by involving them in more practical real life activities such as running their own small local businesses. Again, school visits by parents seemed a way of lending support towards children's learning but in some cases parents saw the need to pay more attention to their children's mathematics learning after realizing the poor performance of their children through interacting with their teachers. Motivation also seemed to be a way parents show support towards their children's mathematics learning. Others also saw the need to have teachers help their children as a way of motivating them in the subject. Parents do engage their children in local games that are more geared towards helping them learn to count. Even though, parents themselves do not play such games very frequently with their children, they do provide both material resources and opportunities (time and space) to allow them do so with friends or others in the community. Provision of financial assistance, school supplies, and supervision of children also seemed to be another way parents are involved in their children's overall learning including mathematics.

4.2 Findings for Research Question 2

The data from parents, teachers, and students was analysed to answer the second research question; "How might parental involvement be interpreted in relation to local sociocultural practices?" This resulted in three key themes. These themes include: 1)

mathematics understood and interpreted in terms of local business transactions; 2) parents' belief that increasing time spent on academic activities improved children's success, within the examination culture of the context; and 3) children's mathematics learning as a communal responsibility

Mathematics understood and interpreted in terms of local business transaction

Sifting through the data corpus revealed certain statements or phrases that parents with low formal education made regarding their understanding and interpretation of mathematics in local business transaction which in turn, seemed particular to the cultural manner in which the business transactions are carried out (mainly cash based) in the community. That is, these parents' views on the importance of mathematics to their children, and how they themselves apply or use mathematics in their own daily lives appear to influence the kind of mathematics support they give to their children at home. Again, the cultural values and norms of the community that espouse fairness and respect for others seem to be governing parents' engagements with and in their children's mathematics learning through local business transactions.

As previously indicated, five of the six parent participants shared the relevance and application of mathematics in their local business transactions. More specifically, four parents pointed to mathematics involved in daily purchases they make, while two parents explained the relevance of mathematics to them and their children in their daily trading activities. For example, Alison (P1) and Susan (P2) both shared the application of mathematics in their daily activities involving shopping from local markets whereas Paulina

(P3) and Vic (P6) shared how they apply mathematics in their trading activities and ways they involve their children in order to help them develop the needed financial literacy skills.

The following statement was captured in Alison's data:

“Any time I go to the market, I compare the money I have to the items I will buy from the market by asking the prices of the item. If what I have could purchase the item I go ahead”

The above statement expressed by Alison (P1) was in agreement with how Susna (P2) elaborated on a similar application of mathematics anytime she goes to the local market. Hence, it seems to suggest that parents see the importance of knowing basic operations on money in order to budget well and that in turn, they assign similar tasks to their children, to be certain they learn this. Shopping with cash in the Ghanaian context seems common and it appears that one will always come face-to-face with activities that will require instant application of mathematics such as in buying ingredients/groceries from the market sheds for an evening meal. For this reason, it seems important to every parent in helping his/her child acquire certain aptitude of financial literacy to enable him/her to function well in the daily economic life in their Ghanaian context.

Again, Paulina (P3) and Vic (P6) seems to make similar application of mathematics with reference to local business transaction as Alison and Susan shared but they however do this by involving the children in their own trading activities. For Paulina (P3) and Vic (P6), they seem to mostly apply mathematics in their daily trading activities such as selling to customers and hence shared that mathematics learning in school is very important to their children in aiding them to perform daily basic transactions such as giving change to customers as well as other daily errands. Phrases like: “It helps him in his daily transactions”.

“He is able to run errands and brings back the appropriate change and sell to customers” as in Paulina’s data and “I expect her to help me with calculations I find difficult in my trading activities”, “I also like her to help me with counting my monies” as expressed in Vic’s data indicate parents’ own expectations and mathematics learning opportunities they appear to create for their children. Again, this daily application of mathematics speaks to the nature of trading activities undertaken in the Ghanaian context that usually require traders to have enormous knowledge in dealing with issues of “change”, “profit” and “loss” during selling as they might not want to run at a loss by mistakenly giving out more change to customers than expected or go against the sociocultural values by cheating their customers. Cheating inadvertently or deliberately is a forbidden communal practice or behavior. Parents therefore appear to value the financial literacy skill of “giving correct change” in business transactions, and hence seem to ensure they involve their children in their trading activities to mentor them mathematically into acquiring this necessary skill. In the case of John (P4), he tried to draw in occupational aspiration and application of mathematics to what his child is learning in school and the relevance this could offer. He thinks his child’s ability to excel in school mathematics will earn him a place to offer a course such as “accountancy” in the secondary school”. Despite not mentioning about mathematical applications in local business transactions, John seems to link school mathematics to dealing with money and other monetary figures.

Furthermore, beneath parents’ guiding children in the use of mathematics in local business transaction is also the emphasis on the moral dimension. For instance two parent participants (Vic and Mercy) in the study appeared to express some moral dimension associated with the learning and using of mathematics and more specifically informal and

contextualized home setting mathematics. These came in two interrelated folds: applying or using one's mathematical knowledge to ensure "fairness in transactions" Mercy (P5) and helping others who might not have the knowledge and understanding of mathematics to accurately carry out their daily financial transactions without being cheated by others (Vic).

The following illustrative excerpts from the data clearly express the sentiments of Mercy and Vic;

Mercy (P5): Knowledge in mathematics gives one the ability to be able to help others finding it difficult in counting their money and help them to purchase items with the right amount and receive the right change without being cheated.

Vic (P6): For instance, if I have 10 Ghana cedis and I want to buy an item of 5.50 pesewas I check to see whether the change given me is 4.50 pesewas which should add up to 10 Ghana cedis. If the change doesn't add up to or more than the money (10 cedis), I try to explain things to the seller or give back excess change if any.

Likewise, Sandy who is Vic's daughter reveals an adherence to the moral principles expressed in the interview excerpts with the P6 above.

Sandy (L6): She teaches me that anytime I receive more change from sellers than I deserve I should give back any excess amount because it is not good to cheat people with what you know.

The above excerpts shed light on the connections between moral ethical practices and mathematics learning and knowledge used within the socio-cultural context of rural Ghana. The application of mathematics in this context has a socio cultural value and moral principal; wherein all community members deserve equal treatment and all are charged with assuring that they are fair with one another.

In all, the responses and personal experiences shared by the above mentioned parents throughout the interviews seems to suggest their interpretations of school mathematics and its relevance to their immediate socio-cultural needs (local business transactions). The views shared by the five parents seems to reflect their contextual applications of mathematics in a specific cultural context (Ghana) which primarily dwells its economic activities on cash bases and with no money counting machines used by traders in shops and market sheds. Such lived experience by these people appear to require them to have significant knowledge of financial literacy in carrying out daily transactions either in buying or selling to other customers. Hence, parents, in turn, place value on this kind of financial literacy skill and tend to support their children in variety of ways in acquiring such competency.

Parents' belief that increasing time spent on academic activities improved children's success, within the examination culture of the context;

This theme was derived from phrases and statements from parents', children's and teachers' interview responses. Proportion of time spent on mathematics was understood to have impact on children's success in the subject. For instance three of the parent participants (Alison, John and Vic) expressed the need for mathematics extra classes or remedial lessons after regular school hours. They also saw additional mathematics assignments as a sure way of increasing students' understanding and retention of mathematical concepts and in some instances parents might deny their children play in favour of more academic work. Play here refers to generic play as opposed to specific games (eg Oware and ludo) in which parents engage children after school. It appeared this was partly due to their own experiences of

mathematics learning and the “academic culture” they experienced in their school days where parents will not allow children to play after school but rather have them read their books till bed time. For that matter, parents seems more likely to inculcate their academic experiences unto their children. For instance, Alison (P1) shares explicit statements that point to the above assertion:

Alison (P1): The children need more time to learn and extra classes will be a good way.

Likewise, John (P4) seems to downplay the essence of child’s play in favour of more mathematics homework and a more rigorous academic work for children.

John (P4): Math was a very difficult subject for me during my school days. So I won’t mind getting my child another tutor in additional to the tutor I have already hired so that he spend more time studying. I don’t want to see him playing around.

From the above statement, John seems to suggest that more time on task is the surest ways to his child’s success in mathematics learning. To my own understanding of the Ghanaian school system, this seems to have been the case some two decades ago where the academic work appeared very competition driven among children in classes. Students in class were order ranked from first to the last person and results displayed on the school’s notice board at the end of every academic term. As a result, many slow learning children who failed to excel in term exams felt embarrassed and their families felt dishonoured. Children who perform below expectation were mocked by others. Such a school system appeared to put lots of academic pressure and demand on both children and their families; children ruling out play because they feel pressurized by parents to be “on their books” after school in order to excel

in exams to avoid being mocked as failure. Therefore, it is more likely that parents like P4 who experienced this kind of school culture will still want to apply their previous experiences in raising their children.

In addition to increased school work for children as suggested by other parents, some parents also seem to add more academic work for their children at home. For instance, Mercy (P5) and Vic (P6) want their son and daughter respectively to spend more time with their respective teachers to do more mathematics exercises and seem to view play or games as “waste of time” and having a negative influence on their children’s mathematics learning and hence would rather prefer their children solving more mathematics problems after regular school hours.

Vic (P6): I think the extra classes and assignments will help a lot. They will be able to do more assignments to keep her always focused on studies instead coming home to play unnecessarily.

The statement of Vic (P6) further seems to influence her increased supervision given to her daughter Sandy (L6) after regular school hours. Sandy shared how her mother restricts her from going out to play and ensures that she solves mathematics problems indoors each time she comes from school.

Sandy (L6): My mother doesn’t allow us to play after school. She supervises me to learn ahead from my Class Four Math Textbook. I am able to understand some topics when being taught the following day.

The framing of the question to Sandy (L6) was influenced by the fact that Vic (P6) is not one of those who were inclined to playing locally and culturally based games, hence it is no surprise that Sandy’s categorically states that her mother (Vic) does not allow her to play

games when she gets home after school. Instead Vic (P6) supervises Sandy (L6) academic mathematics. From my experience and understanding of the Ghanaian culture, this seems to emanate from the long held academic cultural belief within the Ghanaian society that lays emphasis on intense academic work and little or no time for children to engage in games or play. Anything outside academics is considered extraneous to the child's future success in education, which is perceived to be dependent on success in mathematics learning.

Even though Mercy (P5) did not explicitly link increased mathematics contact hours to high success in mathematics learning, she remembered that her elder son ensured that Zimba (L5) did all his assignments and in Mercy's view to also "give him additional mathematics exercises on regular bases so that he does not forget what he is been taught in school." This had to happen before Zimba (L5) went to the playground. Actions like this stem from the cultural belief in the importance of home to augment the school. As such, every parent plays a role in enacting measures that ensure children spend more time with books by assigning them additional mathematics problems at home.

In summary, the responses from five parent participants indicate to some extent parental interpretations and understanding of increased mathematics academic load on their children to be pivotal in achieving success in school mathematics. Furthermore, both teachers in the study also emphasized the need for parents to increase formal mathematics activities for their children through constant practice of what is thought in school in order to increase students understanding of concepts.

Children's mathematics leaning as a communal responsibility

Four participants in this study expressed mathematics learning as a collective communal responsibility and hence, elders in the community, relatives, and other neighbours around the child are equally seen as responsible for helping children learn mathematics either formally or informally. This understanding and interpretation by the participants is conveyed in the interview responses regarding the way parents support their children's mathematics learning at home. Besides close family relatives of the children who may need mathematical support at home, participants also consider other community members as a resource to support children's mathematics learning both formally and informally as expressed by one of the parents.

Susan (P2): I am not able to assist her [with] ... most of primary four ... mathematics. So I call one of the guys behind this house to help her [with] math homework or I refer her to her elder sister who is in form two.

Although Mercy (P5) did not explicitly state requesting for assistance as Susan (P2), his son Sandy (L5) indicated getting similar assistance from a neighbour in the absence of his elder brother.

Sandy (L5): When I am given homework and my brother isn't at home, she calls a neighbour to help me with it. She makes sure my brother checks to see if it's correct when he comes home.

Similar understanding was conveyed in statements by teachers in the study. They saw other relatives besides the children's parents and community members around the child as potential resources for the children's mathematics learning.

Mark (T1): I think those with low formal education and cannot help can look for people in their communities who can be of help to their children in the learning of mathematics.

Dan (T2): Usually we give kids challenging problems so that when they get home they could rely on little guidance from brothers, sisters, neighbours or even their literate parents to help them. So our expectations is that parents could assist in a way or have their elder brothers, sisters or neighbours to guide them.

The two parents (Susan and Mercy), previously mentioned, clearly do request for mathematics homework assistance for their children from other community members. Similarly, the two teachers, Mark (T1) and Dan (T2) validate the significant role of community members in children's mathematics learning, an apparent reference to a community's collective responsibility for children's learning. In the same vein, parental support appears to be a key influence on such communal responsibility.

In summary, it is apparent that socio-cultural factors are critical influence on the importance parents place on mathematics and how they get involved in their children's mathematics learning. These socio-cultural factors include the nature and manner of daily financial transactions (shopping, buying selling etc). There seem to be a clear connection between how the parents experience mathematics learning when they were young and the manner in which they support and wish their children should be supported in mathematics learning. This parallels Nashon's (2006) assertion with regard to teachers, that often when confronted with a challenge, teachers turn to teach the way they were taught.

Also, emergent from the study, parent participants valued "fairness" as a moral virtue in the community in which the children are enculturated. Finally, it appears to be the case that parents feel obligated to request help from neighbours within the community whenever

they feel there is a need for support for their children's mathematics learning. Thus, they see it as a collective communal responsibility to support mathematics learning among children in the community.

4.3 Findings for Research Question 3

Further analysis sought to answer the third research question: *“how do parents with low formal education, teachers, and children perceive parental involvement in children's mathematics education”*. Research question 1 investigated how parents with low formal education support their children's mathematics learning. In the third question, I sought to understand the perceptions each of the participants held about parental involvement in children's mathematics learning. With respect to data from parents and their children, three key themes were identified and are illustrated below: 1) Parents see their involvement as a way of mentoring children to perfect their mathematical skills; 2) Parents perceived mathematics as a predictor of future education success; and 3) Parents perceived their role as a way of motivating children to learn mathematics.

4.3.1 Parents' and Children's Perceptions

Parents and children consider parental involvement in children's mathematics learning as a way of helping them improve their mathematics skills

All six parents and most of the children who participated in the study expressed that it was parents' responsibility to provide opportunities for their children to practice and put into use the learned mathematics skills through exposure to and engagement with local business-like transactions. While Alison (P1) and Paulina (P3) use shopping errands opportunity to teach their children “correct change”, Susan (P2) repeatedly talks to her daughter Jenn (L2)

about the relevance of mathematics to business in addition to teaching her related business mathematics problems. Thus, these three parents seem to place importance on daily business transactions, a community's socio-cultural characteristic.

Alison (P1): Sometimes I teach her. There is a small shop close to this house where I send her to do minor shopping. And she sometimes ask me questions like: If you have this amount of money and you deduct a particular amount what will be the remainder? So it enables her to know lots about correct change.

In the same vein, Monica (L1) indicated that she improves her mathematics skills when her mother involves her in shopping errands involving “change” in daily transactions as a form of parental support.

Monica (L1): “She sends me on shopping errands. It helps me to know the appropriate change to receive. Any time I am not sure of the change, I try to ask her for clarifications”.

As noted above, in talking to her daughter, Susan (P2) reiterated the importance of mathematics to business.

...If she is weak in mathematics, her daily transactions will be poor as well especially when it comes to selling and giving right change. She will be able to sell well and know when she makes profit or loss. So she needs a tutor to help her in mathematics that. So that she knows that when she sells 1 Ghana cedis item she needs to be able to figure out how much to sell to make profit.”

Not only does Susan (P2) talk to Jenn (L2) about real life relevance of mathematics in business transactions, she also involves her in solving hypothetical real life problems

..., as I said, I teach her the little I know. I take her through basic financial transactions any time I send her. Like one buys one Ghana cedis item with two Ghana cedis she should be able to give a change of one Ghana cedis. I teach her all these things.

In the same vein, Jenn (L2) underscored parental role in her improvement of mathematical skills by saying: “My mother tells me the appropriate change to collect and sends me back for it any time I come home with wrong change.” In Jenn’s statement, there is implied parental appreciation that whatever her daughter learns at home through daily activities or errands will go a long way in improving her mathematics skills.

In this analysis, it is apparent that Alison (P1) and Susan (P2) believe it is their responsibility to make mathematics learning opportunities through daily errands for their children to improve their mathematical skills.

However, Paulina (P3) seems to find dual but related ways of supporting her son’s mathematics learning as embedded in daily trading activities as well as in business transactions errands that involve “giving and receiving correct change”

He is able to run buying and selling errands and bring back appropriate change. He helps to sell some of my goods and is able to determine the profit he gets on them. Mostly I teach him how much to give to customers as change.

Indeed Paulina (P3) son (L3) sees the connection between what his mother teaches him through their trading business and what he learns at school:

Ben (L3): I use the subtraction concept when I go to sell. I am able to subtract the price of an item from a buyer’s big money and give back the appropriate change and in some cases my mother guides me.

Among the six parents, Mercy (P5) seems to have a unique way of providing such learning opportunity to help her son master skills in dealing with daily local business –like transactions. Again, Mercy, just like all other parents participants attaches great importance to her son’s ability to deal with daily business transactions. Hence, on regular basis, Mercy (P5) spends some time every evening to engage her son through questioning on the value of money and appropriate change. This is conveyed in the excerpts below:

Mercy (P5): “In the evening, when we are retiring to bed, I ask simple mathematics questions. For example: How much will you have left if you spend Gh 50.00 from Gh 100.00? If he’s able to tell the correct answer, I ask another question to see how well he understands mathematics.”

Rather than pointing to the actual transactions as involving learning this parent sees her explicit questioning as a way of playing her teaching role in her daughter’s mathematics learning.

The above analysis demonstrates the parents’ and children’s understanding of mathematics’ centrality in daily life business transactions.

Parents perceive mathematics as a predictor of future education success hence, instigator of parental involvement

This theme was prominent among all six parent participants. P1 was very emphatic about the significance of mathematics in the Ghanaian curriculum. For this parent, mathematics is one of the important pre-requisite subjects needed to proceed to senior high school and higher education in general.

Alison (P1): I think it will help her. I can't imagine moving forward without any of the subjects especially mathematics. Because they select the best six subjects and mathematics is one of those subjects.

Alison (P1): ...when they write the Basic Education Certificate Examination the subjects that are chosen for the overall grading of the students are six and mathematics is one of them. So if you are not able to make it in mathematics you will find yourself wanting as you will be unable to get a school."

Alison seems to know the implications of her daughter's success in mathematics learning for her general advancement in the Ghanaian school system. This in turn appears to be a driving motive for Alison's involvement in her child's mathematics learning. Based on negative experiences that Susan (P2) and John (P4) went through, when they themselves were children in school, they often shared these bad memories about mathematics learning so as to be aware of them when helping their children and to preclude their children from experiencing similar failure.

Susan (P2): In fact experiences in those days were terrible. I was not happy at all in the school as I had many difficulties in my learning and especially in mathematics. I felt I was far below the average student in class and this made me feel so bad in class and stopped schooling to learn a trade since I wasn't making any progress in academics. That's why I try to support my daughter (Jenn) as much as I can to be better in math."

John (P4): ... I have made a suggestion of remedial classes at one of the PTA meetings I attended, which was rejected by most PTA members ... My mathematics was not good during my school days and lots of people couldn't continue their education because they failed mathematics and had no money to register to re-write the subject. Many of such people could have been better off. So I don't want my child to face a similar situation in mathematics."

However, Mercy (P5) and Vic (P6) considered it their responsibility to support their children's mathematics learning because they felt that understanding mathematics is a way of preparing their children for future careers.

Mercy (P5): It is connected to their ability to acquire a job when they grow into the world of work. Knowledge in mathematics gives one the ability to be able to help others finding it difficult in that field.

Vic (P6): I wouldn't like to bother her with lots of chores. She needs to study. I expect her to help me with calculations I find difficult to calculate. I also like her to help me with counting my monies.

In all, the six parents were aware of the importance attached to mathematics subject in the Ghanaian curriculum and as a means to secure educational and work-related success in future. This recognition and valuing of the subject in this way conveys the impression that the six parents perceived it as their obligation to be involved in their children's mathematics learning.

Parents and children perceived their involvement in children's mathematics learning as a way of motivating the children to learn

This theme cut across both parents' and children's data sets. Children's views are used here to support those of parents since the data from both seem to have some convergence. This theme were constructed out of the analysis of interview data from four parents and six children. Parents perceived their involvement in mathematics learning as a way of motivating their children to learn the subject due to its relevance in both Ghanaian context and the demand for its application in their daily lives. Similar sentiments were

recorded in the children's data set. For instance, Susan (P2) indicated how parental involvement could encourage children to learn mathematics:

Susan (P2): hmm...I think if even parents cannot teach their children some of the mathematics topics learn in school, I still think we can show concern by consistently asking them about the sort of mathematics learnt in school, their daily mathematics performance at school and also supervise them to do her math homework. This will serve as an encouragement to the kids.

This was corroborated by Susan's daughter (Jenn) who revealed how she feels encouraged to do well in mathematics especially when her mother buys her gifts anytime she does well in mathematics. For Jenn, the positive reinforcement means a lot and she sees it as a major motivating role played by her mother (Susan).

In the case of Paulina (P3), motivating her son to learn mathematics was seen as a major role for her involvement in her son's mathematics learning. She also noted the important role teachers play in motivating the children to learn mathematics.

Paulina (P3): We need to support our children's learning especially in mathematics with encouragements and as well as prayers. Teachers have role to play in this. ...I think they should teach the subject with love and passion so that children will love to study the subject. If the teacher doesn't love math how can he encourage my child to learn it?

Her son (Ben) however, did not state explicitly how his mother motivates him to learn mathematics. Nonetheless, he shared: "I feel happy to be helped and encouraged by my mother to learn mathematics both at home and school". Similar to Jenn (L2), Ben's (L3) expression for appreciation for his mother's motivating support in his mathematics learning is indicative of the value his mother places on mathematics learning. John (P4) shared a

similar understanding of his role in motivating his son's mathematics learning as articulated in the following interview excerpt:

John (P4): I know at the Secondary school, they learn Accounting and others and all these involve mathematics. So will like him to be an accountant in future... (Laugh). So, learning math very well at this stage before he gets to the Secondary school will help him in offering a course like accounting. So I think I have to give him all the support he needs by engaging his teachers to find solutions to all his mathematics difficulties and I think this will build his zeal and motivate him to like and learn the subject.

Again, Zimba (L5), revealed how parent and sibling involvement includes motivating him and his twin brother by rewarding their good performance in mathematics with gifts.

Zimba (L5): My mother sometimes asks us about what we learnt at school. My elder brother will prevent us from going out to play soccer if I and my twin brother fail to tell our mother the mathematics we learned in school on that day. He sometimes buy gifts for us if we are able to tell him what we were taught in school...the fact that I am able to recall what I learn at school and aids me in examination makes me feel very happy and motivated to learn mathematics.

Likewise, Vic's, daughter Sandy (L6) perceived her mother's involvement in teaching her "how to give and receive correct change" as a motivating gesture to continue learning mathematics.

Sandy (L6): She makes me like mathematics and how to deal with money when it comes to the issue of change.

It is apparent then, that positive reinforcements (verbal and nonverbal, tangible and intangible) were a common means by which some parents with low formal education in this

study motivated their children to learn mathematics. Consequently, parents and children in this study perceived parental involvement as a way of motivating their children to learn mathematics.

4.3.2 Teachers' Perceptions

Only two teachers Mark (T1) and Dana (T2) participated in the study. Interview data with these teachers were analysed for their perceptions about involvement of parents with low formal education in their children's mathematics learning. Four themes that cut across the interview data were generated, although subtle differences could be detected where the two teachers expressed different opinions on the outcome of their (teachers') effort to involve parents with low formal education in their children's mathematics learning. From the data sets, both teachers perceived parental involvement in mathematics to include basic childcare. They also interpreted parental involvement as helping children with homework. The teachers also perceived low formal education to be a handicap for parents getting involved in their children's mathematics learning. Both teachers considered involvement of parents with low formal education in their children's mathematics learning as contingent upon teacher-parent relationships. On the one hand, one of the teachers appeared optimistic about their role and relationships with parents in encouraging parents to be involved in their children's mathematics learning, on the other hand, the other teacher appeared to doubt the success of this role having previously failed in this effort.

Teachers perceived parental involvement in children's mathematics learning to include basic childcare

Both teachers perceived parents' contributions to include feeding, providing shelter, paying fees and buying school supplies for their children.

Mark (T1): Some of them are not educated but they buy those materials for them when the teacher tell the parents: your child will be able to perform when he gets this or that. They will buy though they are not educated.”

Dan (T2): I think parental involvement is mostly financial assistance, feeding and buying of relevant books for the kids. Mathematics for example if you are hungry I don't think you can do math. So their support basically involves feeding them and providing other basic needs like paying fees, clothing, and so on.

Implicit in these excerpts is the teachers' belief that although the parents lack formal education, their parental role of giving basic care is a valuable way for parents to support their children's mathematics learning. As such, these teachers perceived parental involvement as providing general basic care for their children

Teachers perceived parental involvement as helping with homework

Both teachers in this study constructed their perception of parental involvement in children's mathematics learning in terms of homework.

Mark (T1): Some of them when you give the home work and they take it to the house, some of the parents who are a bit educated assist them to do the work. They will look at the examples that the child have done in school and follow suit to help the child do the home work. ...What I will be expecting is that, let say if the parent is not educated, may be the child's brother or sister is educated. So I expect the mother or

father to ask a help from those who are educated to help them in mathematics learning.

Dan (T2): Usually we give kids challenging problems so that when they get home they could rely on little guidance brothers, sisters, neighbours or even their literate parents to help them. So our expectations is that parents could assist in a way or have their elder brothers and sisters guide them to do their homework... Basically, anytime we give them homework we expect that they do with some elders in the house and they could be their elder brothers, sisters or educated parents, elders or their neighbours if only they could help... for their parents, especially those not educated, I think not much they could do.

In addition, it appears such perception of parental involvement in mathematics learning was further manifested in how each of them engaged parents with low formal education in their children's mathematics learning. This underlying perception was apparent following a discussion with the teachers regarding how they engage the parent in deliberations on how the parent could participate in the children's mathematics learning.

Mark (T1): So after discussing the progress of their children, they ask me what they could do to support their child's mathematics learning. As for those with low formal education, I tell them they need to help the child with his/her homework or let someone support the child when he brings homework.

Dan (T2): We scarcely involve them. The only thing we normally do is to advise parent during PTAs. We tell them that normally when kids come home they should supervise and guide them to do some homework and they should ask their kids whether they were given homework or not and make sure they assist them to do it.

From the above excerpts, teachers' perceived the parental role as either directly helping children with homework or finding others who can help their child as well as monitoring the

child's homework completion. In addition, these perceptions seem to influence the kind of advice they offer to parents regarding their children's mathematics learning.

The teachers perceived low formal education as a handicap to getting involved in their children's mathematics learning

Further data analysis revealed how the teachers perceived low formal education as a barrier to how much the parent could actually play in their children's mathematics learning. In other words, they seemed to perceive parents with high formal education as best suited for involvement in their children's mathematics learning.

Dan (T2): We expect that parents should "hammer" on what we have taught at school since mathematics is all about constant practice but I think students do not even get 20% of such support from parents. I think is all about the fact that the illiteracy level is so deep and the elder brothers and sisters too their concern for their younger brothers and sisters math learning may not be there. And some students may not also make the request to get support from them. But for the parents, is normally just Zero. I mean only few parents may think of helping.

Mark (T1): If I'm giving a percentage, I will say that only 30% -40% of parents are more concern about their children's mathematics learning and you can imagine what might be the percentage if I want to limit it to those with low formal education... "In general, it is not all that encouraging just the elite ones are helping a lot but those who are not educated do not really take their children mathematics seriously"

These excerpts, then, seem convey the teachers' perception that parents with low formal education are incapable of, or at the very least, are not, helping their children with mathematics learning.

The teachers considered involvement of parents with low formal education in their children's mathematics learning as contingent upon teacher-parent relationships

The teacher's opinions varied regarding their roles in building good teacher-parent relationships in involving parents with low formal education in their children's mathematics learning. Both teachers seemed to indicate their roles as including taking the lead in involving parents in children's mathematics learning.

Mark (T1): So in short, I think is up to the teacher to team up with parents and brief them on why it is important to help the child in the learning of mathematics or other subjects. So, is all about the teacher and parent relationship for the parent to understand why there is the need for the child to get certain things to learn at home.

Dan (T2): I think we need to work with parents to get their active participation in their children's mathematics learning. If the children get home and they don't get the support from parents, then it becomes very hard.

However, Mark (T1) seemed to express pessimism regarding fruitful parental involvement, while Dan (T2) was more optimistic about the fruitfulness of parental involvement in children's mathematics learning.

Mark (T1): Sometimes, is a bit difficult, actually once they have low formal education. Some of them... is very difficult. It is only few who are educated who can really help.

Dan (T2): You (parent) bring your children here and we can't leave you in the dark as what they learn in classrooms. It is our (teachers) responsibility to let parents know what goes on in class. So when children go to the house, parents are already aware of what we do and if there is any help, they can also give. So I think we can do this.

Moreover, Dan (T2) was able to suggest possibilities such as, teachers or schools in general using forums like PTA's to educate parents with low formal education on explicit

relationships between the mathematics children learn through home activities and the nature of mathematics they learn in school.

Dan (T2): ... If there is an item like this in our PTA meeting agenda it will let parents know what we do in these school subjects and how it relate to what children do in the house. If we do not create that link kids might even think what we do in school is different from what they experience at home... For instance parents send their kids on errands and they can set time for them to know how long it takes them to complete a task. In this way, it is in way teaching kids the concept of time and time duration from one event to another have you see.

Such recognition by Dan (T2) implies an appreciation for home experiences. However, he still reckons the limitations of what parents with low formal education can do giving that there is a high possibility of struggling with academic representations of such mathematics in home settings if they are not assisted to do so.

4.4 Summary

To sum up, with respect to research question three, interview data on parents, teachers, and children has revealed key insights into how these groups of stakeholders perceive parental involvement in their children's mathematics learning. All parents in the study perceived their involvement in their children's mathematics learning as a parental responsibility to provide opportunities for their children to be mentored into using and perfecting mathematical skills involved in dealing with local business-like transactions. They also perceived mathematics as a predictor of future educational success and hence, the perceived demands on them to be involved in their children's mathematics learning including motivating them to succeed in mathematics learning. These were corroborated by the children who were interviewed. There were variations in the teachers' perceptions of

involvement of parents with low formal education in their children's mathematics learning including generic roles of care giving, indirectly and directly helping with homework and constraints due to parents' low education.

Chapter Five: Discussion, Conclusions and Implications

In the previous chapter, elaborate analysis of data resulted in themes that served as answers to following research questions: *1) how are parents with low formal education involved in their children's mathematics learning? 2) how might parental involvement be interpreted in relation to local sociocultural practices? and, 3) how do teachers, the parents with low formal education, and the children perceive parental involvement in children's mathematics education?*

For question 1, six themes were extracted: 1) Parents with low formal education use local business transactions to teach their children mathematics; 2) Parents support their children's mathematics learning by actively engaging and interacting with their school mathematics performance; 3) Parents' high propensity for mathematics as a hallmark of future success is the basis for motivating their children to learn mathematics; 4) Parents play local games with their children to assess and enhance mathematics learning; 5) Parents support their children's mathematics learning by providing financial support and school supplies; and 6) parents supervise and assist children with their mathematics homework.

For question 2, three themes were extracted: 1) mathematics understood and interpreted in terms of local business transactions; 2) parents' belief that increasing time spent on academic activities improved children's success, within the examination culture of the context; and 3) Children's mathematics leaning as a communal responsibility.

Lastly, for question 3, themes we extracted based on the components of the research question. Since the question sought to investigate parents', teachers' and children's perceptions of parental involvement in children's mathematics learning, the analysis revealed three themes as applying to both parents' and children's perceptions. Both parents and

children perceived parental involvement in children's mathematics learning as: 1) a way of mentoring children to sharpen their mathematical skills; 2) a predictor of future education success; and 3) motivating children to learn mathematics. Four themes were extracted as characterizing teachers' perceptions of parental involvement: 1) parental involvement in children's mathematics learning necessarily includes basic childcare, 2) parental involvement as helping with homework, 3) parents' low formal education as a handicap to getting effectively involved in their children's mathematics learning, 4) involvement of parents with low formal education in their children's mathematics learning as contingent upon teacher-parent relationships.

For purposes of the discussion in chapter, I reconsider the themes with a view to focusing only on those that specifically address parental involvement in children's mathematics learning. This might mean a redefinition of the themes to broaden their scope with a view to merging some and excluding others from this discussion. Nonetheless, the overall essence of this chapter is to further interpret and elaborate on the key findings that serve as responses to the study's main research questions

5.1 Discussion: Research Question 1

Of the six themes characterizing how parents with low formal education are involved in their children's mathematics learning as key responses to research question 1, three (using local business transactions to teach their children mathematics; playing local games with their children to assess and enhance mathematics learning; and supervising and assisting their children with mathematics homework) appear to be more directly associated with parent-child involvement in mathematics learning. Although the other three themes are important,

they either relate to parental involvement in children's general education or parental support for their children's overall learning. Therefore, I now turn to a discussion of the three mathematics-related themes.

Parents with low formal education use local business transactions to teach their children mathematics

As participants in this study explained, in everyday rural Ghana, children participate in the full life of their families. They start getting assigned responsibilities and roles at a very early age. But what is important is that they are mentored or apprenticed into these roles (Rogoff, 1994). Recall Paulina (P3) and Vic (P6) who engage their son and daughter in their family trading activities. As shared by the parent participants, such engagements are meant to mentor their children on concept of "appropriate change" which seemed to be more prevalent in the people's routine activities as far as local business transactions are concerned. This finding resonates with my own personal experience growing up in a similar cultural setting where the children while still breast fed, they are tied to mothers' backs as they sell vegetables, buy items from local shops, and often talking about "correct change". As they grow up, they start to be sent to sell and buy things from local markets or stands or makeshift sheds where say paraffin is sold. This mentoring involves both the morality of life and mathematics learning – contextualised, authentic mathematics learning. Of course, this current study confirms other studies that have highlighted the essence of similar contextualised and daily life activities as potentially rich in mathematical learning (Anderson, 2007) and the role of such context in providing the space for parents to engage in legitimate mathematics activities with their children (Anderson & Gold, 2006). Receiving

and giving of correct change is considered paramount as moral as well as obedience to cultural or societal moral law. I recall Sandy (L6) (daughter of Vic) who shared the moral lesson her mother taught her with respect to not taking more change than she deserves or making sure she receives correct change any time she is sent to buy items from the shop or market sheds.

The current study reveals parents with low formal education seemed to judge mathematical competence of children based on their ability to perform certain tasks with precision; making sure they are receiving and giving correct change, honestly returning excess change to sellers and so on. I recall a phrase used by Susan (P2) during my interaction with her when she stated that Sandy (L2) is good at mathematics because she “comes home well” when she sends her on buying or selling errands, implying she is able to bring home correct change. Another phrase used by Vic (P6) when she stated Sandy’s (daughter) elder sister is not good at mathematics because she is not able to determine “correct change”. These and other similar phrases reported in the findings speak to rural parents’ interpretation of what constitutes mathematics competence. In this context, the child’s ability to run financial errands with precision is a major determinant of his/her mathematical capability.

The moral side of mathematics as portrayed in this current study appears to be a distinction that may not have yet been seen in other studies in mathematics. This study tends to inform us about other forms of social justice issues such as equity and moral commitment that many studies or researchers might overlook. Moral and equity as a form of ensuring social justice (as described by participants in this study) on a more individual level appear different from political social justice championed by Gusein (2007) and Freire (1974). Gusein (2007) noted that “the goal of teaching (mathematics) for social justice is for

students to become agents of social change and join in, and eventually lead, the struggles to remake our world for peace and justice” (p.116). This is similar to Freire’s (1974) discussion of the internalization of oppression and his idea of education as the practice of “freedom” or “conscientizacion” as he termed it. This view seems to contradict the view that mathematics is neutral or universal, unconnected to politics and society (Tate, 1994). It was intriguing to note from the current study’s findings that parents clearly value the equity and moral commitment as a form of social justice “good mathematics” can have. For instance, if children are poor calculators then they may unknowingly cheat the customers or their families (accepting or giving incorrect change). Thus, it can be argued, which is often the case, that the cultural law embedded in morality that does not allow accepting what does not belong to one is an enforcer of mathematical competency with an emphasis on social justice (being fair with others). It is therefore often common to find parents expressing assessment of their children’s future success in mathematics and related careers based on their perceived child’s ability to receive and give correct change.

From this perspective, parents play an important role in the learning process of their children (Von, 2013) and more specifically children’s mathematical computational literacy through discourse or interaction with their children (Anderson, 1997; Cobb, 1994). Moreover, the study’s findings are consistent with claims made by Benigno and Ellis (2008) who posited that much of children’s mathematics learning is not done in an explicit dialectic interaction but rather during routine cultural activities such as mealtime, play and household chores. Indeed it was obvious that the interactions between parents and children in this study were unstructured, non-formal and mostly related to the daily up-keep within the cultural setting of the families as in local business transactions (receiving and giving of correct

change) and this possibly provides fodder for mathematical conversation between parents, other adults and children. However, my own experience of parents is that they are like connoisseurs or possess tacit knowledge (Polanyi, 1974) about when parents, children, and other community members relinquish the power to decide what to charge, what morally acceptable profit to make as well as justifying these to customers and above all giving and receiving correct change.

In summary, socio cultural activities and interactions in home environments in terms of engaging in contextualized local activity such as the interactions that occur during local business transactions could be perceived as tools these parents have that could be tapped into to enhance children's mathematical literacy and other competencies. Moreover, mathematics is indeed embedded in peoples' out-of-school activities. Hence, home settings and interactions among parents with low formal education and their children, as revealed in this study, has the potential of creating an enabling environment for children's mathematical competencies to be developed as they interact with their parents.

Parents play local games with their children to assess and enhance mathematics learning:

As shared by the participants, mathematics is at the centre of every parent's perception of his or her child's success in life. Therefore, certain activities in the society are designed specifically to enhance, promote, improve, sharpen or remediate children's mathematics. For instance I recall Alison (P1) who shared that she plays *Ludu* with her daughter mostly in the evenings. Again, Susan (P2) allows her daughter (Jenn) to play *Oware* with her neighbouring friends. Most of these games and activities are peculiar to the culture

of the community under study and parents believed playing cultural specific games like Oware and Ludu with their children or creating opportunities for them to play such games would enhance their children's mathematics learning. These games are different from generic play like 'hide and seek' (chasing to catch a partner) which parents thoughts could disrupt children's learning. These local games contrast Lego, building blocks, or IPads used by children in other contemporary societies and contexts worldwide. That said, although the specifics of the games played differ based on culture, this finding corresponds with game playing middle class parents point to in other studies (Lynch et al, 2008; Anderson, 1997; Phillips, Norris & Anderson, 2008). The cultural setting of a society or community plays significant role in the kind of interactions, communication or activities parents engage their children at home - may it be games or daily household activities. As Rogoff (1990) pointed out: there are important cultural variations in arrangement for and interaction with children (p. 9). In other words, such interactions may differ from culture to culture. For instance, adult-child shared book reading was found to be a medium through which parents and their children, in an urban setting in western Canada, attended to mathematical concepts (Anderson et al, 2005). Whereas, parent participants in this study in rural Ghana participated in cultural games, like Oware for engaging children in interesting and rich mathematical structures which have been found to further young children's problem solving skills (Powell & Temple, 2001; D' Ambrosio, 2014). Even if peculiar task differs, it worth acknowledging that parents whether low education or middle class support math through child-friendly activity.

This study therefore adds to the building evidence that socio-cultural practices of families do influence the specific kind of activities with which parents engage their children

at home. Despite the potential of such local games in promoting mathematical thinking and reasoning (Powell & Temple, 2001) coupled with my personal experience with the local games, the explicit mathematical interactions that emerge when parents engage their children in such local games still remains unknown. However, that parents with low formal education recognize such socio-cultural games as contexts within which they support their children's mathematics is a significant contribution in itself.

Parents supervise and assist children with their mathematics homework

Participants in this study shared that parental supervision of children's mathematics is a routine practice. From my personal experience in rural Ghanaian context, parents generally value their children's education and have high expectation for their children's education but greater emphasis is on their children's mathematics learning regardless of parents' education level. This is due to the greater emphasis placed on the subject by the Ghanaian school curriculum. For that matter, parents consider supervision of their children's homework as paramount. Usually in such rural areas, after parents return from the farms or trading activities in the market, it is common practice to see them sitting beside their children outside their grass thatched houses supervising them to finish their homework before they go to bed and whenever parents are unsure of their children's mathematics homework, they direct them to next door neighbours or other people in the community for assistance or have them double check what their children have done. Moreover, as shared by parent participants, neighbours or siblings who are ahead of the child in terms of grade level also take part in supervising their younger sisters or brothers to accomplish mathematics homework and other related

school assignments. Again, as it is grounded in the cultural practices of the community, every adult sees a younger child as a son or a daughter irrespective of family relationship and appears responsible for the child's learning. In other words, every capable adult in the community is seen as having a stake in the general learning process of the child in both school and out-of-school experiences with emphasis on mathematical competency. The role of such an extended system of support for children's learning is echoed in the study of Gregory et al. (2007) cited in Anderson et al. (2010). Gregory et al.'s (2007) study of South Asian immigrant families reported the important role of grandparents in young children's literacy development. Through ethnographic case study approach, they concluded that grandparents used a complex blend of traditional teaching practices from the Bengal and contemporary western pedagogy as they worked productively with their grandchildren with a wide array of texts. Hence, the grandparents expose children to a variety of learning strategies with activities and practices from both contemporary and indigenous perspectives.

Not only did parents in the current study express the usefulness of other adults in the community in helping their children's mathematics learning through supervision and monitoring, they also recognized the role of older siblings in helping and double checking the younger children's mathematics homework. Hence, older children were seen as capable of passing on their mathematical knowledge and skills to younger children as well as serve as a model for the younger ones to imitate. This is consistent with Vygotsky's (1978) socio-cultural approach to learning that recognizes the role of the mediator (a teacher, adult or more knowledgeable sibling or peer) in initiating children into new cultural practices or guiding them in the learning of new skills. Likewise, the current study's finding is similar to Gregory's (2004). As discussed in earlier in Chapter 2, Gregory (2004) observed that older

children exhibited characteristics of “a facilitator” as they supported the development of younger children’s literacy. Similarly, parents in this current study likely saw similar characteristics in siblings as they indicated they get older siblings to help the younger. Thus, the current study reveals that parents as well recognize the potential of older siblings mentoring younger ones to build their literacy and other mathematical competencies. Hence, as well as placing more emphasis on getting parents involved (Epstein, 2002; Cai, 2003), we should consider siblings and others in the community as additional resources for supporting children’s mathematics learning. Better still, when we think of parental involvement, we need to consider the ways in which they commandeer other people (with skills and strengths that they do not) to support their children as legitimate ways in which parents are involved with their children’s math learning (i.e. indirect, rather than just teaching the math to them themselves)

Moreover, present in the finding of parents’ mentorship role in this study is the process of *intersubjectivity* a term used by Rogoff (1990) to mean involving shared understanding of focus and purpose between children and their more skilled partners. Congruently, parents in this current study expressed varying ways they mentor their children mathematically through daily activities ranging from sending them on shopping and selling errands to parents actively engaging them in their trading activities. Most importantly is that such parents-child engagements as described by parents in this study seem to be dialogical with focus on parents (more skilled) guiding the child (the explorer) to build mathematical competencies in solving problems in daily life very similar to what Rogoff (1990) noted as intersubjectivity. Recall P6: “I let her count the clothes I sell in tens and writes them down. Paulina (P3) “Mostly I teach him how much to give to customers as change.” Significant of

parents' involvement in shared understanding and problem solving through routine home situated tasks as noted above is aiding children appropriate an increasing advanced understanding of and skill in managing the intellectual problems of their daily lives and the community (Rogoff, 1990). Thus, the current study revealed that these parents in rural Ghana despite their low level of formal education could be seen as mentors of their children's mathematics learning through non-formal home situated activities that enable them to acquire mathematics competency in carrying out daily tasks deemed relevant to the socio-cultural context they live.

5.2 Discussion: Research Question 2

Three key themes were constructed in response to research question 2: "*how might parental involvement be interpreted in relation to local sociocultural practices?*": 1) mathematics understood and interpreted in terms of local business transactions; 2) parents' belief that increasing time spent on academic activities improved children's success, within the examination culture of the context; and 3) children's mathematics leaning as a communal responsibility.

Mathematics understood and interpreted in terms of local business transactions

As elaborated by participants in this study, children's mathematics capabilities valued in home settings depend on how well they take up roles regarding daily socio-cultural activities. Children's ability to perform tasks within the socio-cultural context determines how competent they are in mathematics as opposed to how well they solve school

mathematical problems. Hence, mathematical application in that specific cultural context is paramount (Gutstein, 2007). For instance, in a cash based economy like Ghana and within the cultural setting where parents mentor children (as in this current study's finding) into roles to apply their cognitive skills in solving problems in real life situations (such as buying and selling), the demand of cognitive skills and measure of mathematical competence is largely based on one's ability to perform certain real life tasks accurately in that cultural context. This might differ from the value educators or researchers assign to a child's cognitive skills. For instance, the value assigned by educators to taxonomic classification (rather than functional classification) as a more mature or sophisticated classification may relate to schooling's and literacy's emphasis on defining, organizing, and classifying, and on learning concepts from general definitions rather than solving real life problems as people encounter them (Rogoff, 1990, p. 57). Hence it is worth to know that the taxonomic classification valued in school may not be valued so much in a real life problem solving situation in certain cultures. This points to differences that exist in interpretation and understanding of mathematics through the lenses of cognitive skills and how the two contexts; school versus rural folks might interpret it.

Interpretation and understanding of mathematics is intrinsically tied to socio-cultural aspects of problem solving situations that also take into consideration the cultural practices of the society (Nielsen, Nicol & Owuor, 2008). However, it appears that in recent years there has been an emphasis on global possibly to the detriment of informal mathematical knowledge used in the local context of specific cultures (Silver, Smith, & Nelson, 1995). Of course Math for too long was seen as universal not context specific so this current study again reminds us to understand the immediate context of the child. In specific reference to this study's context

is the cultural practice of daily use of physical cash in local business transactions as opposed to the use of credit or debit cards in more advanced economies (Odior and Banus, 2012). In this perspective, it is deemed important for us as educators to open our views to multiple value systems and appropriate goals and also re-define the purpose of children's mathematics learning in a fashion that is responsive to local circumstances and aspirations (Nicol & Brown, 2008; Nielsen, Nicol & Owuor, 2008). For instance, redefining the purpose would help us to understand how life problems' solutions or routine cultural activities are similar to those in classroom or test problems. Moreover, it would help us better understand the need to recognize the importance of differences in the context of global migration where peoples are uprooted from contexts (like rural Ghana) and find themselves in "Vancouver say, as immigrants (or refugees) or students etc, and enter a school system. Teachers of these students may focus on the local and might lose sight of the different "local" these students from different cultural backgrounds may bring. This therefore raises our awareness in finding lean ways to ensure culturally responsive mathematics teaching (Nicol & Brown, 2008) but most importantly taking into consideration the moral and other non-cognitive aspects of children's mathematics learning valued in different cultures.

Parents' belief that increasing time spent on academic activities improved children's success, within the examination culture of the context

As revealed in this study, parents' interpretation of their children's school mathematics achievement within that cultural context rely on children's recall of mathematical facts (say multiplication tables) and high marks in exams. I recall Susan (P2)

who shared that she expects her daughter to score higher marks in school mathematics and be smart enough to recall mathematics facts. John (P4) and Mercy (P5) also shared a similar expectations. Braithwaite and Huang (1982) shared similar findings on Chinese parents who regard memory for facts as very essential but contrast this with Australian perceptions on memory skills as trivial. Parents in this current study geared their suggestions on increased and constant school mathematics workload on children to be a way of ensuring children learn more mathematics and recall the facts. For example, all parents in the study suggested increased mathematics schoolwork as a sure way for success in mathematics learning. They also alluded to the fact that in “their days” teachers used to give them more mathematics assignments and other school related work to the extent that they never had time to play. This, according to the parents (John and Alison) helped them to memorize lots of mathematical facts and pass some of the school exams. The academic culture experienced by the parents seems to speak volumes of why some parents in this current study (say Mercy) always want their children to be beside their books after school and often see child’s play as waste of time. For some parents, even if they could afford items like kite for play, will not buy with the view that such play could distract the children from learning, although the local games (Oware and Ludo) parents sometimes play with them appear to be an exception. For these parents, generic play such as flying kites, “hide and seek” (running to catch a partner) are not considered educational and for that matter, parents mostly discourage their children from such play. Instead, they would prefer their children to have more school-based activities. This seems to contrast with middle class Caucasian mother-child play where parents see game playing as part of their role (Anderson, 2010) and to some extent arrange play dates with other friends, hence balancing play with child’s academic work. In the case

of Ghanaian rural context as reported in the current study findings, more time on books is seen as a sure way of increasing children's academic performance which stands in contrast to the significance of "child's play" in development of children's mental skills (see Anderson, 1997; Vygotsky, 1978).

Parents' view of pre-occupation of school work both in school and at home as a way of increasing mathematics achievement among children could also be attributed to how parents themselves were raised with regards to their mathematics learning during their schooling days even though they themselves were not successful or could not complete school. This to some extent contradicts the parents' own ways of judging their children's mathematical competencies and how they would like to see their children apply mathematics in their daily lives. This is so because parents themselves appear to feel some sort of disconnect between what their children do at home versus what they do at school due to the nature of mathematics "homework" assigned to children (Remillard & Jackson, 2006). As an instructional strategy, "homework" represents an important resource to stimulate independent study habit, extend learning and connect previous and subsequent class work" (Carvalho, 2001, p. 121). Even though, homework is supposed to take place in homes, demanding on families to organize their activities around it, its content and form usually rely heavily on school curriculum. As a result, it relegates the home conditions necessary to draw the desired home support from parents and other family members. With such disconnection between home and school, parents just like the participants in the study are likely to see more schoolwork or pre-occupation with schoolwork as a way of increasing children's mathematics achievement as opposed to other useful informal engagements at home that might have the potential of fostering mathematics learning.

Children's mathematics leaning as a collective communal responsibility

As shared by the participants in the study, in the socio cultural context of Ghana, a child's general upbringing including his/her mathematics learning is entrusted in the hands of the entire community; close relatives, extended family members, and neighbours. In doing so, parents, siblings and other adults in the community see it as their responsibility to guide the child through what is deemed appropriate in the cultural context of the society in terms of education, moral standards, societal norms, and social responsibilities. On the other hand, children see every adult in the community as a mother, father, uncle, brother or sister regardless of the close, distant or no blood relationship and hence, accept to be corrected, guided, or mentored through the socialization process. This might look very different from western societies, as seen in urban centres like Vancouver, where in most cases neighbours are less familiar with one another and oftentimes one does not know the name, let alone academic level, of the other. The current study findings is consistent with other studies that have found that parents sometimes rely on others in the community to support their children's mathematics learning' (Delgado-Gaitan, 1992; Hoover-Dempsey, et al 1995). For instance in Hoover-Dempsey's et al (1995) study with elementary parents from different socioeconomic background, the researchers noted that the parents reflected on their knowledge and skills when confronted with specific demands of helping their children. If they believed their skills were inadequate, parents tended to ask others in the family to help, ask the children to get more information at school, or seek additional help themselves (e.g., call the teacher or knowledgeable family member or friend). That said, parents with low formal education in rural Ghana then appear to go further afield than those in Hoover-Dempsey et al (1995) as they rely on academic strengths of the broader community than

limiting it to only friends and family members as in Hoover-Dempsey et al (1995). Such communal relationship also create the opportunity for significant others within the community to engage and guide the child in other informal activities in the cultural context that could arouse mathematical discourses between adults and children. This is particularly rooted in what Rogoff (1990) described as guided participation. Rogoff (1990) noted that caregivers and children make arrangements for children's activities and revise children's activities as they gain skill and knowledge. These arrangements facilitate children's extension of their existing knowledge to encompass a new situation. It is however worthy noting from the current study that such responsibility extends beyond the caregiver as stated by Rogoff (1990) to include other members of the community who might not necessarily have a direct relationship with the child.

The findings with regard to parents in this study contradict Civil's (2001) study with middle class parent participants in a Math for Parents' course. Civil (2001) noted that issues of lack of confidence, feeling inadequate at mathematics and feelings of alienation were common among the participants. However, parents in this study despite their low formal education did not indicate lack of mathematics content knowledge as hindrance in supporting their children's mathematics learning but rather focused on explaining non-formal home based activities they engage their children to support their learning of mathematics. Instead, it was in fact the teachers who expressed such a concern. It seems on the one hand that there is some kind of anxiety among parents with formal education and seems to focus more on acquiring school mathematics content knowledge in order to support their children's mathematics learning. On the other hand, parents with low formal education seem to pay more attention to the daily routines in which they could involve their children to engender

mathematics learning as well as relying on the academic strengths other community members at least from this study's findings. Although, it is important to appreciate parents helping their children with mathematics content support at home in case they do have such competency, other ways like parent-child interaction during routine activities in the home present themselves with mathematical problems in daily circumstances, that are often solved with attention to social and cultural relationships (Anderson, 1997; Goldman & Booker, 2009) for which parents may not need any school mathematics content background. Hence, parental role in children's mathematics learning might not be limited to parents' providing direct assistance with children's mathematics homework to show that they are actively involved.

In summary, there are socio-cultural factors influencing parental understanding of and involvement in their children's mathematics education. Such factors are premised on parents' and society's view of mathematics learning as individuals functional efforts to solve specific problems of cultural importance in their societies. This understanding casts a socio-cultural interpretation of parental understanding of mathematics in two dimensions; cognitive and moral. The cognitive being the application of the knowledge and skills deemed culturally relevant in solving everyday problems in the cultural setting. And as previously discussed, in Ghanaian culture, one is expected to apply culturally relevant cognitive skills in solving problems in a way deemed morally acceptable; for instance valuing moral principles such as fairness and respect for other persons' rights. Moreover, previous academic "culture" experienced by parents in the study influenced parents' perceptions or beliefs to associate children's future success in mathematics to increased school mathematics workload. Lastly, the interconnection that exist between community members and the crucial role the society

bestows on the community in the child's education makes parents interpret children's mathematics learning as a collective or communal responsibility and therefore feel inclined to rely on other people in the community for mathematical support for their children.

5.3 Discussion Research Question 3

Thematic responses to this research question about parents', teachers' and children's perceptions of the involvement of parents with low formal education in their children's mathematics learning are discussed in two clusters: parents-children perception and teachers' perceptions. As indicated previously, parents' and children's perceptions of parental involvement in their children's mathematics learning in this study triangulated with each other and resulted in three key themes: 1) Seeing parental involvement as a way of mentoring children to sharpen their mathematical skills; 2) Seeing competence in mathematics as a predictor of future success in education; and 3) Seeing parental involvement role as a way of motivating children to learn mathematics.

On the other hand, the two teachers perceived parental involvement in mathematics to include: 1) basic childcare, 2) helping children with homework 3) low formal education as a handicap for getting effectively involved in their children's mathematics learning, and 4) The teachers considered involvement of parents with low formal education in their children's mathematics learning as contingent upon teacher-parent relationships. For purposes of focus, theme 1 about basic childcare as characteristic of teachers' perception will not be discussed as it applies to education or learning in general. What is discussed in this chapter are themes that directly involve mathematics while still recognizing the fact that mathematics learning is situated in the context of a multiplicity of factors that shape the teachers' perception.

5.3.1 Parents' and Children's Perceptions

Parents and children consider parental involvement in children's mathematics learning as a way of helping them sharpen their mathematics skills

As expressed in the data sets of parents, they perceived their involvement as mentoring children through daily trading errands to build their children's mathematics competency. This was consistent with my own personal experience growing up in a similar environment, where parents provide guidance and mentorship to children right from childhood before they even start formal education. They are guided through simple tasks as they help their parents undertake daily activities such as buying items from the market sheds, watering vegetables, carrying water from the well, and so on. This mentorship role of parents as described in this study resembles the *guided participation* as theorised by Rogoff (1990). She stressed on the importance of routine arrangements of children's activity and their participation in skilled cultural activities that are not conceived as instructional (p. 8). Such routine activities are noted as social resources for guidance – both support and challenge-in assuming increasingly skilled roles in activities of their community. Likewise, through the interviews and observations, these parents spoke of mentoring role and how it serves mathematics through activities that are not directly related to explicit school mathematics and most importantly provide such guidance through unstructured, non-formal home based routine activities that are related to the culture of the people. In other words, the parents themselves perceived their involvement as a way of providing mentorship or guidance purposely aimed at helping the child become more functional within the cultural context in which they grow and develop their understanding of issues around them. Thus, they recognized the mentorship they provide and its significance in learning math and in turn

learning their roles in community and society. As noted earlier, such perceived guidance may not have explicit connection with school mathematics but as Rogoff (1990) pointed out such mentorship in culturally valued activities are essential to children's thinking.

Parents-children perception of mathematics competence as a predictor of future education success is instigator of parental involvement

Per the findings, parents in the current study showed great interest in support of their children's mathematics learning. From my personal experience growing up in a similar rural community in Ghana, families seem keen with their children's mathematics learning both within home and school context. Hence, like other countries and jurisdictions achieving well in mathematics is key to school success and thus Ghanaian parents want their children to do well. I recall P2's statement: "... if you are not able to make it in mathematics you will find yourself wanting as you will be unable to get a school." If a parent finds mathematics valuable and imparts that value to his or her child, the child will be more likely to strive for higher achievement in mathematics (Levpušček, Zupančič, & Sočan, 2012; Alan 2006) which shows that the interest and importance parents attach to mathematics could affect how children approach the subject. The current study's findings also concur with Allan's (2006) observation about the significance attached to mathematics worldwide whereby in almost all countries around the world, mathematics seems a basic requirement for one to be able to advance and be successful in general education. The results of this study indicate that such success in education might not only be limited to the child's ability to excel in academics. Such future education success also includes the child's applying mathematics in carrying out culturally-relevant tasks on daily bases. Hence, being successful in education from the rural

parents' perspective also includes ability to be successful in solving routine problems in the home setting and such ability is of paramount important to every rural parent. For instance, in the Ghanaian rural context, it is very common to hear elders showering praises and predicting future education success for children who carry out errands successfully or able to follow an elder's instruction to successfully execute a task. Thus successful future education has to do with being able to do well not just in school mathematics at every level but also successfully carrying out daily task that involve use of mathematics such as in local business transactions as discussed previously. Rural parents therefore see their involvement as a way of creating opportunities for children to attain success in mathematics to enable them to succeed in their advancement in education and to achieve this, mostly support their children's mathematics learning through daily activities at home.

Parents-children perceived parental involvement in children's mathematics learning as a way of motivating the children to learn

This finding seems to be in consistent with other studies that have recognised parental involvement as a way of motivating children to learn mathematics (Cai 2003; Cai et al 1999). Cai et al. (1999) participants were middle school and mainstream. However, the findings from this current study suggest that non-mainstream parents just like their mainstream counterparts do motivate their primary children to learn mathematics. More so, the nature of motivation parents provide to the middle school children in Cai et al (1999) study seems unknown, whereas positive reinforcement and other ways of extrinsic motivation were explicit among non-mainstream parents like those in this current study as motivation for their children to learn mathematics. For instance, Paulina (P3): "We need to support our children's

learning especially in mathematics with encouragements”. Jenn (L2): “My mother buys me drinks whenever I excels in mathematics”. Thus we see the value parents (and children) attach to motivation despite their low level of education and what they do to support their children’s mathematics learning either directly or indirectly.

5.3.2 Teachers’ Perceptions

Presented in the findings chapter, the analysis of teachers’ data revealed four key themes: as listed earlier in this chapter. However, in order to keep the discussion focused and due to data convergence during analyses and result presentation, I limit my discussion here to themes specific to children’s mathematics learning: 1) Teachers perceived parental involvement as helping children with mathematics homework; 2) Teachers perceived parents’ low formal education to be a handicap for getting effectively involved in their children’s mathematics learning; 3) The teachers considered involvement of parents with low formal education in their children’s mathematics learning as contingent upon teacher-parent relationships.

Helping children with mathematics homework

This seemed the most significant form of involvement in the teachers’ view. This perception seems to be teachers’ own construct about the role of parents in their children’s mathematics learning. In other words, it is these teachers’ belief that parents should be doing helping children with homework to enhance their children’s mathematics learning. From my personal experience both as a pupil and a teacher in schools in Ghana, and as is the case in many countries, homework (sent home) tends to be the exact extension of what children learn

in classrooms. Hence, requesting that parents or guardians assist the children with some form of mathematics content knowledge is always on the teachers' minds. Thus, teachers perceive that once parents are not directly assisting their children's school mathematics learning, they might not be actively involved. For instance, I recall statements like one from Mark (T1): "We expect that parents should 'hammer' on what we have taught at school since mathematics is all about constant practice" I also recall similar sentiment from Dan (T2): "In general, it is not all that encouraging just the elite ones are helping a lot but those who are not educated do not really take their children mathematics seriously". Thus, teachers' perception of parental involvement in children's mathematics learning in the current study seems congruent with what Cai et al. (1999) described as parents acting as mathematics content advisors (parents provide advice to their children on mathematics content) but seems to contradict what parents in this study actually do to support their children's mathematics learning. As discussed earlier, parent participants in rural Ghana with low formal education seem more consistent with Benigno and Ellis' (2008) notion that parents may not necessarily be engaged in their children's homework tasks but "are able to build mathematics within the everyday contexts their children enjoy" (p. 303). For instance it was noted that parents in this current study engage their children in routine home activities, create learning opportunities within the environment to support mathematics learning, provide emotional support (encouragement) and help with homework directly or indirectly. Therefore, parental involvement in mathematics learning seems to go beyond content support as perceived by teachers' in this current study. Indeed, Cai et al. (1999) have found the indirect assistance of parents as motivators, resource providers, and monitors seem to be the most important predictors of students' mathematics proficiency and performance. They concluded that

parents' direct assistance roles as content advisors and learning counsellors are less important predictors among children from mainstream families. Thus, although teachers perceive homework support as the most important way for parents to be involved, it appears such a view is not supported by research.

Teachers perceived parents' low formal education to be a handicap for getting effectively involved in their children's mathematics learning

The findings in this current study suggest that while the teachers seemed to acknowledge other non-content roles parents with low formal education played in their children's mathematics learning, they considered low formal education a handicap. Recall Mark's (T1) comments that "sometimes, is bit difficult to involve them, once they have low formal education...It is only few who are educated who can really help." Comments such as these lend to describe the teachers' view as suggesting parent's formal education is being commensurate with their level or extent of involvement. Hence, they seem to suggest that parents with high formal education seem to be involved more as compared to their counterparts with low formal education. This perception seems to echo the work of Sanders, Epstein, and Connoros-Tadros, (1999) finding although their study was conducted among high school parents and schools. Sanders et al. (1999) noted that "parents who have more formal education are more likely to report being involved with their teens' learning at home than are parents who have less formal education" (p. 7). Sanders et al. (1999) observation was not different from how teachers in this current study perceived parental involvement among parents with low formal education. However, it appears that the teachers' limited focus on equating homework support with parental involvement is contributing to this view.

That said, the current study with non-mainstream parents suggests parents, despite or because of their low education background, support their children's mathematics learning through non-formal means, such as daily home activities. Teachers might downplay this parental involvement but it is well noted that such home rooted activities have been found to provide numerous opportunities for parents to involve their young children in meaningful mathematics learning (Benigno & Ellis, 2008). For instance, I recall my observations with Sammy (L4) in his Aunt's store arranging cans into shelves, my observation with Sandy (L5) in the garden and Jenn (L2) sawing with her mother after school wherein the children were aware of some mathematics connections of the activities they do at home. These observations point to the fact that it might not necessarily be what teachers' think and how they believe parents should assist their children's mathematics learning but rather whatever parents themselves do at home and the mathematics learning opportunities they may present through activities worth considering as supporting or developing mathematical competencies of their children.

The teachers considered involvement of parents with low formal education in their children's mathematics learning as contingent upon teacher-parent relationships

The teachers in the study considered involvement of parents with low formal education as dependent on kind of parent-teacher relationship. They recognized their own responsibility and role in building relationships and partnering with parents with low formal education to get them involved in the mathematics learning of their children. This finding concurs with other studies that have pointed to the need for school or teachers to develop programs for effective school and family partnerships (Sanders, Epstein, & Connor-

Tadros, 1999; Hoover-Dempsey, Walker, Sandler, Whetsel, Green, Wilkins & Closson, 2005). Hoover-Dempsey et al (2005) posited that when school systems attempt to promote teacher and principal contributions to effective parental involvement, they support schools' effectiveness in educating children. Thus teachers' roles in making efforts to reach out to parents and in this case parents with low formal education seems to be appropriate, since parents themselves are primary, most committed, and effective educators of their children irrespective of their education (Goldman and Booker, 2009) and deserve our support.

5.4 Conclusions

In considering the key themes discussed above, several key points stand out about involvement of parents with low formal education in their children's mathematics learning. Among these is the practical nature of how mathematics learning and use are engaged in the rural Ghanaian's community. It was featured prominently that participation through mentorship and engagement in local business transactions is used as learning as well as an evaluation context for one's mathematics competence. Giving and receiving correct change is perceived a key determinant or characteristic of one's moral standing as well promise of future success in mathematics and education in general. The study has revealed the value placed on mathematics learning by the parents, teachers and children as being the hallmark of future success. It is also clear from the study that the parents in particular see increased homework that takes away time of play from children as an indication of useful use of time as mathematics engagement is seen as predictor of a child's future success in education in general. Ironically teachers see low formal education as a handicap of parental involvement in children's mathematics learning. However, the teachers recognizing this handicap implied

that the extent to which parents with low formal education are involved in their children's mathematics learning is a function of their level of formal education. And, that their involvement can be enhanced by the kind of teacher-parent relationships they develop.

5.5 Implications for Future Research

The current study expands our understanding of the ways parents with low formal education are involved in their children's mathematics learning. More so, since similar cultures and socio-cultural backgrounds exist within communities globally, this study assists us in determining future directions into parents' involvement in mathematics worldwide. Thus, the study sought to give further detail insight into the situation of parental involvement among communities with non-mainstream cultures globally. In addition to the above mentioned contributions, the current study points to valuable considerations and implications for future research.

Although having all participants (teachers, parents and children) from same community gave a clear and detailed understanding of what pertains in that specific cultural setting (rural Ghana) with respect to parental involvement in children's mathematics learning, parents in the current study were from similar socio-cultural and economic background. This raises the question as to if, and how, the data might change if I had included families (parents & children) from different socio cultural, educational and economic backgrounds. For example, Ghana is divided into about 75 ethnic groups with somewhat distinct socio-cultural practices and beliefs. Thus, in Ghana, as well as elsewhere, it behoves us to examine parental involvement with participants other than Akan tribe (one of the major ethnic groups in Ghana). Furthermore, with the emphasis here on rural Ghana, it is

important to consider whether urban parents with low formal education would be involved in their children's mathematics learning in similar or different ways. As this study illustrates, parents with low formal education may/do support their children's mathematics but further research taking into consideration families from different ethnic origins in other parts of the country, and indeed in other countries, with different socio-economic backgrounds is needed to examine any differences in parental involvement attributed to the issues raised. It was no doubt this current study's findings indicate parents with low formal education engage and support their children in mathematics learning at home through informal, culturally situated strategies. That said, the study raises the question of the role of context in the ways in which the culturally based parental strategies are practiced. It is therefore recommended that future study explores the extent if at all, to which similar strategies enable or hinder the mathematics learning of children from Ghanaian immigrant families in more advanced countries considering differences in socio-cultural and economic activities and practices.

It was evident from the current study's findings that parents with low formal education in rural Ghana do support their children's mathematics. From previous experience with focus groups, it seems that parents sharing with teachers, and not just with the researcher as in the current study, would prove informative for all those participating. For example, teachers will get to learn directly from parents on ways they are involved in their children's mathematics learning and more specifically the daily home based tasks they engage their children in support of their learning. Further research with focus groups (parents, teachers, and researcher) and/or mixed group events would provide insights and activities through which educators and parents might support one another in making connections between home and school activities, thereby augmenting our knowledge on

parent and teacher perceptions of parental involvement in mathematics. Moreover, researching with six families in the current study through interviews and observations over a three months period proved invaluable in capturing baseline data from parents with low formal education, a non-mainstream, sometimes marginalized population, regarding parental involvement in children's mathematics learning. However, increasing the number of families and/or the longitudinal nature of the study may provide more data and further insights into more activities parents engage their children at home in support of their children's mathematics education. Hence, there is need for researchers to further examine parental involvement in children's mathematics so we might better informed on ways parents from other cultures or other marginalized groups are involved in their children's mathematics learning in order for educators to find meaningful ways bringing them on board in support of their children's mathematics learning

5.6 Implications for Practice

For practicing teachers, this work offers information on how parents with low formal education support and engage their children's mathematics learning at home through non-formal and unstructured home based activities. Many intervention programs such as IMPACT project, Ocean Mathematics Projects in UK (Merttens & Vass, 1993), and Project BRIDGE (Linking Home and School: A Bridge to the Many Faces of Mathematics) (Civil, 2001) have attempted to engage parents in programs to bridge home-school mathematics or foster parental involvement in the subject. Basically, mostly, these projects focus on equipping parents with mathematics content support for parents to enable them to assist their children at home, which implies parents need to have formal education in order to participate.

This study therefore is one of the few to offer a greater insight for teachers to respect and acknowledge the legitimacy of home math practices and other contributions parents with low formal education make towards their children's mathematics learning. This study would therefore serve as a call for educators to recognize and validate parental involvement more broadly conceived, and to build strong partnerships with parents including those with low formal education in ways, which harness the potential of parental supports, and other non-formal activities parents engage children at home.

5.7 Closing Thoughts

This study has shown that parents with low formal education do support their children's mathematics learning. Per the findings of this study, teachers seem to underestimate, and possibly undervalue, the mathematics support parents with low formal education give to their children. However, these parents described various ways they support and engage their children in mathematics learning through varied daily tasks that offer opportunity for real life problem solving involving math practices. As we continue to encourage various ways of reaching out to non-mainstream parents to support their children's mathematics learning, this study serves as a major resource on which others may build.

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Appendix A

Interview Protocol for Parents (English Version)

At the beginning of the interview, verbal consent to proceed with the interview and to audiotape will be sought. Co-investigator will remain sensitive to the participants' comfort and on occasions during the interview re-affirm that participants wish to continue.

Introduction and Brief Background about Parent

1) Could you briefly share a bit about yourself? (Education background, occupation etc)

Parental Perceptions about Mathematics

2) What are your own previous experiences in learning mathematics during your school days?

- Interesting, can you tell me more about that?
- How did that happened?
- Can you explain a bit more on that?
- In what ways do you apply mathematics in your daily life?

3) Why do you think your child should learn mathematics at school?

- Can you elaborate more on that?
- What are your views on the expectations of the school and your child in terms of mathematics education?
- What goals have you set for your child with regards to his/her mathematics learning?

4) In what ways do you think the mathematics your child learns in school relate to his/her daily life activities?

- Can you give any specific example(s) of daily activities that involve the application of mathematics?

Parent and teacher relationship in promoting children mathematics education

5) What are your perceptions about parental involvement in children's mathematics learning?

- In what way(s) (negative or positive) do you think parental involvement could have effect on children's mathematics learning?
- Will you like to give any specific example(s) or illustration?

6) How do you engage with the school or your child's class teacher in the mathematics education of your child?

- What do you know about your child's current mathematics curriculum used at school?
- Can you tell me more about that?
- Can you describe one memorable interaction you had with your child's class teacher about his/her mathematics progress?
- What makes it a memorable interaction?
- In what ways do you think such interaction with your child's teacher altered the kind of mathematical support you give to your child at home?

Parental support at Home

- 7) How do you usually support your child's mathematics education at home?
 - What mathematics activities (formal or informal) do you engage your child to support his/her mathematics learning?
 - How do you assist your child with his/her math homework?
- 8) Is there anything else that you'd like to add that you feel I might have forgotten to ask?
 - Comments, thoughts, questions?

Questions designed to encourage participants to expand on their answers or provide in-depth comments may also arise throughout the interview.

NB: Parents participating in the interviews will have provided written consent prior to the first interview.

Appendix B

Interview Protocol for Parents (Fante Version)

MPENSEMPENSEMU A WOAHYEHYE AMA AWOFO

Wɔ dɛm mpensempensemu yi n'ahyɛse no, wɔ hwɛɛ dɛ wɔdze anokasa a wobotum akye egu kasafir do edzi dwuma. Nhwehwɛmufo no begyina pintsinn ahwɛ dɛ dwumadzinyi no n'eyiedzi atotɔ yie na osi pi dɛ ɔbɔko do eyiyi nsɛm ano.

Nyi enyim na nsɛm kakra a ɔfa ɔwofo ho

1) Ana ibotum akā biribi kakra afa wo ho? (Dza ɔfa wo nwomasua ho, oedwuma a ho na dza ɔkekā ho)

Dza ɔwofo n'adwen ye no wɔ Nkontaabu ho

2) Woara ankasa wo suahun wɔ nkontaabu ho ber a ekɔ skuul no nye dɛn?

- Enyigyesɛm, ana ibotum akā bi akā mo ho?
- Na ɔbaa no dɛn?
- Ana ibotum akyerɛ mu kakra aka ho?
Kwan bɛn do na edze nkontaabu dzi dwuma wɔ wo daa abrabɔ mu?

3) Dɛn ntsi na edwen dɛ ɔwɔ dɛ wo ba sua nkontaabu wɔ skuul?

- Ana ibotum abaabaa iyi mu akɔ ekyir kakra?
- ɔadwenkyerɛ nye dɛn ber a oenyi da skuul na ɔabofra kwan wɔ nkontaabu nwomasua mu?
- Botae bɛn na edze esi hɔ ama ɔabofra sɛ yerekā no nkontaabu adzesua a?

4) Kwan bɛn do na edwen dɛ nkontaabu a ɔabofra sua wɔ skuul no ɔdze toto

ne daadaa dwumadzi ho?

- Ana ibotum ama mfatoho pɔtsɛɛ a ɔye daa dwumadzi a ɔkyerɛ dɛ nkontaa na wɔdze reyɛ?

Owofo na kyerekyeranyi nkitahodzi a oboa mbofra nkontaabu nwomasua ma obo n'enyim

5) Dε awofe dze hɔn ho bεhyε mbofra hɔn nkontaasua mu no ɔadwen yε wo dεn wɔ ho?

- Kwan bεn (dε ɔyε kankɔ anaa ekyirsan) do na ɔadwen yε wo dε awofe hɔn ahokekā benya nsunsuando wɔ mbofra no hɔn nkontaasua do?
- Epe dε ebεma mfatohe pɔtsēe bi anaa nhwεdo bi?

6) Isi dεn na edze skuul anaa ɔabofra ne kyerekyeranyi ba nkontaabu nwomasua a ɔabofra rusua mu?

- Ebeɔadze na inyim fa sesie nkontaa adzesua a ɔabofra dze dzi dwuma wɔ skuul ho?
- Ana ibotum aka ho asεm pii akyerε me?
- Ana ibotum akyerεkyerε nkaa nkitahodzi kor a enye ɔabofra ne kyerekyeranyi nyae wɔ no nkontaasua kankɔ ho?
- Ebeɔadze na ɔma ɔyε nkaa nkitahodzi?
- Wɔ akwan bεn do na edwen dε dεm nkitahodzi a enye ɔabofra ne kyerekyeranyi nyae no dze nkontaasua mboa abrεε wo wɔ dza edze ma abofra no wɔ fie?

Awofe hɔn mboa wɔ Fie

9) Mpeɔn pii no eyε dεn na eboa ɔabofra no nkontaa nwomasua wɔ fie?

- Nkontaa dwumadzi bεn (dε ɔyε skuul dze anaa fie dze) na edze ɔabofra fa mu ma oboa no ne nkontaasua?
- Eyε dεn na eboa ɔabofra no ne fie nkontaa dwumadzi?

10) Ana biribi wɔ hɔ a epe dε edze kā ho a ɔadwen yε wo dε mo werε efir dε mibisa a?

- Nsusu/nkasaho, adwenkyerε, nseɔmibisa?

Nsɛmbisa yi wɔhyehyɛ dɛ wɔdze rehoahoa esuafo no ama woetum akyerɛkyerɛ hɔn nyi ano no mu yie akɔ ekyir wɔ nsɛmbisa dwumadzi no ne nyinara mu.

NB: **Adwen ngyinado:** Nhwɛhwɛmufɔ no bɛgye awɔfo no hɔn ngyentomu krataa a woetsintsim ansɛana nsɛmbisa a odzi kan no akɔ do.

Appendix C

Interview Protocol for Students (English Version)

At the beginning of the interview, verbal consent to proceed with the interview and to audiotape will be sought. Co-investigator will remain sensitive to the participants' comfort and on occasions during the interview re-affirm that participants wish to continue.

Background of Children

- 1) Tell me a bit about yourself (your grade or class and your career goals)
- 2) What are your favourite subject(s) and why?
 - How will you describe your interest (like or dislike) in mathematics?
 - Can you tell me about that?

Children's Perceptions about Mathematics and Parental involvement

- 3) What activities do you do at home after school?
What games or activities do your parents (mother, father or guardian) have you play or perform after school?
 - What kind of games or activities do you play together with your parents (mother, father or guardian) or with friends at home after school?
 - How do you like/dislike those games or activities?
 - Describe your feelings when playing or performing such activities or games with your mother, father or guardian.
- 4) What lessons do you learn from such games or activities with your parents?
- 5) In what ways do your parents (mother, father or guardian) help in your education?
 - How do your parents (mother, father or guardian) support you in your mathematics learning?
 - How do your parents assist you when you are given mathematics homework?
- 6) What motivation do you get from your parents (mother, father or guardian) in your mathematics learning?
- 7) Is there anything else that you'd like to add that you feel I might have forgotten to ask?
 - Comments, thoughts, questions?

Questions designed to encourage participants to expand on their answers or provide in-depth comments may also arise throughout the interview.

NB: parent/guardian written consent for each child will be obtained prior to interviews. Verbal assent is in addition to the written consent.

Appendix D

Interview Protocol for Students (Fante Version)

MP&NS&MP&NS&MU A WOAHYEHY& AMA ESUAFO

Wɔ dɛm mpɛnsɛmpɛnsɛmu yi n'ahyɛsɛ no, wɔ hwɛɛ dɛ wɔdze anokasa a wobotum akye egu kasafir do edzi dwuma. Nhwɛhwɛmufo no begyina pintsinn ahwɛ dɛ dwumadzinyi no n'eyiedzi atoto yie na osi pi dɛ ɔbɔkɔ do eyiyi nsɛm ano.

Background of Children

Dza ɔfa Mbofra no ho

1) Ka wo ho asɛm kakra kyɛrɛ me. (wo tsipɛn anaa gyinapɛn nna botae a osi oenyi do)

2) Adzesua bɛn na oenyi gye ho na dɛn ntsi so na oenyi gye ho?

- Ibesi dɛn akyerɛ dɛ oenyi gye nkontaabu ho anaa oenyi nngye ho (dza epɛ na dza ikyir)?
- Ana ibotum aka ho asɛm akyerɛ me?

Mbofra Hɛn dwumdzi wɔ nkontaabu ho nye Awofɔ afamudze.

3) Eɛn dwuma na sɛ ifi skuul ba fie a idzi anaa eyɛ?

Eɛn agodzi anaa dwuma na wo awofɔ (maame, papa anaa ahwɛfo) nye wo dzi ber a ifi skuul aba fie?

- Agodzi anaa dwumadzi potsɛɛ bɛn na enye ɔawofɔ bɔ mu dzi ber a ifi skuul aba fie anaa sɛ wɔ pon skuul a eɛn agor anaa dwuma potsɛɛ na enye ɔanyɛnkofo bɔ mu dzi?
- Kwan bɛn do na oenyi gye dɛm agor anaa dwumadzi no ho anaa oenyi nngye dɛm agor anaa dwumadzi no ho?

- Kyerε atsenkā a inya ber a enye wo maame, wo papa anaa ɔahwεfo ridzi ago anaa dwumadzi bɔ mu.
- 4) Esuadze bɛn na sε enye ɔawofo dzi dɛm agor anaa dwumadzi no a inya fi mu?
- 5) Wɔ ebɛn kwan do na ɔawofo (maame, papa anaa ahwεfo) boa wo wɔ wo nwomasua mu?
- Kwan bɛn do na ɔawofo (maame, papa anaa ahwεfo) boa wo wɔ wo nkontaabu adzesua mu?
 - ɔawofo yε dɛn boa wo ber a ɔama wo fie nkontaabu dwumadzi?
- 6) Nkuranhyε bɛn na inya fi ɔawofo (maame, papa anaa ahwεfo) hɔ wɔ wo nkontaabu adzesua mu?
- 7) Ana biribi wɔ hɔ a epε dε edze kā ho a ɔadwen yε wo dε mo werε efir dε mibisa a?
- Nsusui/nkasaho, adwenkyerε, nsembisa?

Nsembisa yi wɔhyehyε dε wɔdze rehoahoa esuafo no ama woetum akyerεkyerε hɔn nyi ano no mu yie akɔ ekyir wɔ nsembisa dwumadzi no ne nyinara mu.

Adwen ngyinado: Nhwehwɛmufɔ no bεgye awofo/ahwεfo no hɔn ngyentomu krataa a woetsintsim afa abofra biara ho ansāana nsembisa no akɔ do. Dza wɔdze ano akā no so wɔdze bεkā ho anaa wɔ bεgye ato mu.

Appendix E

Interview Protocol for Teachers

At the beginning of the interview, verbal consent to proceed with the interview and to audiotape will be sought. Co-investigator will remain sensitive to the participants' comfort and on occasions during the interview re-affirm that participants wish to continue.

Introduction and Brief Background about Teacher

1) Could you briefly share a bit about your education/professional background?

Teachers' Perceptions about Mathematics and Parental involvement

2) In what ways do you think the mathematics you teach your primary four children is relevant to them?

- Can you tell me more about that?

3) What roles do your primary four children's parents play in educating their children?

- What are your expectations from parents with regards to their children's mathematics education?
- What role(s)/assistance do you think primary four students' parents with low formal education play in mathematics education of their children?
- Interesting, can you tell me more about that?

Teachers' Role in Involving Students' Parents in Mathematics Education

3) From your previous interactions and experiences with your students' parents what do you think parents expect from you or the school with regards to their children's mathematics education?

4) In what ways do you involve your students' parents in their children's mathematics education and more specifically, parents with low formal education?

- Can you tell me more about that?
- Can you describe any memorable move or effort you or your school made in communicating your students' mathematics curriculum and mathematics progress to their parents? Can you elaborate more on that?

5) What specific measures have you or your school put in place to ensure continuing parental support in mathematics education of their children?

6) Is there anything else that you'd like to add that you feel I might have forgotten to ask?

- Comments, thoughts, questions?

Questions designed to encourage participants to expand on their answers or provide in-depth comments may also arise throughout the interview.

NB: Teachers participating in the interviews will have provided written consent prior to the first interview.