Improving Kenyan Secondary School students' relationship with mathematics through self-regulated learning

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He has been my pillar, my hope, strength and joy throughout this process. Through his Grace, nothing in this study was too difficult to do and no deadlines too tight to meet.

It is God Almighty's doing: In a space of four years, I am taking home this, Doctor of Philosophy (PhD) in mathematics education: a Master's degree in Research-Sociology and policy planning; and postgraduate certificate in mathematics education.

But God works through people, I felt his presence through the unwavering support of: my spouse, Dalmas Menya and my three beautiful girls-Michelle, Gabrielle and Noelle; my parents, siblings and other family members; my church community; my Facebook fans, many of whom were my school friends in my early years of education; my newly found friends and colleagues from Sheffield Hallam University; my fellow commonwealth scholars; my supervisors, Prof Hilary Povey and Dr. Gill Adams-two ladies with hearts of gold and the best supervisors one could ever wish to have; and the noble participants, from the three schools where I carried out my field work.

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Indeed, Africa is now one step closer to actualizing the vision of shaping a citizenry with demonstrable zeal, passion and prowess in mathematics.

ABSTRACT

Through this study I explore the influence of self-regulated learning on Kenyan secondary school students' relationship with mathematics.

The study which involved form two students from three secondary schools in Kenya is guided by the following research questions: what are the contextual factors influencing Kenyan secondary school students' self-regulated learning of mathematics including any gender related differences?; how adequate is the core mathematics textbook in supporting self-regulated learning?; what is the relationship between students' self-regulation and their relationship with mathematics? and what are the unique features of a local model of self-regulated learning of mathematics?

Employing a critical realist philosophical paradigm and an ethnographic intervention approach, I used qualitative methods such as interviews, metaphoric drawings, and reflective writings to collect data on the nature and extent of students' self-regulation during a period of six months.

The study findings suggest that a reciprocal and bidirectional self-regulation of personal (cognitive and affective) attributes, behaviour and learning environment is involved, each being significantly shaped by external co-regulatory elements, and that there exists a positive relationship between self-regulated learning and students' relationship with mathematics. This relationship is depicted through a critical realist self-regulated learning model that is developed out of the study's findings.

Given the paucity of similar qualitative research within the African context, the findings extend the theoretical understanding of self-regulated learning, providing insight into the influence of contextual factors, including culture, post-colonial/neoliberal factors and students' social economic status, and into the nature of the interaction between co-regulation and self-regulation. Further, it extends the theoretical knowledge on the relationship between self-regulated learning and other related constructs such as students' epistemic beliefs and academic emotions towards mathematics.

Recommendations of policy implications for teaching, learning and assessing mathematics in Kenyan secondary schools and possible future areas of research are also provided.

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ACRONYMS AND ABBREVIATIONS

DQASO		District Quality Assurance Officer
iSRL		integrated Self-regulated learning
KCPE	-	Kenya Certificate of Primary Education
KCSE	-	Kenya Certificate of Secondary Education
KCT	-	Knowledge of Content and Teaching
KICD	-	Kenya Institute of Curriculum Development
KLB		Kenya Literature Bureau
PhD		Doctor of Philosophy
SES		Social Economic Status
SMASSE	-	Strengthening of Mathematics and Science in Secondary Education
SMT		Science, Mathematics, Technology
SRL		Self-Regulated Learning
STEM	-	Science, Technology, Engineering, and Mathematics

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CHAPTER ONE: INTRODUCTION.

Introduction

In 2006, I penned a poem in which I outlined my dream of an African Continent characterised by, amongst other things, healthy lives and strong economies. I articulated my belief that achieving the aforementioned dream would be predicated by Africa-led technological advance and innovation. Noting that the foundation of such technological advance would be increased prowess in mathematics and science, I dared the current generation to break away from the status quo and take their space in the global economic sphere with a clean conscience by crunching the numbers and embracing science.

The poem was informed by a long-term love for mathematics and sciences; observations and concern as a teacher of a sense of apathy by a majority of Kenyan students (in primary and secondary schools and university) towards mathematics; a conviction that the aforementioned poor perception towards mathematics and sciences could be reversed; and a determination and commitment to play an active role in contributing to efforts to transform aforesaid negative behaviour and perception amongst learners in Kenya.

In the eight years that followed, I dedicated a considerable part of my time to researching and shaping small-scale interventions whose focus was to transform Kenyan primary and secondary school learners' affective orientation towards mathematics. Some of the activities that I implemented in this period include: in-house after-school mathematics clubs; hosting MathScience festivals; giving motivational talks to students; hosting mathematics tournaments and publishing the first of its kind mathematics magazine in Kenya.

In 2014, the Commonwealth Scholarship Commission, in recognition of my passion and interest in the transformation of students' relationship with mathematics, offered me a scholarship to pursue this doctoral study. In essence, one could surmise that undertaking this study was an act of introspection: through the study, I sought to theoretically understand both my approach to learning mathematics and the processes and results that I had observed during the implementation of some of the abovementioned interventions. Further, the doctoral study was an opportunity to explore more deeply the processes of teaching and learning mathematics in Kenya with a view of understanding better the factors that contributed to the observed poor performance in, and perception of students towards, mathematics at secondary school education level.

Mathematics education in Kenya

As is the case with governments across the world (cf. Conway & Sloane 2005; Gardner et al. 1983), mathematics proficiency amongst primary and secondary school students is a key policy concern for the Government of Kenya (Government of the Republic of Kenya 2007). The Kenyan government through its current development blueprint titled *Kenya Vision 2030* recognises the critical role of mathematics alongside science and technology in steering the country towards global competitiveness. As a result, the country has set key science, mathematics, technology (SMT) national policy directions, including attaining international ranking in SMT and increasing and expanding enrolment of students in science and technology subjects in technical institutions and universities in the country (ibid). Attaining these policy goals has, however, remained elusive due to persistent underachievement in secondary school-level mathematics (Githua & Mwangi 2003; Njoka et al. 2013). An evaluation of the Kenya Certificate of Secondary Education (KCSE) examination results between 2014-2016 established that an overwhelming majority of the candidates continue to post poor results for mathematics and sciences. For example, more than half of the candidates who sat the 2016 examination scored grade E, the lowest one can achieve in any KCSE examination (Otieno 2017). The achievement levels have been reported to be worse for female candidates who continue to post much lower grades in SMT subjects compared to their male counterparts in the national examinations. Indeed, a 2011 Ministry of Education study, *A Report on Causes of Poor Performance in Mathematics and Science in KCSE Examinations in Kenya,* observed that while the gender gap seems to have stagnated overall in other science subjects and vary in other technical subjects, the gap in mathematics performance over the last decade was found to be widening (Njoka et al. 2013). Across the two genders the low achievement levels in mathematics by Kenyan secondary school students have been mostly attributed to a complex interplay between learner attributes such as their attitude towards mathematics (Githua & Mwangi 2003), teachers' attributes such as content knowledge (Khakasa & Berger 2016) and pedagogical practices (Sifuna &Kiame 2007).

Despite the recognition of the contribution of both learner and teacher attributes in the successful learning of mathematics in Kenyan secondary schools, an observation which resonates with existing frameworks, for example, the didactic triangle (Goodchild & Sriraman 2012; Schoenfeld 2012), it is significant to note that, so far, very few interventions that directly target students have been implemented in the country. Indeed, apart from few, distant and unsystematic interventions that have been implemented by mostly non-government organisations to try address the gender gap in mathematics achievement (Njoka et al. 2013) only one other key intervention directly targeting students has been implemented by the government: the introduction of an alternative curriculum for mathematics (assessed by the B KCSE examination) for learners whom the government deem may be of low mathematical ability level (Kosgei 2015). Notably, this intervention has not borne much fruit: very few students have opted for this option (ibid) and hardly any significant improvement in the performance at KCSE has been observed for the candidates registered in this option. Indeed, almost 99 percent of those who obtained less than grade C (average pass grade) in the 2016 KCSE examinations fell in the category of those who sat the alternative B KCSE mathematics exams (Otieno 2017).

The other key intervention that has been instituted by the government in the last decade is professional development of mathematics teachers, through a government-funded in-service teacher training programme called *Strengthening of Mathematics and Science in Secondary Education* (SMASSE). Originally adopted from Japan, the SMASSE programme, through its trainers, seeks to transform the teaching of mathematics and science in Kenya secondary schools to make it learner-centred. However, despite the training, evidence from extant research show that over 80% of the trained mathematics teachers still practise and identify more with teacher-centred pedagogical practices (Sifuna & Kiame 2007; Bett 2016).

The observed persistence by teachers in using teacher–centred pedagogies even after undergoing professional development training has been attributed to factors external (Sifuna & Kiame 2007; Bett 2016) and internal (Otieno 2018) to the teachers. More importantly, in considering this observed persistence and the outcomes of interventions targeting teachers that I have participated in, in the last decade, I was persuaded that banking on teacher reform as the single avenue for improving success in learning of mathematics in Kenyan secondary schools is problematic. Noting from my personal experience as student and later as a teacher/tutor in some of the country's secondary schools and universities, I was further persuaded that the poor performance by Kenyan secondary school students was not so much a matter of innate ability (thus poorer performance and interest in alternative B mathematics), but more about affective and attitudinal factors (cf. Githua & Mwangi 2003). Specifically, my research interest was shaped in part by my an incident (and subsequent actions) that occurred in my early years of primary school learning: My mathematics teacher out of a fit of frustration tore my mathematics exercise book into two and banned me from her class, declaring that I did not have the "capacity to do mathematics." It took the intervention of my parents especially my mother who was a teacher to get me to cognitively and affectively reconnect with mathematics as a subject after that unfortunate incident. In addition to transferring me from that school, my mother made particular effort to inculcate in me (through explicit training) a deep sense of responsibility towards my learning and less dependence on the teacher. As a result, I was persuaded that that there was a need to explore the extent to which empowering learners to be better at learning mathematics could improve their motivational patterns (Dweck 1986) towards mathematics.

The ultimate location of my implicit research interest within the scholarship of self-regulated learning was arrived at as a result of my exploration of literature at the initial stages of my PhD studies. Specifically, noting that the underachievement in secondary mathematics in Kenya has been found to be worst amongst students who learn under the most challenging situations (Glennerster et al. 2011; Kimsop, Otiso & Ye 2015), my research direction was foundationally influenced by two main assertions from mathematics education research literature: the contention that mathematics learning is context- and value-laden (Abram, Taylor & Jee Guo 2013); and the significant empirical evidence from a number of studies (cf. Paris & Paris 2001; Nunez et. al 2006) that suggest that shifting students to adopt self-regulated learning improves their: strategic efforts towards learning; skills for learning; and achievement (Nakata 2011) in unique learning environments. Added to this was also a sense of resonance with my own experience and approach to learning mathematics in my school years and the general conceptualisation of self-regulated learning as not only constituting strategic skills (cf. Zimmerman 2002) and effort but also to affective factors such as: students' self-efficacy (Schloemer & Brenan 2006; Butler & Winne 1995); and adaptive motivational patterns such as resilience and persistence (Paris & Paris 2001; Sungur & Tekkaya 2006; Leidinger & Perels 2012; McCasilin 2009).

General features of the Kenyan education system

Also important in refining this study’s objectives, research questions, choice of research participants and general approach to collection of data were some distinct features of the Kenyan education system which I now discuss.

Centralisation of the education system

Under the 8-4-4 system, students undergo eight years of primary school education, four years of secondary school education and four years of university education.
Despite shifting from a 7-4-2-3 system of education, which it inherited from its former colonial master, Britain, to the 8-4-4 system which ismodelled on the American system of education, Kenyan education system continues to be centralised under the national government (Wallbank 1938; Colclough & Webb 2012). The students sit two high-stakes national examinations, one at the end of the eighth year of primary school and another at the end of the fourth year of secondary school. One's performance in the Kenya Certificate of Primary Education (KCPE) examination may terminate one's educational journey or determine the type of secondary school that one is admitted to.

Kenyan public secondary schools are organised into a four-tier system, with the top tier being occupied by boarding schools that are generally better equipped in terms of infrastructure and admit the top performers in KCPE, a majority of whom are from private primary schools, therefore perennially produce the top scores in KCSE (Glennerster et al. 2011). On the other hand, the secondary schools in the lower tier, which are the majority, are less equipped in terms of physical infrastructure such as laboratories and libraries, are in many cases understaffed and are known to post poorer results in KCSE (Kimsop, Otiso & Ye 2015). A small proportion of the secondary schools are privately owned and run by individuals or church-affiliated institutions. Until very recently, the stakes linked to the KCSE examinations have been heightened by the fact that both public and private universities could only admit about 30% of those who achieved the pass mark for university admissions (Bagaka 2010) and less than 10% of these admissions were allocated to the most sought-after courses such as medicine, engineering and business-related disciplines.

Post-colonial and neoliberal influence

The Kenyan education system, as is the in many sub-Saharan countries, is strongly influenced by colonial and neoliberal ideologies (Shizha 2010). A key colonial legacy is the continued use of English as the key medium of instruction (learning and assessment right from primary school education (Spernes 2012)). Other colonial vestiges that characterise the Kenyan education system are: centralisation of the education system; implementation of a western-based schooling system characterised by book- and teacher-dominated learning; Eurocentric curriculum and pedagogical practices; and elitism (Shizha 2010; Colclough & Webb 2012). The continued implementation of a tiered public secondary school education system, with fewer schools at the top (most resourced tier) and the majority of the schools (and least resourced) at the lower tier, is another key colonial legacy of the Kenyan education system.

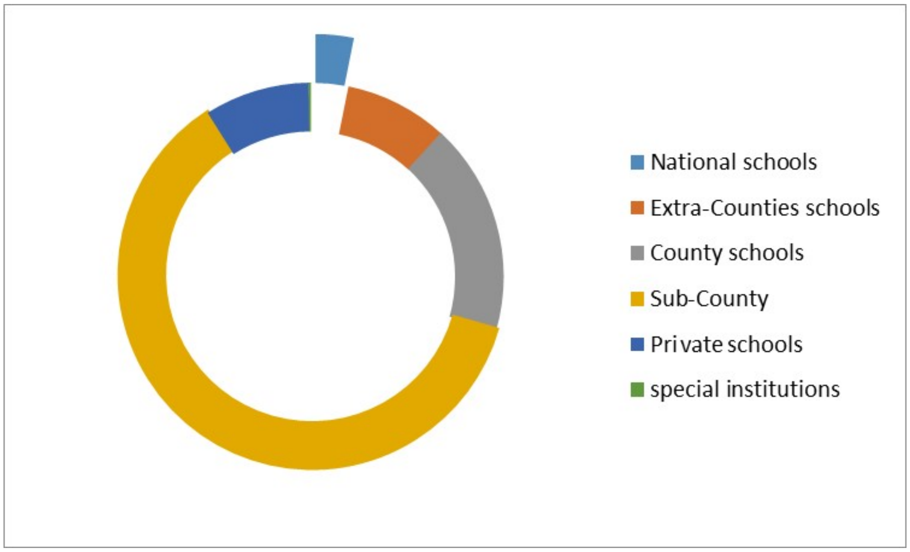


Figure 1. Pictorial Representation of Distribution of Secondary Schools' Admission of 2015 KCPE Candidates (Ouma 2016)

In step with the practices of many of the other colonised countries and former colonisers, Kenya continues to adopt neoliberal education practices. In particular, the education policies are increasingly being underpinned by neoliberal ideologies such as marketisation and making cost efficiency against achievement outcomes one of the key markers of quality education (Milligan 2011). The implied focus on outputs versus input has since entrenched examination results (and not contextualised understanding of the classroom process) as the primary measure of quality education at both primary school and secondary school levels.

In recent years, the push to teach for the examination may have been heightened by a new accountability process (Muhia 2015), entitled the Teachers Performance Appraisal system, being implemented by their national employer, the Teachers Service Commission. A key focus in this performance appraisal is the students' achievement in summative KCSE-like examination tests administered periodically by the school (Muhia 2015; Oduor 2015). Ultimately, the teachers' and head teachers' continued employment and promotion is largely pegged on the track record of their students' performance in these examinations (Oduor 2015). Informing the performance-based policy for appraising teachers are policies at the national level which also being anchored on the neoliberal education agenda (Shizha 2010) tend to promote education for the market as the key thrust of the Kenyan education system. Indeed, in its economic blueprint, the *Kenya Vision 2030*, secondary education is deemed key in the country's quest to shape a productive workforce (Kenya Government 2007). In particular, the country has earmarked improving the quality of teaching mathematics, sciences and technology at secondary school level as one of its key policy strategies for achieving its vision of being globally competitive by the year 2030 (ibid).

Curricular materials

Published textbooks are used as the main teaching and learning tools in Kenyan secondary schools. Students spend most of their time both in the classroom and out working on mathematical content from textbooks. As in other countries (Pepin & Haggerty 2001; Mesa et al. 2012; Li 2000), mathematics textbooks act as the key resource for making the national mathematics curriculum manifest to the students. Of all the mathematics textbooks available in the market from both national and international publishers, the one published by a state-owned publisher, the Kenya Literature Bureau (KLB), is recognised as the core mathematics textbook for secondary schools. The KLB textbooks are published for each year of learning and are generally considered the de-facto curriculum for secondary school mathematics. The KLB student textbook for each class or form is accompanied by a teacher guide which, apart from offering suitable answers for the exercises at the end of each topic, also offers guidance on structuring mathematics lessons and proposes the pedagogical practice to be adopted by the teachers. In essence, the KLB is considered a government-approved blue-print for content coverage and instructional sequence for teaching and learning of mathematics. In effect, with the teacher guide it comes close to representing both the intended and implemented mathematics curriculum in Kenyan secondary schools.

That said, many secondary schools also purchase other mathematics textbooks as an additional resource and tools for teaching and learning. The purchase and use of these complementary textbooks, however, varies across the schools: public schools in the higher tier and the private ones, due to their "purchase" power, have more money to purchase different publications while those in the lower tier, depending on limited government resources, in most cases have to solely rely on the KLB mathematics textbook.

Gaps in knowledge about self-regulated learning

Alongside the considerations discussed in the foregoing section, this study's main and specific objectives were also shaped somewhat by my consideration of the following gaps in knowledge about self-regulated learning: the concentration of the current studies in self-regulated learning scholarship in Western countries and paucity of similar research in the African context; the limited understanding of the nature of the influence of instructional and social contexts and other aspects related to naturalistic contexts of learning on self-regulated learning (Perry 2002; Patrick & Middleton 2002); the reliance by most of the self-regulated learning researchers on survey methods; the limited understanding on how self-regulation and co-regulation cross-fertilise each other in real life collaborative learning situations to create adaptive learning and development (Volet, Vauras & Salonen 2009); the paucity of short-term, one-off classroom-based mathematics education interventions in mathematics education research (Stylianides & Stylianides 2013); and in African countries such as Kenya the lack of classroom-based mathematics education research in general and the consequent limited theoretical understanding of classroom phenomena and related processes (Njoka et al. 2013).

Purpose and specific objectives of the study

In sum, the considerations of: the results of teacher-centred interventions in improving learning in Kenyan secondary schools; personal experience as a student and teacher/tutor in Kenyan learning institutions at various levels; empirical and theoretical evidence on the relationship between self-regulated learning and students' affective and cognitive engagement with learning; the considered gaps in current knowledge on self-regulated learning; and key features of the Kenyan education system, as discussed in the foregoing section, informed my arrival at the main purpose and objectives of the study.

Purpose of the study

The main purpose of this study was to explore the influence of self-regulation during learning of mathematics in Kenyan secondary schools on the students' relationship with mathematics.

Specific objectives

To facilitate my achieving, the above mentioned purpose of the study I set out the following specific objectives:

- To explore the extent to which the students' level of success at self-regulation during learning of mathematics was influenced by contextual factors within the students' learning environments;
- To explore whether there are gender differences in the students' self-regulation;
- To explore the students' perception on the adequacy of the core mathematics textbook in supporting self-regulated learning of mathematics;
- To explore the nature of interactions between self-regulation and other related constructs such as co-regulation;
- To shape a local model of self-regulated learning of mathematics by Kenyan secondary school students.

The literature review during the first six months of study contributed to the identification of self-regulated learning as the construct that I was keen to explore. The decision to limit my exploration to the interaction of the construct (SRL) with students' relationship with mathematics and not achievement was in part informed by concerns that the duration of the field work was not adequate to track possible 'impact' on students' achievement. The identification of additional focus areas such as gender and textbooks was informed by my general knowledge of the Kenyan education system and the awareness of a persistent gender differences in KCSE mathematics achievement and role of textbooks in mathematics education in Kenya. Seeking to shape a local model of self-regulated learning of mathematics was informed by the observation (in the early stages of the study) that most of the extant SRL models were shaped from studies done in the West.

Research questions

To operationalise the specific objectives outlined above, I set out the following as my key research questions:

- What are the contextual factors that influence self-regulated learning of mathematics?
- What gender differences are there, if any, in Kenyan secondary school students' practice of self-regulated learning?
- How adequate is the core mathematics textbook in supporting self-regulated learning by Kenyan secondary school students?
- What is the relationship between self-regulated learning and students' relationship with mathematics?
- What are the key components of a local model of self-regulated learning of mathematics in Kenyan secondary schools?

Outline of thesis

In this chapter I have

- Outlined the development of my interest in the implementation a student-centered intervention research, particularly focusing on self-regulated learning and students' relationship with mathematics;
- Provided background information on teaching and learning of mathematics in the Kenyan secondary schools;
- Outlined my study objectives and the key research questions that guided the study.

The remaining chapters are organised into four main parts.

Part one: Background to the intervention

Part one consists of Chapter two: Theoretical framework for self-regulated learning in which I discuss the theoretical framework for the study and chapter three where I explore the literature on self-regulated learning.

Part two: Philosophy, methodology and field work

Chapter four: Research philosophy and methodological approach provides an overview of the philosophical underpinnings and the methodological approach for the study. This is followed in Chapter five: Field work and ethics approval in which I briefly discuss the key features of the three schools which were the main sites of the study and offer an overview of the processes followed for field entry and ethics approval for the study. A discussion on the key features of the ethnographic dimension of the study is then presented in Chapter six: Working ethnographically. The discussions in Part three are concluded by a synthesis of the implemented interventions and the data collection methods for the study in Chapter seven: Deliberative dialogues and the key interventions implemented, and Chapter eight: Other interventions and data collection, respectively.

Part three: Analysis and discussion of field data

Chapter nine: Overall approach to and process of data analysis, provides a brief overview of the overall approach and process of data analysis. Chapters ten to thirteen focus on study findings. In Chapter ten: Contextual factors influencing self-regulated learning, the contextual factors that were found to influence the students' self-regulation are presented. This is followed in Chapter eleven: Mathematics textbooks and self-regulated learning, which details the findings on the students' perception on the adequacy of the core mathematics textbooks on factors influencing self-regulated learning. An exploration based on the study's findings on the interaction between self-regulated learning and students' relationship with mathematics follows in Chapter twelve: Self-regulated learning and students' relationship with mathematics. This part of the thesis concludes with Chapter thirteen: Structural factors influencing self-regulated learning, in which I present a discussion on the structural factors that were found to generate the influence of the aforementioned contextual factors on the students' self-regulation.

Part four: Conclusion

Chapter fourteen: Summary, conclusions and recommendations, provides a succinct discussion of the overall findings of the study. It also includes: discussion on the implications of these findings for policy and practice in the Kenyan education system; further contributions of the study to knowledge; and an outline of the study's limitations and recommendations for future research.

Summary

In this chapter I have provided background information on the context within which my study is located. In addition, I have clarified the focus of my study by stating both my overall research objective and the specific objectives. I have also presented the research questions that acted as a framework for the carrying out the study. Also included in this chapter is a discussion on the value of this study, that is, its potential to improve the quality of learning of mathematics in Kenyan secondary schools and theoretical understanding of self-regulated learning of mathematics.

CHAPTER TWO: THEORETICAL FRAMEWORK FOR SELF-REGULATED LEARNING

Introduction

In this chapter, I discuss the various theoretical conceptualisations of self-regulated learning and provide the basis for adopting particular models in this research.

Defining self-regulated learning

Self-regulated learning is a construct that describes the regulation of one's cognitive process in an education setting (Pulkkinen & Puustinen 2001). According to Perry (2002), students' self-regulation during learning entails independent metacognitively ledstrategic action fuelled by the students' intrinsic motivation. In a similar vein some self-regulated learning theorists (Nunez et al. 2006; Paris & Paris 2001) put an emphasis on the active involvement of the students in setting learning goals and their seeking to achieve them by monitoring, regulating and controlling their cognition, motivation and general learning behaviour. In other words, the implied active engagement of the student during self-regulated learning is taken to involve a fusion of skill and will: it represents a determination of the students to improve and increase their academic achievement by 'systematically applying a learning method' (Nunez et al. 2006 p. 140).

Accordingly, self-regulated learning is widely considered as an individual characteristic involving a cyclic adaptation of thoughts, feelings and actions in attainment of personal goals (Beishuizen 2008; Boekaerts & Cascallar 2006). Further, its strategic and regulating aspects are taken to be dynamic and intrinsically driven and to be spurred on by enthusiasm, persistence and curiosity (Iran-Nejad 1990). As a result, a number of self-regulated learning researchers consider it to consist of 'hot' (motivational and affective) and 'cold' (cognitive and metacognitive) components (Patrick & Middleton 2002).

In considering aspects of students' regulation during collaborative learning activities, some researchers have since reconsidered the emphasis on the individual, when exploring students' regulation during learning. Calling for attention to 'external coregulatory elements in the self-regulation' (Volet, Vaurus & Salonen 2009, p. 217), these researchers (Rogat & Adams-Wiggins 2014; Hadwin & Oshige 2011; McCaslin & Burross 2011;) contend that students' regulation during learning should be considered more as an act of socially shared regulation / social regulation or co-regulation. For example, Hadwin and Oshige (2011) profess that co-regulation plays an important part in students' practice of self-regulated learning. They opine that co-regulation is 'a transitional process in a learner's acquisition of self-regulated learning, within which learners and others share a common problem-solving plane, and self-regulated learning is gradually appropriated by the individual learner through interactions' (p. 247).

Notably, both groups, those who identify with the individual or with socially shared characteristics of self-regulated learning, consider it to be made up of three main components: goal setting, monitoring of the learning process and modification of learning strategies (Schloemer & Brenan 2006). These elements are directly linked to what extant literature outlines as the key main stages of self-regulated learning: the preparatory or preliminary phase; task completion phase and appraisal or adaptation phase (Pulkkinen & Puustinen 2001). That said, the overall process of self-regulated learning is generally considered to be dynamic and recursive. The dynamism of the process has been considered variously by different researchers resulting in different models of self-regulated learning (Pulkkinen & Puustinen 2001).

Review of self-regulated learning models

In their review of the existing self-regulated learning models, Pulkkinen and Puustinen (2001) arrived at five main self-regulated learning models which they labelled by their authors' names: Boekaert's self-regulated learning model, Zimmerman's self-regulated learning model, Pintrich's model, Borkowski's self-regulated learning model and Winne's self-regulated learning model. They noted that the first three models mentioned above defined self-regulated learning as a goal-oriented process thereby emphasising the constructive or self-generated nature of self-regulated learning and the last two define self-regulated learning as a metacognitively governed process, thus putting a greater emphasis on strategy and the role of feedback on self-regulated learning.

Further, they noted that all the models underscore the role of cognitive, motivational and social factors in the self-regulated learning process but consider them in different ways and in different degrees. The variation was found to a good extent to be linked to the theoretical foundations of the four self-regulated learning models; Zimmerman and Pintrich's self-regulated learning models were found to be based on a socio-cognitive theory of learning, Boekaert's model was found to be mostly influenced by action control theory and transactional stress theory, Borkowski's model seemed to rely on information processing theory and the metacognitive research tradition and Winne's model, was found to have a more heterogeneous theoretical background having been influenced by the socio-cognitive theory, action control theory, information processing theory and metacognition research tradition.

Prior to my field work, I proposed to use Winne's self-regulated learning theoretical model as the theoretical framework to guide the shaping of the interventions and make meaning of data collected. My persuasion then was that the heterogeneous nature, in terms of theoretical underpinning of Winne's model (Pulkkinen & Puustinen 2001), provided a broad enough basis to consider interventions that blended both individual and social aspect of self-regulated learning. Furthermore, I found the model's emphasis on the role of metacognitive monitoring and feedback during self-regulated learning important given the significant role that has been attributed to metacognition in learning of mathematics (Schoenfeld 1992).

However, further considerations during the field work led me to abandon Winne's model as a key theoretical framework for making meaning of the evolution of the interventions and data collected during the field work. In particular, I found the emphasis on process, sequential and temporal characteristics of self-regulated learning of Winne's model out of step with my research focus and emerging emphasis during the field work. Specifically, I discovered during field work that my interest in exploring and fostering self-regulated learning of mathematics within the natural context of the students' learning of mathematics in the three schools, called for a broad exploration of self-regulated learning of mathematics as a subject instead of in relation to explicit mathematics tasks. As a result, my focus centred on how self-regulated learning of mathematics as a subject was influenced by broad contextual layers, including class interactions, types of school, "type" of home and even broader aspects related to government policies and post-colonial influences.

My observations and other data collected during the field work pointed me to the fact that a suitable self-regulated learning framework for my study would be one that is cognizant of the environment context, individual differences and features within the macro context of mathematics learning (Ben-Eliyahu & Bernacki 2015). With these considerations in mind, I embarked on further exploration of self-regulated learning literature after my field work and arrived at a shaping theoretical framework for making sense of the field work data by adopting two of the extant self-regulated learning models: The Zimmerman model and the integrated model (i-self-regulated learning).

The Zimmerman (1989) model of self-regulated learning is informed by Bandura's (2001) socio-cognitive model of learning. This model is predicated on an assumption that self-regulation is subject to a triadic reciprocal influence of three distinct processes: personal, environmental and behavioural. Accordingly, it presupposes that self-regulated learning is determined by personal processes (affective and cognitive), which are always under a reciprocal influence from both environmental and behavioural events. The suggested reciprocal influence is taken to vary in strength and direction in different learning contexts (Zimmerman 1989).

Notably, in its formulation and application, Zimmerman's triadic model of self-regulated learning is largely taken to account only for contextual factors related to the students' immediate learning environment (Zimmerman 2013; Puustinen & Pulkkinen 2001). It is this restriction that led me to consider using a second self-regulated learning model – the integrated Self-regulated learning (iSRL) model (Ben-Eliyahu & Bernacki 2015) to make sense of the superordinate contextual factors (home, government policies, postcolonial factors) that seemed to have a significant influence on the self- regulated learning of mathematics by Kenyan secondary school students. In the succeeding section, I provide a more in-depth exploration of the key features of the two self-regulated learning models and insight on how I used them in a complementary manner to make sense of data collected during my fieldwork.

Zimmerman’s socio-cognitive model of self-regulated learning

This model is anchored on four main social cognitive assumptions. The first assumption is that self-regulated functioning, as any human functioning, is influenced in reciprocal fashion by personal, behavioural and environmental determinants (Zimmerman 1989; Zimmerman 2013). The triadic reciprocity suggested in this assumption is taken to be bidirectional and to vary in strength given its sensitivity to variations in context and one’s personal experience of the said exercise - in our case learning. Accordingly, the strength, direction and mutual interconnection among the personal, behavioural and environmental influences of self-regulation are taken to be subject to: one’s personal efforts to self-regulate; the outcomes of one’s behavioural performance; and changes in the environmental context within which one is functioning. Based on these assumptions on the triadic reciprocity of human functioning, self-regulated learning is taken to be influenced by students’ success at using personal processes to ‘strategically regulate behaviour and the immediate learning environment’ (Zimmerman 1989, p. 330).

The second key socio-cognitive theory assumption on self-regulation that influenced Zimmerman’s model is the assumption that self-regulated learning is affected by one’s perception of one's self-efficacy. Specifically, they contend that there exists a reciprocal positive relationship between the students’ perceptions of self-efficacy and their behavioural performance during learning. This perceived relationship is predicated on observations from empirical evidence which suggest that there is an inherent feedback loop between self and behaviour during self-regulated functioning. The resulting perception of one's self-efficacy based on this feedback is also considered by socio-cognitive theorists to affect one's ability at manipulating and choosing appropriate learning environments. It is this considered influence of self-efficacy on both behavioural and environmental aspects of self-regulation that gives it a critical place in Zimmerman’s self-regulated learning model.

The third assumption by social cognitive learning theorists that was critical in shaping Zimmerman's self-regulated learning model is the assumption that self-regulation involves three main sub-processes: 'self-observation, self-judgment and self-reaction' (Zimmerman 1989, p. 331). The three sub-processes are taken to interact in a reciprocal fashion. In a learning context, self-observation is taken to involve systematic monitoring of one's learning performance to amongst other things provide information on how one is progressing towards one's learning goals. As part of the behavioural process during self-regulated learning, self - observation findings from research suggest that self-observation is influenced by a student's personal processes like self-efficacy, goal setting and metacognitive planning. Also dependant on the aforementioned personal processes is self-judgment, which is a self-evaluation processes involving comparison (systematically) of a learning process based on a given standard or goal. In a learning context, self-judgment is generally taken to trigger self-reaction to the perceived level of success at performance. Also known to be affected by personal process such as self-efficacy, goal setting and metacognitive planning self- reaction may present itself in the form of a sense of self-satisfaction with one's performance and or making of adaptive or defensive inferences from the performance.

The fourth and final assumption from social cognitive theory that informed Zimmerman's model is that of the effect of social and enactive experience on human functioning. Specifically, in the formulation of his model, Zimmerman reports to have paid particular attention to the assumptions that enactive experience (informed by observing one's own learning and enactive outcomes) shapes a learner's perception of self-efficacy and improves their retention of knowledge. Similarly, he considered assertions by socio-cognitive theorists that social experience during self-regulated learning such as: modelling; verbal persuasion; social support from more knowledgeable others; and symbolic forms of knowledge like diagrams and structuring of social learning environment from which the learning occurs have significant impact on the students' 'cognitive, affective and academic skills' (Zimmerman 1989, p. 335).

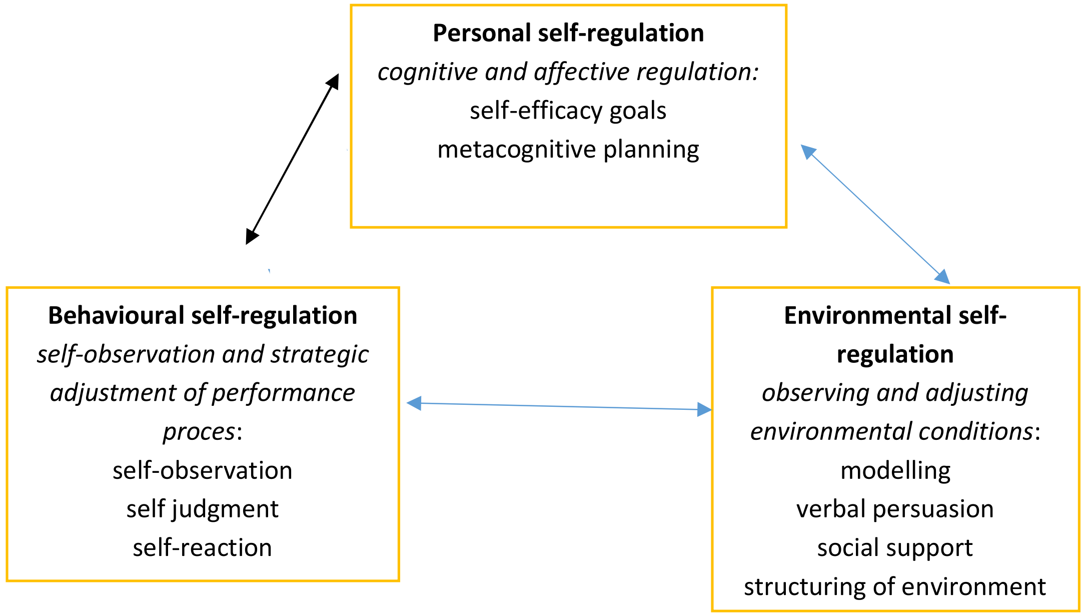


Figure 2. Zimmerman triadic model of self-regulated learning

This original version of Zimmerman's self-regulated learning model is different from his more recent model for self-regulated learning, which is widely referred to as the cyclic model of self-regulated learning (Zimmerman 2000). Through the cyclic model, Zimmerman depicts how self-regulated learning unfolds in discrete learning tasks. He provides a sequential account of self-regulated learning and addresses the causal and dynamic relations of the individual self-regulated learning process and accompanying motivational beliefs. Accordingly, he categorises the self-regulatory phases during self-regulated learning into three distinct phases; forethought, performance and self-reflection (Pulkkinen & Puustinen 2001). To some extent I found the cyclic model useful in theorizing my set of data on the students' responses on interview questions touching on aspects of the adequacy of the core mathematics textbook in fostering self-regulated learning. This is because in responding to these questions the students seemed to focus and/or share their reflections on their experiences during their engagement with specific mathematics learning tasks. For the other sets of data linked to the other research questions touching on influence of context and demographic variables such as gender on the self-regulated learning of the students, I found the original triadic model of self-regulated learning by Zimmerman (Zimmerman 1989) more useful because it provides a framework for exploring and making sense of the influence of the immediate learning environments on self-regulated learning (Zimmerman & Martinez-Pons 1990; Wolters & Pintrich 1998).

The difference noted above notwithstanding, the two Zimmerman models (triadic and cyclic) models are largely similar in that they restrict themselves to the immediate learning contexts and do not take into account distal contextual factors affecting self-regulated learning as was observed with the self-regulated learning of mathematics by the Kenyan secondary students.

I now turn to discussing the integrated self-regulated learning (iSRL) (Ben-Eliyahu & Bernacki 2015), which I used alongside the Zimmerman models, to make meaning of the superordinate contextual factors influencing the students' self-regulation.

Integrated self-regulated learning framework

Having roots in social and clinical sciences the integrated self-regulated learning (iSRL) was conceived to situate discussions of self-regulated learning within a broader life context (beyond the immediate learning context) of an individual (Ben-Eliyahu & Bernacki 2015). Specifically, it allows for consideration of how superordinate contextual factors like home environment, types of neighbourhoods, government policies and political structures influence self-regulated learning. As such, it presents a view of self-regulated learning occurring in a hierarchically nested context which can be best understood through an ecological perspective: according to this framework, self-regulated learning is taken to be a finite and depletable construct which extends beyond the immediate learning task and context. The conceptualisation of self-regulated learning as depletable and finite is in part informed by the understanding that cognition is a limited capacity and that implicit self-regulated learning requires less cognitive load compared to explicit self-regulated learning (Ben-Eliyahu & Bernacki 2015).

Notably, the iSRL framework takes into account the fact that, at any one given time, a learner's attempt at self-regulation may be hampered by competing cognitive processes that may also be vying for their attention. In other words, it conceptualises self-regulated learning as not being independent of the co-occurring non-learning-related regulatory processes. As depicted in the diagram below, the iSRL allows for consideration of how an ecology of factors (self, school, neighbourhood, educational policies) that hold influence of a learner's lives uniquely interact to influence their attempt at self-regulated learning.

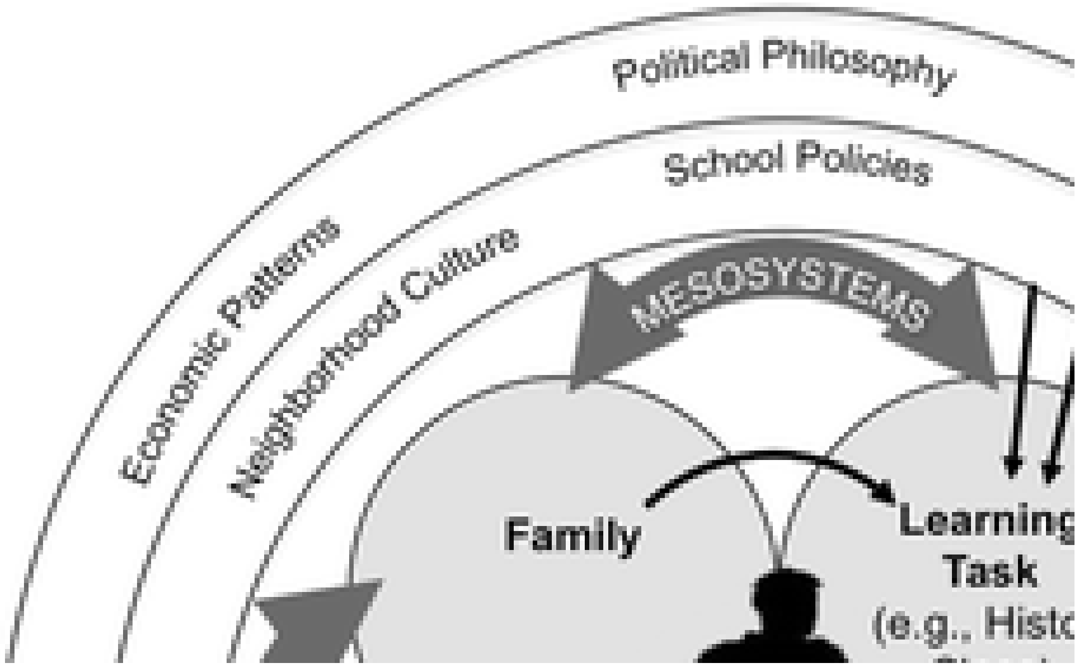
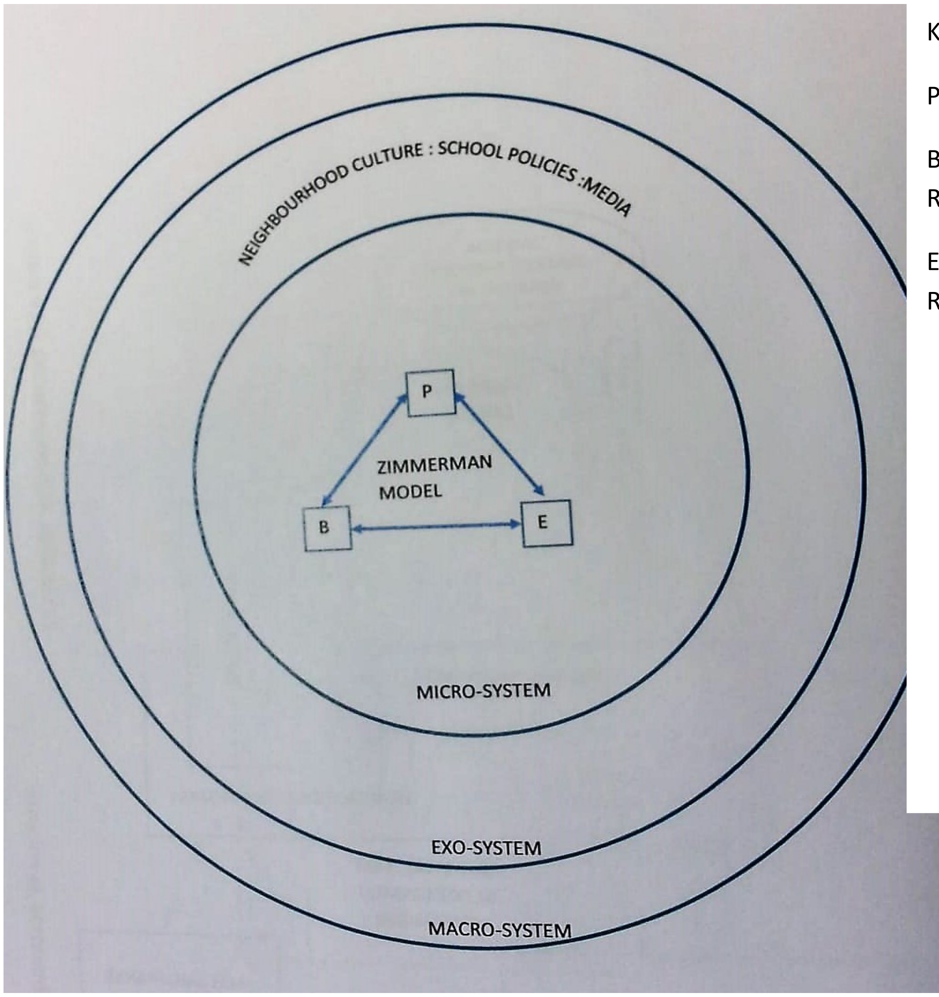


Figure 3. An illustrative depiction of the integrated Self-regulated learning (iSRL model, reproduced from Ben-Eliyahu & Bernacki 2015, p.7).

My consideration to use the iSRL alongside Zimmerman's triadic model of self-regulated learning was informed by pointers from my field data that distal factors like the neighbourhoods within which the students lived, Kenyan education policies and family characteristics influenced the Kenyan students' self-regulated learning of mathematics. In addition, employing an integrative perspective to self-regulated learning provided me with an opportunity to explore the interaction between co-regulation and self-regulation during peer-led mathematics learning activities during my field work.

Put differently, using the two models concurrently (see diagram below) provided me with some sort of a hybrid model, thereby overriding some of the presumed weaknesses of both socio-cognitive and social-cultural models of self-regulated learning. In other words, I sought to explore: how the mutuality (Volet, Vaurus & Salonen 2009) of the individual students and the collective (class/peer groups/schools/neighbourhoods) influenced the students' self-regulated learning of mathematics and what individual attributes affected the students' self-regulation at the micro level.



KEY

P – Personal Self-Regulation

B – Behavioral Self-Regulation

E – Environmental Self-Regulation

Figure 4 : Hybrid (Zimmerman 1989 & i-SRL (2015)) model of self-regulated learning

Summary

In this chapter, I have provided an overview of different models of self-regulated learning and explained which of the models I found most useful in making sense of the data from my field work. Specifically, I have underscored in my discussions that my interest in exploring self-regulated learning of mathematics within broader contexts extending beyond classrooms demanded that I employ an integrative perspective (self and co-regulation) of the influences of the students' self-regulated learning of mathematics. The adopted hybrid model was useful not only in allowing for the exploration of broader contexts beyond the classroom on the students' self-regulated learning, it also provided a framework for exploring the interaction between the self and the social in specific contexts of learning mathematics like classroom or peer learning sessions.

Consequently, the discussions in this chapter, and particularly on the adopted self-regulated learning signal the findings of this study will make a contribution to filling the current knowledge gap in understanding the process of cross-fertilisation of co-regulation and self-regulation during self-regulated learning (Volet, Vaurus & Salonen 2009). In the next chapter, I present a literature review of some of the contextual factors that have been found to have some impact on students' practice of self-regulated learning.

CHAPTER THREE: FACTORS AFFECTING SELF-REGULATED LEARNING

Introduction

The discussion from the previous chapter on different self-regulated learning theories points to the primacy of social interaction (as facilitator of modelling and or appropriation) in students' regulation of their engagement and participation in learning activities. Accordingly, self-regulated learning is taken (differentially across the perspectives) to be social in nature and to be considerably influenced not just by the social learning environments within which specific learning occurs but also individuals' socio-historical and current process, artifacts and other environmental aspects (Volet, Vauras & Salonen 2009; McCaslin & Burross 2011). Based on this understanding, I will in this chapter explore literature on interaction of self-regulated learning of mathematics using the subheadings below. Most of the subheadings were generated from the initial themes that emerged from the data analysis after my completion of the field work.

- ✓ Teacher-student relationships
- ✓ School instructional and assessment practices
- ✓ Family relationships and backgrounds
- ✓ Peer relationships
- ✓ Mathematics textbooks
- ✓ Gender
- ✓ Culture
- ✓ Religion
- ✓ Socio-economic status and self-regulated learning
- ✓ Training
- ✓ Students' relationship with mathematics.

Teacher-student relationships

Both teacher support (Ryan & Patrick 2001) and instructional practices (Ryan, Pintrich & Midgley 2001) employed by a teacher have been found to have a significant impact on the level of self-regulated learning by students. According to Ryan and Patrick (2001), a supportive teacher may be taken as one who makes effort at providing both emotional and academic support for their students. Having a supportive teacher has been found to facilitate students' self-regulated learning in a number of ways.

Firstly, supportive relationships with teachers have been found to engender a sense of interest and enjoyment towards learning tasks associated with the teacher and the student's academic self-concept. These attributes are known to enhance students' achievement motivation, which is one of the personal attributes that has been linked to enhanced levels of self-regulated learning (Zimmerman 1989; McCaslin 2009; Volet, Vauras & Salonen 2009). In particular, supportive teacher relationships have been found to have a stronger effect on the motivational beliefs on adolescent students than younger students.

Secondly, a supportive relationship has also been found to increase students', especially adolescent students' (Ryan & Patrick 2001; Wentzel 1998), propensity to ask for help during learning sessions. Help seeking is considered a key self-regulated learning strategy, which is positively linked to students' self -monitoring, self- evaluation and self-reaction (Zimmerman 2000). Generally, supportive relationships with teachers have been found to reduce students' sense of anxiety towards task engagement particularly because it engenders a sense of confidence that help is available whenever needed (Ryan & Patrick 2001). Related studies (Ryan, Pintrich & Midgley 2001) have also presented findings pointing to a negative relationship between teacher's concern about social-emotional nurturing of their students and help avoidance by the students. The relationship was particularly significant for low achieving adolescent students who generally have been found to have low self-efficacy.

Thirdly, teachers' supportive relationship has also been found to be important in enhancing the students' social development and social competence. Both attributes are considered important in shaping the quality of individual students' relationships with peers. An in-depth exploration of literature on the influence of peer-relationships on students' self-regulation during learning is presented later in this chapter. Staying with school and classroom practices, I now present a literature review on influence of the school's instructional and assessment practices on self-regulated learning.

School instructional and assessment practices

Both the socio-cognitive and social cultural-inclined self-regulated learning theorists agree that the learning environment provides affordances and constraints for the practice of self-regulated learning by students (Zimmerman 1989; Volet, Vauras & Salonen 2009). In addition to the interactions and nature of relationships within classrooms, empirical evidence from extant research on learning suggests that the instructional and assessment practices that are promoted in a school interact with each other and play a significant role in influencing the students' practice of self-regulated learning (Nicol & Macfarlene-Dick 2006). Specifically, the prevalent instructional and assessment practices have been found to have an impact on students' use of self-regulatory strategies like help seeking, goal setting, monitoring and self-evaluation due to their influence on the students' sense of social and academic efficacy, motivation; and goal orientations towards learning.

According to existing evidence from research (Zimmerman 1989; Nietzel & Davis 2011), the students' self-efficacy and motivation to learn have generally been found to be enhanced in schools where collaborative and or student-centred instructional practices are promoted and supported. In particular, the students' self-efficacy and use of self-regulated learning strategies like help-seeking, strategic planning and self-monitoring during mathematics lessons have been found to be supported in school environments where teachers are encouraged to shape classroom environments to allow for: students' interaction, exchange and discussion of ideas during mathematics problem solving activities in the classroom; asking of questions; inculcation of mutual trust and respect amongst class members; and expression by teachers of emotional responses and value for questions (Ryan & Patrick 2001; Zimmerman 1994; Ryan, Pintrich & Midgley 2001).

Concomitantly, the type of assessment adopted and or promoted by a school and the nature of feedback given to students after assessment have been found to have an impact on the students' self-efficacy and motivation towards learning. Types of assessment may fall within two different categories: formative and summative assessments. One key attribute that differentiates the two sets of assessments is the goal of assessments: formative assessments are largely taken to be concerned with promoting learning while summative assessments are largely geared towards establishing progress of learning in relation to some publically given criteria. To achieve their respective goals formative assessments are usually accompanied by high quality feedback mostly descriptive in nature. Conversely, summative assessments tend to give evaluative feedback in the form of grades or rubric scores (Harlen & Crick 2003). A difference has been observed in the influence of the two types of assessments on the students' self-regulation. This difference is mostly attributed to the corresponding difference in the nature of feedback associated with the type of assessment (Neitzel & Davis 2011).

Specifically, summative and formative assessment practices have been found to have a different impact on students' self-efficacy and motivation for learning and therefore practice of self-regulated learning. Findings from the systematic review by Harlen and Crick (2003) of research on the impact of testing on students' motivation for learning suggested that the negative impact of summative assessments in form of tests on students' self-efficacy and motivation for learning was graver for low achieving students. Some of the findings from the studies reviewed suggested that feedback from summative tests contributed to demotivation and loss of confidence amongst weaker students since they indirectly taught the students that they lacked ability. As a result of the reduced intrinsic motivation such students have been found to favour surface learning approaches over deep learning approaches that are identified with self-regulatory learning practices like strategic planning self-monitoring and self-evaluation (Harlen & Crick 2003; Ryan, Pintrich & Midgley 2001; Nicol & Macfarlane-Dick 2006).

Neitzel and Davis (2011) also contend that the descriptive feedback associated with formative assessment is more in line with the tenets of self-regulated learning such as self-evaluation through the identifying of gaps as pointed to in the feedback and considering what strategic action may be appropriate to fill the identified gaps.

In a similar vein, other research findings (Harlen & Crick 2003; Harlen & James 1997; Nicol & Macfarlane-Dick 2006) suggest that the interaction between instructional and assessment practices promoted in a school may influence students’ practice of self-regulated learning through its influence on students’ goal orientations. Specifically, teachers in schools where summative high-stakes examinations are promoted as the traditional culture of assessment have been found to promote a performance goal orientation instead of a mastery (learning) goal orientation. That is, because of the frequent high-stakes nature of summative examinations for both students and teachers, the focus of teaching and learning tend to be narrowed down to examination content and training of students to pass examinations. Furthermore, the measure of learning and progress tend to shift from progress made towards achieving specific learning standards to the level of performance in comparison with peers. Such an orientation has been found to have a negative impact on the self-efficacy and motivation for learning of students, especially low achieving adolescent students. As a result, these students have been found not to favour self-regulated learning strategies like goal setting, help seeking, self-monitoring and self-evaluation.

Formative assessment unlike summative assessment was found to have a more positive impact on students’ self-efficacy and motivation for learning: students in schools which promote formative tests as their core form of assessments have been found to manifest a higher sense of self-efficacy, motivation for learning and promotion (by the teachers) and adoption of self-regulatory learning strategies as a means of achieving their goal of improving and accelerating learning based on feedback from the formative tests (Harlen & Crick 2003; Ryan, Pintrich & Midgley 2001; Nicol & Macfarlane-Dick 2006).

Beyond specific assessment practices, the overall nature of goals promoted by the teacher has also been found to have an impact on the social environment in the classrooms and therefore contribute to the level of motivation for learning amongst the students. Specifically, for adolescent learners, promotion of performance-oriented goals has been found to have a negative impact on students' relationship with their teachers and peers (Ryan & Patrick 2001; Ryan, Pintrich & Midgley 2001).

Family relationships and backgrounds

Family background has been highlighted by mathematics education researchers as a core influencer of the students' experience and achievement in mathematics. In particular research by scholars who employ a socially critical stance (Lubienski 2000; Lubienski & Stilwell 2003; Povey 2014; Gates & Noyes 2014; Povey & Boylan 1998; Boylan & Povey 2009) in their research have consistently argued that learners' engagement in mathematical activity is significantly influenced by the 'early socialisation within the family, home and immediate environment' (Jorgensen, Gates & Roper 2014 p. 223). Specifically, they argue that mathematical activity as generally presented in schools tends to favour learners from more affluent families, because the expected (and promoted) knowledge and practices are usually compatible with the dispositions of and resources available to parents from such families. I discuss the role of socio-economic status (SES) more comprehensively in a latter section of the chapter.

Concomitantly research from the field of mathematics education psychology (Callan et. al 2016; Connell, Felner & Aber 1994; Wentzel 1998) has provided evidence suggesting that the nature of interrelationships in families may influence learners' interest and consequently engagement in academic activities. For example, a study by Connell, Felner and Aber (1994), targeting 10- to 16-year-old African-American youth, found that the particpants' perception of parents' support of, their sense of control over the outcomes of their efforts towards learning and their feelings of sense of self-worth and emotional security with others greatly regulated their activities in school. Indeed, the results from this study imply that the observed impact of family support on the participants' self-regulation and by extension academic engagement while in school was more significant than that of their gender and familys' socio-economic status. The aforementioned findings resonate with findings from similar studies (cf Wentzel 1998) which have also suggested some positive relationship between family support and students' academic goal orientations.

Generally, supportive and responsive parental behaviour has been found to have a powerful influence on the students' emotional well-being, development of social competence and demonstration of social efficacy during class interactions. These findings indirectly suggest that such students may exhibit greater capacity for 'individual appropriation of regulatory control processes' (Volet, Vauras & Pekka Salonen 2009, p. 217) during structured learning interactions with the teachers and/or peers (Alvi & Gilles 2015).

Finally, supportive and responsive parents may also play a role in the students' practice of self-regulated learning through co-regulation of the learning and learning environments at home. Specifically, they may help in the students' regulation of their learning environment by: acting as co-teachers; monitoring and assisting the students with their homework and or other learning projects; and providing of a cognitively stimulating home environment (Davis-Kean 2005; Mistry et al. 2002; Conger et al. 2002).

In a study designed to analyse the contribution of parent-child relationships to the emergence of the gender gaps in mathematics achievement, Muller (1998) established that talking with parents about school had a positive impact on the mathematics performance of younger children (12 years) but had no significant impact on the mathematics performance of older students (14 years). For the older students, parental restriction (regulation of environment) of activity (e.g activity with friends and or television watching) was the strongest positive predictor of their mathematics scores.

Indeed, as discussed in the succeeding section, evidence from earlier studies suggests that interpersonal relationships with peers is perhaps one of the most significant influences on adolescents' academic motivation and engagement.

Peer relationships

The discussions in the preceding section have outlined increasing interest amongst researchers in exploring the relationship of the social environment of the classroom and students' motivation and engagement in learning (Ryan & Patrick 2001). The increasing interest is pegged on findings from related research that have pointed to a link between students' socialisation experiences and academic achievements (Wentzel 1998). At the heart of this socialisation experience is the students' relationship and interactions with their peers, especially those who they learn with in school and specific classrooms (Ryan & Patrick 2001; Ryan, Pintrich & Midgley 2001; Ryan 2000).

In particular, the nature of social goal orientations emphasised by adolescent students during their peer interactions is considered to have an impact on their practice of self-regulated learning (Ryan & Patrick 2001; Ryan, Pintrich & Midgley 2001; Ryan 2000). According to Ryan, Pintrich and Midgley (2001); 'a social goal orientation concerns the purpose and meaning that students ascribe to their social behaviour in the classroom' (pg. 98). Broadly speaking, social goal orientations in academic context are construed as social reasons for engaging in academic activity (King, Mcinerney & Watkins 2010). Though conceptualised differently by different researchers, social goal orientations are deemed to take two main forms: seeking belongingness during an academic activity for some personal or self-good and seeking belongingness during academic activity for both self and collective good. The two forms have been christened as social-status goal orientation and social-intimacy goal orientation respectively by some researchers. Taken to be informed by a desire to be 'popular', a social status goal orientation is characterised by a quest for social visibility and prestige amongst peers. On the other hand, an intimacy goal orientation tends to be driven by a desire for closer, more interpersonal relationship and general acceptance (Hicks 1997; Rose & Rudolph 2006).

Similarly, researchers from the East identify the two forms of social goal orientations as social affiliation goals and social concern goals (King, McInerney & Watkins 2012; King, McInerney & Watkins 2013). Those who espouse social affiliation goals during academic study are considered to be largely driven by a personal need for belongingness to the said group. Conversely, those who espouse social concern goals are driven (out of their sense of belongingness to the group) by a desire to help or show concern to other student members of the group. The different groups have been found to engage differently with self-regulated learning, especially with regard to employing deep learning efforts like help-seeking and motivational engagement during learning.

For example, the students who adopt a social status goal (social affiliation) orientation in their social interactions with peers have been found to be particularly concerned to manifest heightened awareness of self, relative to others, and given to tendencies geared towards protecting their self-worth. As such they are given to working hard at maintaining a certain image amongst their peers. Accordingly, they have been found to largely avoid help-seeking when they need it, specifically because of its potential to garner public attention and evaluation from their peers. In other words, students who have a status goal orientation generally consider help-seeking as a viable threat to their sense of self-worth. The opposite is considered true for their counterparts whose social motivational construct is that of intimacy (social concern): they tend to give and to seek help within the classrooms as part of the means of engendering interaction and forming positive relationships with their peers (Ryan, Pintrich & Midgley 2001; Hicks 1997; Rose & Rudolph 2006).

There has been some observed gender difference in the adoption of the two sets of social goal orientations during academic engagement. Generally, the male adolescent students have been found to be keener to protect their sense of self-worth and present "macho images" (Rose & Rudolph 2006). Accordingly, there is a greater likelihood for them to adopt status goal orientations. On the other hand, the adolescent female students tend to be more attracted to intimate and communion relationships (Rose & Rudolph 2006). These tendencies have, however, been found to vary across cultures, family social economic status, and the students' achievement levels (Ryan, Pintrich & Midgley 2001). That said, adolescents from both genders have been found to seek psychological and emotional independence from adults and instead rely more on peer relationships as a means of establishing and maintaining positive perceptions of self (Wentzel 1998). It may therefore be true that of the three sets of relationships (teachers, parents and peers), the nature of the students' relationship with peers has the greatest impact on their practice of self-regulated learning of mathematics.

Further evidence of the impact of students' relationships with their peers on adolescent students' self-regulation is gleaned from scholarship on peer relations in academic settings (Ryan 2000; Nelson & DeBacker 2008; Lynch, Lerner & Leventhal 2013). The findings from the aforementioned studies provide explicit pointers of how peer-related attributes like: peer climate and culture in classrooms (Nelson & DeBacker 2008;); nature and quality of peer relationships in the wider school context (Lynch, Lerner & Leventhal 2013); and achievement-related values and behaviours of best friends' impact on aspects of students' self-regulation such as self-efficacy and achievement motivations.

Of particular interest to this study, is the considerable evidence that points to a significant interaction between students' social relationships and key drivers of students' self-regulation during their learning including: motivation and sense of efficacy towards learning mathematic (Ryan 2000); capacity for self-monitoring and self-evaluation (Wentzel 1998; Ryan 2000) and students use of specific self-regulating learning strategies such as help-seeking (Ryan, Pintrich & Midgley 2001; Kiefer & Shim 2016; Schenke et al. 2015)

As noted above, the suggested influence of students' relationships with peers on their self-regulation during learning of mathematics was found to vary across achievement levels, gender, culture and social economic status of the students' families or schools (Ryan, Pintrich & Midgley 2001; Davis-Kean 2005; Callan et al. 2016; Eshetu 2015). In latter sections in this chapter, I present a more detailed exploration of literature on how the aforementioned factors have been found to influence the students' self -regulated learning of mathematics.

Mathematics textbooks

In this section, I present an overview of literature on mathematics textbook research. I explore findings on student-textbook relationships and the opportunities for learning that mathematics textbooks may present. I then present an overview of how specific features of mathematics textbooks may support aspects of self-regulated learning of mathematics by students.

The role of textbooks in the intended and implemented curriculum

Curriculum materials play a critical role in any teaching and learning situation (Pepin & Haggarty 2001). In many countries, mathematics textbooks are recognised as one of the key curriculum materials, representing, in part, aspects of the intended curriculum and implemented curriculum (Pepin & Haggarty 2001; Li 2000). As a representation of the intended curriculum, mathematics textbooks, especially those considered as core mathematics textbooks, are usually taken as 'frames' of the approved national curriculum. To this end, the presentation and organisation of the content in the core mathematics textbook is usually closely aligned to the nationally approved mathematics curriculum (Macintyre & Hamiliton 2010).

On the other hand, the classification of mathematics textbooks as a representation of the implemented curriculum is linked to the fact that, for many teachers, the mathematics textbook remains one of the key resources and tools for teaching mathematics (Pepin & Haggarty 2001).

Mathematics textbooks, especially those identified as core, have been found to influence the teachers' choice of questions, topics and issues to be covered in classrooms (Weinberg & Wiesner 2011; Haggarty & Pepin 2002). The level of influence of mathematics textbooks on the teachers' choice, organisation and presentation of mathematics content in the classroom has, however, been found to vary across and within countries (Haggarty &Pepin 2002; Macintyre & Hamiliton 2010; Luke, Castell & Luke 1983; Dowling 1996; Li 2000).

Student-textbook relationship

Despite the traditional association of mathematics textbooks with teachers, reforms in mathematics education, especially those geared at putting the learner at the centre of mathematics learning, continue to challenge the 'sole' mediator role of mathematics text bestowed on mathematics teachers (Pepin & Haggarty 2001). As a result, there is an enhanced interest amongst some mathematics educators (Haggarty & Pepin 2002; Tornroos 2005; Mesa et al. 2012) in placing 'the students at the centre of mediation between knowledge and textbooks' (Haggarty & Pepin 2002, p. 571). In tandem with this shift, is an increasing expectation by teachers for their students to "self-read" the textbooks to facilitate their understanding of different mathematics ideas. Specifically, students have been found to rely on mathematics textbooks when working on their homework or reading for exams. In essence, in secondary schools in many countries (Pepin & Haggarty 2001; Li 2000; Tornroos 2005), the textbook is currently used not only as a resource/tool for teachers but also as a valid tool for students to interact with mathematical ideas and self-instruct. The emphasis on a more active engagement of the mathematics learner with mathematics textbook knowledge has resulted in an increased attention amongst some of the mathematics education textbook researchers on the learner-textbook relationship (Pepin & Haggarty 2001; Weinberg & Wiesner 2011; Mesa 2010a; Lithner 2004).

These researchers have been keen to understand the interaction between specific features of mathematics textbooks and the students' ability to use the textbooks as core resources or tools for learning mathematics. Some of the aspects that have been explored include: the pedagogical intentions of the mathematics textbook (Haggarty & Pepin 2002); the influence of mathematics textbooks' content and presentation on students' engagement and participation in learning of mathematics (Weinberg & Wiesner 2011; Macintyre & Hamiliton 2010); and how explicit mathematics textbooks are, through their examples, in supporting the development of the students' reasoning and verification strategies (Lithner 2004; Mesa 2010a).

Mathematics textbooks and their role in supporting self-regulation

None of the research done so far has had an explicit interest in systematically exploring the adequacy of mathematics textbooks in supporting self-regulated learning of mathematics. That said, given that the core interest of a majority of research done so far has been on exploring the opportunities of learning that mathematics textbooks present to students, it is possible to make an indirect connection between the focus of the extant studies with self-regulated learning. For example, the interest of Mesa (2010a) and Lithner (2004) in control structures manifested in mathematics textbooks is akin to exploring how effective mathematics textbooks are in modelling the process of working out specific mathematics problems. Note that they define control structures as types of criteria within the organisation and presentation of mathematics content and text that would help one know what to do to solve a mathematical problem, determine when one arrives at the answer and verify if the answer is correctly manifested in mathematics textbook.

In the same vein, the interest in the extent to which textbooks use elaborated sentences (Mesa 2010a) and or rhetorical voice (Pepin & Haggarty (2001) to show and justify the connections of ideas presented in the argumentation of examples can be equated to being interested in how effective textbooks are in employing verbal persuasion (another key environmental strategy) as a way of facilitating self-instruction and self-monitoring during the students' self-regulated learning of mathematics. Finally, Mesa's (2010b) focus on the potential of examples for developing metacognitive knowledge maps squarely onto interest in metacognitive planning as a core part of covert self- regulation during mathematics learning. The overview above shows that the understanding of the adequacy of a mathematics textbook in supporting self-regulated learning of mathematics amongst secondary school students is still under-developed. Exploring data from students on their current use of textbooks to support their self-regulated learning of mathematics will be a significant contribution to filling this gap. Furthermore, locating the study in Africa where textbook research may not be as developed as in other parts of the world (Fan, Zhu & Miao 2013), will enhance the understanding of the role of textbooks as key curriculum resources in different cultural contexts and systems of education. Given the established relationship between self-regulated learning of mathematics and students' achievement (Ahmed et al. 2013) the exploration will be valuable for textbook authors and institutions charged with the responsibility ofvetting and selecting mathematics textbooks in Kenyan secondary schools.

Gender

So far, the influence of gender on self-regulated learning of students has not received as extensive attention as that given to the influence of gender on students' general academic achievement and most importantly for this study on the achievement in mathematics (cf. Njoka et al. 2013). As a result, findings in the literature on whether gender has a significant influence on self-regulation and by extension self-regulated learning remain sparse, inconclusive and in some cases inconsistent (Bembenutty 2007). That said findings from the few studies (e.g. Pajares 2002; Bembenutty 2007) that have sought to explore gender influence on students' practice of self-regulated learning, suggest that female students are generally more attuned to practising self-regulated learning than male students.

Such differences favouring female students have been observed even in the context of learning of subjects such as mathematics, where male students generally post higher achievement scores in examinations and post greater self-effiacy for the subject. For example, a study by Zimmerman and Martinez-Pous (1990) to explore differences in self-regulated learning amongst students (grade 5-11) from different ethnic backgrounds and academic achievement levels from a school in the USA found some gender differences in the students' use of different self-regulated learning strategies. The girls in the study reported a greater propensity than the boys for: behavioural regulation through the use of self-regulated learning strategies like record keeping and monitoring; personal regulation through goal setting; and environmental regulation through the use of strategies aimed at structuring their learning environment to make them more conducive.

These findings resonate albeit in part with findings from a study by Bembenutty (2007), which sought to establish whether there were gender and ethnic differences in the practice of academic delay of gratification and therefore self-regulated learning among students from a university college in America. Academic delay of gratification was defined as students' willingness to forgo an immediately available and possibly more attractive option like watching television in favour of possibly a less attractive option like studying so as to secure distant academic rewards. The study findings showed that there was a relationship between use of specific self-regulated learning strategies like rehearsal and organisation, elaboration and metacognition with students' willingness to delay gratification. Further, the study findings affirmed earlier findings from a related study (Bembenutty 1999), which suggested that delay in academic gratification by students may be useful in helping them bring to the fore mental representations of their academic goals and consideration of viable behavioural actions for structuring their learning environments to best support their pursuit of the set academic goals. Most importantly, the study findings revealed that across the different ethnic groups (Caucasian and non- Caucasian) represented in the study, the female students were found to be more willing to delay short-term gratification for academic activities aimed at achieving more long-term goals like attaining a specific grade in a future examination.

Considerable gender differences have also been found in students' employment of self-regulated learning strategy of seeking for social support during learning through help-seeking (Hong & Hwang 2012; Hong; Rose & Rudolph 2006). As has already been discussed in the earlier section, help-seeking is considered as one of the key self-regulated learning strategies given its link to the ascribed role of social support in self-regulated learning by both social-cognitive and social cultural learning self-regulated learning theorists. The gender difference in the use of help-seeking as a self-regulated learning strategy may vary across: classroom contexts; nature of tasks (Hong & Hwang 2012); achievement levels (Zimmerman & Martinez-Pous 1990); and age of students (Ryan, Pintrich & Midgley 2001). Generally, male students, especially adolescent male students, have been found to use less help-seeking strategies than their female counterparts during learning. As we saw above, the differences in the use of help-seeking (especially from peers) as a learning strategy has in part been attributed to the tendency of the different genders to incline themselves to different social goal orientations in their interactions with peers (Rose & Rudolph 2006). Accordingly, the male adolescent students unlike the female adolescent students are generally known to be more (than the female students) averse to calls for mutual participation and help-seeking during learning activities (Rose & Rudolph 2006; Hong & Hwang 2012).

The other reason for gender difference in help-seeking amongst students during learning activities may be attributed to the tendency of the two genders to apply different strategies to deal with stressful situations. According to Rose and Rudolph (2006), there are numerous research studies whose findings have shown that, in stressful situations, girls are likely talk about their problems and enlist support in response to the stressful situation. Conversely, boys in similar situations have generally been found to employ behavioural avoidance and withdrawal strategies like distracting oneself or engaging in diversions as measures of dealing with stressful situation.

Some variations of the aforementioned gender differences and overall practice of self-regulated learning have been observed across students from different cultural backgrounds (Purdie, Hattie & Douglas 1996). I now turn to exploring literature on the influence of culture on self- regulated learning.

Culture

Findings from numerous studies have demonstrated that there is both an indirect and a direct linkage between subjective culture and self-regulated learning. Subjective culture has been defined as the ‘set of values, beliefs and traditions that influence the behaviours of a social group and as it pertains to a society’s characteristic way of perceiving and interacting with the social environment’ (King & Mcinerney 2014, p.176). It is different from material culture (dresses, foods, tools).

The indirect linkage between subjective culture and self-regulated learning can be construed from study findings that have indicated cross-cultural differences in: students’ achievement patterns in different subjects including mathematics (Chen & Stevenson 1995); students’ motivation towards learning (King & Mclenerny 2014; Iyengar & Lepper 1999); the nature of students’ social relationships (Cheng & Lam 2013); gender orientations (Pajares 2002; Bembenutty 2007) towards learning; the use of self-regulated learning strategies (Pillay, Purdie & Boulton-Lewis 2000); and students’ achievement goal orientations (Zusho & Clayton 2011).

For example, findings from Bembenutty's (2007) study indicated a difference in the motivational patterns and academic achievement of Caucasian and non-Caucasian students. The non-Caucasian students in the study not only posted lower academic grades, they also reported lower confidence levels in their capacity to engage in the designated academic tasks. These findings resonate with those from similar studies that have shown difference in academic performance amongst students from different ethnic communities and different nationalities (Chen & Stevenson 1995; Purdie, Hattie & Douglas 1996).

Similarly, in Chen and Stevenson's (1995) comparative study, East Asian high school students posted higher mathematics scores than their Asian-American and Caucasian-American counterparts. The scores from the Asian-American students were also found to be higher than the Caucasian-American students. The study findings attributed the higher achievement by the Asian-American and East Asian students to a difference in: parental and peer support structures; amount of effort and time dedicated to their studies; achievement goal orientations and general attitude towards learning mathematics.

These differences have been attributed to dissonance between the motivational patterns, academic achievement goal orientations and self-construal of the students from collectivist (Asian) and individualist (West) cultures (Cheng & Lam 2013; Iyengar & Lepper 1999). For example, the motivation of the students from Asian countries like China, has been found to be positively impacted upon by the active involvement of parents (for example, help in choice of tasks and approval for doing academic tasks like school homework), other trusted authority figures and peers. This is contrary to what has generally been observed amongst Anglo-American students and other students from individualist cultures in Europe; social approval (linked to performance-oriented goals and extrinsic motivation) and close administration of academic tasks by parents and other authority figures has generally been found to demotivate and result in self-handicapping and maladaptive outcomes. Similarly, the notion that higher self-concept or belief in one's abilities results in higher academic achievement has been somewhat challenged given findings from studies (cf. Chen & Stevenson 1995) that have shown that Asian students generally outperform their counterparts from Western countries despite posting lower self- beliefs in their abilities.

Taking self-regulated learning to be a fusion of will and skill, the findings from scholarship on cross-cultural differences in self-regulated learning of students from Asian and Western cultures also point to the fact that the students from the Asian cultural orientation have a greater sense of will (Chen & Stevenson 1995; Purdie, Hattie & Douglas 1996) than their Western counterparts. Concomitantly, the students from the West may actually be more skilled at using self-regulated learning strategies than their counterparts from the East. For example, Australian students participating in a study done by Purdie, Hattie and Douglas (1996) to compare the use of self-regulated strategies (as conceptualised by Zimmerman & Martinez-Pons 1990) by Japanese and Australian students reported greater use of a majority of the self-regulated learning strategies than their Japanese counterparts. On the other hand, the Japanese students, including the Australian/Japanese students who participated in the study carried out by Purdie, Hattie and Douglas (1996), reported more significant value for 'will' and personal effort as key factors in successful learning. As a result, for both studies, the Japanese students reported a significantly higher use of self-regulated learning strategies involving rehearsing, memorisation and reviewing of textbooks than the Australian students and less of the self-regulated learning strategies involving strategic strategies like goal setting, planning and those geared towards seeking assistance from their teachers and or peers.

The evidence from research on cross-cultural differences in achievement motivation patterns and patterns of use of some of the self-regulated learning strategies as presented in the fore-going section, suggest that culture is an important mediator of practice of self-regulated learning. However, the comparative studies done so far have in the main explored the cross-cultural differences in self-regulated learning between Asian and Western students. There is hardly any study that has explored in a systematic way the impact of culture on the practice of self-regulated learning by students from a purely African context. That said, it can be deduced from the existing studies on cross-cultural differences (King & Mcinerney 2014) on students' motivation towards learning that the practice of self-regulated learning by students within an African learning context like Kenya will be partly influenced by the extent to which the "African" culture impacts on the students' sense of self; their perceived goals of behaviour; and facilitating conditions. In other words employing a cultural lens to understand the Kenyan students' self-regulation during learning involves exploring the extent and nature of influence of the "African culture" on: the students' perceptions, feelings and beliefs of who they are; their purposes (mastery or performance or social solidarity or extrinsic rewards goals) for which they engage in learning activities; and the social cultural norms (e.g those concerning parental, teacher and peer support) and environmental factors that condition their learning (King & Mcinerney 2014; King, Mcinerney & Watkins 2012; Zusho & Clayton 2011).

During these processes, theoretical lenses from similar studies located both in the East and West are useful. The interest in the East is important given that most African cultures are traditionally more collectivist than individualistic in nature, meaning that a good proportion of students may still approach their learning from a relational-interdependent self-construal than the self-construal (King, Mcinerney & Watkins 2012) that is more pervasive in the Western cultures. That said, theoretical frameworks on self-regulated learning from the West are also useful given the acculturation process (through adoption of Western-oriented education systems and other postcolonial-related processes) that tend to encase the learning, teaching and assessment processes in an individualistic mould.

The afore-discussed impact of culture on students' self-regulation has been, however, found to vary based on the students' ethnicity, region (urban and rural), religion and social-economic status (King & Mcinerney 2014; Butler-Barnes, Williams & Chavous 2012). In other words, students from the same nation may identify differently with transmitted norms, beliefs and values depending on the extent of their religious socialisation, the socioeconomic status of their families and schools and attributes of region of residence. These in turn may affect their motivation towards learning and their practice of self-regulated learning. For example, as we saw above, Purdie Hattie & Douglas (1996) found significant differences in the use of self-regulated learning strategies by Japanese students in Japan and Japanese students residing in Australia. A similar study found some differences in the social orientation goals (for learning) amongst indigenous Australian students who lived in remote, very remote and urban settings (Mcinerney 2012).

Religion

The impact of religion on students' practice of self-regulated learning can be deduced from study findings that have shown that students' sense of self, academic achievement behaviour and even facilitating conditions is greatly influenced by their level of religious socialisation. According to Brown and Gray (1991), religious socialisation comprises 'the process by which an individual learns and internalises attitudes, values, and behaviours within the context of a religious system of beliefs and practices' (p. 412). Put differently, religious socialisation (which has also been referred to as religiosity by some of the authors, for example, Butler-Barnes, Williams & Chavous 2011) results in self-consciousness about a religion that drives an individual to evaluate their behaviour and relationship with others against a specific religious perspective.

Numerous research studies (Glanville, Sikkink & Hernandez 2008; Butler-Barnes, Williams & Chavous 2011) done within the US context have shown that religious (Christian) socialisation is one of the cultural assets that can be tapped into to enhance students' motivation for learning and academic achievement. The possible indirect connection between the students' religious socialisation and students' academic achievement can be deduced from study findings that have shown that: students' religiosity has been found to have a positive impact on facilitating positive social relationships between students with their parents and peers.

As discussed earlier, this means religious adolescents may be more open to employing some of the self-regulated learning strategies like help-seeking than their non-religious counterparts. Further, the study findings also suggest some interaction between the students' interest in the spiritual teachings and activities of the church and their amiability to discipline structures and social monitoring through these structures (Glanville, Sikkink & Hernandez 2008; Butler-Barnes, Williams & Chavous 2011). As a result, they have been found to embrace value systems that amongst other things steer them away from risky behaviour (Reynes 1999) and propel them to be more motivated to engage in academic activities. Accordingly, it may be taken that students who take to heart their church teachings and play an active role in the church activities may be more adept at employing the self-regulated learning strategies like goal setting and planning and delaying immediate gratification for long-term academic goals. This supposition is drawn in part from findings from empirical research (Glanville, Sikkink & Hernandez 2008; Brown & Gary 1991) in the US that have shown lower dropout rates amongst religious adolescents than non-religious adolescents and a positive association between education attainment and religious socialisation (Brown & Gary 1991) for African American students.

A link between the practice of self-regulated learning and religiosity can also be deduced from study findings that suggest that religious faith tends to give students extra interest, purpose and motivation for learning (Brown & Gary 1991). Indeed, Butler-Barnes, Williams and Chavous (2011) report of study findings that indicate that religious faith has in some instances been found to provide 'a sense of purpose beyond that which might be offered by individuals' proximal contexts' (p. 489). With regard to education, religiosity has in some instances been found to be a source of personal affirmation and encouragement thereby contributing to students' sense of educational persistence and achievement. In a self-regulated learning context, the personal affirmation and encouragement may contribute to an increase in the students' sense of self-efficacy and the persistence may be linked to more adaptive self-reactions during the learning process.

Evidence from scholarship on religiosity suggests that the aforementioned influence of religiosity on students' motivation for learning and engagement may vary across gender, regions (urban and rural), religious denominations, age of students and sociodemographic and background factors (Brown & Gary 1991; Butler-Barnes, Williams & Chavous 2011; King & Mcinerney 2014). In particular, the evidence points to the fact that the impact may be more profound (Brown & Gary 1991) and positive amongst female students than male students.

Given the differences between the US and Kenyan context, for example having a "racial" nuances as a significant part of the US context, the foregoing discussion on the possible influences of religion on the students' self-regulation is to be considered as not completely generalizable to the Kenyan context. Some parallels may however be drawn given that a majority of Kenyans seem to affiliate themselves with the Pentecostal churches, most of which pattern their practices on the practices of the counterparts in America.

Socio-economic status and self-regulated learning

Findings from a significant number of international studies (Eshafu 2015; Berger & Archer 2016; Jorgensen, Gates & Roper 2014; Gates & Noyes 2014; Lubienski & Stilwell, 2003) across different cultures have consistently pointed to some significant association between students' socio-economic status (SES) and educational attainment. A majority of the aforementioned studies have focused on impact of family SES on students' academic achievement. Family SES has generally been taken to include family income, parental education level, parental occupation and social status in the community (Kainuwa & Yusuf 2015; Berger & Archer 2016).

While there are a number of studies from Africa (cf. Taylor & Yu 2009; Kainuwa & Yusuf 2013) which suggest a positive correlation between students' academic achievement and their family SES, results from studies exploring family SES on students' academic achievement in Kenya have produced mixed results. For example, a case study by Gabriel et al. (2016) to explore the impact of parents' SES on academic achievement on secondary school students established that students whose parents had lower educational attainments and a low-paying occupation seemed to work harder and post better results than a majority of the students from more economically endowed families. That said, for some of the students from low SES family background, learning was sometimes affected because of being sent home for school fees and inadequate parental support with their learning at home.

In recent years, there has been growing interest in exploring the impact of collective SES (district, school, country), especially school SES, on students' academic achievement. Though at its nascent stages, findings from studies on the association of school educational attainment and the two (family and collective) sets of SES suggest that variation in student academic achievement may be attributed more to school SES than family SES (Callan et al. 2017).

Mathematics education research exploring the link between SES and academic achievement may be distinguished into two main categories based on the privilege they place on either sociological (e.g. Jorgensen, Gates & Roper 2014; Gates & Noyes 2014; Lubienski & Stilwell, 2003) or psychological outlook (cf: Callan et. al 2017; Berger & Archer 2016) of the interactions of the two constructs. Findings from some of the studies in the latter group suggest that low SES may have a negative impact on: learners' cognitive development; levels of engagement, progression and interest in academic activities; and language acquisition and proficiency (Berger & Archer 2016). It is instructive to note that much of the literature (most from North America) referred to in my discussions in this chapter is largely inclined towards presenting a psychological outlook of the interaction between self-regulated learning and students' SES. This is because self-regulated learning has largely been explored as an individual and psychological construct.

Using a self-regulated learning lens, it was possible to deduce what possible links may exist between students' family and school SES and their use or practice of self -regulated learning. For example, the impact of family SES on students' personal regulation through goal setting and the shaping of their sense of self efficacy can be deduced from the empirical evidence that suggest a positive relationship between parents' level of income and education and students' perception of achievement (Berger & Archer 2016). In particular, students with parents of moderate/high income and education levels have been found to have a more (than those from low income) positive perception towards academic achievement and thus enhanced sense of self-efficacy (Pajares 2002) because of a greater resonance between their academic beliefs and the expectations of their parents.

In a similar vein, one can deduce a link between SES and students’ capacity to self-regulate their learning behaviours through self -monitoring and evaluation from study findings that have linked family and school SES to students': academic goal orientations and use of different learning strategies (Berger & Archer 2016; Callan et al. 2016); and their language proficiency and acquisition (Callan et al. 2017; Jorgensen, Gates & Roper 2014). For example, findings from a study by Berger and Archer (2016) involving students from two high schools in Australia suggest that students from high SES backgrounds are likely to adopt mastery approach-oriented academic goals than their counterparts who were found to be more inclined towards performance-avoidance academic goals.

Though not directly explored by the two authors, it may be safe to deduce from these findings that the higher SES students are more likely to employ behavioural self-regulating strategies like self-monitoring and self-evaluation during their learning activities. This conclusion is based on the empirical evidence from the literature (which I have also discussed in earlier sections of this chapter) which has linked mastery approach academic achievement goals with: learning dispositions like persistence; and the employment of deep learning strategies like metacognitive summarising, rehearsal and elaboration (Zimmerman & Martinez-Pons 1990).

Indeed, parallel findings were arrived at from a study by Callan et al. (2017) which explored among other factors the relations between students' family and school SES and their use of a number of self-regulated learning strategies in learning mathematics, reading and science. The study, which involved over 500,000 high school students from 65 countries, found that students from wealthier families tended to use more learning strategies than those from less economically advantaged families. The use of the strategies by students from the different family SES groups was, however, found to be mediated by the SES of the schools that the students attended. Generally, students from high SES schools regardless of their family SES were found to be better at self-regulation of their learning behaviours: they reported greater use of self-monitoring and self-evaluation strategies like metacognitive summarising and metacognitive summarising. Using a sociological lens (Jorgensen, Gates & Roper 2014; Gates & Noyes 2014), we could infer that the suggested link between students, SES and use of learning strategies may be due to the resonance of the dispositions actively inculcated in the students through their families/schools and the use of the abovementioned self-regulated learning behaviours and skills.

Finally, a deduction on the possible influence of the students' SES (family and or school) and their use of environmental self-regulation strategies like modelling and seeking social assistance (Zimmerman 1989) may be drawn from findings from studies like the one carried out by Davis-Kean (2005) which showed that parents with higher levels of education are more likely to work towards creating an academically stimulating environment for their children than those with lower academic achievement. In other words, students from those families are not only able to draw inspiration and interest in academic activities from their parents as models, they are also likely to be more comfortable in seeking social assistance from their parents and peers than their counterparts with parents of lower educational attainment levels. While the aforementioned findings by Davis-Kean (2005) should be treated with some caution given its experimental nature and possible difficulties with measuring of some of the variables used like parental warmth, one can deduce some resonance between the findings with arguments from mathematical education researchers (Lubienski 2000; Lubienski 2002; Jorgensen, Gates & Roper 2014;) who, using the notions of capital and habitus, have highlighted the fact that the social background of students plays an important role in determining the success of the students at learning mathematics.

As is the case with family SES, the availability of resources (more teachers, textbooks, learning spaces, including libraries) in high SES schools has been found (Callan et al. 2017) to be useful in creating an environment that is more conducive, both in terms of structure and supportive emotional environment, for supporting and facilitating self-regulated learning. That said, the findings from the studies discussed in the preceding section are to be treated cautiously and may not be taken to apply universally to students of all cultural backgrounds and learning contexts. For example, findings by Berger and Archer (2016) that students from low SES backgrounds are generally poorer at structuring their environment to support learning because in most cases they tend to 'regard school primarily as an extension of their social lives' (p. 180) may not hold in collective cultures and learning environments that foster and promote social oriented academic achievement goals as part of their efforts at supporting students' self-regulation.

Training

There are many studies whose results suggest that students' self-regulatory abilities can be enhanced through training with significant success. A considerable number of these studies have sought to foster self-regulated learning strategies for mathematics learning amongst both primary and secondary school students (see: Hattie, Biggs & Puddie 1996; Dignath & Buttner 2008; Leidinger & Perels 2012). Indeed, findings from a meta-analysis (Dignath & Buttner 2008) of intervention studies aimed at fostering aspects of self-regulated learning amongst primary and secondary school students suggest that the interventions conducted in the scope of mathematics seemed to have achieved higher effects than those targeting reading and writing.

Another key finding was that the outcomes of such interventions were also significantly influenced by the self-regulated learning theoretical background upon which the intervention was grounded and the instructional strategy employed (Dignath & Buttner 2008). In particular, the aforementioned findings seemed to be consistent with findings from an earlier meta-analysis (Hattie, Biggs & Puddie 1996) which pointed out that transferability of self-regulated learning strategies 'taught' during interventions on students' learning was enhanced when the instructions of such strategies were linked to actual content and carried out in a natural setting.

Students' relationship with mathematics

Given that I have already, in my discussion of the theoretical framework (Chapter two) of this study, intimated the role of self-efficacy beliefs in students' self-regulation, I will in this section limit myself to discussing research literature on the relationship between self-regulated learning and the other two constructs: epistemic beliefs and emotions.

Students' epistemic beliefs

Epistemic beliefs are widely taken to constitute individuals' beliefs on the nature of knowing and nature of knowledge. Adopting this definition for my study then implied that my interest was in exploring the interaction between self-regulated learning and the students' beliefs on the structure, certainty, source and justification of mathematical knowledge/knowing. Although more than one framework exists for exploring epistemic beliefs, the frameworks employed by a number of mathematics educational researchers (Muis 2007; Schommer, Crouse & Rhodes 1992; Schoenfeld 1983) seemed to be more inclined to the multidimensional framework like the one developed by Hofer (2004), which depicts students' epistemic beliefs as being within a continuum of four belief dimensions. That is to say, with regard to the students' knowledge about *nature* of mathematics knowledge, they can present the following two belief dimensions: the *certainty* of mathematical knowledge, ranging from mathematical knowledge is unchanging (and is made up of isolated bits and pieces) to mathematical knowledge is evolving (made up of highly interrelated concepts); and the *source* of mathematical knowledge, ranging from mathematical knowledge is handed down by authority to mathematical knowledge is acquired through reason or logic. Concomitantly, the students can present two belief dimensions about *knowing* mathematics: mathematical knowledge is handed down by authority figures who are always correct to mathematical knowledge is constructively built through an empirical and rationally justifiable process (Muis 2007).

Discussions tend to link students' epistemic beliefs with the quality of their learning and academic achievement (Hofer & Pintrich 1997; Muis & Franco 2009). The link is presumed to be mediated by a number of related constructs, including the students' emotional dispositions (Di Martino & Zan (2011), students' intelligence beliefs (Hofer 2004) and self-regulated learning (Hofer 2004, Schoenfeld 1983, Muis & Franco 2009). One of the earliest pointers to the existence of a relationship between students' mathematics epistemic beliefs and self-regulated learning can be gleaned from the findings of a study by Schoenfeld (1983) which suggested that college mathematics students who predominantly held beliefs that depicted mathematics knowledge as certain and mathematical knowing to involve observation rather than rational thinking, did not plan, or monitor their behaviour during mathematics problem solving. This was in contrast to the behaviour of mathematics experts who largely held more rationalist (underscoring complexity and logic) beliefs towards mathematics. This group was found to plan their course of action and closely monitor their actions and progress during the mathematics problem-solving activity.

Following on the findings from the Schoenfeld (1983) study and successive studies by other mathematics education researchers (e.g. Schommer, Crouse &. Rhodes 1992) Muis (2004) developed an integrated theoretical model depicting a bi-directional relationship between students' mathematics epistemic beliefs and their use of self-regulated learning. According to this model, the students' epistemic beliefs influence: how they plan for solving mathematics problems; how they monitor their comprehension or progress during mathematical activity and the attributional feedback that they may give for un/successful engagement in mathematical activity.

Empirical evidence from earlier studies (Muis 2004; Muis 2007) generally points to the fact that students who espouse less constructivist mathematics epistemic beliefs are constrained in their employment of self-regulated learning. Generally, they tend to engage in more surface-level strategies like memorisation and rehearsal. On the other hand, those who adopt more constructivist epistemic mathematics beliefs have been found to be more adept at using deep-level strategies such as elaboration and integration and generally being more adaptive in their learning of mathematics. In part, the espoused relationship between mathematics epistemic beliefs and self-regulated learning may be explained by the relationship between: epistemic beliefs and intelligence beliefs; and epistemic beliefs and students' academic achievement goals. The more constructivist one's epistemic beliefs are, the more one is found to proffer incremental intelligence beliefs (Dweck 1988) and mastery-approach academic achievement goal (Muis & Franco 2009). Intelligence beliefs are considered to be the students' beliefs about the nature of their intelligence (Zhu, Valcke & Schellens, 2008). A widely adopted model for the study of students' intelligence beliefs is Dweck's model of implicit theories of intelligence which postulates that students' intelligence beliefs fall within a continuum of two main distinct conceptions: that intelligence is a fixed innate trait which is beyond the student's individual control and an incremental entity which is malleable and is subject to the student's efforts to learn (Dweck & Master 2008).

The contention by Muis (2004) and other researchers (cf. Hofer 2004) that fostering self-regulated learning also contributes to the shaping of epistemic beliefs is in part hinged on the theoretical assertions that epistemic beliefs are developmental (Hofer 2004; Muis 2007). In other words, the comparisons of set goals and standards with products of learning through self-regulated learning processes like metacognitive monitoring may result in the assimilation, accommodation or alteration of epistemic belief schemas of students (Muis 2004; Hofer 2004). While there is some limited evidence from experimental studies (Muis 2007) supporting these assertions, the reciprocal impact of self-regulated learning on students' epistemic beliefs is yet to be comprehensively explored and this is one of the knowledge gaps that this study contributes to filling.

It should, however, be noted that some scholars (Anderson 1990; Joseph 1987) contend that the presentation of epistemic beliefs of mathematics (nature and way of knowing) as outlined in the discussions in the forgoing section are fraught with Eurocentric bias. Specifically, they decry the tendency by most mathematics education scholars to extol the abstraction and rationalisation (Eurocentric tendencies) of mathematical knowledge and learning over non-Eurocentric epistemic beliefs that tend to identify with utilitarian nature of mathematics and intuitive and empirical process of engaging with mathematical activity.

Emotions

Emotions are considered by mathematics education researchers as one of the key components of the affective domain of mathematics learning (Di Martino & Zan 2011). Specifically, mathematical activity is generally taken to entail a strong interaction between cognitive and emotional aspects, with emotions in particular playing a critical role in the creative phase of mathematical activity (ibid). In step with assertions by educational psychologists from other fields, mathematics education researchers have since recognised that the students' thoughts, motivation and action during mathematical activity is largely subject to their emotional dispositions (Pekrun et al. 2002). That said, the effect of emotions on learning has also been found to be mediated by a number of motivational and cognitive mechanisms, key amongst them being the students' motivation to learn, cognitive resources and self-regulation of learning.

Accordingly, just as it is with the students' epistemic beliefs, the relationship between students' emotions and their self-regulation of learning is taken to be reciprocal in nature. A study by Pekrun et al. (2002), involving both secondary and university students, posted findings suggesting that positive emotions played a part in fostering students' self-regulation while negative emotions inclined students more towards external regulation. Specifically, they found that students who manifested positive emotions (joy, interest) during learning, tend to employ self-regulated learning strategies involving elaboration, organisation, monitoring and critical thinking. On the other hand, students manifesting negative emotions (boredom, hopelessness) were more tuned to using shallow and superficial learning strategies and this was attributed to the detrimental effect of the negative emotions on their motivation and direct attention to task. Their findings resonated with findings by Chatzistamatiou et al. (2015) which found an association between students' enjoyment of learning and their self-regulatory strategy use. On the flipside, Pekrun et al. (2002) also speculated from their findings that self-regulation of learning may also have an impact on the students' emotions. Specifically, they hypothesised that self-regulated learning skills may also play a part in regulating the students' emotions during learning.

More recent studies (Baars, Wijnia & Paas 2017; Asikainen et al. 2015) have since found empirical evidence confirming this. In a study involving university students, (Asikainen et al. (2015), the researchers found that students' capacity for self-regulation during learning affected the way they experienced emotions. Specifically, they found that those who were good at self-regulation during learning had more enhanced self-efficacy beliefs and this allowed them to remain optimistic and to continue with their studies. In other words, self-regulation helped in diminishing the effects of negative feelings such as frustration, shame and or anxiety during their learning.

Given the established interplay between students' mathematics epistemic beliefs and emotions during mathematical activity (Di Martino & Zan, 2011), the theoretical and empirical assertions on the impact on self-regulated learning of both constructs pointed to the critical role self-regulated learning can play in positively shaping the students' relationship with mathematics.

Summary

In this chapter, I have presented a literature review of a number of contextual factors that may influence self-regulated learning of mathematics by the students. The identified contextual factors discussed in this chapter include: students’ relationship with teachers and peers; instructional and assessment practices; influence of parents and other family members; students’ use of media; religion; the socio-economic status of the students’ families and schools; culture; quality of mathematics textbooks; students’ academic emotions and epistemic beliefs; and nature and type of training of students on self-regulated learning.

Note that for a number of these contextual factors, there haven’t been any study seeking to explicitly explore their influence on students’ practice of self-regulated learning. Accordingly, I have had to employ the SRL theoretical frameworks discussed in the preceding chapter to deductively suggest possible influence of a number of the aforementioned contextual factors on the Kenyan students’ practise of self-regulated learning of mathematics. These deductions have to be considered with some caution, given the difference between the Kenyan context and the context of a majority of the studies (case in point, literature on religion as discussed in this chapter) refered to in this chapter.
In the subsequent chapter, I discuss the research philosophy and methodology that guided data collection for this study.

CHAPTER FOUR: RESEARCH PHILOSOPHY AND METHODOLOGICAL APPROACH

Introduction

In the preceding chapter I have been able to express my inclination towards social-cultural theories of learning in exploring aspects related to self-regulated learning. Based on this and my overall research objective, which was to foster and explore self-regulated learning with a view of influencing the students' relationship of mathematics, in this chapter I discuss how I approached the research process and the philosophical reasons that informed those decisions. Specifically, I discuss the paradigm I adopted for this research and the resulting methodological approach.

Paradigms

Research paradigms may be considered as a basic set of beliefs informed by a researcher's ontological, epistemological and methodological assumptions (Crotty 1998; Guba & Lincoln 1994). According to Guba and Lincoln (1994), the set of beliefs as espoused by the researcher can be inferred from their answers to three fundamental and interconnected questions. First is the ontological question through which they establish their assumption on the form and nature of reality. Second is the epistemological question, which seeks to establish the researcher's assumption on the nature of the relationship between the knower and the known. The answer to the epistemological question is constrained by the ontological assumptions. Third is the methodological question which seeks to unveil the researcher's assumption on how they can go about researching the "known" as determined by their ontological and epistemological assumptions. In other words, the researcher's chosen paradigm defines for them what their research is about and outlines the legitimate limits for their inquiry (Guba & Lincoln 1994). As such, even though paradigms cannot be empirically tested, the choice of a paradigm for a particular research project does provide parameters for judging the quality of the research (Allison & Pomorey 2000).

The paradigms employed in social science research can be broadly grouped into two main categories: positivism and non–positivism paradigms (Crotty 1998). Those embracing the positivism paradigm proffer a belief in an existence of an apprehendable reality. In addition, positivism requires that any phenomenon be objectively researched given the independence between the researcher and "object" of study. As opined by Guba and Licnoln (1994), research under this paradigm takes place '*as through a one-way mirror'* (p.110). Care is taken by positivists to ensure that the researcher's values and biases do not have a confounding effect on the research process. In addition, caution is taken by positivists to control and limit the impact of the contextual, political or historical factors on the meaning and knowledge creation process (Cohen, Manion & Morrison 2002). Accordingly, experimentation and manipulation (control) are core characteristics of methodological approaches employed under this paradigm (Guba & Lincoln 1994).

Given the aforementioned key characteristics of a positivist paradigm, it is clear that embracing positivism as paradigm would not support my stance (as presented in the literature review section) that learning and students' self-regulation are not objective processes, immune to the influence of structural, contextual and situational factors. It follows therefore that the paradigm that informed this study can be located within the non-positivism category of paradigm. The paradigms within this category can be broadly classified into two distinct types; the interpretative and the critical paradigms (Crotty 1998; Guba & Lincoln 1994).

The interpretative paradigm presents a transition from considering reality as objective to one that is subjective. In other words, an interpretative paradigm places great currency on the role of human consciousness and sense making in the shaping of reality. Accordingly, the ontological position of the interpretative paradigm is that of relativism. In emphasising the important role of consciousness in the shaping of reality, interpretivists, also referred to as constructivists (Guba & Lincoln 1994; Crotty 1998), contend that there as many realities as there are individuals (Eisenhart 1988). According to Guba and Lincoln (1994) constructivists hold the ontological view that, 'realities are apprehendable in the form of multiple, intangible mental constructions, socially and experientially based, local and specific in nature' (p.110). Concomitantly, they contend that the epistemological stance of the interpretative paradigm is transactional and subjectivist: they espouse that meaning is created out of interaction between the researcher and the participants.

Accordingly, those who embrace the interpretative paradigm put great emphasis on intentionality, the interaction between consciousness and phenomenon (Crotty 1998). For this reason, interpretivists are known to engender a holistic view in approaching reality; reality is time and context-bound and not subject to a general set of rules. Instead of rules, a great emphasis is put on description, interpretation and consideration of emic perceptions and perspectives (Thomson & Perry 2004; Eisenhart 1988).

A key focus of research based on this paradigm is the examination of the perspectives of the individual research participants, including their beliefs and values. The process requires the researcher to act as a "passionate participant"; working within the research environment buoyed by a deliberately shaped rapport with the research participants (Guba & Lincoln 1994; Thomson & Perry 2004). The ultimate goal of constructivism is understanding and reconstruction of meaning with a view of building consensus amongst participants and the researcher.

The interpretative paradigm comes close to my epistemological stance, in as far as it allows for meaning making through a subjectivist and transactional interaction between the researcher and participant. With regard to mathematics learning, for example, the suggested interactive link in meaning making suggests that the conceptualisation of mathematics in a learning context is influenced by the teachers', students' and "situated" others' values (Guba & Lincoln 1994; Eisenhart 1988).

That said, given that my study was fundamentally shaped as an intervention I was more comfortable with identifying with an ontological stance of an apprehendable reality of mathematics learning which we can move towards through the exploration of the external and internal factors that currently constrain the students' self-regulation during their learning of mathematics. In other words, my situating the study within the critical paradigm was informed by the fact that instead of seeking to arrive at a consensus on what self-regulated learning is, I was ultimately interested in exploring the transformative influence of the interventions on the students' self-regulation (Scott 2014; Du Preez & Roux 2008).

Critical paradigm, alternatively referred to as the critical theory paradigm, is a blanket term for an alternative number of paradigms including but not limited to critical realism, feminism, neo-Marxism and participatory inquiry (Guba & Lincoln 1994). Sharing an ontological vision of historical realism-virtual reality, the various forms of critical paradigms pay varied attention to the role of social, political, cultural, economic, ethnic and gender values in shaping this reality over time. This ontological variation notwithstanding, the different critical paradigms share a number of epistemic assumptions, including an affirmation of an interactive link between the researcher and the research participants and upholding the role of researcher and research participants' inherent values in influencing the inquiry process (Meyer & Lunnay 2012; Guba & Lincoln 1994)

From the variants of critical theory paradigm, I chose to underpin my research on the philosophical assumptions of critical realism (CR). The CR paradigm is considered to have emerged in the 1970s and the 1980s through the work of Bhasker who developed it as a 'scientific alternative to both positivism and constructivism' (Fletcher 2016, p.2). According to Meyer and Lunnay (2012), in seeking to understand reality, Bhasker posited that people and societies were made '*possible objects for knowledg*e' (p. 3) thereby promoting an *ontological focus 'on what produces events (experiences) rather than events per se' (p.3*). The CR paradigm has since been elaborated by a number of other authors, including Margaret Archer (e.g. Archer 2002) and Andrew Sayer (e.g. Sayer 1997); all of whom have adhered to its key tenet of seeking to understand social phenomena through causal analysis (Fletcher 2016).

This analysis is anchored on an ontology which presupposes reality that is stratified into three levels (Fletcher 2016; Archer et al. 1999). First is the *empirical* level, which is taken to be made up of empirically measurable/observable actions, meanings and ideas as experienced and interpreted by humans. The second level, the actual level, is considered to be constituted of events which are often different from what is observed at the empirical level primarily because the events are not dependent on human experience or interpretations. In other words, they often occur out of the purview of human filters. The third and final level is referred to as the *real* level. It is presumed to be made up of the causal structures and/or mechanisms whose inherent causal forces produce the events observed at the empirical levels.

The influence of these causal factors is deemed not to be straightforward and deterministic in manner, rather they are considered to be conditioned by the 'uniqueness of geographical and historical context' (Parr 2015, p.195).

As shown in the figure below, some authors have used the "iceberg" to metaphorically depict the stratified CR ontology.

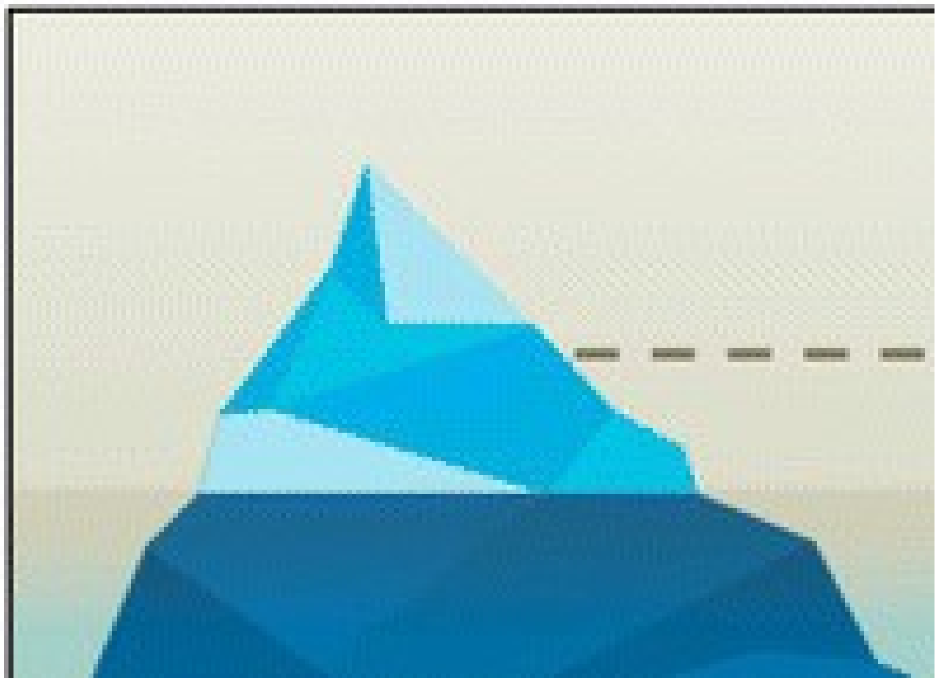


Figure 5. Metaphoric representation of CR ontology (Fletcher 2016, p. 6)

According to Fletcher (2016) the iceberg metaphor is also an apt representation of the critical realist's view of a problematic reduction of ontology to epistemology. The metaphor highlights the fact that what we can observe empirically is only a small part of a deeper reality. As such, critical realists (Archer et al. 1999; Parr 2015) espouse the fact that the generative mechanisms which are generally taken to be structural and agentic in nature are inextricably linked to the activities they govern. Similarly, they argue that the generative mechanisms are also social products that can be ultimately understood through investigation of phenomenon at empirical level. Consequently, they proffer that the investigation of these generative mechanisms should be guided by theories which being fallible may be selected and formed through rational judgments of the social events at the empirical level.

The implied focus in explanation and causal analysis with a view of establishing what "could be" and not just thick empirical descriptions and 'interpretations of symbol and meaning' (Anderson 1989, p.249), is in line with my study's objective of exploring and fostering self-regulated learning of mathematics amongst secondary school students in Kenya.

Specifically, taking a critical realist stance, allowed me to employ a cultural and political lens in my exploration and shaping of interventions to foster the students' self -regulation during their learning of mathematics. Further, the interest in causal powers of culture in influencing the agency (Edgley et al. 2016) of students towards self-regulation informed (as is discussed in the next section) my choice of critical ethnography as the methodological approach for the study.

Methodological approach

Having identified with a critical realism ontological and epistemological vision as discussed in the foregoing section, I considered that a suitable methodology would allow for a dialectic dialogue between the participants and me and result in deeper insights in regards to historical/structural aspects of their sense of agency in as far as learning of mathematics is concerned (Guba & Anderson 1994). The ultimate goal of my study being interest in transformation of students' relationship with mathematics, the methodology and data collection methods employed aimed to help me arrive at explicating not just what was necessary for self-regulated learning of mathematics to be enhanced amongst Kenyan secondary school students but also the possibilities or potentialities amongst them in as far as self-regulated learning of mathematics was concerned (Edgley et al. 2016).

The journey to arriving at the methodology was not a linear process. Given that the vision for the research unfolded gradually through the research process, some aspects of it only became clear at the end of the field work and some as late as during the analysis and writing up period. That said, a clear understanding right at the beginning of the research process was my interest in the lived experience of the students in as far as self-regulated learning of mathematics was concerned. As a result, for a period of my research process I found myself drawn to the phenomenological methodology especially the interpretative methods (hermeneutics) given its provision (unlike eidetic phenomenologists) to paying attention to the meaning implied by the narratives of experiences of the participants. Also attractive to me was the fact that in exploring human action, hermeneutics emphasise situated freedom instead of radical freedom, thereby upholding the role of context in individuals' subjective experiences (Lopez & Willis 2004; Laverty 2003). I, however, found the hermeneutic focus on individuals as a unit of analysis not appealing given my research interest of interacting with ‘whole’ classrooms. As a result, still drawn to the aspect of lived experiences, and whole classrooms as units of analysis I found my attention being drawn to phenomenography, a qualitative method used to discover the research participants’ experiences and conceptualisation of various aspects of a phenomenon (Marton 1986). Indeed, in the research proposal submitted as part of the University process of confirming my PhD studentship, I had indicated that my methodological framework was going to be that of phenomenology and ethnography. However, out of my reflections during and after my field work I was convinced that both phenomenography and hermeneutics could not fit within the paradigm that had unwittingly guided my research process. A glimpse of the deep considerations in locating my methodological framework post-field work can be found in the following excerpt from an email I wrote my supervisors a month after coming back from the field:

> The rumination continues…and I think I may probably decamp from the phenomono/logy/graphy field altogether and adopt grounded theory and ethnography…while phenol…graphy fits some of the aspects, it fails miserably on going beyond tapping into the unfolding reality and taking into considerations of culture…’
> (30th September 2016).

In addition to its limited considerations of culture, I found phenomenography's emphasis on bracketing of the researcher's conception (Omek 2008) of the phenomenon and giving pre-eminence to the research participants' conceptions instead, out of step with my mode of interaction with the students during field work:, instead of enthroning the individual participants' views on self-regulation during learning of mathematics, we engaged in a critical and systematic unveiling of self-regulation geared towards identifying not only the possibilities but also the potentialities amongst the students in regards to self-regulated learning of mathematics (Anderson 1989). The fact that my contributions during this dialogic interaction were theory-laden disqualified my consideration of identifying with a grounded theory.

Ultimately, critical ethnography emerged as the most suitable methodological framework for locating the methodological approach of this study. As is alluded to in the name, critical ethnography is a form of ethnography informed by the critical paradigm. This means that while the conventional ethnography would focus on exploring cultural meanings (values, behaviours and beliefs), critical ethnography would examine the same cultural meanings but through the lens of power relations (Tavakoli & Sadeghi 2011). Further, unlike the ethnographer whose main goal is usually descriptive accounts of the lived culture or in the case of interpretivists ethnographers, whose focus goes beyond thick descriptions and meanings of symbolic actions (Anderson 1987), critical ethnographers are also driven by a sense of ethical responsibility towards addressing unfairness and catalysing positive change. As such, critical ethnographers pay attention to the lived realities of the research participants, seeking to establish the conditions that inform 'both the constructions and possible transformations of these realities' (Anderson 1988, p.252).

The quest for transformations by critical ethnographers is said to be informed by their view that the construction and constitution of the cultural unit are integrally influenced by “outside forces” (Carspecken 1996). This assertion was in line with my exploration, during the field work, of "outside forces", including cultural industries (Carspecken 1996) like entertainment that influenced self-regulation by the student with the classroom as the main cultural unit of learning. Indeed, my interest in a holistic understanding of the contextual factors influencing students' self-regulation as a requisite for shaping interventions resonated with the critical ethnographer’s pursuit of a transformation agenda informed by considerations of the complex relationship between structural/historical forces and human agency (Anderson 1987; Carspecken 1996). The consideration of this complex relationship, considered to be dialectical in nature, is systematised in critical ethnography to enhance reflexivity during the inquiry process and by extension the validity of the findings (Anderson 1987; Carspecken 1996). In the case of this study, I would submit that given the agentic nature of self-regulation, the interventions and the data collection methods employed were largely geared towards catalysing the students’ internal transformation in terms of the students’ beliefs towards self-regulated learning of mathematics and by extension mathematics as a subject. As will be explicated in the next section, there were also significant opportunities for transformation of aspects related to social structures (Carspecken 1996) in the three schools.

The foregoing explication on the suitability of critical ethnography for my study notwithstanding, its adoption came with some risks. The first set of risks can be linked to the ethnographic aspect of the methodology. They include, the restrictive attributes of language and the morphing effect of context (see: Rudklin 2002).

Ethnography allows for the use of different languages as a key tool for data collection. This has been found to be limiting in two main ways. First, the strength of one's understanding of ideas or meanings communicated by data is affected by the language capital that both the researcher and research participants bring to the research process. In other words, the language frames may limit the communication or the perception of the previous experiences, observation and thoughts by either party. Given the esteemed place of dialogue in critical ethnography (Carpersikan 1996; Rudklin 2002) the language limitation can be considered to potentially have a greater effect than in other forms of ethnography. Indeed, in my research process, there was a lot of code switching during the discussions, especially as I tried to explain some of the theoretical concepts that were intended to defuse forms of ignorance and misapprehensions in regards to self-regulated learning. On most occasions, especially with the two public schools, I spoke in the national language Kiswahili (and asked the students to speak to me in Kiswahili or Sheng, colloquial Kiswahili popular with the youth) instead of English, the key language of instruction and curriculum delivery. I also found myself using dramatic devices like facial gestures and tone variations to enhance my communication of ideas to the students.

Second, language has been found to be limiting in ethnography in connection to the wide use of narrative text, especially in reporting ethnographic accounts. In particular, there has been concern that the use of narrative text may result in the domination of the author's voice over that of research participants, also giving more visibility to dominant groups. I sought to reduce this limitation in three ways; employing "thick descriptions" as propagated by Geertz (1994); the deliberative dialogues as a key intervention procedure and data collection process and metaphoric drawings as data collection helped in 'fragmenting authoritative voice*s'* (Rudklin 2002, p.9); and finally written reflective narratives (by all the participants) as one of the data collection methods and the subsequent considerations of every participant's narrative during the analysis reduced biases towards any dominating group or individual.

The shifting environment of a critical ethnography study has also been found to be limiting especially because it makes the study's narrative temporal, a fact that makes generalisations difficult (Eisenhart 1988). The fact that critical ethnography does not put such considerable weight on descriptive narratives, as conventional ethnographies do, reduces the impact of this morphing shift. Indeed, given the ontological vision of realism (historical) and the generative mechanisms of the social structure it is my view that the shifts could actually provide opportunity for enhancing the causal analysis. In the case of this research, there were some dramatic shifts (e.g. change of teachers; merging of streams; sending away from school a significant number of the male members of the class) in each of the schools during the field work. Observations and reflective narratives from students on some of these changes brought to my purview aspects of the causal mechanism that had remained hidden before those incidences.

The other set of risks associated with adopting critical methodology is linked to its "critical" component especially in regards to its concerns with on one hand, empowerment and emancipation and on the other hand, minimising domination and subjugation of research participants (Tavakoli & Sadeghi 2016). Put another way, the focus on transformation has been found to be problematic for a number of reasons. First is the fear that the focus on change may not be very welcomed by propagators of the status quo; second, power issues between the researcher and participants are sometimes detrimental to the required collaboration; third, there is no guarantee for emancipation and there are some possibilities of change for the worse; and fourth is the propensity for "criticalists" to stereotype participants as homogeneously belonging to a particular marginalised group (Scott 1995; Tavakoli & Sadeghi 2016; Scotland 2012).

Indeed, in the course of carrying out this study, I was faced with challenges related to the aforementioned shortcomings. First there was always the fear of the extent to which I would get support from the mathematics teachers in seeking to foster self-regulated learning amongst the learners. The fear was borne out of the understanding that seeking to foster self-regulated learning amongst the Kenyan secondary learners was in essence leaning towards student-centred learning, a concept that has generally not received wide support amongst Kenyan secondary school mathematics teachers (Sifuna & Kaime 2007). While I did not experience any direct resistance from the teachers during my field work, there were instances where I had to take time to persuade the teachers/school to change some of their policies to create a more enabling environment for self-regulated learning. A case in point was the challenge I faced in convincing the teachers from one of the schools to try and reduce the number of contact hours they had with the students and also the amount of after-school assignments (in all subjects) that they gave the students. This piece of advice was implemented half-heartedly in the first phase of my field work given that the teachers believed that the students would not use their personal study time constructively. It was only after a considerable period working with them to help the students take more responsibility for their studies that the teachers were able to reduce their teaching hours and assignments, especially during the prep time (designated private study time). Similarly, there was some level of resistance from students from the same school when I stepped in "firmly" to reorient their study culture during the night preps: With the permission of the school Principal I stepped in to enforce new "rules" for night "prep". The rules included minimal out-of-class movement during the official prep time and designated sessions for self-study and collaborative work. It took close monitoring by the teachers and I in the first few weeks of the intervention to get the students to fully adhere to the rules. To help catalyse the transformation in the students' mind-sets and facilitate the embracing of the new study culture, I periodically stepped in to the different classes to share with them how and why (making reference to related research findings) I applied the same rules as a student way back in secondary school and even as a PhD student. To help model the process of quiet study, I chose to sit in their classroom for my self-study during the prep times. Occasionally, I also led the students in discussion to review and reflect on the experience and establish how much more constructive academic work they had been able to accomplish under those new rules. It took about three weeks of close implementation before the students could fully adopt and appreciate the new study culture. The resistance at the beginning notwithstanding, this reorientation of the study culture was applauded by a majority of the students, teachers and parents by the end of my field work. Indeed, one of the students pointed out at the end of my field work that one of his key lessons from me during the research period was an understanding *'that prep is important'*.

The second concern revolved around sustaining rapport with the students in my focal class and working with them as co-researchers. There were moments when my engagement with them on some aspects relating to their self-regulated learning was somewhat confrontational. A case in point is when I stepped in to reorganise student groupings for the collaborative mathematics sessions in one of the schools where students were having a challenge interacting amongst themselves due to strained relationships. Taking time to explain the reasons behind my actions helped in defusing the level disquiet amongst some of the students. In addition, I did not underplay the aspect of strained relationship amongst the students. Having embraced the critical realists' ontological view, I was keen to explore the factors that were contributing to the strained relationship. As a result, I engaged them in a deliberative dialogue to unearth the reasons behind the strained relationship and seek their suggestions on how they could work towards improving their relationships as classmates. In other words, putting on the hat of a transformational leader, I did not just listen to their submissions as "data" but engaged them in a deeper reflection on what they could do to improve their relationships. I also brought to the attention of the teachers some of the school practices that the students perceived as obstructive to the school's efforts towards nurturing positive relationships amongst the students. The third concern is linked to the aspect of emancipation and empowerment. Critical ethnographers and their co-researchers have sometimes found themselves frustrated by their inability to fully achieve these goals at the end of the research (Tavakoli & Sadeghi 2016; Scott 2004). Part of the frustration is usually linked to the powerlessness that researchers feel towards changing policies that would facilitate the transformation (Anderson 2007). Indeed, in the case of this study as will be expounded in the analysis and discussion chapters, self-regulated learning of mathematics was found to be negatively impacted by the schools' instructional policies such as the assessment and teaching policies. Failure to change some of these policies, in the long run led to the frustration of some of the students, especially when they did not realise change in their mathematics examination scores even after reorienting themselves to become more self-regulated in the learning of mathematics. The following excerpt from a letter from one of the students two months after the end of the intervention aptly captures the kind of frustration experienced by some of the students:

> …Am not moving forward nor backward am just stagnant. I have been enjoying the mathematics lessons with the maths teacher but am still stagnant. I will finally give up in maths and leave it to God…'
>
> (Student participant from Ademba Secondary School)

Despite the afore-discussed limitations of critical ethnography I am persuaded that I took adequate measures to mitigate their impact on the quality of my study and that critical methodology offered me the most suitable framework for achieving my dual research goal of exploring the "possibilities" and the "potentialities" (Anderson 1987) in as far as self-regulated learning of mathematics in Kenyan secondary schools is concerned.

Summary

In this chapter I have been able to explicate the process of arriving at critical realism as the philosophical underpinnings of my study and by extension discussed how my philosophical inclination led to my arriving at critical ethnography as the suitable methodological approach for my study. Specifically, my identification with the crtical paradigm was largely hinged on my interest in exploring the influence of practise (fostered through specific interventions) of self-regulated learning on their relationship with mathematics. Further my locating the study within the philosophical underpinnings of critical realism was informed by the fact that the self-regulated learning frameworks which guided this study suggested that practise of self-regulated learning by the students was in part influenced by power relations within the Kenyan education eco-system. In the latter segment of the discussions in this chapter, I have also presented my reflections on the specific strengths (cf. Carspecken 1996) that critical ethnography brought into this study. Similarly, I have also presented an overview of how some of the risks that have been associated with critical ethnography (cf. Tavakoli & Sadeghi 2016; Anderson 2007) played out during the study and the steps that I took to minimise the impact of the aforesaid risks. In the next chapters, I discuss further how critical ethnography influenced my process of entering the field and my choice and implementation of the interventions, which doubled as my data collection methods.

CHAPTER FIVE: FIELD WORK AND ETHICS APPROVAL

Introduction

In this chapter I discuss the steps I took to prepare myself for field work, the process of field entry, including ethics approval, and the attributes of the three schools which functioned as the social site for my research. Further in the discussion, I explicate how the general process and considerations for field entry were informed by some of the key attributes of critical ethnography (discussed in the preceding chapter), for example, the need to tap into the local knowledge, power sharing with the students, critical reflection and developing of meaningful/appropriate actions to spur transformation (Tavakoli & Sadeghi 2002).

Pre-entry preparation

It is reasonable to say that my preparation for field work began way before I started my doctoral studies. Of specific value to my field work was my prior work in the Kenyan education sector, which involved implementing small-scale interventions aimed at improving students' and the wider populations' interest in mathematics and science (see Chapter 1: Introduction) and education consultancy assignments, which involved working with education leaders including school principals and school management boards of hundreds of secondary schools across the country. Through these activities I got a fair grasp of some of the contextual and cultural factors influencing learning in Kenyan secondary schools and built working relationships with an extensive network of education leaders across the country. In addition, the activities helped in honing my skills to tap into local 'lingo' to connect with students, teachers and parents in discussing matters related to mathematics learning. In other words, because of the above mentioned pre-doctoral studies engagements, I did not arrive at my sites of study (school and communities) as a total stranger (Blommaert 2006; Morgan-Trimmer & Wood 2016).

In addition to being able to communicate and relate fairly comfortably with the participants, I was also fairly at home with the unique demands such as the use of non-traditional modes of travel (motor-bikes and /or walking long distances) and accepted modes of dressing in the schools. As will be seen in subsequent sections, this knowledge went a long way in expediting the process of field entry, especially in regards to acceptability and integration in the three schools. Moreover, the facilitation and communication skills gained through these prior engagements with both the education stakeholders and students from rural secondary schools helped equip me for my role as a research instrument especially in sustaining a dialectic dialogue with the research participants throughout the research process (Blommaert 2006; Bamkin & Goulding 2016; Anderson 1987). Furthermore, these prior engagements contributed to decisions around the focus of my study (for example, my decision to focus on learners and not teachers) and acted as an initial compass for my exploration of literature in the early stages of my doctoral studies.

The exploration of literature prior to my field work played a critical role in making sense of (Salvador, Bell & Anderson 1999) concepts around mathematics learning (garnered from my pre-doctoral engagements) in Kenyan secondary schools and ultimately helped in refining my research direction (Uhan, Malinar & Kurdija 2013; Blommaert 2006). Paying attention to sensibilising concepts around mathematics before field entry is in step with both the critical realist position of furthering the gain of knowledge 'through more or less truth-like theories' (Fletcher 2016) and the emphasis by critical ethnographers on the value of technical knowledge (alongside political) in facilitating sound educational and social change (Anderson 1987). Specifically, the technical knowledge gained as a result of the theoretical exploration in my early stages of doctoral studies acted as an invaluable lens for critical reflection (see Chapter eight: section of data collection methods) during the dialectic dialogue (Uhan, Malinar & Kurdija 2013; Carspecken 1996) on aspects related to self-regulated learning of mathematics in Kenyan secondary schools. It played a key role not only in raising the students' consciousness but also in shaping the strategic actions (Tavakoli & Sadeghi 2011) geared towards transforming their self-regulation of mathematics. As such, it is reasonable to say that the technical knowledge gained through the theoretical exploration in the early stages of my doctoral studies contributed to preparing me for the transformational leader role (Anderson 1987) that I had to play in carrying out the research in the three secondary schools in Kenya.

Introduction to the three Schools

Ademba Secondary School

Ademba is a faith-based community mixed boarding secondary school. It is owned by a church community which acts as a core church to a network of churches spread across Kenya and the wider East African region. The school was primarily started to offer values-based education to children of the members of the church community and affiliate churches. As a result, almost 70% of the students are drawn from these churches with the remaining 30% being admitted through an interview process. The inclination by the parent and student towards a biblical based lifestyle is a key determining factor in the admission of the students.

Likewise, the teachers, who must have at least a Bachelor's degree in Education, are selected based on their track record of grounding in biblical ways and understanding. A significant proportion of the teachers and other support staff in the school are either members of the founding church or of affiliate churches. Other members of the church community, especially those who are teachers in other secondary schools, play an active role in the school by supporting the resident teachers and volunteering a number of teaching (tutorial) hours per week to the school.

Alongside academic development, the school plays a key role in shaping its students' spiritual and character development. To achieve this, the school has mainstreamed specific spiritual and character development programmes in the curriculum which are not just facilitated by the teachers but also external resource persons drawn from the top leadership of the church community.

As a result, the school thinks of itself as one big family, based on the primacy of spiritual identity that the students, parents and staff share. There is therefore a very strong community feeling in the school and generally a very warm relationship between the students and the teachers. Great emphasis is placed on internal government. As a result, unlike many schools in Kenya the school does not have external regulation tools like bells, explicitly outlined and publicly placed school rules and strict punishments like caning or other forms of corporal punishment. The students are continuously reminded through the values-based development forums, a key part of the school programmes, of what is acceptable and why.

Another departure from the tradition in most Kenyan secondary schools is that the school does not rank students at the end of the term after sitting the end-of-term examinations. Instead the school places a high value on collaboration and value for the individual students who can be considered to be of "mixed abilities". In the school term preceding my field work, the school administration decided to 'loosely' stream the students based on their attainment ostensibly to facilitate differentiated teaching and to motivate students to put more effort into their learning. This streaming was to be reviewed every term based on students' scores in their end-of-term exams. The Form Two stream that I was assigned to at the beginning of the field work was the lower attainment stream. According to the school principal the decision to assign me that stream was partly informed by their consideration that this stream would most benefit from the intervention (given their attainment level) and also the fact that in comparison to the other stream they were considered to be a more cohesive unit (a majority were affiliated to the sponsoring church community). I should point out that half-way through my field work, the school reorganised their system back into mixed attainment model and the two Form Two streams were merged. In comparison with the other two participating schools, Ademba stands out as a relatively affluent school, given that a majority of the parents would be considered within Kenyan middle class population. The school boasts a fairly good infrastructure: spacious classrooms and dormitories; one-to-one student textbook ratio; qwell equipped science laboratories; a good and balanced diet; a very large school compound; and a fairly elaborate extra-curriculum infrastructure. Being fully funded by the parents and members of the sponsoring church community one can surmise that the school's infrastructure is reflective of the relative affluence of a majority of the students' families.

Figure 6. Image of Ademba school and parents' cars during a school function

In terms of academic performance, at the beginning of my field work, the school was not considered a top performing school going by the results posted by their first KCSE exam candidates in 2015. Only three out of their 25 candidates scored grades acceptable for direct admission to the Kenyan universities. Mathematics was one of the most poorly performed subjects followed by other sciences. These KCSE results were consistent with the trend in the results posted by the students from lower classes (Form 1-3) in the internal examinations administered at the end of every school term. A final significant fact about Ademba is my close association with it: my family is a prominent (leadership position) member of the founding church; I was one of its pioneer teachers (physics) when it was started in 2014; and two of my daughters are students at this school. During the field work therefore, I had a dual identity: as an insider (member of the founding community and parent) and outsider (functional role as a researcher). However, it is important to clarify that my acquaintance with the Form Two students from my target class was limited to my association to them through church membership and not as a former teacher. Similarly, a good proportion of the resident teachers were also new to me and so I had to make a deliberate effort to connect to them.

Origa Secondary School

Origa is a fairly "new" government sub-county school. It was established in 2013, making it less than four years old at the time of my field work in 2016. Like Ademba secondary school, Origa had its first KCSE candidate class in 2015. Origa can be categorised amongst the very low-tier government-funded sub-county schools. It boasts very basic infrastructure. The buildings, though having concrete walls, are very basic in their construction and furnishing. For example, at the time of the field work: the school principal, her deputy, the senior teacher and clerk had to share one room, which could only accommodate a 1.5 metre by 1 metre table. The staffroom appeared crowded even though the teachers were less than 15. The classrooms were equally crowded with over 50 students in a class, many of whom did not have proper desks or chairs.

Unlike many sub-county secondary schools in Kenya which tend to draw students from a fairly homogenous group (ethnic/rural community), Origa, located in a metropolitan area, has a very diverse group of students in terms of ethnicityand even religion. Further, given the location of the school (and a significant number of the students' homes) near Nairobi, the capital city of Kenya, the students' neighbourhood and by extension the school's culture is largely influenced by the urban culture. Indeed, a walk through the immediate school neighbourhood brings to the fore a sense of poverty and lifestyles associated with inner cities, a proliferation of many small businesses (many of which were small "pubs") intertwined with small and very basic rental houses and homes. The impact of poverty on the students' lives can be deduced from their mostly aging, patched-up or torn uniforms, the poor-diet school meals (mostly beans mixed with maize and porridge) and the strained school infrastructure. A number of the students have to walk over three kilometres to school.

The proximity to the main tarmac road joining the region to the capital city Nairobi notwithstanding, accessing the school during the rainy season is treacherous. The earth roads, cut on black cotton soil, are rendered impassable even on a hired motor bike, the transport mode of choice for a majority of the people living in the area. Indeed, during my field work, I had to resort to wearing gumboots (like all the teachers) during the rainy season to access the school (see associated photo in the section on data collection methods). A majority of the students could not afford gumboots and so had to walk barefoot which, as I experienced one day, is not only uncomfortable but an uphill task given the sticky nature of the soil. The only respite for the students is that the rainy season is generally short and is expected once a year. The wider region within which the three schools are located is predominantly semi-arid.

Another key feature that seemed to have been affected by the location and neighbourhood of the school was the actual school culture. The aforementioned ethnic heterogeneity amongst the students and the influence of the urban culture seemed to have caused a difficulty in unifying the parents, teachers and students into a coherent school community. In addition, the students and even the parents (from those that I met) were living on the boundary of two cultures: there was also a sense of tension of identities or placement with some of students (and even parents) trying very hard to appear urban and affluent (type of hair style for the ladies, for example; use of corrupted version of Kiswahili (Sheng) instead of their native languages).

That said, some of these efforts were generally marred by the visible financial constraints. The students' relationship with the teachers was strongly top-down, reflecting an authoritarian sense of leadership; the cane (thick stick) had a significant place in the teacher-student interaction. In part, this sense of authoritarianism by the teachers was considered a necessary measure because of what the teachers deemed the negative influence of a "care-free" lifestyle linked to the neighbourhood and by extension students' homes.

According to the teachers, the "care-free" posture to some extent was also partly informed by some of the cultural beliefs that most of the families ascribed to, especially concerning the 'boy child', and in some cases the fact that many parents spent a lot of time away from home trying to earn a living for the families. The teachers further opined that the indiscipline situation had been aggravated by the fact that the school, in trying to increase enrolment, had opened its gates to students who had been expelled from other secondary schools for indiscipline.

In terms of academic performance, Origa Secondary School would be considered as a poorly performing school. The general performance in their first KCSE exam was very poor (though they managed to get two of their students into public universities), with the worst results being in the sciences led by mathematics. The students were also constrained in their communication (speaking and writing) in English even though it is the main medium of instruction and assessment.

Rayolah Secondary School

Rayolah is also a sub-county secondary school. Amongst the three participating schools it has been in existence for the longest time. Situated along the highway that connects the region to Nairobi, the mixed day school with a small boarding section for girls, largely attracts students from the wider district within which it is situated. A majority of the students are natives of the region and belong to one ethnic community. A small percentage of the students, especially the girls, come from other regions especially Nairobi. It is this small percentage of girls that mainly stay in the boarding section. The school also has a faith orientation having been founded by one of the churches in the region. The church has since handed over the running of the school to the government and therefore does not play a key role in teacher recruitment or key school policies. That said, the church still have a significant influence in the school. The church building, used by the wider community, shares a compound with the school. The school has weekly prayer sessions in the church led by the church pastor, whose attendance is mandatory for all students. Like Ademba, there is an obvious acknowledgement of the role of faith in the running of the school both by the students and teachers. The difference from Ademba is that the church and general faith orientation are not a key consideration in student admission and teacher recruitment. Unlike the other two schools, ethnic affiliation appears to be a significant factor in teacher recruitment; a majority of the teachers and the leadership in particular are from the native ethnic community. While this may not necessarily be by design it is perhaps by preference.

The main economic activity of most of the parents is farming and small farm- related business. Being generally semi-arid, the area is known to suffer frequent cases of famine, a factor that has contributed to high poverty levels. A high level of absenteeism amongst students is reported in the school especially because of inability to pay fees. On one notable occasion during my field work over a quarter of the class was sent home for non-payment of school fees.

A majority of the students have to travel long distances to school. A significant proportion of the boys ride bicycles to school, while others use public means, or, as I witnessed on one of the days, try to hitch lifts from private motorists driving on the highway. On the other hand, a majority of the girls either have to walk the long distance home or use public transport for part of their journey home. The school infrastructure is better developed than at Origa. I learnt from the deputy principal that a good proportion of the students' families are run by the women because the men had taken to excessive drinking of alcohol and become irresponsible. Perhaps this explains why a majority of those who came for the parent briefing session for the research were women.

The school has two streams for each form. Each stream has around 40 students. Though the numbers sound manageable, the classrooms, furnished with basic school desks for each student, were too crowded for their sizes. The student to (mathematics) book ratio at the time of the field work was two to one. The school had a fairly well-equipped computer lab, but the science laboratory was ill-equipped. During my field work the school held a ceremony, bringing together parents, political leaders and other stakeholders to raise funds for the building of a science laboratory.

Like Origa Secondary School, Rayolah's student and teacher relationship is top-down, with the cane being the common mode of instilling discipline. The student leaders (who have a special uniform) have a prominent place in the leadership of the school.

As is the case with the other two schools, Rayolah students have had a challenge with the science subjects, especially mathematics. It is important to note that the school enrols students from primary schools in the region with a majority of them being those who did not get high enough marks to get admission to higher tier schools. A small percentage, though, opt for the school because of their inability to pay the fees demanded by the higher tier schools.

A summary of similarities and differences across the three schools

Key similarities across the three schools are that they are mixed schools and that all have concerns with their current academic performance and especially in mathematics (and the wider sciences). A majority of the students admitted by Origa and Rayolah were already considered 'poor' performers in mathematics based on their scores in KCPE. Ademba, on the other hand, boasted a more heterogeneous population with regards to their students' KCPE scores; some of its students would have been admitted to the upper tier Kenyan public national secondary schools while a few would have the same scores as the majority in the other two schools. Another similarity between Origa and Rayolah that is not shared by Ademba is the poverty levels of most of the students' families. Notable though is, while a majority of Rayolah's families would be classified as rural poor, the Origa families would fit better with the cluster of rural-urban poor. Economic activities for most of the Rayolah families is agriculture-based while a majority of the parents of Origa engage in a diverse range of economic activities, including small businesses, working at construction sites and working in industries and offices in the capital city Nairobi.

Rayolah and Ademba share the Christian faith characteristic in terms of identity and contribution to the school culture. Ademba, however, differentiates itself in that the school curriculum is viewed and explicitly grounded on a biblical philosophy. For example, while both Origa and Rayolah, predominantly day schools, have a strong authoritarian culture, Ademba is inclined more towards internal government grounded on biblical spiritual guidance.

These similarities and differences provided a broad context for exploring the conditions and external factors that influence self-regulated learning of mathematics amongst Kenyan secondary schools. Indeed, my interaction with the research participants, right from the process of gaining initial entry into the schools, played out significantly differently as a result of the contextual differences and similarities outlined above.

Ethics approval and initial field entry

I obtained ethics approval from the Research and Ethics committees of both Sheffield Hallam University and Moi University, one of Kenyan public universities (see Appendix 1 and 2: copies of ethics approval). Obtaining an ethics approval from one of the public universities is mandatory for one to get a research permit from Kenyan National Commission of Science Technology and Innovation (NACOSTI). As is stipulated in both ethics approvals, I sought the consent of the schools' principals, the focal classroom mathematics teachers and the parents of the students for the focal class in each school. The process of getting the consent entailed having physically separate meetings with each of the principals and groups of parents from each of the schools. During these meetings, I took them through an information sheet on the study, allowing for questions during and after my presentation.

Consent from Origa and Rayolah principals and parents

I was accompanied by the district quality assurance officer (DQASO) and the principal of Ademba Secondary School (who I had earlier connections with) in my first scheduled meeting with the principals of Rayolah and Origa. The DQASO is generally considered a key gatekeeper to Kenyan schools in his or her district of jurisdiction. Indeed, the research permit granted to me by NACOSTI stipulated that before embarking on my field work I had to introduce myself to and take a copy of the research permit to the DQASO in charge of my target schools. Accordingly, in inviting the DQASO to my first meeting with the principals, I was seeking to give an indication of the credibility of the research and myself as a researcher (Blommaert 2006). Involving the DQASO in the entry meetings with the principals did, however, prove to be a little problematic. The two principals from Origa and Rayolah secondary schools failed to turn up twice for the meetings even after they had confirmed that they would be available. Though they gave different reasons for not being able to attend the meetings, one of them was later to quip that '*he did not see why somebody else should convene the meeting on their behalf', suggesting* some power tensions between the principals and the DQASO. In my third attempt to meet with the two principals I opted to directly consult with each one of them about the meetings and to ask the Ademba principal who had already given his consent to accompany me to the meeting. I reasoned that having the Ademba principal introduce me to his peers and vouch for my credibility as a person would not just facilitate my getting consent for the study but also catalyse the process of establishing trust and rapport (Morgan-Trimmer &Wood 2016) with the principals.

Kenyan secondary school principals through structured activities organised by a national association (with regional chapters) interact closely amongst themselves. Indeed, on this third attempt, I was able to meet up with the two principals, discuss with them my study and the required ethics approval process and get their consent for the study. An issue that was received with some level of reluctance by both principals in the initial discussions was my interest in meeting up with the parents to get parallel consent from them. The reluctance seemed to be informed by two distantly related factors. First was the fact that the majority of the research done in the schools was quantitative and in most cases the researchers did not ask for any other consent apart from the consent from the principals. Indeed, the following was the response of one of the principals when I indicated to her that I would need to get consent from the parents of the students from the focal class: '*what do you need the consent of the parents for?... just bring your questionnaires and we will get the students to fill them up for you.*'

The second reason, which is subtly implied in this statement, is the power tension between the school principals and the parents. From my earlier experience working with public secondary schools in Kenya, I observed that a majority of the principals favoured a top-down leadership style which a number of times put them at odds with "enlightened" parents. As such, some of them were uncomfortable with activities that explicitly targeted parents and had the potential of creating a platform for the parents to discuss matters related to students' learning in school.

I was able to resolve these concerns by explaining to them not only the fact that the parents' consent was a mandatory ethical requirement but also the value of involving the parents given the important role they play in facilitating and supporting the students in their learning. Further I assured them that we would focus the discussions of the day on the research and invited them to assign a teacher to co-facilitate the meetings with me. I also requested the principal to invite the parents to the school for the meeting in order to reduce my power as a researcher in the whole process and also to increase the possibility of the parents attending the meeting (Redman-MacLaren & Mills 2015).

During the consent meetings with the parents (Origa and Rayolah), I spent the first few minutes introducing myself, telling them a bit about my family and my secondary schooling history. The stories about my school life and family were not just to help the parents in "placing" me but were also used with the understanding that such stories have been found to play a significant role in developing relationship and trust in many indigenous communities (Redman-MacLaren & Mills 2015). Taking my cue from the teachers present during the consent meeting, I used Kiswahili, the national language, throughout to explain the study to the parents. This was not just to ensure they understood the content in the information sheet, but n additional consideration alongside others (such as the mode of dressing) that were aimed at ensuring a sense of cultural safety (Redman-MacLaren & Mills 2015) and enhancing boldness amongst the participants in taking part in the discussion and asking the right questions (Blommaert 2006; Rudkin 2002).

Indeed, in the discussions during the consent meetings, the parents pointed out a number of factors that they believed contributed to their children's poor performance in mathematics.

Overall the parents, perhaps dismayed by the state of the students' performance in mathematics, expressed great enthusiasm for the study, one of them stating that my going to their school to carry out the research was a sign that 'God answered prayers' and that I was not just a researcher but 'an angel sent to them by God'. This enthusiasm, though positive in terms of gaining access and trust, presented an ethical challenge (Scotland 2012): that of over-expectations and potential disappointment at the end of the research. Taking care not to dampen their hopes of their children transforming their habits towards mathematics learning, I carefully explained to them the fact that this was not a guarantee, especially given that the research period (intervention) was very short. I made an effort to make them understand that overall the study would be beneficial because it would contribute in helping understand what works or does not work in regards to self-regulated learning of mathematics. I explained that this information could be used by the school and other education stakeholders to improve mathematics learning for current and future students.

Consent process for Ademba Secondary School

Given my close association with Ademba, the initial entry process was slightly different. I had visited the school twice after starting my studies, the last one eight months before I went back to Kenya for field work. On each occasion, I spent some time with the students and teachers updating them on my studies and sharing with them some of my findings from my literature review and a pilot study that involved a sample of the students from the school. I also had an opportunity to talk to the wider parents' community. On one of the occasions, I took the schools' teachers through my research proposal and got feedback from them. This was before my PhD confirmation examination. It was based on the feedback from these meetings (and subsequent consultations with my supervisors) that I decided to work with Ademba as one of the schools for the study. The foregoing process notwithstanding, I still took the school's leadership, teachers and parents (focal class) through the ethics process as stipulated in my ethics approval by the university and the Kenyan government.

Students' assent

In each of these schools, I also sought the assent of the students. Immediately after getting consent from the principals, teachers and parents, I arranged for meetings with the students from the focal class. During these meetings, I introduced myself and the study to the students. In each of the schools, I tried as much as possible to make the meetings as informal as I could. In Ademba, for example, after being introduced to the students by the teacher, we rearranged the class and sat in a circle before beginning our conversation. I briefly explained the study to them, emphasising that we were to co-explore the aspect of learning mathematics together. I also asked them to suggest some of the activities that they thought would be valuable for our exploration. The students had a number of suggestions, one key one being organising for an interactive activity involving them and the participating students from the other two schools. This suggestion was also echoed by students from the other two schools. Even though I had not thought about this as I planned for my field work, I took this as a good challenge and began thinking out how this could be constructively built into the whole study.

I also employed this conversational mode for both Origa and Rayolah during my assent meetings with the students from my focal classes. I was, however, faced by a number of challenges. First, unlike the original set of Ademba students who were only 16, these two classes each had an average of 45 students. It difficult to rearrange the crowded classrooms to facilitate an “easy and intimate” process of interaction. Second, I was new to the students and a sense of the power difference (economic background and language) between them and me was strongly felt. This was aggravated by the fact that I had only three weeks to get the students’ assent and collect my pre-intervention data before they had their one-month official school break.

Having all these in mind, I decided to make the assent session a “deep hanging out” moment to facilitate a quick initial entry into their social world and gaining acceptance (Salvador, Bell & Anderson 1999). I employed a number of strategies: I focused not only on myself as a researcher and the study I but also shared with them my journey to PhD studies. I spent a considerable length of time sharing with them my experience as a secondary school student, injecting in some ‘fun’ illustrations of the adventures I had then. I was careful to make them see that I was not a “choppy” (an academic “nerd”) by telling them stories about other extracurricular activities that I participated in, including drama and cheering team member during sports activities. In addition, I deliberately shared with them some of the economic challenges that I had to go through as a young person in school. Further, I took the opportunity to convey the idea that I was aware of some of their current experiences as secondary school students by making references to some of the terms they popularly use in their informal discussions around other aspects of their lives like entertainment or boy/girl relationships.

For Rayolah, I was quick to point out the fact their school uniform was similar to my secondary school uniform. During this time, I code switched, sometimes speaking in Sheng (Kiswahili slang popular amongst the Kenya youth) and invited the students at different points to make comments or ask questions. I also employed a narrative inspirational speaking format using a lot of gestures and tone variation, throughout the session. I emphasised the fact that we were going to work as partners in exploring issues around mathematics and implementing some of the agreed upon strategies. To demonstrate this, when two students from Rayolah raised questions on how they could increase their interest in learning mathematics, I chose not to give them an answer and instead reiterated that through our co-exploration in the subsequent intervention sessions we would be able to arrive at possible solutions together. I also emphasised the fact that their participation was voluntary and that they were free to pull out of the study at any point if they ever felt the need to do so. At the end of the session, all the students expressed interest in participating in the study and their facial expressions and body language indicated to me that they had made the initial step in welcoming me into their "social world" (Morgan-Trimmer and Wood 2016; Blommaert 2006)

Assent from the wider school community

Despite the favourable response from the assent and consent meetings, I knew that to understand the wider social world within which my target students operated, I needed general acceptance from each school as a community. I therefore took the initiative, through the help of the mathematics teacher/school principals, to introduce myself and the study to the teaching staff at each of the schools allowing them to ask questions about the research. In Rayolah and Ademba, I also had a session with the wider student community, allowing them to ask questions about my study and any other matter around learning mathematics and sciences. In both the teacher and student sessions, I had some inquiries outside the main focus of my study; for the students, a number wanted to know if I would also teach them. The senior students at Ademba who had been my physics students before I left for my studies particularly wanted to know if I could resume teaching them the subject. Similarly, some of the students from the other schools wanted to know if I could teach them mathematics. As for the teachers, some wanted to know in what way I would help the other students, while some, who were currently registered as postgraduate students, wanted help around their own studies.

As an act of reciprocity (Corbin & Morse 2003), I offered to add value to the learning experience in the schools during the research period to the best of my ability, taking into consideration some of the limitations, for example, availability of time. In the case of the teachers, I spent quite some time on many occasions sharing with them my experience as a postgraduate student and also invited them to consider participating in a postgraduate forum whose activities I was spearheading.

Summary

In this chapter, I have outlined the key steps that I took at the initial stages of the study to gain entry and access to each of my schools. The key highlight of the discussions are the strategies I employed to build rapport with the school leadership, parents, students from the focal classes and the wider school community. The concerted effort was informed by my understanding as a critical ethnographer that how much naturalistic data (Eisenhart 1988; Blommaert 2006) on self-regulated learning of mathematics I was going to be able to collect and how much locally grounded and locally owned change (Barab et al. 2004) I was going to catalyse in the students' self-regulated learning of mathematics was dependant on the extent to which I was able to acquire an insider status in the respective schools (Blommaert 2006; Morgan-Trimmer & Wood 2016). My awareness of the short period within which I was to carry the study also necessitated the "deep hanging out" that characterised the entry phase (Salvador, Bell & Anderson 1999).

The efforts above notwithstanding, I progressed into the main data collection stage and intervention phase of my study with a clear understanding that I had not totally overcome the social distance between me and my participants. As a result, I made a commitment to monitor my on-going relationships with the various groups, with a view of reducing this distance and increasing trust between the participants and me throughout the research period. Indeed as explicated in the next section, my quest for acceptance continued through into the data collection phase, shaping the choice of the specific data collection methods and the structuring of the data collection process.

CHAPTER SIX: WORKING ETHNOGRAPHICALLY

Introduction

This chapter is a brief overview of my inquiry process in the field. Specifically, it outlines how I employed dialogic inquiry as an overall approach through the various stages of my intervention and data collection process. Further, I reflect on my role as a participant and as an observer throughout the inquiry process; and present a framework for considering my whole field-work engagement;

Working dialogically

The general inquiry process was intensely dialogic: it was hinged largely on communicative interactions (Wells 2000) between the participants and me and amongst the participants. The key thrust of our dialogues during the inquiry process was an attempt at co-constructing knowledge on self–regulated learning in mathematics. Based on my theoretical understanding of self-regulated learning of mathematics (and general learning of mathematics) I particularly sought through different forms of dialogue, to assist the students to appropriate their culturally informed knowledge on learning mathematics to enhance and transform their practice of self-regulated learning of mathematics.

The different forms of dialogue were employed in a cyclic and integrated manner during the field work. The forms of dialogue and the cyclic process of their implementation were similar to the one described and presented in an integrative framework proposed by Plamondon, Bottorff and Cole (2015). This framework presupposes a dialogic inquiry occurring in a cyclic process involving deliberative dialogues and other forms of dialogue. The two sets of dialogues are interspersed by a reflective process in the form of a 'retrospective and prospective gaze' (p. 1534). Notably, the whole dialogic inquiry process is preceded by a pre-dialogue synthesis stage which mainly involves synthesis of the evidence pointing to the need for the intervention; identification of stakeholders; and rallying of the stakeholders towards a common vision for action or in our case intervention (Plamondon, Bottorff & Cole 2015).

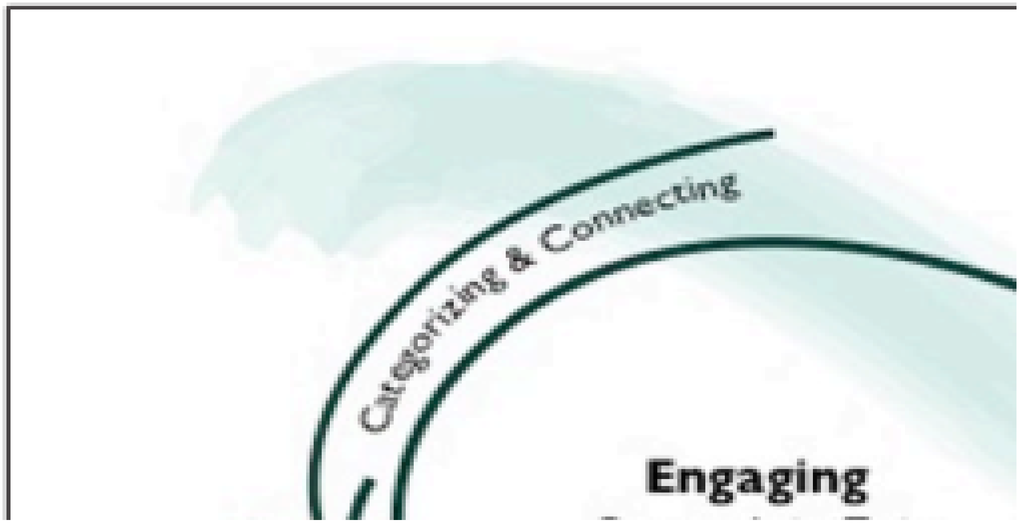


Figure 7. Intergrative framework of dialogues (Plamondon, Bottorff & Cole 2015, p.6.)

One can draw a parallel between the integrative framework of dialogic inquiry with a model of critical inquiry proposed by Carspecken (1996). Through his model, Carspecken suggests that critical research occurs in two main stages; the monological stage and the dialogic stage. As the name suggests, the monological stage is taken to involve very little dialogue between the researcher and participants; it entails collection of data primarily through non-obtrusive data collection methods. Another key feature of this stage is that it involves (through the data collection or otherwise) a conscious effort to enhance rapport with the participants and help in reducing power difference between the researcher and participants.

On the other hand, the dialogic stage entails an intense conversation between the researcher and the participants and amongst the participants. Primarily, it aids in democratising the inquiry process and enabling co-generation of data. The monological and dialogical stages are interspersed by data analysis, which also continues after the completion of the data collection in the dialogical stage.

It is important to point out that right from the early stages of my field work and throughout the data collection process, I had to take specific measures in reinforcing dispositions amongst the school communities that were supportive of dialogic inquiry.

During the early stages of my field work, for example, I desisted from giving a direct opinion on what I thought would work even when the situation presented itself in conversations with the students or even through a direct question from a student. Instead, I kept emphasising that we would find out what the possible solutions were when we came together as a class in the subsequent stages of the inquiry. As a result, by the time we gathered to start off the first set of deliberative dialogues, there was already a sense amongst the students that I would not act in the traditional sense (Carr & Claxton 2002) of dispensing knowledge nor would I occupy the place of overall authority in as far as understanding what it took for them to learn mathematics. In the next chapter on methods for data collection, I give more illustrations of the various strategies that I employed to enhance my working dialogically with participants during the field work. To set the context for the discussions of the specific methods of data collection, I present in the next section an overview of the methods.

Overview of data collection methods

My arriving at the integrative framework as proposed by Plamondon, Bottorff and Cole (2015) as the best representation of my ethnographic work in the field for this study was to a large extent informed by the prominent place given to deliberative dialogues in this framework. Indeed, my process of inquiry, being an intervention, involved engaging the participants in a cyclic form of deliberative dialogues (see discussion in next chapter) on matters related to learning of mathematics and self-regulated learning of mathematics.

The figure below is an adapted form of the integrative framework: it depicts the cyclic process of the dialogic engagement with the participants during the inquiry process. As is presented in the diagram, the first set of deliberative dialogues with the students in each of the schools was preceded by a pre-dialogue stage, which involved collecting data through participant observations and metaphoric drawings. The other forms of dialogue carried out in between the deliberative dialogues took the form of formal and informal interviews with some of the students and other members of the school community like teachers and parents. Analysis of the some of the data being collected occurred concurrently through various forms of retrospective and prospective gazes: I took time to reflectively gaze on some of the data emerging out of and during the various forms of dialogues; and asked the students at different stages of the inquiry to write reflections on specific incidents (that I deemed critical). Further, some of the interviews carried out with some of the students in between the deliberative dialogues were also shaped to reflect on some of the considerations during the deliberative dialogues.

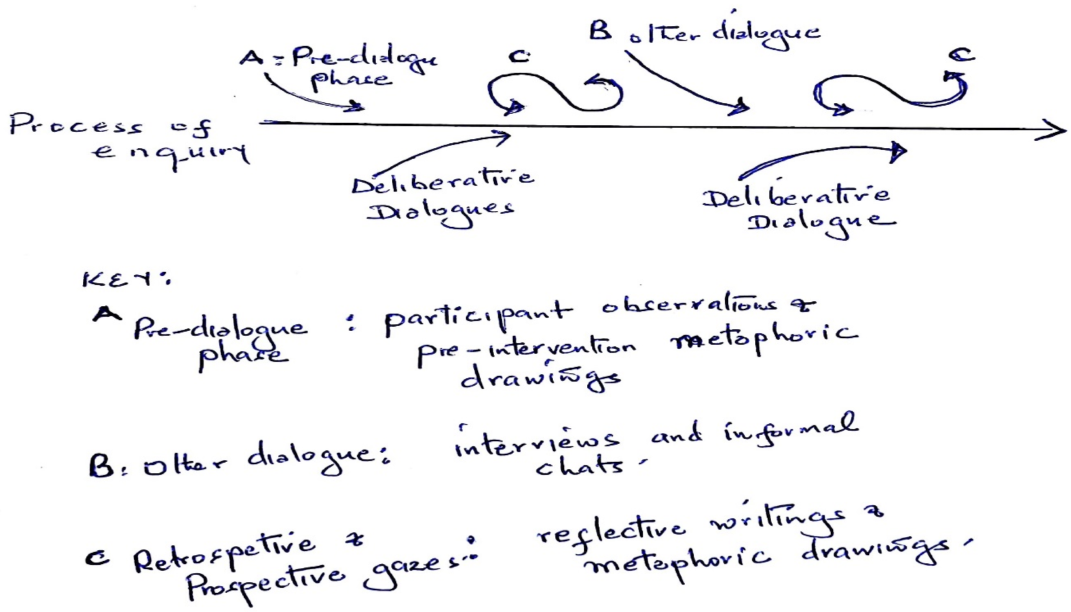


Figure 8. An adaptated form of the Plamondon, Bottorff & Cole (2015) intergrative framework of dialogues

That said, a core part of the retrospective gaze occurred through my active role in the field as a participant and observer throughout the inquiry process. Indeed, I would argue that the whole inquiry process was anchored on the role I played as a participant and observer during the field work.

As such, I consider it a core part of my working ethnographically in the field and will take time to reflect on it in the subsequent section before proceeding to discuss in greater detail the other methods of data collection.

My role in the field as a participant observer

Participant observation (PO) is a research method normally applied in situations where a researcher is interested in gaining an insider's view of the research participants' world (Takyi 2015). The use of participant observation as a research method is said to have been introduced in the early 20th century by Bronsilaw Malowinski, a cultural anthropologist who spent a considerable length of time observing a native community with a view of capturing the natives' view of the world (Zahle 2012; DeWalt & DeWalt 2002).

Over time, participant observation has evolved from its original narrow focus on an unobtrusive and non-disruptive participation in and observation of life of the participants under study. It has broadened to include targeted conversations (formal or informal interviews) with participants, document analysis and narration and analysis of participants' life stories (Zahle 2012). Accordingly, those who embrace the broad view of participant observation can, alongside observation and participation, deliberately provoke behaviour or manipulate situations and observe the resulting participants' responses (Takyi 2015).

My role as a participant observer during my field work fell within the broad view of participant observation. Alongside observing and participating in the daily life routines of the students and looking at key documents like their exercise books and assessment reports, I deliberately, through the intervention activities, manipulated situations (e.g. reorganising the students to sit and work in groups during the deliberative dialogue sessions; enforcing new night prep rules in the whole of Ademba Secondary School) and stepped back to observe the resulting mathematics learning-related behaviours amongst the participating students.

In addition, I was keen to glean core aspects of the participants' culture (Becker & Geer 1957; Spradley 2016; Dewalt & Dewalt 2002) in relation to self-regulated learning of mathematics. Specifically, in playing my role as a participant observer throughout the inquiry process, I sought to gather both practical and tacit knowledge (Fine 2003; Dewalt & Dewalt 2002) on aspects related to self-regulation by the students in their learning of mathematics.

Indeed, my participant observer role during the field work provided an opportunity to become involved with the students' (three schools') central activities with regard to learning and teaching of mathematics and to enhance my relationships (Kawulich 2005; Li 2008) with the students throughout the field work period.

Further, it contributed significantly in reducing the power differences between the students (wider school community) and myself and increasing the depth of the data that I collected (Kawulich 2005; DeWalt & DeWalt 2002). It not only afforded me access to backstage culture but also, in facilitating my immersion in some of the schools' cultural activities, it helped in uncovering more detailed descriptions of behaviours and contextual factors linked to the students' self-regulation in learning mathematics.

Some of the activities that I participated in across the three schools included: attending their worship sessions; joining the students during their games; participating in the teachers' forums; spending a considerable amount of time in the teachers' staffroom; actively participating in some of the teachers' conversations and also sharing in their meals during lunch or tea breaks; and walking home amongst the students and teachers.

Overall, these close interactions allowed for a gradual developing of a friendly relationship between the three school communities and myself. Accordingly, over time, the participants (both students and teachers) willingly inducted me into the intricacies of their personal and social worlds. My "hanging out" with teachers in the staffrooms at Rayolah and Origa, for example, gave me a glimpse of the nature of the relationships amongst the teachers and between the teachers and the students. In the case of Origa, I was also able to glean key information from the teachers with regard to the students' home culture, especially the level of parental oversight and its perceived influence on deviant behaviour (by some of the male students) like taking of alcohol and other forms of illicit drugs (in Kenya) like tobacco and marijuana.

Equally, my participating in non-organised (planned) routine activities like walking home after sessions amongst the students and teachers helped in uncovering some key data. For example, taking a walk with one of the Origa teachers through the back streets of the school neighbourhood pointed to me the connection between observed deviant behaviour among some of the Origa male students and the high number of bars (alcohol selling shops) in the neighbourhood. Similarly, walking amongst the students as they went home also enabled me to make critical observations like noticing that: a majority of boys, unlike the girls, generally tended not to have bags (with books); some of the boys played mobile phone games as they went home; and the boys and girls from Rayolah used different modes of transport. Also important were observations made during participation in unplanned activities like having to walk (alongside the students and teachers) in thick mud (see related image below) to and from Origa after a heavy rain on one of the school days.

Figure 9. Image of me trying out Wellington boots at a local supermarket to aid in walking through the mud (see muddy shoes) during my field work.

The active and open engagement with the students and the wider school community demonstrates that I considered it not appropriate to play either a complete observer or observer as a participant role (Kawulich 2005) during my field work. The choice was informed by a number of theoretical and practical reasons.

As a complete observer, a researcher assumes a completely passive role during the study, and works towards making his or her identity unobtrusive. This usually results in the complete detachment of the researcher from the group being studied, an aspect that has been hailed by some researchers (Takyi 2015; DeWalt & DeWalt 2011) for its value in enhancing the objectivity of the researcher. However, complete detachment of the researcher with the participants during observations has been faulted for presenting (DeWalt &DeWalt 2011) obstacles to a researcher's quest to fully understand the context. In particular, it has been found to limit the researcher's access to full conversations or opportunity to ask participants questions of clarification (Li 2008). Moreover, the commitment to not alter the situation being studied (in many cases) results in the researcher concealing his or her identity during the study. This is bound to present an ethical challenge (Kawulich 2005; Li 2008). Indeed, authorisation for studies where a researcher proposes to take a complete observer role is not very common (Li 2008), limited mostly to very sensitive research.

Clearly the complete observer role would not have been appropriate for my study. It does not qualify to be categorised as sensitive research and, more importantly, assuming such a role would have worked against my interest in understanding the contextual factors contributing to self-regulated learning of mathematics in the three schools.

The second stance that I could have taken as a researcher in my participant observation during the inquiry process is that of observer as a participant. Taking the role of observer as a participant allows for overt observation and very limited participation. That is to say, it involves very minimal interrogations in forms of interviews or informal conversations with the participants. Inclined more towards the original and narrow view of participant observation (Takyi 2015), taking an observer–participant role during field work is also lauded for allowing for greater objectivity by the researcher given that it allows for observation of events in their natural state and limits the emotional connection between researcher and participants (Kawulich 2005). However, having initially decided to employ design-based research (Barab & Squire 2004) in the implementation of the studies' interventions, it is clear that I could not take an observer-participant stance during my field work. In particular, the 'engineering characteristic' of design-based research (Stylianides & Stylianides 2013) puts the flow of ideas between the researcher and participants at the core of the implementation of the interventions. Remaining faithful to this tenet goes against the call for limited participation by observer-participants in the field.

Furthermore, like many other researchers (Li 2008; Kawulich 2005), I find the assertion that the minimal participation associated with observer-participant allows for making observations of behaviour in its natural state inherently flawed. My experience from the field during this study tended to agree with the contention that any overt observation of participants is likely to lead to some change of behaviour by the participants and also to reduce the depth of the data that one gets access to (Takyi 2015; Kawulich 2005) especially because of the tendency of participants to refrain from sharing sensitive information with persons they tend to take as strangers to them (Li 2008).

Indeed, in my six months of field work, I noticed that the openness of the students and richness of data collected both through informal conversations and interviews increased over the period of my field work. I noted, for example, that the students from the three schools were more open during the interviews carried out at the end of the intervention period than during the interviews carried in the pre-intervention stage. Equally, I noticed that with end of intervention interviews, students from Ademba and Origa were freer with me than those from Rayolah. I attributed the observed difference between the two sets of students to the fact that I was more deeply immersed in the activities of Ademba and by some extension Origa than with Rayolah where I tended to interact with the students only once a week, on Saturdays.

The other key disadvantage of the kind of detachment associated with the complete observer and observer as a participant stance is that it may limit the researcher's ability to understand fully the discourses of the participants under study. This may lead to misconceptions of observed events or related discourses like follow-up interviews. As was noted by Becker and Geer in their seminal paper of 1957, every distinct social group always has some unique cultural attributes which usually find expression in 'a language whose nuances are peculiar to that group and fully understood only by its members' (p. 29). Indeed, there were a few instances during my field work, when I found myself unable to understand what the students were saying even though they were speaking in English and/or Kiswahili. A good illustration is an incident that occurred in Ademba: during one of the night preps (individual study time), I walked into one of the classroom and found that the students had written on the blackboard that I was "dope" just as some other persons (specific students and parents) were "dope". Having never come across that term, I was totally at a loss what the students were trying to communicate. On inquiring I was informed by one of the students that it meant being "cool". Which again from further observations and conversations, I came to understand meant they felt a sense of connection with my personal "style", which in this case included aspects like way of dressing, hair-styles and being outgoing and friendly to them. In essence, through the term, the students conveyed a tacit message about the sense of rapport that was developing between us and also communicated information on the sort of teacher that the students found easy to approach and relate with in the school.

The incident is an illustration of how taking a participant observation role during my field work allowed me to gather a wealth of information and "impressions" which not only acted as cues for succeeding observations but also informed the kind and content of conversations with the students and teachers in subsequent interviews.

Accordingly, the use of participant observation helped in enhancing the validity of the data collected through the other methods. For example, in interviews it made it possible for me to (at least to some extent) ‘check description against fact and, noting discrepancies, become aware of systematic distortions made by the person under study’ (Becker & Geer 1957, p.31). Similarly, my access, through participant observation, to some of the things that lie beneath the students’ learning practices, helped in informing my choice of culturally relevant illustrations during the deliberative dialogue sessions with the students. Giving the culturally relevant illustrations also contributed to transforming my (and students') consciousness (Li 2008) about some of the challenges they faced in their quest to make progress with their education at secondary school level. For instance, some of the students from Ademba reported that hearing (from me) about some of the challenges that students from Origa and Rayolah went through like having to walk long distances to school or struggling on foot through muddy roads on a rainy day impacted on them positively: they felt inspired and challenged at the same time to put more effort in their learning, given, as a number of them put it, the “privileges” that they enjoyed as Ademba students.

The foregoing discussions help in illuminating the reasons as to why I chose to play a participant observer role during my field work. More importantly some of the illustrations (e.g. the "dope" story) presented in the discussions add credence to assertions of DeWalt and DeWalt (2011) that the practice of participant observation enhances the quality of data obtained during field work and the quality of the interpretation of the data. Furthermore, it helps in demonstrating that my playing a participant observer role resonated with the active instigating role required of me as a researcher working from a critical realist paradigm and the call for critical ethnographers to move away from 'acting like voyeurs, viewing their research subjects' lives with detachment characteristics of television viewing' (Anderson 1989, p. 262).

The use of participant observation did not, come without challenges: the aspect of participation came with additional demands on resources, key being time and money. In addition, as has been intimated by some other researchers (Dewalt & Dewalt 2011; Kawulich 2005), use of participant observations did present me with some ethical challenges. For one, even though I had informed consent of the students and the school community as a whole in collecting data from them, a number of times I found myself disturbed by the sometimes covert nature of data collection. Examples of that include moments when I listened to conversations amongst teachers in the staffroom or conversations amongst them in my presence in their car on their way home on occasions when I got a ride back home with them from one of my participant observation sessions with the students. Even though the teachers were aware of my role as a researcher, I was conscious of the fact that, as I got more immersed in the school activities, they engaged with me more and more as part of the community and less as an outsider researcher. Thus, as time went by, collecting data from them inevitably became more deceptive (DeWalt & DeWalt 2011) especially since in most cases I did not openly take field notes. Noting that this unethical practice could not be avoided, I have exercised caution and given the participating schools and individuals anonymity to try to hide their identities. Given the lack of assurance that the anonymity of the participants will be maintained in the long term, I have also taken care to 'think a bit first' (Punch 1986, p. 95) before reporting any of the information in my thesis. In other words, my decisions on what to report or not to report have been informed by careful considerations of the ethical ramifications of the information to the informants.

Another key ethical challenge of participant observation that has been noted (DeWalt & DeWalt 2011) concerns the relationships that I developed with the school community and especially the participating classes. While it is taken that relationships developed in the field are necessarily transient in nature, the close and frequent interactions that I had with the students resulted in a very strong sense of attachment between the students and me. I have continued to make some efforts towards motivating the students to continue playing an active role in their learning of mathematics. Within seven months of my arrival back at the university from field work, I have made contacts twice with the three school communities. On one occasion, I asked the students to write to me individually and tell me how they were doing with their mathematics. On the second occasion I paid a visit to the students in the schools and had a brief talk with them to point out areas that they could focus on improving (based on the preliminary analysis of the data) in their self-regulation in learning of mathematics and as students in general. In Origa and Ademba I also got to discuss with the teachers some of the highlights from my data analysis, pointing out some of the school policies and practices that they should consider improving to enhance self-regulated learning of mathematics amongst the students.

Summary

In this chapter, I have reflected on my work in the field as an ethnographer, specifically outlining how I adopted a dialogic approach to shape the core intervention interactions which also doubled as data collection methods. I have also reflected on my role as a participant observer throughout the inquiry process, highlighting the benefits and challenges that came with the role. In the next chapter, I reflect on the first phase of my field work, which as presented in the integrative framework involved data collection through metaphoric drawings and first set of deliberative dialogues.

CHAPTER SEVEN: DELIBERATIVE DIALOGUES AND THE KEY INTERVENTIONS IMPLEMENTED

Introduction

In this chapter I discuss my application of deliberative dialogues as a key process in engaging with the students to collectively arrive at key interventions that they would implement as individuals and as a collective to improve their self-regulation. Thereafter, I provide an outline of the specific interventions and my observations on how they were implemented by the students.

Deliberative dialogues

Seen as a distinct and important feature of democracy, deliberation continues to attract attention from deliberative democracy theoreticians (see Niemeyer 2011; He 2010; Hitchcock, Mcburney & Parsons 2001). Even though there are varying conceptualisations of deliberation amongst democracy scholars, there seems to be some agreement (Schneiderhan & Khan 2008) that the root of its theorization can be linked to earlier theoretical discussions by John Rawls (1971, as quoted in Kritsch 2011) and Jurgen Habermas (1984). The two are said to have taken tangentially different positions in theorizing the process of deliberation: while Rawls emphasised rationality as the core aspect of deliberation, Habermas, leaning more towards communicative action, underscored the complementary social aspect of deliberation. He insisted that rationality during deliberation should be tempered with considerations of values, assumptions and preferences by all those affected. Essentially, those who identify with Habermas share in his position that deliberation must have both a rational and practical component to it (Hitchcock, Mcburney & Parsons 2001; Knops 2006).

Despite these differences in theorizing deliberation, theoreticians inclined towards either Rawls or Habermas agree on the key features of deliberation as: the centrality of giving reasoning amongst participants during the dialogues; the engendering of inclusion of all the participants in the dialogues; and the resulting in outcomes/actions that are collectively agreed upon by the participants (Goodin & Niemeyer 2003; Schneiderhan & Khan 2008).

My arriving at categorising the nature of my conversations with the students during the main intervention sessions as deliberative dialogues was informed by two main reasons. Firstly, I was able to identify the three features (mentioned above) in the recorded dialogues and, secondly, my reflections on the process of engagement made me realise that I deliberately and consciously put effort (during the field work) in ensuring that those tenets were upheld.

In the next section, I discuss the features within the context of the deliberative dialogues that I carried out with the students during the field work. The discussions help in identifying my deliberative dialogues with those democratic theoreticians who are inclined towards Habermas' theorization.

Focus on action and a common purpose

Though not unique to deliberative dialogues the action link is considered to be one of deliberative dialogues' key features which make it popular with interventionists-like policy makers and action researchers (Plamondon, Botrorff & Cole 2015). Indeed, with regards to my research, it resonated with the fact that, as an intervention research, one of my key objectives was to explore together with the students viable learning activities and practices that they could embrace to enhance their self-regulated learning of mathematics. As such, my interest was on actions shaped out of individual and corporate considerations of reasons offered by the students as learners and myself as learner and emerging self-regulated learning theoretician. Given that the process of engaging in deliberations was fairly novel to the students, to help in stimulating the reasoning process, I decided to shape a scaffold for our deliberations in the form of a training manual. The reflection manual (Appendix six) which was titled "Learning how to learn" consisted of reflection prompts on what it takes to learn mathematics in terms of practices, dispositions, resources (mental, time, other resources) and learning environment.

Choosing to shape a reflection manual rather than an instruction manual on learning was an indication that I did not have any fixed preferences of what students needed to adopt as strategic actions geared towards enhancing their self-regulated learning of mathematics. Doing so would have turned the dialogues from deliberative dialogues into strict persuasive dialogues (Hitchcock & Parsons 2004), a practice that I had employed with not very significant results in my earlier practice as a mathematics motivational speaker.

My shift to deliberative dialogues was marked by closer attention to students' contributions to their dialogues on their shared knowledge, values and beliefs about mathematics. I listened to these contributions through the lenses of both theoretical assertions on core aspects like cognitive processes from extant literature and my own personal experiences in similar learning situations. During the deliberations I broadened my considerations of the "reasons" to include both what can be typified as practical (mainly from students) and rational (from literature).

Below is an excerpt from one of the deliberative sessions with Rayolah students presenting a flow of deliberation during the deliberative dialogues:

Me: have you written? OK, then turn to your neighbour and talk to them about what you have written. If not your neighbour, whoever you want to talk to… Ok. Have we shared our thoughts with each other? What makes you learn? What are some of the things that you have discussed? Anybody who wants to share?

Student 1: being committed to work

Me: what does that look like? So that I say that you are committed to work, what do you do to show that?

Student 1: being dedicated

Me: ok, let's say in studying English. If you say that you are dedicated, what does that mean?

Student 1: pay attention in class and take time to revise your work

Me: So, according to her, that helps you to understand something or learn something. And that is true, if you want to be a footballer, must you not be committed? You can't go for practice today, then stay home for two weeks without attending then go back. You can't come to class today and not attend tomorrow. Or for others, you know some stay in the class but are not here? You are here but you are "building a house at home". But you are here physically. And then you listen a bit then go (in your mind) and begin planting in your garden. So we must be committed.

Anything else we discussed in our groups? ...Yes at the back?

The process of deliberation as depicted in the above excerpt points to another key differentiating feature of deliberative dialogues - that of a mutual focus.

Before starting the deliberations, I made the students understand that we were going to collectively explore how we learnt mathematics and by sharing our experiences agree on what we could do individually ('…write in your books…') and collectively ('…now discuss…') to improve our experiences in learning mathematics. Having a mutual focus enabled the students to share their thoughts freely with one another and reduced aspects of competition amongst them. Further the mutual focus helped in putting an emphasis on the presentation of each of their ideas for corporate considerations thereby allowing for pooling of information and resources from the individual participants. In essence, having a mutual focus provided an opportunity to extend beyond individual rationality to deliberative rationality (Hitchcock, McBurney & Parsons 2001). As such, a mutual focus extends the breadth of rationality by facilitating the participation of all those affected. This, according to Habermas (1984), is important in that it enhances the quality (appropriateness) and ownership of the actions arrived at by participants.

The excerpt above points to the fact that deliberation during our dialogue sessions occurred on at least three levels; at the personal level, when the individual students had to consider what worked/did not work from their personal experience; at the group level, when they shared and discussed their individual considerations; and at class level, when I asked them to think through a group's submission or when I added value (using empirical or theoretical knowledge) to submissions from a member of a specific group.

Obstacles to inclusivity during the deliberations

A key observation during the deliberations was that the breadth of inclusivity (participation and quality of reasoning) across the three schools was subject to a number of situational and contextual limiting factors. This was a case for concern given the suggested correlation between optimality of proposed strategic actions and the level of inclusivity during deliberative dialogues (Goodin & Niemeyer 2003; Schneiderhan & Khan 2008). In this section I discuss some of these limiting factors and use a theoretical lens to exemplify some of the strategies that I employed to mitigate their impact on inclusivity during the deliberative dialogues.

Some of the concerns were unique to Rayolah and Origa, both being public secondary schools. The first obstacle to their participation in the deliberations was related to their level of proficiency in their use of English as a language. As already pointed out, I noticed in the early stages of my engagement with the students that most of them could not communicate effectively in English. This was confirmed by the students' writings and first pre-intervention interviews with a few of them on their metaphoric drawings. The second challenge unique to the two schools was related to their large numbers; each class had over 40 students. It was not practically possible to get each of the students to participate in the third stage of the deliberations (class level) especially because the sessions allocated for the deliberative sessions were very short; less than 40 minutes per session (three sessions a week) for Origa and about one and half hour session once a week for Rayolah. The third concern was related to the hierarchical culture in the schools which I considered had shaped dispositions in the students that did not accommodate dialogic engagement well especially with an adult.

A review of literature during and after the field work confirmed the validity of the aforementioned concerns. Davidson and Moses (2012), for example, proffer that professional status, ethnicity and language competence have been found to affect the level of participation during deliberative dialogues. They specifically point to the fact that deliberative principles like open-mindedness and reciprocity have been found to resonate more with the habits and skills of the middle class and the highly educated. Parallel observations have also been made by a number of mathematics education researchers: they have presented empirical evidence suggesting that pedagogies based on social cultural theories of learning may present some challenges to some children especially those from lower socio-economic backgrounds (Pape, Bell & Yetkin 2003; Gates & Noyes 2014; Lubienski & Theule 2000). Gates and Noyes (2014) discuss empirical evidence that suggests that learners' ways of 'thinking, speaking and writing' (p.41) promoted through such pedagogies, being largely incompatible with dispositions of learners from working class (unlike those from middle class) homes in the UK, do present obstacles to those learners' efforts at learning mathematics. Similarly, some American learners from low socio-economic backgrounds were found to have dispositions that were not very supportive of open-ended discussions (Lubienski &Theule 2000) in mathematics learning.

Indeed, my observations were that Ademba students, who were from more affluent families, were generally more comfortable with participating in the deliberative dialogues. From observations made during the field work and considerations of some of the theoretical assertions mentioned above I attributed this difference (with Rayolah and Origa) to both their language capital and the more democratic contexts (home and school) within which they were being developed. Another contributing factor could have been the more enhanced rapport that I had with Ademba students occasioned by my gaining entry into their school earlier and my being more deeply immersed in their school community.

The generally negative attitude towards mathematics amongst students from the target class from the three schools also posed a threat to inclusivity in terms of students' effective participation through verbal contributions and presenting their ideas for consideration during the deliberations (Davidson & Moses 2012). I was particularly concerned with the first set (before merger) of Ademba students who because of the practice of ability streaming by the school seemed to present a more pronounced sense of debilitation and hopelessness towards mathematics learning (Otieno 2015a).

A final consideration about inclusivity was linked with concerns on how to present theoretical evidence on self-regulated learning and other related education constructs during the deliberative dialogues. Specifically, I was faced with the challenge of contextualising the research evidence and helping the students see its meaning in light of their tacit knowledge and real experiences of learning of mathematics (Bokyo et al. 2012).

Strategies employed

In this section, I discuss some of the strategies that I employed during the deliberative dialogue sessions to enhance inclusivity given the challenges that have just been presented. The strategies were generally informed by my evolving understanding of social cultural theory of learning and a cultural sensitivity honed through interaction with Kenyan secondary school students in the period before my PhD studies and during my field work. To aid in the discussion, I have used theoretical understanding gleaned before, during and after my field work to label the strategies employed as: engendering a community of inquiry (Wedlin & Adawi 2014; Povey 2014); "not-knowing" facilitation stance (Anderson & Goolishian 1992); and use of stories and narrative (Schneiderhan & Khan 2008).

Community of inquirers

Earlier in my PhD studies, I took a mathematics education Master's Module course titled Understanding Mathematical Activity. For my assessment for the module, I wrote a reflective paper (2015b) on my emerging understanding of mathematical activity, whose title read in part, *From Individual Consciousness to Social Consciousness*. Implied in the title was an emerging appreciation by me of the value of collective sense-making in learning of mathematics. My taking a dialogic approach in the current inquiry was largely informed by this appreciation which has since grown stronger. The readings and class activities which informed the writing of that paper also influenced to a great extent the strategies that I put in place to strengthen our operating as a community of inquiry, which in essence meant optimum inclusivity especially with regard to getting verbal contributions of the students.

One of the strategies that I adopted was that of rearranging the students to sit in groups (Povey 2014) during the deliberative sessions. This helped to enhance participation in the deliberative dialogues by the students in three ways. First, it shifted the emphasis from me to the group members and class as a whole. Second, it helped to create a picture of collaboration and thus reinforced the fact that we were to co-construct knowledge, and share our understanding around the learning of mathematics. Third, it improved the interaction between the students and me during the deliberation sessions, since it allowed for my easier movement in the class and ensured that I could draw the attention of a number of them at any one time when I stopped to take a comment from a group member. Put differently, organising the students in groups during the deliberation sessions "shrunk" the number of students in the classrooms.

The second strategy adopted from my reflections on the module was introducing norms (Pape, Bell & Yetkin 2003) to be observed during our deliberative sessions. Emphasising that our quest was not to arrive at a right answer but a shared understanding on how we could improve our learning of mathematics, we worked towards creating an environment that could support diversity amongst the students (Povey 2014) and increase the opportunity for each to share his or her reflections with other members of the group and the class at large. Accordingly, we underscored the value of respect and asked the students to first share their thoughts with one another before volunteering to share what had emerged out of their corporate discussions. This helped in creating a safe environment for all and demonstrated our value for each other'scontributions. The reflective questions in the reflective manual were used as scaffolds for both the individual and corporate discussions/reflections. Using the manual during the deliberative dialogues helped in ensuring that there was both personal and collective sense-making (Stein et al. 2008) of what constituted effective learning of mathematics.

Facilitation stance

Facilitation style is considered to be a key determinant of the quality of deliberation amongst participants. A number of democratic theoreticians advocate facilitators taking the middle ground during deliberations to ensure participation parity during the dialogues (Davidson & Moses 2012; McCoy & Scully 2002).

This proposal to occupy the middle ground during the deliberations was not tenable during the deliberative dialogues with the students given our choosing to function as a community of inquirers. A middle ground stance was also not applicable given that it also suggested an existence of competing interests amongst the students. Instead of taking a middle ground position, I sought to adopt a "not-knowing" facilitation stance (Anderson & Goolishian 1992) during the deliberation sessions. I considered this stance most appropriate for encouraging the participation of the students in the deliberative dialogues, especially those from the predominantly hierarchical contexts of Origa and Rayolah.

The “not-knowing” facilitation stance is characterised by an expression of genuine curiosity by the facilitator during the facilitation process (McCoy & Scully 2002). In other words, in adopting a “not-knowing” facilitation stance during the deliberations, I generally expressed through my actions and words a need to know more about the students’ experience of learning or self-regulating learning of mathematics. My theoretical and tacit knowledge of self-regulation learning of mathematics notwithstanding, I placed primacy on the students’ sharing of their experiences with regard to their self-regulated learning of mathematics. My contributions in the deliberations were hinged on the students’ contributions and in most cases were directed towards reinforcing these either by giving some theoretical elaboration or giving related personal testimonies or probing students to elaborate further on their or each other’s contributions. In essence one can surmise that I played the role of a participant-observer-facilitator during the deliberative dialogue sessions.

Placing primacy on the students sharing world views (amongst themselves first), meanings and understanding on self-regulated learning instead of just "telling" them about it enhanced inclusion since it in effect expanded the conversation space (McCoy & Scully 2002; Anderson & Goolishian 1992) for the students during the deliberations. Specifically, using a “not-knowing” stance allowed for the students to share their locally developed meanings around self-regulated learning thereby reducing the possibilities of internal exclusion (Parkins & Mitchell 2005; Anderson & Goolishian 1992) that may have been instigated if I chose to relate with them as an expert.

Using of stories and metaphors

I used stories and metaphors during the sessions to elaborate on some of the suggestions and contributions proffered by individual students during the deliberations. In mostinstances the stories, which were sometimes told in Kiswahili and or Sheng, revolved around similar experiences by other students (known to me), my experience or experiences of my daughter in learning mathematics during her secondary school education. In sharing the stories and metaphors (usually in an evocative and animated way), I sought to demonstrate a sense of similarity with the students and hoped to enhance receptivity of the participants to both my contributions and their counterparts' contributions. Thus, it can be said that my choice of stories and/or metaphors and the process of delivery was informed by a quest to help the students explore aspects related to self-regulated learning of mathematics in the students' own language (Parkins & Mitchell 2005) and from their current position. Telling the stories in an evocative manner especially with the students from Rayolah and Origa allowed me to tap into the students' emotions (Davidson & Moses 2012) and use these to stimulate their interest in the deliberations. Further, the care to ensure that there was a sense of similarity in the stories and metaphors used was part of my strategic actions to enhance trust and strengthen the relationship (Parkins & Mitchell 2005) between the students and myself and by extension encourage increased self-disclosure (Flicker et al. 2008) in terms of the individual students' experience in learning of mathematics.

Two examples of stories and metaphors are the "sleeping pills" story and the grass path.

<u>The "sleeping pills" story</u>: during our deliberations the students from the three schools extolled theimportanceofconsistent practice as key to their learning of mathematics. Noting that this was pointing to the aspectsof mastery goal orientations of learning I sought to reinforce this in two ways; first, I told them how I inculcated in my own daughter the value of practice in learning maths by insisting that every day before she slept, she did five extra "sums" a day. And that we (my daughter and I) chose to call these sums "sleeping pills"- the joke in the family being that failing to do them on any day would lead to her not having a good sleep.

<u>The grass path</u>: to elaborate further on why practice was important to their learning, I briefly discussed with them some basic facts around brain plasticity and learning (Blackwell & Trzesniewski 2007) and watched a video on learning and the brain

(https://www.youtube.com/watch?v=cgLYkV689s4). The video depicted how neuro-pathways were created and strengthened as a result of consistent and progressive advancement in learning a certain concept. To try to bring home the concept of the connection between the creation of neuro-pathways and consistent practice, I used the metaphor of creating a path on a grassy patch by walking through the place a number of times until the path is visible and can easily be used in subsequent journeys.

This grass path metaphor is one illustration of how I used stories and metaphors to present facts in a culturally sensitive way and also, in some instances, for the purpose of breaking down some of the complex research evidence on learning or self-regulated learning of mathematics. My use of metaphors and stories as illustrated above is in line with the assertions of Plamondon et al. (2015) that organic inclusion of metaphors and stories in deliberative dialogues can help in enhancing collective understanding of complex concepts and/or helping the group to come to some contextually informed agreement.

Given the strong Christian identity of the students and wider school community of Rayolah and Ademba, my choice of stories and/or metaphors sometimes extended to include biblical illustrations of some of the suggestions made by the students in regard to learning or self-regulating during learning of mathematics. An example is when I used the biblical scripture Deuteronomy 32: 30 **"...**one will put one thousand to flight (meaning demons), but two will put ten thousand to flight…" to open a discussion on a suggestion by one of the students on the value of collaboration in learning mathematics. I subsequently pushed the discussion to illustrate the benefits of reciprocal learning (Rohrbeck et al. 2003) in peer groups

Final reflections on the deliberative dialogues

My tapping into aspects like the students' biblical orientations towards life in deciding on stories or metaphors, to illustrate or support a point, demonstrates the value of not just similarity in experience but also an understanding of the participants' eco-cultural niches (Bokyo et al. 2012; Anderson & Goolishian 1992) during deliberative dialogues. Tapping into the two helped in enhancing inclusion during the deliberations since they allowed me to give contributions that fitted the students'cultural context. Further the use of cross-cultural forms of narratives and metaphors to explain theoretical aspects of self-regulated learning of mathematics enhanced understanding across structural and cross-cultural differences (Schneiderhan & Khan 2008; Parkins & Mitchell 2005) and in turn contributed to our being able to collectively agree on actions required to remedy their current practice of self-regulated learning of mathematics. In the following chapter, I discuss briefly the main actions that we collectively agreed on out of the deliberative dialogues.

Self-regulated learning of mathematics actions

The focus of deliberation was to explore the students' practice of self-regulated learning of mathematics and to collectively agree on actions that the students could take to improve their self-regulation in the learning of mathematics. In this section I present a brief outline of five actions that were the main outcomes of the deliberative dialogues: the specific activities were all directed at helping the students shift towards functioning as a community of learners to support their self-regulated learning of mathematics. To provide an anchor for discussions of the specific activities I present some of our considerations during the deliberations that led us into a collective agreement to work towards an adapted form of community of learners: a student-led community of learners.

Student-led community of learners.

One of the key reflections during our deliberative dialogues was on the kind of classroom environment that supported successful learning of mathematics. Guided by the section of the reflection manual (appendix six, p. 4) titled '*my perfect classroom to learn maths is where*…' we explored the role the individual students, the class members and the teacher played in our successful engagement with mathematics. Out of the deliberations the students reflected on some of their current practices that negatively impacted on their engagement with mathematics. Top of the list was disruptive behaviour, including noise making and sleeping while the teacher was teaching. The students also expressed concern with competitive behaviour which sometimes made some of them not participate in class and discouraged them from collaborating in their mathematics learning. Copying of class assignments from each other was also highlighted as a practice amongst a majority of the students from the three schools. The students from the three schools also noted that their influence on each other's engaging with mathematics extended beyond formal mathematics class sessions. For Ademba and Rayolah girls (boarders), the classroom behaviour during self-study sessions like night or weekend preps had an impact on the individual students' engagement with mathematics. Similarly, for Origa and Rayolah day scholars (boys and girls) the after-school interactions, including chatting with each other on the phone or "hanging out" in the neighbourhood (for most of the boys), were highlighted as some of the key practices that hampered the students' engagement with mathematics.

Out of the deliberations we arrived at the understanding that we could re-engineer the students' interaction and classroom behaviour to support and enhance more self-regulation of mathematics. Specifically, we arrived at an agreement that making positive self-engagement with mathematics a collective goal would enhance the students' learning experience and achievement in mathematics. In other words, we agreed to institute some actions that would make the class move more towards operating as a student-led community of learners instead of individual class members.

In participating in deliberations that led to the collective agreement to implement an adapted form of community of learners as a key framework for improving self-regulated learning of mathematics amongst the students from three schools, I considered a number of key theoretical assertions on self-regulated learning including the outcome of research done by Beishuzen (2008) which highlighted the potential of a community of learners in fostering the development of self-regulated learning. In particular, the research showed that the key attributes of a community of learners that contribute to fostering self-regulated learning amongst students include: students playing a critical role in the process of knowledge building; emphasis on individual and corporate reflection strategies; and opportunity for collaboration amongst students and with the teacher. These findings echo assertions that ‘students engage in self-regulated learning in classrooms where they receive opportunities to participate in complex, open-ended activities, make choices to influence their learning and evaluate themselves and others’ (Perry et al. 2002, p.6). Further, I took into consideration research findings that suggest that social connectedness in achievement settings, as is espoused in a community of learners, not only plays a role in the strengthening of cognitive aspects of self-regulated learning but also in inspiring individual achievement motivation (Trow et al. 1950; Walton et al. 2012). I found a consistency between the aforementioned theoretical contentions and the social-cultural theorists' position that most if not all cognition is socially shared (Baumeister, Twenge & Nuss 2002).

Class norms

We agreed on some class and mathematics norms to help reduce the incidence of disruptive behaviour during the mathematics lessons and reduce the sense of stereo-type threats amongst the students. The move towards class norms as a key component of operationalising the students' shift towards functioning as acommunity of learners resonates with discussions in mathematics education research on social norms and socio-mathematical norms. McClain and Cobb (2001) posit that general social norms are concerned with general classroom participation structure while socio-mathematical norms are specifically concerned with participation in mathematical activity (Otieno 2015b).

Some of the norms agreed on by the students included: respecting each other's contribution during mathematics lessons; desisting from disruptive behaviour like noise making or sleeping during mathematics class sessions or self-study sessions; being more active and attentive during mathematics class sessions; making a personal effort in engaging in mathematics activities; discouraging copying of class assignments from each other; and supporting one another in adhering to these norms, for example, waking up peers who had fallen asleep or who were not sitting upright during class sessions.

Collaborative mathematics peer groups

To help strengthen their working as a community of learners the students from the three classes agreed to activate collaborative mathematics groups for reciprocal teaching and learning of mathematics. Apart from the reconstituted class of Ademba where I had to step in to help constitute the groups, the students from the other two schools had the freedom of choosing with whom to work as group members. Apart from engaging in reciprocal teaching of mathematics, the groups' members agreed to take action to rally the individual group members to consistently engage with mathematics activity (teacher and individual assigned mathematics work) and exhibit positive mathematics learning behaviours during formal mathematics sessions. As such, the students agreed to be accountable to their group members on their engagement with mathematics both in school and out of school (for day scholars). To help reinforce individual accountability amongst members each of the groups deliberated on, shared, subjected to discussion with the whole class and adopted a set of group rules to be observed by group members. The image below is a sample of group rules from some of the

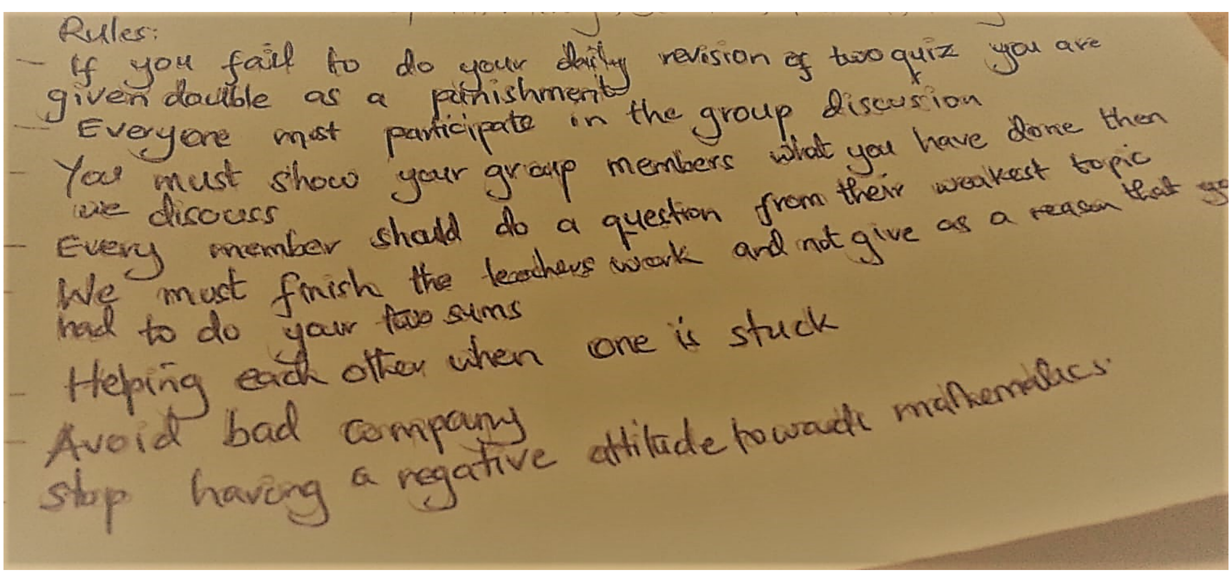


Figure 10. Image of handwritten group rules for one of the math groups from Rayolah

In supporting the proposal to constitute collaborative groups by the students I considered literature on social-cultural perspectives of self-regulated learning which conceptualises self-regulation as a social process that first appears in the intrapsychological plane before being transferred to the interpsychological plane. Accordingly, it puts emphasis on joint problem solving as a key means of appropriating self-regulated learning (Hadwin, Wozey & Pontin 2005).

As mentioned in the earlier section of this chapter on inclusivity we agreed that there was value in consistent practice in learning mathematics. After sharing the story on how I made my daughter do five mathematics "sums" each day the students decided to adopt this strategy and agreed that they too would each be doing five extra "sums" a day. These five "sums" were supposed to be the focus of their reciprocal teaching in their collaborative groups and one of the actions to be primarily accountable for to their group members.

Metacognitive engagement with mathematics

The deliberative dialogues (towards the end of the inquiry process) focused on trying to understand the kind of skills that the learner needed to effectively engage with mathematics activity. Our exploration led me into introducing basic aspects of metacognition, underscoring the value of thinking about their thinking as they engaged in any mathematics learning activity. Most importantly, I sought to make the students understand that bringing the process of learning during mathematical activity to a more conscious level helps in gaining mastery of mathematics concepts (Fisher 1998) and has significant impact on the quality of their learning and academic achievement in mathematics (Spada, Nikcevic & Moneta 2006).

To help the students in appropriating metacognitive engagement with mathematics as part of the process of fostering self-regulated learning, I developed a metacognition outline (see appendix six, p. 21-23) whose components were discussed with the students during the deliberative session and which I asked the students to use as a scaffold during their subsequent engagement with mathematics activity. Given that this discussion was at the end of the inquiry process, we did not have adequate time to actually practise using the metacognition outline with the students from the three schools. I did get a chance though to try it out with a pilot group of students and with the first set of Ademba students who first tried using it as individuals and then with peers during the mathematics group discussions.

“Best class in town” mathematics tournament

Right at the start of the inquiry process, the students from the three schools separately expressed interest in meeting with their counterparts and engaging in some common mathematics activity. After deliberating with them on this during later stages of the inquiry process we decided to integrate a mathematics tournament as part of the intervention activities. The shaping of the mathematics tournament, titled “best” class in town, was informed in part by my experience and observations from implementing similar tournaments before my PhD studies; and exploration of mathematics education literature on connection between goals and motivation for learning. The tournament was designed with the understanding that working towards a common goal (interdependent group awards) has been found to promote peer encouragement, reinforce effort and establish norms (amongst the student community) emphasizing academic achievement (Rohrbeck et al. 2003). Further the tournament was designed out of consideration of assertions that implementing both collaborative learning and constructive competition allows for healthy group experience that enhances the benefits of each of the strategies (Rosol 2012). According to Johnson and Johnson (2009) a competition is considered constructive if: winning is not perceived as crucial; winning is hinged on the amount of effort put in and not some innate “ability”; and clear rules and time frame are set and clearly communicated to the participants.

The tournament was designed to engage the students in curriculum-based experiential mathematics activities which would lead to the awarding of the “best” class (cumulative points from the activities) and “best” collaborative groups from the three schools. Further there were also to be awards for the “best” male and female students from an “exam like” assessment which all the students were to do before embarking on engaging in the other experiential game-like mathematics activities. The awards included a trophy for the “best” school; mathematics calculators; mathematics revision books; mathematics exercise books; and certificates. The mathematics topics which were to be assessed through the tournament activities were arrived at out of a discussion with the mathematics teachers from the three schools. This was after I discussed with them the basis and objective of the tournament. The topics were communicated to the students about three weeks before the tournament. I spent time with each class discussing and exploring some additional strategies that they could employ in their preparation for the tournament.

The tournament which was held at Ademba marked the end of the field work activities and was therefore shaped to be some form of celebration (they ate together) and official closure of my field work activities. The budget for the awards, meals and transporting to the venue totalled £1,000. It was covered by savings from my field work budget and contributions from friends.

Remarks on implementation of the intervention activities

While we collectively agreed on these activities during the deliberative dialogue sessions, apart from the tournament which was attended by a majority of the students from the three schools, the implementation of the other activities was entirely left to the students. That said, I tracked (and reinforced) the progress of their implementation through complementary intervention activities like the interviews; reflective writing of students; observations of their designated sleeping pills books; and discussions during the deliberative dialogues. The implementation of the activities varied across the schools and amongst the students/groups.

Summary

In this chapter, I have presented considerations that guided the deliberative dialogues that I had with the students to facilitate our arriving at locally grounded, relevant and owned (Bara et al. 2004) interventions for improving the students' self-regulation. In addition, I have provided an outline of my observations on the implementation of the specific interventions by the students from the three schools.

CHAPTER EIGHT: OTHER INTERVENTIONS AND DATA COLLECTION METHODS

Introduction

In this chapter, I discuss the data collection methods employed in this study. In addition, I discuss and give some illustrations of the secondary role of the said methods as additional interventions for enhancing the students' self-regulation.

Metaphoric drawings

In many of the mathematics intervention activities that I implemented before my PhD studies, I often asked participants (students and teachers) to draw metaphoric drawings on personal experiences of learning or even teaching of mathematics. I noted that through the drawings and discussions of the drawings, the participants opened up to me more on their experiences on learning of mathematics than they would have necessarily done in a traditional interview, especially if I required them to do so within a short period of interaction. In the early period of my PhD studies, I piloted the use of metaphoric drawings with a small group of secondary school students to explore their relationship with mathematics (Otieno 2015a). From the exploration of existing literature during the pilot study I came to the understanding that the use of visual methods like drawings is increasingly gaining traction amongst sociologists (Lorenz 2010; Packard 2008) for a number of reasons. Firstly, it continues to be celebrated for its capacity to decrease power differentials between researcher and research participants (Packard 2008). Secondly, visual methods like drawings have strength for unearthing tacit knowledge that otherwise may not be easily captured by other text-based research methods (Lorenz 2010; Packard 2008). For example, drawings collected during the pilot study did make suggestions on the affective (emotions, intelligence and epistemological beliefs) dimensions of the students' learning of mathematics (Otieno 2015a).

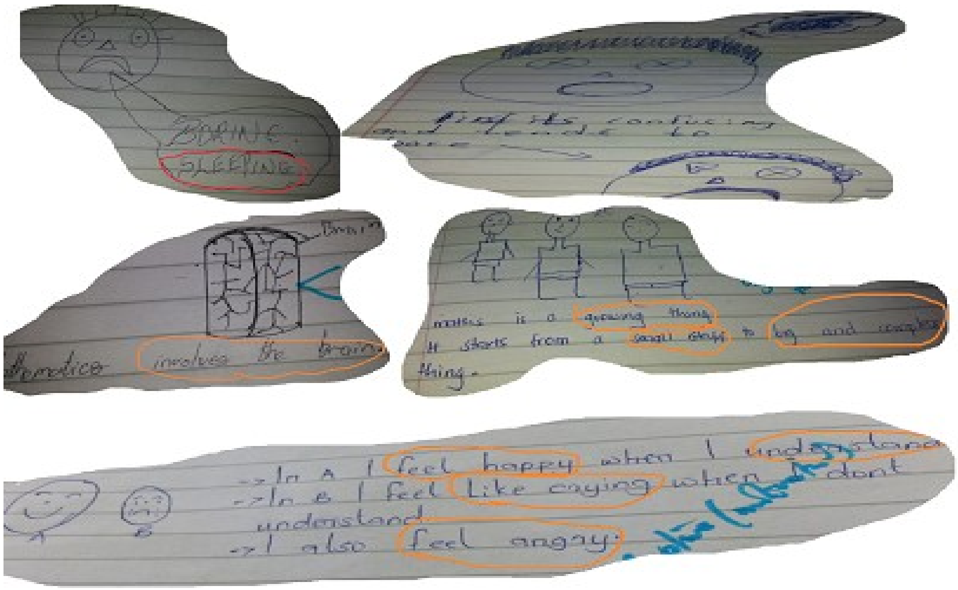


Figure 11. A collage of samples of students' feelings towards mathematics

Thirdly, drawings have been found to allow for holistic narration and collection of holistic thick descriptions in a condensed manner (Bagnoli 2009). Finally, the creative dimension of drawings which encourages deeper thinking amongst the participants has been associated with enhanced data credibility (Buckley &Waring 2013) since it reduces cases of participants giving socially desirable answers.

Metaphoric drawings in particular have been found to involve 'critical thinking aimed at giving shape to understandings and distilling the meaning of experiences' (Lorenz 2010, p. 212). As such, they are useful in helping participants bring to the fore deep meaning and multiple perspectives, allowing for the expression of feelings and experiences that would otherwise be difficult to bring to consciousness through words alone (Lorenz 2010; Bagnoli 2009). Indeed, my asking students to make metaphoric drawings depicting their feelings or thoughts towards mathematics or learning of mathematics before and after the intervention was in part informed by an appreciation of the abstract nature of feelings towards and especially thinking about the subject. Given that producing metaphoric drawings requires the participants to express abstract concepts in terms of well understood visuospatial phenomena (Risch 2008), I expected that they would use familiar objects to try to maximally explain their experiences with learning mathematics. As can be seen from the image mural above (Figure 12) of some of the students' metaphoric drawings before and after the intervention, a majority of the students from the three schools used discrete, tangible and familiar objects, for example, cars, stones, houses or even animals, to represent their perception of what mathematics or learning of mathematics is.

Accordingly, the metaphoric drawings were particularly useful in engaging with the participants about their perception of mathematics since it allowed for data on contextual and situational aspects influencing the student's engagement with mathematics to emerge naturally instead of being forced or directed by me. Further, based on my analysis of metaphoric drawings drawn during the pilot study, I was also aware that most of the students' drawings (and explanations) could give pointers to their sense of relationship (display of emotional dimensions) with mathematics. Furthermore, given the dominant top-down cultural orientation in two of the schools and the limited proficiency in use of English by a significant number of the participants, the use of drawings with the students helped solve the challenge that the students would have faced particularly at the pre-intervention stage in engaging in open discussions on their personal experiences of learning mathematics.

Key observations

I noted that some of the students, especially those from Origa and Rayolah, had some difficulty interpreting the drawing task, mostly at the pre-intervention stage. In most of these instances, I used illustrations (gave examples such as, drawing a cat drinking milk to depict the fact that perhaps I love learning mathematics just as the cat is known to love drinking milk) to try and help them understand the task.

Further, I noted that the students did not go straight into drawings and spent a considerable length of time in contemplation before beginning to draw their metaphoric drawings, the posture of contemplation remaining throughout the session as they continued drawing. The observation adds credence to assertions by Risch (2008) that the process of drawing an analogical/metaphorical diagram is considered to be more reflexive and thoughtful than ordinary diagrams

That said, the depth of reflection may have varied amongst the students; a number of students ended up not with metaphoric/analogical drawings as such, but drawings representing actual feelings or reactions towards mathematics or learning of mathematics.

Overall, the students' drawings were evocative in nature, allowing the students, in a condensed manner, to thickly describe their unique perceptions (Buckley & Waring 2013) of learning mathematics. In addition, the drawings and accompanying explanatory narrations pointed to some of the contextual/situational factors affecting their learning of mathematics. Through the drawings and narrations, I was also able to pick up on key attributes like their level ofproficiency in English. In essence, the data gathered through the metaphoric drawings went a long way in: shaping the content of subsequent interviews; contributing to the building of rapport between the students and me; and shaping the nature of interactions (language use; illustrations) during the deliberative dialogues which I discussed in chapter seven.

Reflective writing

Overview

The consideration of reflection as a process of enhancing understanding can be traced back to the days of Confucius, who is known to have picked out and compared: reflection, imitation and experience as the three ways of learning wisdom (Diezmann & Watters 2006).
Over the years, reflection has gained traction as a key practice in professional development across many disciplines, key amongst them being education and more recently health. Each of these disciplines in seeking to promote reflection has paid considerable attention to how reflection as a process plays out and in particular what the stages are that one goes through during a reflection process. Further, there has been considerable attention to the variation in levels of reflection amongst different people during a reflection exercise (Thorpe 2004; Wong et al. 1995; Chiu 2006)

In education, the models have evolved from a view of reflection as a process of controlled thinking on problematic aspects of practice to a contemporary view of reflection as a social process with social, situational and dialogic aspects (Chiu 2006; Diezmann & Watters 2006; Ovens 2002). In both views, reflection is considered to involve an internal weighing of reasons and considerations of evidence provided through discourse (Niemyer 2014) which, according to contemporary reflective practitioners, occur both at the corporate and individual level. Indeed, the individual's internal reflection, which generally takes the form of a conversation with oneself about an experience or subject of dialogue, can be stimulated, facilitated and made explicit through reflective writing (Niemyer 2014). Depending on the level (surface or deep) of internal conversation with oneself about an experience, the resulting reflective writing may fall within a continuum ranging from reporting to reconceptualisation of the whole experience (Wong et al. 1995; Diezmann & Watters 2006).

Empirical evidence from extant literature suggests that education practitioners (teaching and health) tend to use reflective writing on past learning and teaching experiences (Chiu 2006) to stimulate learning and shape future experiences. According to Diezmann & Watters (2006), the reflective writing currently employed by most teacher and health professionals straddles two models: the reflection-on-action model by Schon (1983 as discussed in Schon 2017), which involves retrospective thinking (Boud 1998) about practice, and reflection-for-action developed by Carr and Kemmis (2005) which, being proactive in nature, links the reflective process to future action.

Given the shift by many practitioners in seeing learning more as a social process than an individual process there has been a commensurate shift in viewing reflection as a social process (Ovens 2002). Accordingly, an individual–centred approach (on and for action) to reflective writing is increasingly being abandoned for one that is progressively shaped by discussions and considerations of the viewpoints of other community members on their initial ideas and interpretations of actions during practice (Ovens 2002).

Regardless of the approach taken, educators in teacher education and health disciplines are increasingly turning to reflective writing largely because it has been found to encourage deeper exploration (than other forms of reflection) of the affective dimensions of experience (Levine, Kern & Wright 2007). In other words, reflective writing has been found to stimulate the emotive part of reflection in a deeper way than other forms of reflection. Accordingly, reflective writing tools are increasingly being used to reposition and address (or seek help in addressing) generalised and unaddressed feelings of past or even present learning experiences (Thorpe 2004). In mathematics education, for example, reflective writing of past learning experiences has been used to help address the issue of negative attitude towards mathematics amongst pre-service teachers (McNaught 2010). Similarly, reflective writing has also been found helpful in bringing to the fore and facilitating discussions on aspects like learners' sense of confidence, self- esteem and general emotions towards mathematics (Powell 2001; McVarish 2009; McNaught 2010). McVarish (2009), in extolling the value of reflective writing to mathematics learning, surmises that the essence of reflective writing (in journals) as she sees it, is 'that they are the product of emotional labour that can provide the glue to make sense of some aspects of mathematics teaching and learning' (p. 473).

During the inquiry and intervention process, I engaged the students in two main kinds of reflective writing activities: reflective writing guided by a reflection manual during the deliberative sessions; and prompted reflective narratives on the progress they were making with implementing some of the agreed upon actions (for example, doing of the sleeping pills or working in groups) and on critical incidents related to their mathematics learning during the intervention period.

My integrating reflective writing as a key component of the intervention was partially informed by theoretical discussions on the value of reflective writing in reshaping negative dispositions towards mathematics as a subject and the empirical evidence on the inherent potential in using autobiographical data collected through reflective writing in helping learners focus on their learning, appreciate their central role in the learning process and in inspiring them to take greater responsibility towards their learning (McVarish 2009).

In the following section, I reflect on the implementation of each form of reflective writing by the students.

Reflective writing as an integrated part of the deliberative dialogues

According to Niemeyer (2003), 'the whole point of deliberation, political or otherwise, is usually to make our decision process more reflective' (p.629). Accordingly, our deliberation was anchored on a continuous process of reflection, guided by the reflective manual which allowed for a macro and micro reflection on aspects related to learning and self–regulated learning of mathematics by the students. The macro level of reflection during our deliberations involved individual and corporate deliberations on the broad areas such as what it takes to learn mathematics, while the micro level of reflection occurred when the students had to write at the end of each section what they considered most useful from the deliberations on the macro areas and what learning actions they were considering to take as a result.

A retrospective look at how we carried out the process of reflective writing during the deliberative dialogues points to some parallel between the process and the reflection process proposed by Watson and Wilcox (2000) for reflective reading. Their reflection framework (which has since been adapted for reflecting on non-reading-related reflection) divides the reflection into three distinct stages: firstly a general scan to identify the range of issues touching on the experience being reflected on; secondly a "zooming in" to pursue a fine grained analysis of specific aspects of the experience; and thirdly "a zooming out" involving a final synthesis and evaluation and resulting in some reconciliation and sense-making on key issues on the experience (Watson & Wilcox 2000; Diezmann & Watters 2006).

Our reflections during the deliberations and resulting students' reflective writing on the specific components (what it takes to learn maths; why the mentioned aspects were important for effective learning of mathematics; and what actions the students needed to take to improve their learning of mathematics and about mathematics learning as outlined in the reflection manual (cf appendix six, p. 9) occurred in three similar, distinct stages: the first stage of the reflective writing required the students to scan, identify and reflect on specific issues related to aspects of their past and present experience of learning mathematics. The "zooming in" was enhanced through the discussions with their peers in designated groups and later with the whole class and myself as a participant facilitator. The "zooming out" formally occurred at the end of each section of reflection after our corporate deliberations when they were required to take time as individuals and summarise their key reflections in terms of new understandings and considered action points. Given that the "zooming out stage" was a considerably more intense session of reflection at the individual level, I not only allocated longer time for it but also provided scaffolds in the form of prompts (*What? So what?* and W*hat now?*) to help guide the students in the synthesis and the sense-making of the things they had been able to consider in the first two stages of the reflection process. Further at the initial stages of the deliberation, I also used illustrations to help the students through this last stage of reflection. Over time though, in subsequent stages, most of the students were able to go through the "zooming out stage" with very little help, perhaps signalling that their capacity for reflection had grown over the period of intervention.

The following is an excerpt from a recorded version of one of our deliberation sessions. It presents an example of my attempts at guiding the students through the last stage of the reflection process - the "zooming out".

Me: I want you to imagine that you are talking to a form one in Origa. OK? And you are telling them the things that you have been discussing. OK? The key things that we have been discussing, that we have learned, that we have been learning on learning math. What have we said so far about learning math since we started discussing on Wednesday?

What?

So under <u>What</u>, write what you would tell that person. What would you tell them are the important things that we have talked about since we started? OK? So put some points there. So you will be saying "I have learned that…" Just summarise it in your own words. As an individual before you look at your friends. We will discuss. Have we written that?

So what?

Me: Now that we have written that. Imagine the form one student then asks you, why [do] you think the things you have written under <u>What?</u> are important to know as a student? Let us have an example that someone has written as a <u>What</u>?

(Student responds)

Me: So, he has written: 'I have learned that we must concentrate when learning math'. And then somebody asks you <u>So what</u>? Why is that important to know? And then he says, so that…

(Student responds)

Me: So, the reason why that is important is that I will be able to learn more and I will be able to improve in my math. Or in my grades. Do you see that?

<u>So what</u>? is why that is important. Why is it important? OK? So let's answer that. All those things that you have written under the first section… <u>What…?</u> Why do you take them to be important? What is the usefulness of it? Write that down…

<u>What now?</u>

Me: So what is <u>What now</u>? <u>What now</u> is, now that you have understood these things, what are you going to start doing. And what are you going to stop doing. So that is <u>What now.</u> What do you want to start doing that you have not been doing? What do you want to stop doing that you have been doing? What do you want to change out of what we have learned? And these are things that we are not just writing. We will actually try[to] start and or stop doing.

Me: Let us get examples.

Student: doing revision and asking questions on the work that has been done.

Me: That is something worth doing.

Me: Somebody else, what do you want to start doing?

Student: responding to teachers when they ask questions.

The students were then required to share their (What? So what? and What now?) reflective writings with their group members.

While the micro-level of the reflective writing could be considered to be aligned to the reflective process framework (Watson & Wilcox 2000), the general order of the broad categories of reflection and the resulting reflection on the broad areas in essence seemed to turn the same framework upside down. Our deliberations first involved a "zooming out" in terms of an initial focusing on the social context (general learning, school/class environment and home context) within which the students learnt mathematics before "zooming in" to explore the individual students' dispositions and metacognitive practices that also have an impact on the individual student's learning of mathematics. In doing so I was going after a grounded understanding and exploration of factors influencing the students' self-regulation in learning mathematics, an approach that is in line with: Dewey's contention of an existence of 'an organic connection between education and personal experience' (McVarish 2009, p. 473); Lave & Wanger's (1991) theory of situated learning; and an assertion by Eisenhart (1988) that a joining of cognitive theories and social-cultural theories provides a more comprehensive theory of human activity, in our case self-regulated learning of mathematics. Indeed, the "zooming out" and "zooming in" did help in exposing, both to me and the students, the considerable influence of social-cultural context on the students' learning of mathematics.

Reflective writing narratives

At different stages of the intervention period I asked the students to write reflections on their evolving feelings for and thinking about mathematics and/or to reflect and write on significant occurrences (related to their mathematics learning) that occurred during the intervention period. These writings were less structured in that, beyond giving the topic of reflection as prompts, the individual students were left on their own to decide on what to write and how to construct their reflective writings. Generally, the students' reflective writings took a free flowing style almost akin to narratives. My initial plan had been to engage the students in on-going reflective writing through journals. However, my early interactions with the students dissuaded me from this. I noted that the students' daily schedule was already overcrowded by so many activities and would therefore not accommodate the investment in terms of training and implementation of journal keeping. Further, I considered that introducing journal writing could end up being burdensome thereby depleting the energy that the students needed for the primary intervention-related activities like participating in deliberation sessions and operationalising the agreed upon actions like working in mathematics groups and taking "sleeping pills." According to Stuart (2012), narratives represent an experience that is encoded into words and relayed verbally or in textual or in story form (p. 441). The focus of the narration may be of three different kinds: experience-centred narratives whose focus is the reconstruction of experience with a view of making sense of the experience; event–centred narratives which tend to focus on the sequence of events; and discourse-centred narratives which draw attention to aspects of power as revealed in the narrative (Andrews, Squire & Tamboukou 2013). The reflective writings which the students wrote as a response to the above indicated prompts could fall within the category of experience-centred narratives given their focus on specific experiences during the intervention period. Indeed, in asking the students to write down their reflections on those experiences, I was particularly interested in the students moving beyond recounting specific components of the experience to their capturing in their narratives their personal reconfiguration of the experience. In essence I was interested, out of their personal reflection, in the individual student's interpretations of the experience (Stuart 2012) and the revelations from their writings on how the specific events impacted on different aspects of their (and self-regulation during) learning of mathematics (McNaught 2010; Bullough & Pinnegar 2001). Importantly, I also considered the writing activities as a critical part of the interventions: through the writings, I expected the students to take deeper and more critical observations of their role in the mathematics learning process (Levine et al. 2007).

In addition to giving the students prompts for each of the reflective writing activities, and stopping to explain to those who had difficulty interpreting the prompts or what was required of them, I also took care to schedule the writing of the narratives during non-formal class sessions: night or weekend prep time for Ademba and Rayolah and games time for Origa. This was to ensure that the students had enough time for reflection and were not interrupted by teachers coming in for lessons.

The table below provides a summary of the reflective narratives that the students wrote during the study:

Reflection prompt	**Stage**	**School**
Mathematics: my feelings and thoughts	Midway through the intervention	Rayolah, Origa and first group of Ademba students
Learning mathematics this week	Midway through intervention / before intervention	Merged class Ademba
Midterm mathematics results: feelings, thinking and reactions	Midway through the intervention	Ademba and Origa
Tournament: before, during and after	End of the intervention	Ademba, Rayolah and Origa

Table 1: Titles of reflective narratives written by participants

Key observations

Despite the efforts made to make the students understand what I required out of their individual reflective writings, a significant number of them ended up with more sequenced-based narrations than sense-making based narrations (Wong et al. 1995). In other words, the writings fell within a continuum ranging from the narrations being event to experience-centred. This variation could be taken as a pointer to a variation in the students' levels of reflection, a reality that resonates with empirical evidence in extant research that point to different levels of reflection amongst students or practitioners (Wong et al. 1995; Levine et al. 2007). In the study done by Wong et al. (1995), the participating students were categorised into three groups of reflectors. The first group, which he called non- reflectors, were found to focus on reporting the happenings instead of revisiting the experience and analysing it; the second group, the reflectors, were able to arrive at some new insights out of their writing, also paying attention to the feelings and associations that they made out of the experience. They were, however, not able to demonstrate in their writings aspects of transformation. The writings of the third group, the critical reflectors, had similar features to those of the reflectors and in addition demonstrated a change of perspective in their writings.

In addition to the variation in the levels of reflection, I noted a significant variation in the length of narration amongst students. The variation was noted across different reflection writing tasks and possibly across the genders. The girls generally seemed to write longer narrations than the boys. I also noted that in a number of cases, the boys more than the girls seemed to prefer not to identify themselves in their writing, choosing instead to present them in an anonymous manner. These observed variations add credence to assertions by Boud (1998) on the influence of broader social, political and cultural context on students' participation in reflection learning activities. The fact that the students' reflective writings on the last activity, the tournament, seemed to be longer and more free (some of them even resorting to using Kiswahili or Sheng) may be an indication of a higher level of trust that may have progressively developed between the students and me through the intervention period. Further, the sense of discomfort or reservations (and thus length) exhibited especially by the students from the two public secondary schools in participating in their first reflective writing exercise may in part be attributed to the novelty of such an exercise especially given the emotional aspect of the reflection process. Furthermore, the tendency for the boys (more than girls) to write shorter reflective narrations and to leave their writing as anonymous may be an indication that the boys more than the girls found it culturally problematic to express their thoughts and feelings to people and in my case a female stranger (Boud 1998; Robinson 2014).

Ethical and validity concerns

A key concern that has been raised about reflective writings is the ethical challenges that come with it (Boud 1998). Evidence from extant research (MacNaught 2012; McVarish 2009; Boud 1988) points to the fact that the process of engaging in experience-based reflective writings can unearth some painful memories and thus be emotionally upsetting to the participants. Accordingly, researchers are advised to only consider using reflective writing as a pedagogical or data collection tool for the sake of benefiting the participants and not the researcher or reader. In other words, the latter two should be secondary reasons for engaging participants in such deep and personal explorations as are demanded during reflective writings (MacNaught 2012). In the case of our study, my use of reflective writing was significantly informed by my theoretical understanding of its therapeutic effects (Wright & Chung 2001; Aaarika Stenroos 2010;) especially the empirical evidence from extant research that extols the virtues of reflective tasks as tools for learning and personal growth which have the potential of catalysing personal transformation (McNaught 2012; Bullough & Pinnegar 2001).

That said, I did not witness any experience of serious emotional breakdown amongst the students and (on one occasion the teachers of Ademba) as they wrote their reflection narratives. However, I did sense a level of discomfort amongst some of the students as they wrote some of the narratives: the reflections on midterm mathematics results by Ademba students and reflections on the experience of learning mathematics the week after the Ademba students were merged into one stream. In the latter case, after reading the reflective writings, I organised a discussion session with the students who seemed to be most affected by the merger. During the discussions, I allowed some of them to share the strategies that they were employing in dealing with difficulties related with the changes and also helped them in coming up with a strategy to support each other during the transition process. In the case of the reflective writings on midterm results, I took time in subsequent deliberative sessions to address some of the concerns that the students had raised in their reflective writings. Further, I also pointed out to the school's leadership aspects that they could possibly improve on in their assessment to enhance the students' positive experience with the learning process in general.

A final concern with reflective writings as data collection tools is that of validity: whether the writings present the "truth". Truthfulness in reflective writings is generally taken to be concerned with the authenticity (McNaught 2010: Bullough & Pinnegar, 2001), that is, the level of honesty of the reflective writings. A psychological barrier like a sense of unease in expressing emotions has been found to contain and limit what students include in reflective writings (Maloney et al. 2012). Given the variations in the length and depth of the students' reflective writings, I concluded that the authenticity of the reflective writings of some of the students may have been affected by psychological barriers. Being aware of this I sought to clarify the verisimilitude of the reflective writings through post-writing interviews (McNaught 2010) and explorations of some of their assertions in subsequent deliberative dialogue sessions.

Interviews

Basis for interviews

I carried out a series of interviews during my field work. The first set of interviews was done right at the beginning of the field work before officially launching the interventions. The interviews were designed to help me make meaning of metaphoric drawings done by the students about their feelings and thinking towards mathematics. The key goal of this first set of interviews was to explore the students' past and present (before the interventions) view of learning mathematics. The second set of interviews was carried out almost midway through the interventions and was also designed to explore the students' thinking and feelings towards mathematics midway through the intervention process. Specifically, through the interviews, I was keen to explore the individual students' experience with self-engagement with mathematics especially their doing of the "sleeping pills".

Prior to carrying out the second set of interviews, I had asked the students to write their reflections on their feelings and thinking towards learning mathematics at that point. As a result, the interviews doubled as avenues for seeking further clarification on some of the content of their written reflections. Additionally, during the interviews I sought to ask questions related to my observations during the deliberative dialogue sessions or analysis of the content of their "sleeping pills" mathematics books. For Ademba, I was also able to carry out a third set of interviews which focused on exploring their experience in preparing and participating in the tournament. These interviews also linked to the reflective writings that they had done for their preparation and participation in the tournaments.

The interviews

The opening questions for my interviews were aimed at making the students provide me with a 'grand tour' (Corbin & Morse 2003, p. 339) of their experience with learning or engaging with mathematics at various stages of the intervention process. In the pre-intervention interviews, for example, I asked the students to help me understand what their diagrams (and related features) represented about their feelings or thinking about mathematics as a subject. Similarly, in the second set of interviews I asked the students to tell me something about themselves (I would use their actual name) and mathematics…their thinking, feelings or anything they wanted to say about themselves and mathematics. Preceding the opening questions was a brief session of rapport building, which involved preliminaries like asking after how they were doing and explaining to them the reason for the interview.

The initial response of the students to my first questions was in most cases not free flowing. Instead the students tended to give a short and fairly generalised answer to my broad question. In most cases I had to probe further or seek more clarification using another open-ended question (Rapley 2001; Corbin & Morse 2003). This gradually stimulated a flow of narratives or ante narratives from the students on their feelings or experiences of learning mathematics or engaging with the agreed upon activities. Employing active listening acts like nodding as the students narrated or brief responses (hmm…) in between the narration helped in keeping the conversations flowing. The students, especially those from Rayolah and Origa, generally spoke in Kiswahili using a few English words now and then. In most cases my follow-up questions were in Kiswahili or a mix of Kiswahili and English. My contribution in the conversations did vary across the two sets of interviews (pre- and post-start of interventions) and across the period of interviewing. In essence my interview evolved from being fully unstructured to taking the shape of interactive unstructured interviews.

Unstructured interviews are open-ended and conversational in nature, usually requiring the interviewee to tell their story as 'they see it, feel it, or experience it' (Corbin & Morse 2003, p. 339). During unstructured interviews, the interviewer tends to offer minimal steerage (Pawson 1996) after providing the broad area for discussion. The interviewee takes the centre stage in the process (Corbin & Morse 2003), and the interviewer plays an active listening role. The interviewer may ask for clarification or probe an interviewer's response further during the interview. This may happen in the course of, or at the end of, the interviewees' narration (Rapley 2001; Corbin & Morse 2003).

In comparing the unstructured, semi-structured and even the quantitative interviews, Corbin and Morse (2003) contend that the key difference among them is in the level of power accorded to the interviewees in controlling the interview process and content gathered from the interview. For semi-structured interviews the interviewee's responses are generally influenced by the researcher's agenda and theoretical framework for the research (Pawson 1996). In other words, the interviewer has a higher level of control in semi-structured than in an unstructured interview.

In the latter phases of the intervention my interviews, while maintaining their unstructured format, became more interactive. Hinged on the established relationships amongst the participants, interactive interviews are collaborative in nature - both the researcher and the researched share their stories with each other in a reciprocal manner (Ellis, Adams & Bochner 2010; Rossetto 2014). My interviews with the students in the midway and last phases of interventions were characterised by mutual self-disclosure. My contributions to the conversation during the interviews sometimes involved sharing some of my personal stories around my school experience with learning and/or offering ideas and suggestions on some of the topics or issues of concern (around general learning and learning of mathematics) that arose from the students' narrations. I particularly took time with some of the students to rehearse (or expound on) some of the highlights from our deliberative dialogues. These contributions were geared towards helping the student interviewee to address concerns on some challenging aspect of implementing some of the agreed on actions or to reinforce and help illuminate the reasons behind some success in implementing some of the actions.

Some observations on interactions during the interviews

I noted that the level of interaction between the students and me during the interviews varied across the interviews and across the participants. For Rayolah and Origa, the level of interaction, in terms of my probing and seeking for clarification and the students speaking in free-flowing narrative and intimate form, was less in the first interviews carried out at the beginning of the interventions compared to the ones carried out in the last one to two months of the intervention period. The difference affirms the fact that the conversational intimacy generally experienced during unstructured interviews is usually anchored on the trust that has been built between the interviewers and the interviewees (Rapley 2001; Corbin & Morse 2003).

As such, the difference in the level of interaction between the Rayolah and Origa students during the interviews can be attributed to the fact that during the first set of interviews, the students interacted with me as an impersonal professional (Rapley 2001; Corbin & Morse 2003) while towards the end, given our intense interactions during the series of deliberative dialogues, my identity had now shifted to that of a "friend".

I also observed that my interactions with Ademba students through the sets of interviews were richer than with Rayolah and Origa. This could be attributed to the fact that I had an earlier entry into Ademba and was more immersed in its school activities than the other two schools. The other reason was linked to the fact that being a member of the same church community, I had a sense of relationship with many of the Ademba students that transcended the school and research relationship. As such the interviews that I had with some of the Ademba students even at the early stages of the intervention could also be categorised as acquaintance interviews. According to Garton & Copland (2010) acquaintance interviews are ‘interviews in an ethnographic research culture in which the researcher is an insider and in which the interviewer and interviewee have a prior relationship’ (p. 535). The relationship in this case is different from that between an ethnographer and research participants in that it is shaped in part by interactions outside the research context. Implicit in this a priori relationship is a shared world which is often invoked, made relevant and tapped into as a resource to co-construct the interview (Garton & Copland 2010).

Indeed, during my interviews with some of the Ademba students, I found myself linking part of our conversation to some of the cultural activities or entities within our wider community outside the school or classroom context. In most cases the discussions relating to wider community acted as a significant enhancer of the rapport between the student and me at the beginning of the interviews. In addition, it also helped in boosting the mood and level of interaction in the subsequent stages of the interview. The interaction during the interviews was one of the mechanisms that allowed for the interviews to be not just for the traditional purpose of data collection but also as an intervention method.

Types of questions asked in the interviews

A retrospective look at questions asked during the interviews (midway/final phases of intervention) identified them with circular questioning more than linear questions. Oriented towards a positivist view of linear cause and effect, linear questions are useful in establishing definitive facts, or eliciting content and detail about a situation or experience (Brown 1997; Evans & Whitcombe 2016). An example is the opening question to an interview with one of the Origa students: … “*tell me about Meheso and mathematics…”*

On the other hand, circular questioning, which finds its origin in systemic thinking, underscores the value of understanding the relationship between individuals and their situations (Dixon 2007; Evans & Whitcombe 2016). For example, appreciating that the students' learning of mathematics occurred within a social cultural context, at the latter stage of the interview with abovementioned student, to explore the extent to which overlapping nature of forces within this context (Mauksch & Roseler 1990; Brown 1997) also influenced their self-regulation, I fielded the following interview question to the student "…*tell me about discussions about maths at home…"* In sum, circular questioning during the interview allowed for natural emergence of data on differences (and contributing factors) in students' engagement with mathematics in different settings: the classroom during the traditional mathematics teaching; group work at school; and non-teacher initiated work at school and home. Through circular questioning I was also able to explore how the emergent social cultural factors differentially influenced the female and male students' engagement with mathematics.

I now turn to discussing how the students who participated in the interviews were chosen.

Selection of interviewees

My choice of which students to interview was guided by a process similar to theoretical sampling (Creswell 2013). Choosing whom to interview and on what criteria occurred relatively late in the inquiry (Charmaz, 2000), the selection being made to maximise variety and in response to themes emerging from already collected data (Onwuegubzie & Leech 2007). Accordingly, to facilitate an understanding of the contextual factors that influence self-regulated learning of mathematics amongst the students, I was keen to: select students from each of the three schools; have both male and female students represented in each of the schools; and have both day scholars and boarders represented amongst the girls interviewed from Rayolah.

Further, the decision on who were selected from these categories was informed by emerging theoretical interests. In the first set of interviews, for example, I selected students based on key words from the short texts they had written to explain what their metaphoric drawings represented in as far as learning mathematics was concerned. I specifically looked out for words that suggested some form of academic emotions attached to learning of mathematics. The selected cases were a representation of those who had expressed negative academic emotions using words like hate or fear, for example, and those who in explaining the drawings expressed some sense of positive academic emotions by using words like love, enjoy or fun. Pekrun et al. (2002) define academic emotions as the students' emotions linked to 'academic learning, classroom instruction, and achievement (p.92) (see Chapter three: Factors affecting self-regulated learning, section on: Students' relationship with mathematics for a more detailed discussion on academic emotions).

Similarly, some of the participants were selected in subsequent interviews in the later stages of the study for further exploration of implied insights in their written narratives. There were also those who were selected for interviewing because their names had been mentioned by an earlier interviewee as persons who had some unique or related experience in learning of mathematics. Equally there were those who were selected because of particular submissions or manifestation of some unique learning behaviour during the deliberative sessions or class observation sessions and based on data collected from their "sleeping pills" (see discussion on use of stories and metaphors in Chapter seven) exercise books. For example, I was keen to vary the selection based on the level of engagement (consistency) with the "sleeping pills" as manifested in their sleeping pills designated exercise books. Finally, in the case of Rayolah, there are those who were selected for interview based on convenience; this happened when I stayed back in the school on a Saturday to interview the girls who board at the school. Even though I had a list of girls, who I was interested in interviewing, I ended up interviewing those who were available for the interviews at that time. Even so I was able to group the girls interviewed in two categories based on their consistency with engaging with the "sleeping pills".

The consistent referral to the initial categories was important because interviewees were recruited for participation in the interviews not just as individuals but also as instances of social reality. In a way, it could be surmised that I was employing an interactionist epistemology whose main underpinning assumption is that the unit of investigation is the social interaction (Evans & Whitcombe 2016). In other words, in selecting the individuals to participate in the interviews it was not so much the individual that was being selected but rather variants (and interactions therein) of different settings of learning mathematics and the resulting experiencing of self-regulated learning of mathematics in those settings. For example, in selecting the students, I was interested in finding out how self-regulated learning of mathematics "panned out" in different settings, for example, traditional teacher-led class sessions, individual engagement with mathematics at school or home and during collaborative learning sessions with peers. Therefore, my selection of the individual students for the interviews was not just because they were bearers of a priori designated properties but more because they were instances of states within unique circumstances within my research field. An illustration of this was my interest in interviewing two different sets of girls from Rayolah, those who were boarders and those who were day scholars. My interest in each set was not so much about the individual experiences of the students with engaging with mathematics as how the experience (what they did and what they endured) was shaped by being day scholars or boarders.

The process of exploring the unique experiencing by the various instances (day scholars, boarders, boy, girls) was an intense process involving amongst other things, historical analysis, intuitive judgment, cross case comparisons and continuous reference to extant theoretical knowledge during the data collection (Crouch & Mackenzie 2006). In other words, I had to keep most of the data collected from individual cases in mind throughout the interview period.

Accordingly, given that the interviews were happening alongside other activities like the deliberative dialogue sessions and normal learning sessions, I took caution to keep the numbers of interviews small in each stage. Keeping the number of interviewees small allowed me to locate and to a good extent keep track of individual voices in the whole set of data and through the study period. This, as is posited by a number of researchers (Guetterman 2015; Robinson 2014), is important in allowing for extraction of thick and rich data. The concern for thick and rich data over the number of respondents can perhaps be explained by the contention of Crouch and McKenzie (2006) that the key focus of qualitative methodology is in determining "how things are" rather than "what things exist". Put another way, they contend that in qualitative research we are more concerned about 'the dynamic qualities of a situation rather than its constituents and proportionate relationships among them' (p. 489).

That said, even though I took every caution to ensure that I did not get bogged down by data (Robinson 2014), I was still conscious of the fact that keeping the number too small at the outset would amongst other things hinder my achieving theoretical saturation (Strauss & Corbin, 1994). Thus, I did not set a pre-determined number of interviewees as I began to collect data through the interviews; instead, I progressively increased the number until I judged I had attained data and theoretical saturation (Robinson 2014; Onwuegubzie & Leech 2007). In the table below, I present a list of those interviewed and give pointers as to how, when and why they were included in the sample.

No	Name	Gender	School	Basis for selection for interview	Stage of field work at which participant was interviewed
1.	Ebbie	Male	Rayolah	Indication of maths practice from "sleeping pills book"	During intervention
2.	Kadogo	Female	Rayolah	Indication of maths practice from "sleeping pills book"	During intervention
3.	Owino	Male	Rayolah	Indication of maths practice from "sleeping pills book"	During intervention
4.	Olonde	Male	Rayolah	Mentioned doing an interview with another student	During intervention
5.	Odeny	Male	Rayolah	Metaphoric drawing with indication of negative sense	Pre-intervention & during intervention

No	Name	Gender	School	Basis for selection for interview	Stage of field work at which participant was interviewed
				of relationship	
6.	Ado	Female	Rayolah	Indication of maths practice from "sleeping pills book"	During intervention
7.	Auma	Female	Rayolah	metaphoric drawing with a sense of positive relationship	Pre-intervention
8.	Hellena	Female	Rayolah	Indication of maths practice from "sleeping pills book	During intervention
9.	Maria	Female	Rayolah	Metaphoric drawing with sense of negative relationship with maths Indication of maths practice from "sleeping pills" book	Pre-intervention During intervention
10.	Odhis	Male	Rayolah	Indication of maths practice from "sleeping pills" book	During intervention
11.	Kyla	Female	Rayolah	section of reflective writing Indication of maths practice from "sleeping pills" book	During intervention
12.	Adhis	Female	Rayolah	Section of reflective writing Indication of maths practice from "sleeping pills" book	During intervention
13.	Achuku	Male	Origa	Section of reflective drawing participation during deliberative dialogue sessions	During intervention
14.	Juma	Male	Origa	Section of reflective writing	During intervention
15.	Atie	Female	Origa	Indication of maths practice from "sleeping pills" book Participation during deliberative dialogue sessions	During intervention

No	Name	Gender	School	Basis for selection for interview	Stage of field work at which participant was interviewed
16.	Kauku	Male	Origa	Participation during deliberate dialogue sessions	During intervention
17.	Odour	Male	Origa	Indication of maths practice from "sleeping pills" book Participation during deliberative dialogue sessions	During intervention
18.	Kish	Female	Origa	Indication of maths practice from "sleeping pills" book	During intervention
19.	Ambonya	Male	Ademba	Metaphoric drawings Participation during deliberative dialogue Section of reflective writing	Pre, during and towards end of intervention period
20.	Nyagonyango	Female	Ademba	Metaphoric drawings Participation during deliberative dialogue Section of reflective writing	Pre, during and towards end of intervention period
21.	Ogello	Male	Ademba	Special needs student Participation during deliberative dialogue	During intervention
22.	Shoza	Female	Ademba	Metaphoric drawings Section of reflective writing	Pre and during intervention period
23.	Mwangi	Male	Ademba	Participation during deliberative dialogue Section of reflective writing	During and towards end of intervention period
24.	Adie	Male	Ademba	Indication of progress made with "sleeping pills" Participation during	During intervention

No	Name	Gender	School	Basis for selection for interview	Stage of field work at which participant was interviewed
				deliberative dialogue Section of reflective writing	
25.	Elle	Female	Ademba	Section of reflective writing	During intervention
26.	Hyawqal	Female	Ademba	Metaphoric drawing Participation during deliberative dialogue sessions	Pre and during intervention
27.	Simcha	female	Ademba	Metaphoric drawing with a sense of negative relationship Section of reflective writing	Pre and during intervention
28.	Yoga	Male	Ademba	Section of reflective writing	During intervention

Table 2: List of participant interviewees

Trustworthiness of the interview data

I employed a number of strategies to improve the trustworthiness, especially the credibility (Otieno 2015a) of the data collected through the interviews. For example, I took care to build adequate rapport (Lechuga 2011) with the students before and during the interviews. In addition, during the interviews I paid keen attention to the emotional feedback from the interviews. This allowed me to tap into both the verbal and non-verbal cues to probe and increase disclosure from the interviewees (Voldnes, Gronhaug & Sogn-Grundvag 2014).

Similarly, the credibility of data collected during the interviews was also enhanced by the fact that a number of questions asked were based on data represented in some of the students' metaphoric drawings (Bagnoli 2009). As discussed earlier in this chapter, drawings not only tend to encourage holistic narrations from participants, they also, through their evocative nature, allow for revalation of sensitive aspects that some participants may find difficult to relate in words (Buckley & Waring 2013). As such I may surmise that using data collection methods such as metaphoric drawings and data gleaned from analysis of the students' reflective writings, deliberative dialogue sessions and students' "sleeping pills" books, helped in "bottom up" emergence of data and reducing opportunities for forcing data from the students (Renganathan 2009). Further, basing the interview questions on the data collected from the aforementioned sources and responses from earlier interviews also helped in triangulating the data and increasing the credibility of the data collected. Finally, using strategies such as circular questioning (Evans & Whitcombe 2016) and allowing for thick descriptions also reduced opportunities for participants giving me responses that they thought I wanted to hear (Tellis 1997). This care for "bottom up" emergence of data was particularly important given the fact my close relationship with some of the participants may have increased the tendency of the study participants to provide socially desireable responses to my interview questions.

Summary

In this chapter, I have provided insight into my employment of specific data collection methods for the purpose of: collecting data for my study; and supporting/reinforcing the students' efforts at self-regulation. In addition, I have also provided insight into the selection process of participants who were interviewed during my field work. Overall, the discussions in this chapter provide an in-depth view of how the different data collection methods were used in an integrated manner to enhance both the validity and quality of data collected on the students' self-regulation.

The discussions in this chapter marks the end of Part 3 of the thesis and leads into Part 4 where I provide an explication of the data analysis process and the key findings from this study.

CHAPTER NINE: OVERALL APPROACH TO AND PROCESS OF DATA ANALYSIS

Introduction

In this chapter I discuss the process and tools of analysis that I applied to make meaning of the data collected during this study. Specifically, I discuss and demonstrate how my identification with critical realism as the overarching philosophy guiding this study informed the means and steps taken to understand and synthesise this study's findings.

Approach to and process of data analysis

As intimated in the *Introduction*, the overall process of the data analysis was guided by the ontological and epistemological orientation of critical realism. In particular, the data analysis was guided by the critical realist position that reality is stratified into three levels (see Chapter four: Research philosophy and methodological approach) and that the world, which critical realists deem as open and social, is 'theory laden but not theory determined' (Fletcher 2017, p. 4). The general implication of embracing the aforementioned critical realists' position was that the fundamental aim of the data analysis (Danermark, Ekstrom & Jakobsen 2005) was more about an explanation of self-regulation as a social phenomenon and revealing the generative mechanisms which produced it during the learning of mathematics in the Kenyan secondary school context. In other words, rather than strictly focusing on providing thick empirical descriptions, the philosophical underpinnings of critical realism steered the analysis (Meyer & Lunnay 2012) of the data from this study towards exploring both subjective experiences of self-regulated learning by Kenyan secondary school students and the mechanisms that underlay the experiences.

The process of arriving at the explanation and identification of the generative mechanisms, which was largely driven by theory, was not linear given the critical realists' view of the social world as an open system which allows for interaction and overlapping of occurrences and events (Danermark et al. 2005). Put differently, considering the social world within which the students' learning took place as an open system implied that the subjective experiences related to learning and, important for this study, self-regulated learning of mathematics was complex and multi-faceted.

Accordingly, following in the footsteps of other critical realists (Fletcher 2017; Meyer & Lunnay 2012), I deduced that after coding the data into general themes through an inductive inferencing, I needed to employ both abductive and retroductive inferencing to arrive at a deeper understanding of the students' experiences of self-regulation and to explicate its generative mechanisms. Fletcher (2017) refers to abduction as 'theoretical description' (p. 18) and defines it as a thought operation involving interpretation of a particular phenomenon using extant fallible theories. In other words, abductive inference, unlike deductive inference, allows for consideration of findings in the lay accounts of participants that do not fit with a pre-determined theoretical frame. For example, in using abductive inference, I was able to come to the conclusion that self-regulated learning as experienced by the Kenyan secondary school students did not fit the mould of a strictly cognitive model of self-regulated learning as I had conceptualised before embarking on my field work (see Chapter two: Theoretical Framework for Self-Regulated Learning). Indeed, after a dialectical process of considering the data and literature on self-regulated learning, I arrived at the conclusion that I needed to use an amalgamated form of three of the extant theories on self-regulated learning to try and deduce the students' experience of self-regulated learning.

Such theoretical discrepancies also emerged in later stages of the analysis of the data, especially as I sought to explore the mechanisms underlying students' practice of self-regulated learning. In a number of instances, I found that some aspects of the data did not tally with the theoretical assertions of the extant frameworks that I was using as a lens to make meaning out of the data. An excerpt of an email below (and succeeding discussion), that I sent to my supervisors at some point of my data analysis perhaps provides insightinto how I applied abductive inferences in such instances:

> *…On another note…there is an aspect that is rather "eating my mind" that I would like some help mulling over: From my data it is emerging that peer interactions in connection to learning mathematics played out differently for a number of reasons for example…'I have got friends so that they may help me read' and I have got friends so that we can just be friends...;A lot of the literature that I have come across talk about social motivation goals which is more in the opposite direction: I am reading so that I can get friends…Do you know of any literature that would fit better with the first statement: "I have got friends so that I may read"....*

My subsequent exploration of literature to try to understand the noted theoretical disconnect between students' self-regulation and their relationship with their peers finally led me to literature on peers as socialising agents of adolescents' academic motivation and engagement (cf. Ryan 2000). This example is an apt illustration of how abductive inference enabled me to seek clarification for aspects that did not fit with my original theoretical frameworks and to remain sensitive to aspects unique to the cultural contexts of my study participants. Accordingly, one could surmise that the use of abductive inference allowed me to remain true to both the theory laden feature of critical realism philosophy and the centrality of culture as espoused by my study's overall methodology, that of ethnography. More importantly, using abductive inference alongside deductive inference helped in ensuring that I did not force the extant western-based theoretical frameworks of self-regulated learning onto the African context. However, the fact should not be lost that, ultimately, abductive-deductive inferencing was used hand in hand during the data analysis. Indeed, the findings presented in the next chapter are theoretical abstractions arrived at by applying the integrated model of self-regulated learning (see Chapter two: Theoretical framework for self-regulated learning), which as discussed in the forgoing section, were shaped out of abductive inferencing. An illustration of the deductive process and some of the theoretical abstractions of the students' experience of self-regulated learning of mathematics is provided in the extract below showing how I initially annotated the transcripts:

Me:	and hating the teacher (content-centred teacher)? How did it come that you hated the teacher?
Ado:	because I started failing {self-judgment} when I started failing I just gave up {maladaptive self-reactions}…I was just not interested in the subject
Me:	and you say something about the exam?
Ado:	my attitude was: let it come as it will come {minimal effort towards self-observation}.
Me:	what about your parents? What did they tell you about maths?
Ado:	they used to encourage me to work hard but I just said "ah, math is hard {reduced sense of self-efficacy}, siiezi [I can't] - there is no point {maladaptive self-reaction}"
Me:	And currently, what is your approach to learning mathematics

Ado: I do {effort towards self-observation} some sums…two {strategic planning/goal setting} "pills" a day from different topics. Then I take {openness to seeking social assistance} to the teacher {points to environmental self-reaction} to mark for me. The teacher gave me encouragement to keep trying {adaptive self-reaction}.

Me: how do you choose the topics of what to do?

Ado: the hard {implied self-observation} topic which I don't understand {self-judgment}; I started doing practice {behavioural-self reaction}… based on what I do not {efforts to self-observe} understand. I stated doing practice. Once I take {help-seeking, window for self-monitoring} to the teacher and if I get it wrong {self-judgment}, she explains how it is done {an adaptive self-reaction}.
(Ado, female student from Rayolah)

In addition to arriving at some of the findings, I deductively analysed some of the data collected through metaphoric drawings. To support the analysis, I applied the Gentner (1983) structure of analogical modelling and comprehension, which presupposes that the features that are preferentially selected for projection in metaphoric drawings are those that express systematic relations among the relevant concepts in the source domain which in this case was the students' view of learning mathematics. Accordingly, I deductively sought to identify the extent to which the conceptual objects, object attributes and inter-object relations of the students' diagrams are corporately indicative of theoretical aspects implied in a theoretical framework (see a number of examples in subsequent chapters on findings).

To identify the generative mechanisms and conditions that may have generated the contextual factors that supported or inhibited the students' subjective experiences of self-regulated learning of mathematics which, as explained above, were largely arrived at through abductive-deductive inferencing, I applied retroductive inferencing which is considered as the characteristic mode of inferencing in critical realism (Danermark, Eksrtom & Jakobsen. 2005). Different from deduction because of not being strictly logical and from abductive inferencing because of it being partly informed by the researcher's a priori knowledge and assumptions brought to the research, retroductive inferencing is anchored on critical realists' contention that social structures unlike the natural world are activity dependant (Fletcher 2017)

As suggested by Meyer and Lunnay (2012) I employed four main strategies to facilitate my employing retroductive inference as a data analysis tool. The first strategy was that of counter factual thinking: considering the different scenarios and conditions that existed and/or presented themselves (for example, learning in class; during peer groups; at home; when teachers were changed) I considered the difference in students' learning of mathematics (as presented in the data collected) under these conditions to help arrive at some of the constitutive factors that influenced their self-regulation. The second strategy that I employed to facilitate retroductive inference was from data collected on students' learning of mathematics due to some of the interventions such as establishing of peer groups to support their learning of mathematics and running of the *"Best class in town"* mathematics tournament. Exploring the data on the students' interactions and engagement with mathematics during these interventions provided an additional window for explicating some of the social structures that supported the observed subjective experiences of the students' self-regulation during their learning of mathematics. In addition to the abovementioned strategies, my running of the study as a multiple cases study involving three schools with some distinct attributes helped facilitate the process of retroductive inferencing during data analysis. Analysis of data of students' learning of mathematics during extreme cases that emerged during the field study such as the change of mathematics teachers for the three schools and the merging of two different streams for Ademba also provided some opportunity to draw out some of the constitutive conditions that influenced the students' self-regulation. Finally, my prior knowledge of some of the past and present education and non-education policies in the country also helped in sharpening my retroductive lens: it partially informed my identifying the interaction of the students' self-regulation (as empirically observed during the field work) with deeper structural mechanism such as those related to the country's colonial history.

In the table below, I provide an outline of the analysis process (and key outcomes) through different stages beginning from field work right through to writing.

Stage	Forms of analysis	Key outcome
Field work	Inductive reading and consideration of the data as it was being collected	Review of some of the intervention activities
(February 2016-	Writing of memos on key analytical thoughts	Review of data collection tools
	Reviewing of literature to make sense of	Increased immersion in the data and

Stage	Forms of analysis	Key outcome
August 2016)	some of the preliminary emerging findings from the data	an evolving sense of the very broad drivers and nature of self-regulated learning as experienced by the students
	Periodical discussions of preliminary findings with research supervisors	Refining of some of the data collection tools
	Some transcriptions of interview data and typing out of the reflective narratives of the students	Identification of aspects to explore further data on Refining and shaping of interview questions Identification of additional interview participants
Post-field work phase one (Sept. 2016-April 2017	Further immersion in data through transcriptions and repeated listening to the audio recording of the data Further exploration of matters related to philosophy and reading/trying out the potential data analysis methods	Additional and refined themes Identification of some inconsistent patterns emerging from the data Facilitation of a workshop on metaphoric drawings as a data collection method at the SHU Institute of Education student seminar Presentation of paper on field work process and first reflections on findings at 2016 BERA conference
	Review of literature on SRL theories based on the broad understanding of the data collected.	Shaping of an integrated theoretical framework for making sense of self-regulated learning as practiced by the students
	Deductive coding across all the data (each interview script) to identify broad themes of contextual factors influencing students learning of mathematics Merging of excerpts from each interview (grouped per school and per gender)	New themes and identifications of aspects of self-regulation and Influencing factors from the data Identification of some of the constitutive factors
	Exploring data from reflective narratives, field notes and metaphoric drawings to	Corroboration of findings and identification of possible accidental

Stage	Forms of analysis	Key outcome
	establish links and non-linkages with the earlier identified themes.	events and/or observations Initial excerpts from the data (colour coded) from across the different sets of data linked to the emerging themes as evidence from across the different sets of data
	Reading through the excerpts to compare findings across genders and schools.	Additional constitutive/structural factors with pointers of how they influenced student's self-regulation
	Summary of broad findings and feelings from data presented and discussed with supervisors and a few research colleagues	A sense of comparison of preliminary findings across the three schools and two genders An article for one of the school's newsletters on the broad findings of the study (see appendix 8)
Phase two of data analysis (May 2017-Septemeber 2017)	Review of literature to explore extant theoretical and empirical evidence on how the identified broad themes (e.g. teacher, peers, parents) have been found to influence self-regulation.	Identification of some inconsistencies between extant theoretical assertions and findings from the study Identification of new theories Shaping of literature review chapter for the thesis
	Further data analysis based on some of the theoretical assertions from the aforementioned literature review to explicate additional generative mechanisms influencing the students' self-regulation.	Enhanced understanding of the mechanistic generative relationship between the contextual factors and students' self-regulation
	Further deductive analysis of the data using the integrated theoretical framework to establish how different aspects (personal/behavioural/environmental) of the students' self-regulation actually played out under the influence of each of the contextual factors.	Enhanced understanding of the influence of the identified contextual factors on the students' self-regulation
Phase three	Drafting of the findings chapter: effort at	A multi-layered presentation of the

Stage	Forms of analysis	Key outcome
of data analysis (November 2017-May 2018)	coherent presentations of the findings in alignment with the key research questions	study findings
	Periodical discussions of emerging findings with supervisors	
	Further review of the data and refinement of the argumentation of findings based on feedback from the supervisors	
	Continuous reflection of the findings based on the evolving drafting of the findings chapter and sometimes leading to some further digging through the data (and browsing through some additional literature) for more appropriate evidence and connections across the presented findings Presentation of findings to different audiences in the UK and in Kenya	Sense of theoretical saturation on the ‘empirical’ 'actual' and 'real' aspects of students' practice of self-regulated learning Complete thesis findings chapters

Table 3: Outline of road map of data analysis for the study

In reality, the whole process was not as systematic and structured as represented in the table above: a good part of the analysis was informed and spurred on by the continuous reflection, rumination and conscious/sub-conscious internal dialogue over the data that carried on in most of my waking moments. In other words, from the initial stages of my field work up until writing this chapter, the data has remained consciously embedded in my conscious mind, running as background noise in my thinking.

Generally, the whole process of analysis was a reflexive, (data speaking to theory) iterative (back and forth) and dialectical process (using contradictions in data to probe initial findings or initial theoretical suppositions) involving theory and data. Also significant in this process was the feedback that I got from my supervisors on my preliminary analysis and synthesis of data in line with my research questions.

Summary

In this chapter, I have provided an overview of the data analysis process that was employed to understand the data and synthesise findings from this study. Through the discussions, I have demonstrated how I employed abductive, retroductive and deductive inferences to distinguish between: the 'actual' of the students' self-regulation (how and what aspects of self-regulation actually played out in my participants' context); and the 'real' - the generative mechanisms (structural and social contexts) that supported and/or constrained the students' self-regulation (Archer 2002). In the succeeding chapters, I present the study findings.

CHAPTER TEN: CONTEXTUAL FACTORS INFLUENCING SELF-REGULATED LEARNING

Introduction

In this chapter, I present the findings on a number of contextual factors perceived by the students to influence their self-regulation. The findings are presented under the following key broad themes:

- The mathematics teacher
- Peer interactions
- Assessment practices
- Parents and other members of the family
- Media use
- Religion

The mathematics teacher

Evidence from a number of studies has shown that teachers' instructional practices and their level of emotional nurturing have significant impact on students' self-regulation during learning, specifically, on students' sense of mathematics self-efficacy and their application of key self-regulation strategies (see section on teacher–student relationships in chapter three).

In this study also, the mathematics teacher emerged as one of the key influences on self-regulation, both during and after formal mathematics class sessions: The three components of self from Zimmerman's triadic model of self-regulation (see chapter two) - the students' perception of their sense of self-efficacy; their motivation to engage in learning; and their setting of learning goals - were generally negatively impacted upon when the teacher was deemed by the students to be teaching too fast and with less accommodation of students' active participation in the learning process. Sentiments decrying a mathematics teacher unwilling to respond to or solicit questions from students are provided below:

> But sometimes the teacher may come to class, you don't understand and when you ask he says "you seem you are not with us" as a result, you start doubting your dream of doing mathematics well…
> (Auma, female student from Rayolah)

> I drew it because sometimes the teacher comes to class and the lesson is just boring, the lesson just bores you. You just start thinking about other things. It is boring because the teacher gives long explanation, he just dwells on one question for long, about 20 min and yet the teacher does not ask us "do you know?" or "how can you explain the question?"
> (Odeny, male student from Rayolah)

The allusion to a feeling of doubt and boredom in class as captured in the excerpts above suggests a general dent in the students' sense of self-efficacy and motivation to learn mathematics. Some of the students from Ademba similarly bemoaned (through reflective narratives) their mathematics teacher's speed of teaching, offering further evidence of the influence of the teacher's teaching style on students' sense of self-efficacy and motivation for learning:

> He is also fast such that I understand nothing when he is teaching the concept. Personally, the maths lessons for me weren't helpful. They just seemed like a waste of time since I was understanding nothing at all. I actually felt like I was more blank than before

(Anonymous student from Ademba).

> Learning mathematics this week was challenging. A lot was not being understood (by me) especially during the lessons. It was boring and draggy for me…What I didn't like was that our maths teacher's aim is not for us to understand but to finish the syllabus. He also doesn't want to be asked questions or any opinion
> (Anonymous student from Ademba).

The impact of the mathematics teachers' teaching style and pedagogic relationships on students' self-regulation was made more explicit in students' comparisons of their learning of mathematics after they got a change of mathematics teachers during the field work. For example, Rayolah students had a change of mathematics teacher who, as is demonstrated in the excerpt below, they found to teach at a more measured speed and with greater inclination to support students' participation in the learning process:

> I like the way she is free with us. She encourages us to say what we think about it. And she also gives us chances to try
> (Hellena, female student from Rayolah).

It is instructive to note that weeks into being taught by the new mathematics teachers, a majority of Rayolah students reported a significant change in their strategic engagement and affective reaction towards mathematics. For example, Odeny, who as we had seen earlier, espoused maladaptive motivational patterns towards learning of mathematics, had this to say:

> I am progressing on well…I am beginning to appreciate mathematics…I am following the teacher …and as I continue to follow the teacher I am beginning to understand…kujua [know] hesabu [maths] and as I concentrate, I am beginning to know. To see that maths is easy. Before I didn't use to follow even if I did, not that much…I used to see it as boring -and to have a headache.

In a similar vein, some of the students also alluded tosome change in their behavioural and environmental self-regulation:

> I started doing practice…based on what I do not understand. I started doing practice. Once I take to the teacher and if I get it wrong, she explains how it is done
> (Ado, female student from Rayolah)

The response suggested some significant shift in Ado given what she presented as her perception of mathematics before the change of mathematics teacher:

> I started hating the teacher…because I started failing…when I started failing I just gave up…I was just not interested in the subject…even when my parents encouraged me to work hard I just said…"ah, math is hard, siiezi [I can't] - there is no point".

A change in mathematics teacher in Origa also seemed to have a positive influence on some of the students' behavioural and environmental self- regulation:

> We got a new teacher called teacher Omondi (pseudonym). He was teaching maths well and then I started to like maths; started doing revision on my own. When I am stuck I would ask him; he explains well until you understand; and when you ask him he answers well with a clean heart without frowning.
> (Kish, a female student from Rayolah).

From the responses of both Ado and Kish above, we can infer that the mathematics teachers' contribution to the students' environmental self-regulation centred on: their availability to provide help to the students outside their formal mathematics lessons; and their adeptness at using verbal explanations. In general, some of the students' responses suggested that they perceived the teachers who employed more explicit explanations and openness to questions as better at playing the role of coping models (mirroring the students' own learning experiences in terms of difficulties and sense of self-efficacy). As a result, they were deemed to be better at supporting both self and behavioural self-regulation. Note for example, the assertions by Ado below comparing their new and former mathematics teacher:

> …this one [talking about a new mathematics teacher] is understanding; she understands people's problem; when you take to her a question she will explain to you slowly; she will tell you slowly. She is able to take you through what you have not understood and is patient as well. But the one of last term would have taken you fast and if you say you have not understood he would tell you to go ask your friend.
> (Ado, female student from Rayolah).

Some of the students' efforts at self-regulation seemed also to be affected by their mathematics teachers' affective dispositions. As we saw above, for Kish, a female student from Rayolah, her interest in doing extra practice and revision of mathematics was partially sustained by the demeanour of her new mathematics teacher, who she said: "*answered her questions with a clean heart, without frowning."* On the other hand, Maria, a female student from Rayolah, reported that her overall interest in mathematics was dampened because her mathematics teacher frequently came for the lessons *while in a bad mood and angry*. Another pointer of possible influence on the teachers' affective disposition on the students' self-regulation was provided by Ambonya, a male student from Ademba:

> Moments that I get to concentrate and learn from mathematics lessons, -they are fun. The teachers' mood was happy, he came to class he was happy;. You know he sometimes talks to us, when we have other challenges he stops teaching and we discuss with him. Being taught by the other teacher doesn't seem to work for me well, I have not bonded with him. Yhere is that expectation, the level of concentration psyche and paying attention is low…

Peer interactions

The findings support studies that identify peer interactions as integral to adolescent students' learning largely through their influence - positive or negative - on behavioural self-regulation. I evidence, first, these two contrasting influences and then explore three of the key factors generating them.

Positive influence

I observed during the field work that a majority of the students' efforts at doing their "sleeping pills" improved (content anlysis of the excerscise books revealed that some of the students' who did not do their sleeping pills and the beginning were now regularly doing their "sleeping pills") after they were put in groups and especially after they shaped individual peer group (see example below) and class norms to guide their engagement with mathematics. Further, some of the students' responses suggested that their efforts at self-observation and self-judgment in the process of learning mathematics were improved because of more regular and structured peer interactions:

> We are active coz if I didn't do sleeping pills they [peer group members] ask me why have I not done. I tell them I will do another day; and when we come to school we can discuss; we exchange books to discuss;
> (Odhis, male student from Rayolah).

> Someone goes and does it on their own then we discuss; first, there are answers. You first mark before you bring it. If you have a difficult sum that proved a challenge, we do it all together then we explain to you how it is done…There is order, when we choose to work out a sum, everybody does. I can be able to look at your work and so can you…
> (Kyla, female student from Rayolah).

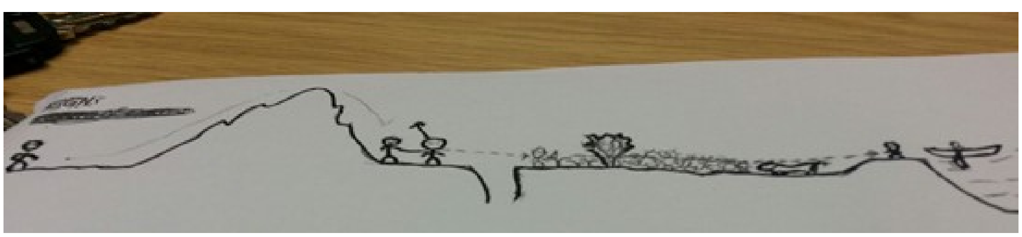
> When I get home I ask my friend if he knows the mathematics topic that we had been taught that day. If he says he knows, I give him a question to do, and then I mark from him. He also gives me a question from the topic to do and then he marks for me. If we are stuck, we discuss until we get the answer-if we are completely stuck we go to a teacher…
> (Odeny, male student from Rayolah)

Working out sums with and or alongside peers as alluded to in the excerpts above did provide the students with extra opportunities (outside formal class sessions) for monitoring and evaluating their understanding of specific mathematics concepts.

In addition, a number of the peer groups agreed on norms, aimed at regulating their behaviour during formal mathematics class sessions: "*Avoid talking when the teacher is in class"* and "*each group member must be attentive in class*" were two key norms adopted by Origa students; "*no copying of assignments from each other*" was top in the list for Rayolah students; and *"we must be our brother's keeper*", which meant amongst other things waking up the students who fell asleep during mathematics class sessions was embraced as a key norm by Ademba students. In helpin some of the students' pay more attention in class or shun from copying assignmnets from each other and distractive behaviour such as talking and or sleeping in class when the teacher was in class, one can surmise that these norms helped in structuring the classroom learning environment to be more supportive of personal aspects of self-regulation such as cognitive engagement.

The opportunity to seek and/or provide help to each other also contributed to an enhanced sense of self-efficacy, affective connection and cognitive engagement with mathematics.

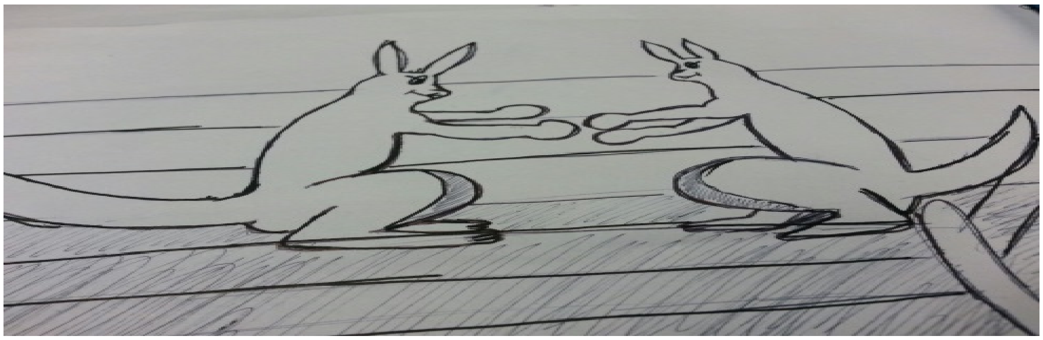
> Nowadays coz I am in a group and I have improved at least I have started to improve and now I have started to like it; group imechangia [has contributed]-coz; groups sleeping pills- you have to do sleeping pills then in the morning you discuss–and then you understand better. (Adhis, female student from Rayolah).



> Once I start the journey it looks tough. But as I move on I meet a peer who has been through to the end and is heading to the start to get others to enjoy what he has enjoyed and he guides me on what to do and when I listen and put his advice into practice I find it easy to get through. Though at some point-, I have to stop and think of how to overcome the challenges.
>
> (Ambonya, male student from Ademba)

Negative influence

In some cases, peer interactions had a negative impact on the students' self-regulation. Simcha, a female student from Ademba, depicted her efforts to cognitively engage during mathematics as a battle [two rabbits fighting]. As explained in the accompanying narrative part of the battle is in overcoming distractions from her peers.



> I'm maybe absent-minded or something, there is nothing that can end up being absorbed…if maybe someone [peer] is doing something other than math and maybe the teacher is teaching, you tend to shift and maybe concentrate on what that other person is doing…sometimes they may be trying to distract you or something…Maybe he or she wants to talk to you, for example, on a topic which is different from math…maybe reminding you of something that happened another day.
> (Simcha, a female student from Ademba).

Somewhat echoing this is the following confession from Ambonya, a male student from the same class, "…when people are sleeping, I also felt influenced somehow to sleep…."

Another example on how peer interactions may negatively influence aspects of students' personal self-regulation is provided by the following sentiment by Ado, a female student from Rayolah:

> I think boys…like assuming things; they spoil each other…Now you will find one boy telling the other; "why do the extra work? You are not the brightest in the class; why pretend and you are one of those who will score an E". And then the boy says, "let me just leave coz I have already been told E is my designated grade"…Even me some girls have come to me when I am reading, to ask me, "where will this take you?…are you now the choppy [top performing student] of the class?…"
> (Ado, a female student from Rayolah).

Note that I deduced sense of self-efficacy towards mathematics from statements from students suggesting a level of confidence in engaging in mathematical activity successfully which in some cases they measured through the marks from assessment tasks. On the other hand, I deduced sense of affective connection from statements alluding to some academic emotions, whether negative or positive. Finally, I took any suggestion of engaging in mathematical activity as signs of cognitive engagement.

Factors generating peer influence

Differences in peer interactions emerged amongst students from within/ across schools and also across the two genders (see also discussion in Chapter Thirteen). The students' responses suggested that the differences were due to a number of factors: the quality of the peer relationships; the availability of shared achievement-related attitudes and behaviours; and the time allocated for peer interactions.

In terms of the quality of peer relationships, from some of the students' responses and observations made during the field work, it emerged that the willingness to offer and/or seek help from peers was somewhat affected by the level of intimacy and shared affection amongst them.

> …must say today's session [forming mathematics peer groups] was not an easy nut to crack: there seemed to exist tension between the students since the merger; the relationship amongst members is not very good. Personal differences amongst individual students, generalised to the whole class and perception that members of one class were of better ability than the others contributed to the poor relationships…
>
> (field notes May 2016)
>
> So you found that as form 1s you still fear the form 4s (senior students) you could not ask for help from them and you still fear your classmates-you also can't ask for help. So you found that we rarely discussed maths amongst ourselves…and in our present math group I can say that the group members are not active…They are not free; you know you should be free and able to say all your problems. You would expect people to be freer with fellow students than with the teacher. You may find you talk to yourself –you would rather work on your own.
>
> (Adhis, female student from Rayolah)

In terms of achievement-related attitudes and behaviour of peers, findings from this study offer some support for emerging findings from studies (Nelson & DeBacker 2008; Ryan 2000) indicating that peer groups may act as a context for the socialisation of motivation for learning amongst adolescent students. For example, I observed that part of Ademba students' challenge with self-regulation was due to the achievement-related attitudes, and behaviours espoused by the school's student community. A number of the students spent most of the time designated for self-study on non-academic social interactions and/or sleeping in class. To support the efforts by students from my research class to self-regulate, I had to work with the school leadership, teachers and general student population to change this culture.

Origa teachers were similarly concerned that a majority of their students, especially the male ones, did not seem very interested in learning. They gave examples of frequent incidents of students coming to school while under the influence of alcohol and/or in possession of what are considered by the school as illicit drugs in schools. Indeed, in the last phase of the field work, a majority of the boys in my research class had been sent away from school (for an unknown period of time) because of being found in possession of some of these drugs. Their being sent away from school impacted not just on their individual engagement with mathematics but also, as is captured in the excerpt below from one of their classmates, other students.

> Many [mathematics group members] were suspended-we are just three; some have gone-and most of them are boys; and the one that is remaining is quiet…
> (Oduor, male student from Origa)

They partly attributed such incidents to the influence by individual students who had been admitted to the school after being dismissed from other schools on disciplinary grounds.

On the other hand, students who placed high value on learning tended to positively impact their peers' self-regulation:

> In class, my friends will get higher grades and I will get low ones. Then they would ask me, "What happened? We know that you are not like this, you are a very bright girl." Then one would tell me that next time they want to see me there with them. Getting sixty's and seventy's not getting fifty's. So I would try.
> (Nyagonyango, female student from Ademba).

> My friend encourages me to study-coz he does maths…he knows maths more than me-it is his best subject…I want to be like him…I want maths to be my best subject…
> (Odeny, a male student from Rayolah).

Lastly, the time available for academic-related peer interactions was a mediating factor on the influence of peers on students' learning. The students from the three schools decried the fact that they had to squeeze most of their structured mathematics group discussions into their own free time.

> For boarders, there is time for group work; from 3 p.m. until 6 p.m. (after formal school hours). For day scholars…there is no time for group discussion…they find it difficult-totally they don't have…their time is very fixed
> (Hyawqal, female student from Rayolah)

> When the teachers don't come for extra lessons then we have good time; in the morning…like today and yesterday we have been able to do some exercise…
> (Ado, a female student from Origa)

> I have also not done as much personal and group study because I have found myself with less time this term; last term I would finish my assignment within the first one hour and use the rest for personal study but this time I have found myself using even up to two hours on my assignment.
> (Ogello, male student from Ademba)

The examples given above suggesting that the students' engagement (individually and through peer interaction) with their learning of mathematics was significantly impacted upon by the amount of "work" they had from other subjects resonates with the contention by Ben-Eliyahu and Bernacki (2015) that self-regulated learning is a finite and depletable construct.
It is instructive to note that the reference to influence of peers is also made in other sections given its interactions with contextual factors found to influence the students' self-regulation.

Assessment practices

In line with common practice in Kenyan secondary schools, students from the three schools sat at least two sets of timed written examinations during the field work. The questions for the tests, which were usually picked from past mathematics examinations, were designed and graded to give a summative evaluation of their performance in mathematics that far. For Rayolah and Origa the students were ranked based on their total scores and the list with the ranks and corresponding percentage scores in each subject pinned on the classroom wall for all to see. I observed a class session, where the mathematics teacher in Rayolah, on bringing back the students' examination worksheets, called out the marks of each individual student, in most cases making derisive remarks on the low performance as the students came forward for their scripts. In most cases his remarks attracted giggles and murmurs from the other students. In contrast to this, as part of the interventions, the students participated in assessment activities through the tournament (see Chapter seven: Deliberative etc.) which were exemplified by a problem-solving mentality.

Unlike the individual-based school test whose focus was to sum up the students' performance in mathematics over their period of learning in secondary school, the tournament focused on a limited number of mathematics topics all of which had been taught during the specific term. Further, a critical part of the tournament was its emphasis on collective learning during the preparation phase: the teachers and wider school community worked closely with the students in preparing for the tournament and some of the points earned for each school were awarded based on the demonstrated effort by the students towards preparation for the tournament. In essence, the tournament-linked assessment activities were more formative in nature than the individual-based tests given their explicit focus on: the mastery of the topics in question; and improving the students' skills and behaviour towards learning mathematics as a subject.

Individual, timed summative-like mathematics tests

Some of the students' responses suggested that they employed less self-regulation duringg individual, timed summative-like assessments:

Me: Did the training influence how you did your exam in any way?

Ambonya: Yes, but not all the questions. It came to a point I noticed that time was running out…and I wanted to finish the paper. So I had to do it the normal way of rushing through.

Me: So are you saying that you were doing something different at the beginning? What was it?

Ambonya: I first read the question, think of the topic try to remember the formulas in that topic. Then I would try this formula, see it is not working, and try another and another.

Me: Then as time went by?

Ambonya: I just had to shift to the normal way of doing things.

Me: So what is the normal way of doing things?

Ambonya: Just look at the question, read the numbers, write them down and start calculating.

Influence on learning

The summative feedback from the written, time-based examinations also seemed to have a direct and indirect negative influence on students' personal and behavioural self-regulation and thus an impact on their learning:

> Before the tournament took place I had no interest in math completely because I would fail a lot in the examination and I used to find it very hard. All in all, I lost all hope in ever knowing math. I did not use to do anything at all. In all honesty, I never was interested in even trying to understand the contents
> (Shoza, female student from Ademba).

> I find it hard, sometimes I strain hard to revise but the same question comes and I fail … it lowers me and I feel to just leave math because though I study I still fail.
> (Odeny, male student from Rayolah).

> You will find one of the boys telling another: why are you doing the "sleeping pills"…will they be tested in the examination? Now you are posturing to be doing the sleeping pills as if you are the bookworm of the class; you are trying to pretend …and you are the one who scores E in class…" Then you will hear the boy saying, "let me just leave because I have been told I am an E student."
> (Kyla, female student from Ademba).

The summative results (percentage score and grade per subject) were reported to parents through a termly report card and this also sometimes had an indirect negative influence on the students through their parents' responses. The feedback associated with the individual, time-based assessment was also observed and reported.

It emerged also that when the schools hosted parents to an academic day to discuss the students' progress, the focus of the discussion was on overall performance grades. As a result, some of the parents focused their discussions and evaluation of their children's work in school on the overall grade achieved rather than on exploring specific areas of weakness and/or strength.

A sense of the focus that some of the parents put on grades when evaluating their children's work is captured in the , following question by which was posed by an Ademba parent to fellow parents on a WhatsApp platform:

> How can we help a student who has been in class for a whole term, gets a grade E in a subject, which has five lessons a week i.e. 5 hrs under a teacher per week but the student scores very low grades?
> (Parent of a student from Ademba).

Alongside focusing on grades as suggested in the above excerpt it also emerged that some of the parents judged their children's performance on the basis of the performance of the other members of the class.

> My parents always want to compare me with other results, top students, and inquire why I am not able to get as high marks. But you see for me I know that I am an average student since baby class.
> (Anonymous student from Ademba)

Collective-based formative-like mathematics tests

The tournament provided an alternative experience of assessment, one which was both collective and formative, and this impacted differently upon the students' learning.

Influence on learning

The feedback from students through reflective narratives and interviews suggests that, for a majority, the whole experience of participating in the mathematics tournament had a positive impact on their self-regulation:

> It was really good getting to know my weak points during the period of preparation. The questions on the snap quiz were a little bit challenging but I got to manage some which was really encouraging. Most of the questions were those that we had done as a group. I know that it was due to good preparation that I was able to achieve the best boy in the competition
> (Mwangi, male student from Ademba).

> I was able to learn a lot from some topics. But when the trophy went to the other school, I felt very disappointed and I pledged to do better. Though we didn't do well, I am starting to enjoy the subject. And I took it upon myself to challenge myself on why I should fail math and pass other subjects, it just does not make sense. So I am putting a lot of effort now.
> (Shoza, female student from Ademba).

> I also enjoyed the snap quiz since I was able to identify my areas of weakness in order for me to improve on them…I also learnt how to spot errors on my working in order to perform well. Basically, it was more of a learning experience than a competition…
> (Anonymous student from Rayolah).

> Before the tournament we really discussed in groups. The teacher gave us some work and we discussed as preparation for the tournament. We ensured that the group members understood what we were discussing
> (Abele, female student from Origa).

The responses above suggest that the tournament as a collective assessment exercise had both a direct and indirect impact on the students' self-regulation. It seemed to have shifted the students' achievement motivation goals from performance measures (pass or fail) to towards mastery (identifying areas of weakness and/or areas of improvement). Indeed, even though there was a competitive aspect to the tournament, a majority reported that it made them focus more on improving their understanding and/or learning better the mathematics concepts from the target topics rather than just focusing on winning. This orientation towards learning was aptly captured by one of the Rayolah students in the following statement: "*the whole experience was more of a learning experience than a competition.*" Despite the individual and school performance during the tournament, a majority of the students committed themselves to making more effort to improve their performance in mathematics.

Positive peer climate

The tournament also appeared to have an indirect impact on the students' self-regulated learning through the peer-climate that it helped create. Given its collective focus, it emerged from the data that it helped tune a majority of the students and to some extent the school to adopt more positive achievement-related attitudes, values and behaviour. Most of the students reported that they focused as a collective in preparing for the tournament given that the final assessment was to be cumulatively built on individual participation and contribution to a "marks" pool.

> We prepared well and we were attentive in class and in our groups we had some 'sleeping pills' which every group member had to do as an assignment every day. The group members shared ideas and we were focused in doing the work. Every member of the group had to be determined to learn and to manage time well during free time.
> (Otis, male student from Rayolah)

> It was a very important thing and it helped us to bring our [collective focus] mind together and help each other. The tournament was good and brought some students to having good emotion about math, not hating it. The tournament should be continued because it is helping a lot of students having positive emotions of maths. It has helped the students in bringing the ideas and suggestions together to help each other.
> (Njoroge, male student from Origa)

These findings are in line with findings from earlier studies (cf: Ryan & Patrick 2001; Harlen & Deakin Crick 2003) which suggested that formative assessment may help in enhancing the social relations between students.

Teachers' instructional practice

Feedback from the students and observations made during the tournament activity suggest that preparation and participation in the tournament contributed to a more positive emotional connection between the teachers and students. Further, it seemed to have also had some positive impact on the teachers' style of teaching: in helping the students prepare for the tournament the teachers seemed to be more inclined towards promoting mastery of the outlined topics. In addition, they seemed to have been more available to provide assistance to the students.

> Our class was usually practising mathematics - not almost but every day. We knew that we were going to win. We believe it and our teacher was encouraging us to keep on practising and we as his students we could do it. We even had discussion groups every evening and each group were trying their best to do it. That was the day before the tournament.
> (anonymous student from Origa).

Interaction between collective efficacy and self-efficacy

Finally, the reflections of the students after the tournament seemed to suggest that the collective nature of the assessment instigated a sense of collective efficacy during preparation and even after the tournament and that there was some sense of positive interaction between the collective sense of efficacy and individual self-efficacy towards mathematics with a positive spillover effect onto other components of the students' self-regulation. Some of the excerpts shared above reveal strands of this interaction between the two levels of efficacy.

Some of the students spoke of their belief in doing well as a collective and some put great effort into ensuring that every individual understood the target mathematics topics.

> After we returned back to our school I had many questions in my head. First I said "Yeah, we are the winner but if it was individually, where could I be?" I had no answer for that but I promised myself to work hard and look forward to when I will achieve my goal. I remembered the way I had confidence in my group discussion and the manner I was reading maths. I decided not to fail but always to be a winner. I declaredto myself not to fear but just to try and be with confidence all the time during my studies.
> (Mwanzia, female student from Rayolah)

> We were able to learn many things from the other schools. We were able to calculate some of the sums which we were not able to know. If one was not courageous, he or she could gain courage on that day. We have realised that we are able and if we cooperate and work together we can improve in maths.
> (Kyla, female student from Rayolah).

Parents and other members of the family

The findings support recent studies (cf. Callan et al. 2017) that identify self-regulated learning as one of the academic enablers influenced by parental involvement in adolescent students' learning. A majority of the students also identified other members of the family as key in their self-regulation during their learning of mathematics at home.

Parents

Some of the students' responses suggested that their parents played an important role in co-regulating their learning of mathematics at home. In particular, these students pointed out that their parents took the initiative to ensure they had done their homework and checked that they set out time to do extra revision of mathematics:

> My father and mother help me wake up to do my studies in the morning
> (Ebbie, male student from Rayolah).
> My mother tells me to do 'sleeping pills'…it is a must I show I have done. She confirms that I have done. Ssometimes she wakes me up to do it if I have not done. I have to do it no matter the time.
> (Odeny, male student from Rayolah).
> I have a timetable which I follow… my parents check my timetable-mostly my dad; he makes sure I follow my timetable…
> (Adhis, female student from Rayolah).

The parents played a part in the students' efforts at not just strategic engagement (setting time) but also efforts at self-observation, contributing to students' cognitive and metacognitive engagement. For some parents, their contribution took the form of their acting as co-teachers

> I told my father about the 'sleeping pills'. He said it is ok to do it. He evenehe helps me. If it is hard, he sends me to the teacher. He also helps me do some of my homework. If I tell them that the homework is too hard, they help me.
> (Olonde, Rayolah male student).

For some students, their parents contributed by helping with house chores. For example, Juma, a male student from Origa, reported that his parent did not want him to perform chores after school –all he was expected to do was to wash his uniform and read–because she wanted him to improve in his academic performance in school. A similar sentiment is shared by Kish, a female student of Origa: "*they give me enough time to read; my mum doesn't give me too much chores; I don't have too much work*".

Some of the students' responses also suggest that their parents contributed through verbal encouragement:

> There is one person who inspires me a lot, that is my mother. She reminds me that when she was in secondary school, she did well in mathematics, not because she was born knowing it but because she put into practice what she was told. I have therefore have told myself that if my mum was capable and yet she didn't have enough material and all the time she was being sent home for fees. She used to stay in school for few days; now I am not being sent home. I am just here and I don't have so much work at home and even when I have, I try to finish early so that I can read before I sleep…then she inspires me positively about mathematics, and then she is one kind of person when you do something well, she will tell you have done something and if you haven't, she will also tell you…
> (Achuku, male student from Origa)

The last sentence suggests that another way that parents may contribute is through the nature of feedback they give the students towards their work and/or achievements. Similarly, Maria talked about her mother inquiring from her what difficulties she faced in a specific examination and either stepping in to give help or sending her to seek help from the teacher. Another indication of the sense of support towards the students' self-regulation that feedback from parents on their assessment results may provide is presented in the excerpt below:

> …My results weren't what I could have expected…somewhat discouraging, my reaction was somehow angry with myself for not reaching my target, but I guess there is room for improvement. I was also sad but after sharing it with my dad, I wasn't sad any more. I believed and still believe I can make it in not only maths but also in other subjects…
> (Anonymous male student from Ademba).

The students' responses also suggested that the parents played a major role in structuring their learning environment, reporting that the parents took away phones or regulated their time for entertainment as a measure of encouraging them to work on their studies. For example, Achuku, a male student from Origa, had this to say about how he got to keep away from playing music from his radio instead of reading:

> My parent: I used to argue with my brother so I had spoilt the radio, there is part of the remote I had outside; if he puts it off I put it on from outside, so the parent intervened. The parent redirected the wires that takes electricity to the main house so he would switch it off from the main house. I could not go in to main house to switch on, so I in the process I got used to not have music at the time.

Other members of the family

Alongside parents, other members of the family also emerged as key influencers of some of the students' personal and behavioural self-regulation. This played out differently for different students. Some reported that older members of their family played a role of co-teachers in their efforts to learn mathematics at home:

> We have a cousin who is at Kenyatta University, so he takes us and goes to teach us.
> (Maria, female student from Rayolah).
> I have a brother who is an engineer who likes teaching me math and that is why I loved it.
> (Auma, female student from Rayolah).

There were also students who sought help from siblings when they had a challenge with solving a specific mathematical activity. Many such siblings were either still in secondary school or just recently graduated.

> ...at home I have timetable which I follow. Sometimes I go to my brother to help me with my study.
> (Adhis, female student from Rayolah).

> When I am home I ask my sister who helps me.
> (Kish, female student from Origa).

> I study with my brother; don't normally have discussion; do assignments; when a sum defeats me…he teaches me and then I continue.
> (Nyagonyango, female student from Rayolah).

Finally, some of the students' responses suggested that their personal self-regulation of mathematics, especially their affective connection with mathematics and cognitive engagement, had been positively impacted upon by their siblings' mathematics achievement behaviour, attitude and values:

> I used to hate math when I was in primary. I began to love math in form two. Because I saw my brother doing it daily and he loved it. So I wanted to be like that as well. So I began doing it just like him.
> (Kadogo, female student from Rayolah)

I have another who is in form 4 who we help each other out when he is around. He is very good in math and I try follow what he is doing so as to get it right. When he is learning I also learn

(Auma, female student from Rayolah).

Me it started with my brother, who is a student in a boarding school. So he understands a lot of things; when I was in class eight I used to see him…have his private studies; so when I got to form one I decided to try it a little, his pattern; that is focusing on studies instead of not listening to music at some point; and I saw it helps-coz when I was in form one I could understand things easily…

(Achuku, male student from Origa).

In addition to the direct impact on students' self-regulation through teaching, providing assistance and helping shape a cognitively inspiring environment, some students' reported that their siblings helped out with chores at home and thus allowing them more time to engage with their mathematical activity:

…They (sister and mother) give me enough time to read; my mum and sister don't give me too much chores; I don't have too much work…

(Kish, female student from Origa)

…I have a big brother in university; when he comes I am free and able to do more studies because he will take care of my younger sister…

(Olonde, male student from Rayolah).

In some cases, siblings had a negative impact, for example, for students taking care of younger siblings.

…When I get home from school, I get my small sister from school; wash her clothes…

(Olonde, male student from Rayolah).

Some of the students also reported that sometimes their siblings created an environment that was not very conducive for learning at home.

My siblings, they don't help me at all to study, while I am sitting down and studying…you are the only student meanwhile they are on their phones chatting, watching movies, playing instruments, just having fun; you are the only student, you just sit down and read; you want to rest and have fun with them…

(Hywaqal, female student from Ademba)

> My house is next to my brother, who puts his music from the radio on high volume most of the times…so for me to study I have to go to my mother's house….
> (Owino, male student from Rayolah)

Media use

Evidence from the students' responses suggests that there is a link between media use and students' self-regulation. A majority of the students were regular users of media, especially through the mobile phone, television sets and movie screening shops, which were found in some of the students' neighbourhoods.

A majority of responses pointed to a negative impact of media use on their learning. One of the things that reduced their attention to academic learning activities was media-based entertainment activities. Competing interest in such entertainment, like watching movies or listening to music, impaired their efforts at doing the "sleeping pills" and other mathematical activities like teacher-assigned homework:

> One of the things that takes many boys away from their books is movies…there are places in the neighbourhood that they can go to watch movie. Then there are those who have screens and DVD in their houses…those who don't have may also come to your place to tell you a story about a movie they watched …they end up making you to abandon reading to think about the movie. Or they tell you to accompany them to another friend's house to watch another movie…
> (Achuku, male student from Origa).

> Those who board at school have a better opportunity to study because when one is at home, instead of studying you may find yourself watching a movie; because maybe there is a movie coming up at some point and you don't want to totally miss, so depending on the timetable you may say you will wake up and try and recover and then you still don't find yourself studying the way you want.
> (Hellena, female student from Rayolah).

Use of mobile phones for text chatting with friends and other entertainment activities such as listening to music was particularly distracting. Some of the students thought that chatting with friends through mobile phones was one of the activities that interfered most with their effort at engagement with their learning at home:

When you have a phone it is difficult to concentrate. When I want to read I switch off the phone then I revise. Normally when the phone is on, I use it for chatting, playing games and listening to music.

(Owino, male student from Rayolah).

My mother took away my phone; my mum would be thinking I am reading but I am not reading just chatting with class members. Many students have access to a phone and they use it for chatting and maybe listening to music.

(Maria, female student from Rayolah).

One of the things that distract me from reading is a phone-I normally chat with my friend. Students should not have a phone because the kind of messages that one receives through the phone distracts one from studying.

(Adhis, female student from Rayolah).

…I feel that I don't have time with my phone and the TV as I used to watch movies all day…

(Odeny, male student from Rayolah)

Access to mobile phones presented one of the greatest challenges for the students' practising academic delay of gratification (Bembenutty 2007) as a key strategy of their self-regulation.

That said, some students' responses provided evidence that the mobile phone and access to the internet could support the students' self-regulation, facilitating and improving peer support for their learning:

…sometimes it is advantageous to have a phone, you may use it to ask a question from a friend; like once I used it to ask my cousin some questions on some form two work that we were going to be tested on…
(Adhis, female student from Rayolah).

…having a phone as a student is not completely bad…for example, you can ask your classmate about their progress on doing some assignment; "have you done the assignment, should I come we do together?" And you can use it to google up important information.
(Kyla, female student from Rayolah).

…we do "sleeping pills" sometimes, they text to ask me if I have done and if I have not done we come and do in the morning.
(Owino, male student from Rayolah).

Texting each other and finding out if we have all done the sums
(one of the group rules set by members of one of the peer groups from Origa).

The extent of use of mobile phones and access to internet to support students' self-regulated learning may have to been affected to some extent by the limited availability of online education content, that is locally developed education content. The students' who indicated that they had made some attempt at accessing online educational content to support their learning seemed to limit their search to seeking definitions or finding out more about some famous scientists.

Religion

It emerged from data from the three schools that faith in God played some role in influencing the teaching and learning practices. In all the three schools, I observed that meetings involving parents and teachers, for example, always started with prayers, which in part invoked God's presence and guidance in the discussions and their being able to provide oversight to the students' learning.

As a government policy, pastoral lessons are formally included in the students' weekly timetable in all schools in Kenya. In Origa students, the Muslim students were released every Friday to go to the mosque for prayers. For Ademba and Rayolah students, however, in addition to the mandatory pastoral lessons there was an opportunity to engage in individual and/or corporate worship daily. The sense of value given to prayers by some of the students was captured by the following statement from Hellena, a female student from Rayolah:

> There is a church building in the school compound and even some of the students have prayers in the morning before they come to class…In the morning it is up to you to drink your porridge fast then head off to church. Or just leave breakfast and go to church…then we sit and pray for yourself.

Additional responses from some of the students suggested that the consideration of their Christian faith in God had some influence on their personal and behavioural self-regulation. Specifically, some of the students' self-efficacy including doing mathematics was in part shaped by their belief in God: A number of the groups from the three schools explicitly outlined praying to God before embarking on their group discussions as part of their agreed upon peer norm. Asked to explain why, Kyla, a female student from Rayolah, had this to say: "*to do anything, God is the one who must lead…so God firs*t".

Additional evidence on how some of the students' self –efficacy towards mathematics was imbued through their faith in God is captured in excerpts below:

…some girls will discourage others…like one time I came to class and they were telling me; "what are you reading and you usually do not pass?…why do you even bother and you cannot get an A? why do you even study;?"; I told them I know what I am doing…I told them my God is a living God. Let me read, one day, one time He will help me make it…

(Ado, female student from Rayolah).

…you know there are students who don’t care [about praying] and there are those who care a lot. Mostly students who are here, they are people who are very careful when it comes to that sector [praying]…me I belief for God to help you, you should first work hard. I just do my best…and I know I have to be active so that when I ask from God he can give.
(Hellena, female student from Rayolah).

There was also some evidence that some students and even parents tapped into their religious socialisation as a key asset for shaping strategies for regulating their learning behaviour. For example, in shaping their class and peer norms for supporting mathematics learning Ademba students tended to borrow a lot from biblical principles:

The three peer groups had three diverse drawings [depicting their vision for learning mathematics]. Though the explanations were not so explicit about the norms; one could see the influence of the school community-ethos on how they presented this; biblical nuances were implicit in most of their explanations.
(Field notes, June 2016).

An example of how some of the parents employed their Christian faith as a lens and framework for understanding and supporting their children's efforts at behavioural self-regulation is provided in the reply to a WhatsApp question from one of the Ademba parents:

Maybe we approach the subject of students with low grades from scriptures…New Revised Standard Version Proverbs 22:15: 'Foolishness is bound up in the heart of a child, but the rod of discipline drives it far away'…You know my daughter scored 4 Es, and, the first thing I have done is to accept this scripture. Second I am now trying to define, the term foolishness in this context and the rod that can get rid of it. The scripture must be carrying the solution.
(Anonymous parent from Ademba).

The difference in the context of religious practices in Kenya and USA not withstanding, some distant parallels can be drawn between the suggested positive influence (from the responses above) of students’ religious faith on their engagement with learning mathematics and scholarship on religiosity (cf. Butler-Burnes, Williams & Chavous 2011) from the USA that has suggested some influence of religious socialisation on US students’ motivation for learning and academic achievement. Further research within the Kenyan context will be useful in exploring further the possible influence of Kenyan students’ spirituality on their academic motivation and or engagement.

The above positive findings notwithstanding, it emerged from some of the students' responses that the use of biblical scriptures by adults in learning contexts may sometimes lead to a sense of withdrawal and cognitive disengagement by some students. Evidence of this is provided in the following interview excerpt:

> …Immediately a teacher comes you have the morale to find out what he is going to be teaching. But when he comes and writes a scripture…you go like…"Oh Lord" …the morale for learning goes down…sometimes it is a motivation to me…sometimes it speaks of something that you have ever come across…but that is if you are a Bible reader; but others take it like "urgh, this teacher" which is not good…
> (Adie, male student from Ademba).

Summary

In this chapter I have presented findings on the range of contextual factors that were found to influence students' self-regulation during their learning of mathematics.In my discussions in this chapter, I have provided some insight on how the contextual factors which include: relationship of students with their teachers, peers, parents and other members of the family; the students' use of media; and the instructional and assessment practices promoted by the schools seemed to differently influence the students' personal, behavorial and environmental self-regulation when learning mathematics. Though the contextual factors have been discussed as individual entities, the evidence from the study findings suggests an interaction between them and that their influence on the students' self-regulation when learning mathematics is also inherently influenced by a number of generative structural factors. I will present the study findings on the nature of these structural factors in Chapter Thirteen: structural factors influencing self-regulated learning. In the next chapter, I present study findings on the adequacy of the core mathematics textbook in supporting the students' self-regulated learning.

CHAPTER ELEVEN: MATHEMATICS TEXTBOOKS AND SELF-REGULATED LEARNING

Introduction

In this chapter, I present my findings on the use of mathematics textbooks by students in the three schools.

It is important to note that, as is the case with many African education systems that have a colonial past (Shizha 2010), learning in Kenyan schools is very much textbook-based (see section on General features of the Kenyan education system in Chapter one). That said, my interest in exploring the adequacy of the key mathematics textbook in supporting the students' learning was spurred by a response by one of the students midway through my field work. The student reported that he had not done as much revision during the term partlybecause he had lost his preferred mathematics textbook (not the core textbook KLB). Our discussions around his preference for the said book for his self-study made me see the importance of seeking to explore in subsequent interviews the adequacy of the KLB textbook in supporting the students' learning of mathematics. During the interviews, I asked the students which textbooks they used during their self-study and the reasons behind their preferences. In some instances, I asked them to compare and share their experiences of using KLB and other textbooks and, given the opportunity, which of the books they would advise the government/school to purchase.

The findings are presented in two sections: an overview of the ownership and use of the textbooks in the three schools; and presentation of findings from interviews with the students on the extent of their use of the core mathematics textbook, KLB, to support their self-regulated learning of mathematics.

Mathematics textbooks use in each of the three schools

Textbook use in Ademba

As a private school, Ademba did not benefit from any support from the government in provision of learning and teaching resources. The textbooks, which are distributed to the students by the school. were purchased through pooling of money from parents. Each student had an individual copy of the core textbook, KLB, and at least one other mathematics textbook by a different publisher. The books were kept by the students for one academic year. At the end of each academic year, the students returned the textbooks before they were issued with the one for the class they were proceeding to. In the course of the year, the students had the freedom to use the books both at school during the term and at home during holiday breaks. I observed that Ademba teachers used the KLB as their key reference. The classes were conducted in English. The teacher referred to his/her copy of KLB as each of the students referred to their individual copies. Most of the mathematics assignments given at the end of the mathematics lessons were assigned from the KLB mathematics textbooks.

In addition to the KLB and the additional mathematics textbooks, Ademba stocked its library with copies of other mathematics textbooks and revision textbooks. The students were free to borrow these whenever they felt the need to. Moreover, a majority of the students had purchased mathematics texts, most of them being revision mathematics textbooks.

Textbook use in Rayolah

Most of the copies of the KLB mathematics textbooks used during lessons in Rayolah were purchased by the school through government funding. Due to limited resources, at least two students were expected to share one copy. The books were distributed to the students at the beginning of each academic term and collected for safe keeping during the holiday. Given that not all students had their personal copies, the assigned work by the teacher from KLB at the end of the lesson was always written on the chalkboard for the students to copy. A few of the students opted to buy their own copies of KLB. Most students who could afford to do so, on the advice of the teacher, opted to acquire a copy of a revision textbook instead of KLB. A majority of these students were girls. These copies of the revision textbooks were frequently lent out to other students (mostly girls) within and across different classrooms. Almost all of the boys interviewed from Rayolah said they did not own any other textbook and that they mostly used KLB as their core reference book for studying mathematics.

Textbook use in Origa

Like Rayolah, most of the copies of KLB used by the students were purchased by the school through government funding. Being a smaller school and not having benefited from the textbook fund from the government for as many years, the textbook student ratio was higher, with one copy sometimes being shared amongst more than two students. As was the case with Rayolah the books were distributed to the students at the beginning of each term and collected for safe keeping during the holiday. Again, the assigned work at the end of the lesson was always written on the chalkboard for the students to copy. Fewer students than those in Rayolah opted to buy their copies of KLB and of these, many opted to purchase revision books instead of KLB. The girls who were interviewed reported that sometimes they borrowed revision mathematics textbooks from some of the senior students to use for their personal study. Again, the boys who were interviewed largely restricted themselves to using KLB and past papers in their self-study with mathematics.

Adequacy of core mathematics textbook (KLB) in supporting self-regulated learning of mathematics

The students who were interviewed from the three schools explained how specific features of the core mathematics textbook (KLB) supported or inhibited their effort at self-regulated learning of mathematics. Many of the emerging themes related specifically to a given section of the textbook: exposition, examples or exercises. In the succeeding section I present the discussions of the themes based on their relationships with the aforementioned sections and in the same order.

Comprehensive and comprehensible exposition

The students' submissions suggested that how comprehensible the exposition section was affected the self-regulated learning of mathematics in a number of ways. They favoured:

- comprehensive explanations;
- the use of explicit, full and clear sentences;
- situating the explanations within some context through the use of real life examples;
- the demonstration of connections with earlier learnt concepts;
- the accessibility of the language used; and

- the use of visual aids like drawings to make the intended meanings more explicit.

The students valued *comprehensive* explanations. For example, Nyagonyango professed that, even though her preference was usually to consult notes given in KLB first before attempting questions from other textbooks, a number of times she found the summary notes in KLB not comprehensive enough and was forced to look for other revision books to support her self-instruction and self-monitoring.

> Me: Now when you are revising your math, when you sit down to do self-study, which textbook do you find yourself using?
>
> Nyagonyango: This math book, the KLB....I use the KLB to look at the notes then the other book to look at the questions…sometimes it does not really have what I need. So I will look at Spotlight Math or other revision books to get the notes...Also if we have been given a question by the teacher or there is a question that I really need to get the formula. Then when I look at KLB and it doesn't have that particular formula then I have to look at other books.
> (Nyagonyango, a female student from Ademba).

This supports the view that introducing all necessary concepts in the right order in mathematics textbooks is helpful in preparing students for learning (cf. Pepin & Haggarty 2001).

Ambonya from Ademba said that he preferred the *clarity* of another textbook rather than KLB whose exposition he said tended to "*mix him up*." Similarly, Kish from Origa preferred the more extended sentences in one of the revision books rather than KLB.

> It has…explanations I can understand; KLB-the explanations don't explain in depth like the other one-I prefer the revision book.
> (Kish, female student from Origa).

Ogello opined that an alternative textbook explained mathematics better because it used *real life examples* and also demonstrated the connection of the new concepts with concepts learnt earlier. This, he said, made '*the understanding of the normal syllabus to flow better*' especially because the real life connection, according to him, aided in *'remembering the concept being explained*' and the demonstration of the new concepts connection with an earlier learnt concept helped in the concept *'going inside'*.

> I would dedicate the first quarter of my study time to KLB to have a basic understanding of the topic then use three quarters of the time on the other book for internalising of the concept. (Ogello, male student from Ademba).

Adie on the other hand said that the *use of drawings* to help explain the concept was useful. He had this to say about the alternative textbook:

> That book is gold, according to me. It is gold since it explains the question first. You are also given a drawing to explain that particular thing. The other books just give a formula. It is like you only have the formula. And you do not have anything on what is being talked about.
> (Adie, male student from Ademba).

The sentiment by Ogello on the usefulness of the real life examples and connection of new concepts with earlier learnt concepts and of Adie bemoaning the fact that the core textbook tended to just give formulas without clear supportive explanation or illustration of the mathematics concept resonates somewhat with the assertion by Mesa (2010a) that definition and context maybe useful in understanding the internal logic of arguments. They also resonate with assertions by Pepin and Haggarty (2001) that the pedagogical capacity of a textbook is in part connected to its ability to help students see the value of new methods and/or the relationship to earlier learning.

Number of methods presented

Some of the students' responses suggested that giving more methods in the exposition section was useful for self-instruction, self-monitoring and self-evaluation when learning mathematics

> Coz it [an alternative textbook] has many methods, explains better than KLB…it has methods…more than one method which you didn't know.
> (Adhis, a female student from Rayolah)

> That book shows you that is not the only way that you can do it. It gives you another way to do. Another formula…KLB teaches you one method. You know the publisher, or the one who wrote it has one method so that you can do each and every topic quickly…
> (Adie, male student from Ademba)

The examples above echo assertions in the literature (cf. Pepin & Haggarty 2001; Mesa 2010) that being able to see the relationships between different methods/approaches can help enhance conceptual fluency amongst learners, since it provides them with the opportunity to make connections across different strategies and notions.

Logical structure and plausibility of the explanations supporting problem solving in the examples

Some of the students professed that their effort at self-instruction was sometimes hampered by the difficulty they faced trying to follow the argumentation in examples presented in KLB:

> Sometimes me hupotea [get lost/confused]-when I look at the examples.
> (Atis, a female student from Origa).
>
> I don't use examples from KLB-I was told by my cousin who had done well in maths-KLB examples can changanya [mix you up]; I like looking at the teacher's If I don't understand I ask…; I don't use the KLB ones.
> (Juma, a male student from Origa).
>
> I prefer the revision book over KLB because it gives the step by step explanation [in the examples]; KLB is shallow…it kind of jumps to the answer and does not give the explanations.
> (Ogello, male student from Ademba)
>
> You will find I am using KLB and sometimes I don't understand…it depends on the question…totally I don't understand; there are some gaps…here are some gaps; for example, you will find that there is a number 12 and you are not sure where it has come from. But in these others, they will explain step by step, they will tell you 'for example'…'therefore'…
> (Hellena, female student from Rayolah

The students' concerns with the logical structure of examples in the core mathematics textbook and preferences for plausible explanations in the example as expressed in the excerpts above resonate with earlier assertions by some of the mathematics textbook researchers (Fan, Zhu & Miao 2013; Lithner 2004; Pepin & Haggarty 2001) that explicit explanations and some rhetorical presence in mathematical examples is key for self-regulated learning of mathematics.

Number and variety of examples and exercise questions

The number of examples given to illustrate the working out of a specific mathematics technique also emerged as a key feature in supporting the students' self-instruction and self-monitoring. Specifically, having many examples to illustrate the working out of a specific mathematics concept seemed to be important in supporting procedural and conceptual fluency (Mesa 2010b):

> ...some of the textbooks have many examples so based on how much I have not understood that is what I use... KLB should give more examples as the current number sometimes is not enough to understand a concept that is more complicated.
> (Ado, female student from Rayolah).

Some of the students reported that for their personal study they used other textbooks instead of KLB because those books had a wider variety of questions, which they found useful for self-evaluation:

> …haina [it doesn't have] many revision questions like the other textbook.
> (Hellena, a female student from Rayolah)

> …other books 'also test' various [a variety of] questions
> (Nyagonyango, female student from Ademba)

> These books ask questions differently from what was in KLB…and these other books have other questions because for KLB we will definitely use it with the teacher. So I use the other book when discussing with my friend, so that we can do revision and if there is a problem then the teacher can answer from all the books that I have access to.
> (Kyla, female student from Ademba)

Cognitive complexity of questions asked

Some of the students' responses did suggest that the cognitive complexity of the questions in the exercise section had some l influence on different aspects of their self-regulation when learning mathematics. One group of students, mainly boys from Rayolah and Origa, indicated that they used KLB during their study because the questions in the exercise section were not complicated or very difficult:

KLB: has not given complicated things, the sums are just of moderate difficulty...It is not a must for one to be a fast learner, for one to understand, because it does not have 'mambo nyingi vile' [doesn't have many things (demands)]. You will just pass through them slowly and you will come to understand things…

(Achuku, male student from Origa).

From his submission, he alludes to the fact that not finding the questions in the exercise section too challenging boosted his confidence and sense of efficacy (alluded to in use of term, "fast learner") towards learning mathematics. The link between the students' self-efficacy and the sense of cognitive demand required for "doing" the questions in the exercise section was also captured by Odeny, a male student from Rayolah, who had this to say about the exercise section of KLB:

I like questions in KLB because it is what we have done in school.

Conversely, some of the girls, especially those from Rayolah, seemed to prefer the exercise section of other books because they found them cognitively challenging:

…It has sums that are ngumu kiasi [fairly difficult] that makes you think…

(Maria, female student from Rayolah)

…it has a hesabu [maths questions] ngumu kidogo [a little difficult] -so you can go to the group or teacher to be helped…

(Adhis, female student from Rayolah)

Implied in the responses above from Maria and Adhis is a supposition that cognitive challenge may support aspects of self-monitoring and self-evaluation. Accordingly, this echoes the contention by Mesa (2010) that the cognitive complexity of mathematics questions may lead some students into paying more attention to considering what (and how) knowledge and resources need to be deployed for the student to successfully solve the mathematics problem at hand. Further, conscious reaching out for difficult questions that may lead to asking for help as alluded to by Adhis also adds some credence to assertions by Bembunutty (2007) that the nature of questions may influence the strategic planning in terms of learning strategy of some of the students during their self-regulated learning of mathematics.

Link between questions in the exercise section and examination questions

Some of the interviewed students indicated that they did some of the exercises in KLB to help them prepare for the continuous assessment tests:

> I like KLB-coz most of the exams (internal) questions come from KLB; most questions like for mid- term are from KLB.
> (Juma, male student from Origa)

> …I will spend at least one quarter of my time doing questions from KLB because that is where the exams come from….
> (Ogello, male student from Ademba)

The interest in doing the questions because of their being close to possible examination questions may be taken as a strategic action by the students to acquaint themselves with the cognitive complexity in lower-stakes environment before encountering them in a high-stakes test (cf. Mesa 2010a).

Solutions and/or answers to questions in exercise section

Some of the students bemoaned the fact that KLB did not provide worked-out solutions or answers for the questions in their exercise section:

> …because KLB doesn't have answers. Sometimes you want to do practise and see if what you have done is right. You can check the answers or have someone mark for you, that is the advantage of using [an alternative] textbook.
> (Ado, female student from Rayolah).

The value of solutions or answers for questions in the excerscise section as presented in the above excerpt echoes findings in earlier studies that have pointed to a positive link between the provision of effective feedback and self-regulated learning (cf. Bembenutty 2007).

Organisation of exercise questions in relation to exposition and examples sections

How explicitly the exercises were linked to a topic, exposition or examples also emerged as a feature that was important for some of the students. Specifically, some of the students reported that they found the organisation of key revision questions for a number of topics as a mixed exercise in KLB confusing:

> …from mixed questions you have difficulty to interpret, you don't know which topic it has come from…I like the questions, after I remind myself which topic has the questions.
> (Owino, male student from Rayolah)

> …I prefer the other textbook because it has those topics branched and in different places
> (Ambonya, male student from Ademba).

The examples above echo findings from a study by Lithner (2004) which suggested that providing explicit links between questions and topics facilitated a quicker access to the cognitive knowledge required for working out the answers.

Accessibility of English language as used in the textbooks

Some of the students, mostly from Origa and Rayolah, raised concerns with the accessibility of the English language as used both in exposition and exercises:

> …it [explanations in the exposition section] is easier to understand, I mean the words; when you read, you feel like you understand than KLB which has English inanichanganyisha [mixes me up-confuses]. Sometimes you have to use a dictionary…and I also don't use the KLB questions in the exercise section because sometimes I find the questions difficult (language) to understand.
> (Atie female student Origa)

> It has nice questions; the English is easier to understand than that of KLB…it is easy to understand…
> (Ado, female student from Rayolah)

In professing that the level of accessibility of the English language as used in KLB had resulted in some difficulty in understanding the mathematics in the text, the two students were highlighting a concern that has been the focus of attention of a number of mathematics education researchers (Abedi & Lord 2001; Schleppegrell 2007; Clarkson & Idris 2007; Kwasi 2009). The findings from these studies suggesta positive relationship between the students' level of proficiency in the language of learning and teaching of mathematics and the students' mathematical performance. More specifically, the suggested connection by the students above between language accessibility and student's comprehension resonates with assertions by Abedi & Lord (2001) that 'when a student is reading, pauses for unfamiliar words or constructions are likely to disrupt the flow of comprehension' (p. 223). Accordingly, language accessibility of mathematics text may have some direct impact on students' efforts at self-instruction and self-monitoring during self-regulated learning of mathematics.

Summary

In this chapter I have presented my findings on the students' use of the core mathematics textbook (KLB) to support their efforts at regulating their learning of mathematics. The findings suggest aspects that may need to be improved in each of the sections of the core mathematics textbook so that it can support better the students' efforts at self-instruction, self-monitoring and self-evaluation when engaging with mathematical activity. The accessibility of the English language used; the comprehensiveness and comprehensibility of explanations and argumentation in both the exposition and examples sections; and the topical arrangement, variety and cognitive complexity of the questions in the exercise section emerged as some of the key aspects that can be improved to make the core textbook more adequate at supporting the students' self-regulation.

CHAPTER TWELVE: SELF-REGULATED LEARNING AND STUDENTS' RELATIONSHIP WITH MATHEMATICS

Introduction

In this chapter, I discuss the findings on possible interactions between the students' self-regulation and two key components of students' relationship with mathematics; their epistemic beliefs and emotions. The discussion is made with the understanding that, self-efficacy which is considered to play a critical role in students' personal self-regulation (Zimmerman 1989) has also been identified as a core influencing component of students' affect towards mathematics alongside the students' epistemic beliefs and academic emotions towards the subject (Di Martino & Zan 2011).

Epistemic beliefs

In tandem with findings from related studies (cf. Muis 2007), the findings from this study suggest a reciprocal relationship between students' epistemic beliefs and their self-regulation during learning.

Some of the students' responses during the early stages of the field work were characterised by lower levels of self-regulation and seemed to point to a passive approach to mathematical knowledge and an absence of a constructive view of mathematical activity (Schoenfeld 1983; Muis 2004). At this stage, a majority of the responses revealed a culture of engaging in mathematical activity which was centred on the teacher as the sole source of learning and characterised by minimal personal self-regulation:

> Before you came, I was not performing well in mathematics, because I used to hate the teacher, I was sleeping in class and I was not attentive either.
> (Ado, female student from Rayolah).

> I have not had such a good attitude towards maths coz of the teacher and how he teaches since I don't get anything that he teaches; most of the things that I remember him teaching looked difficult and I ended up either doing another subject or sleeping and so most of the stuff that he taught appeared on the paper and I didn't get most of it and so that led to a drop in my midterm math results. If possible, I'd suggest that the teacher is talked to in order to change or he be changed and we have a new math teacher for our improvement in math.

(Anonymous student, from Ademba).

> You see before people didn't use to do this practice [efforts at elaboration and rehearsal]; we used to do the homework [teacher assigned work] and that was it.
> (Adhis, female student Rayolah).

The examples above suggest a resident epistemic belief associating mathematical knowledge with an external authoritative source, in this case, the teacher. Further, the examples echo findings from related studies (cf. Muis 2004; 2007) which have associated such an empirical view of mathematics with limited self-regulation and the employment of surface-level learning strategies.

In contrast, the students' responses in the final stages of the field work provided some evidence that as they improved their self-regulation, they began to espouse rational epistemic beliefs: that ideas and logical arguments from one another were also key sources of mathematical knowledge.

> We had some 'sleeping pills' which every group member had to do as an assignment every day. The group members shared ideas and we were focused in doing the work.
> (Otis, Rayolah male student).

> We were able to learn many things from the other schools. We were able to calculate some of the sums which we did not know earlier. We have realised that we are able and if we cooperate and work together we can improve in maths.
> (Kyla , female, student from Rayolah).

> Learning was a two-way traffic [during the competition], students from the other schools were able to teach each other and learn from one another.
> (Anonymous student, from Ademba).

> I got into a group discussion every day in the last hour of night prep; this helped me to answer more complex mathematics questions. The questions are based on reasoning together with concepts which I was not used to. I got to be open-minded and creative when answering mathematics questions.
> (Ella, female student from Ademba).

The examples above also pointed to some shifting towards a constructivist epistemic view of learning of mathematics. The students began to see sharing ideas amongst themselves as key to learning.

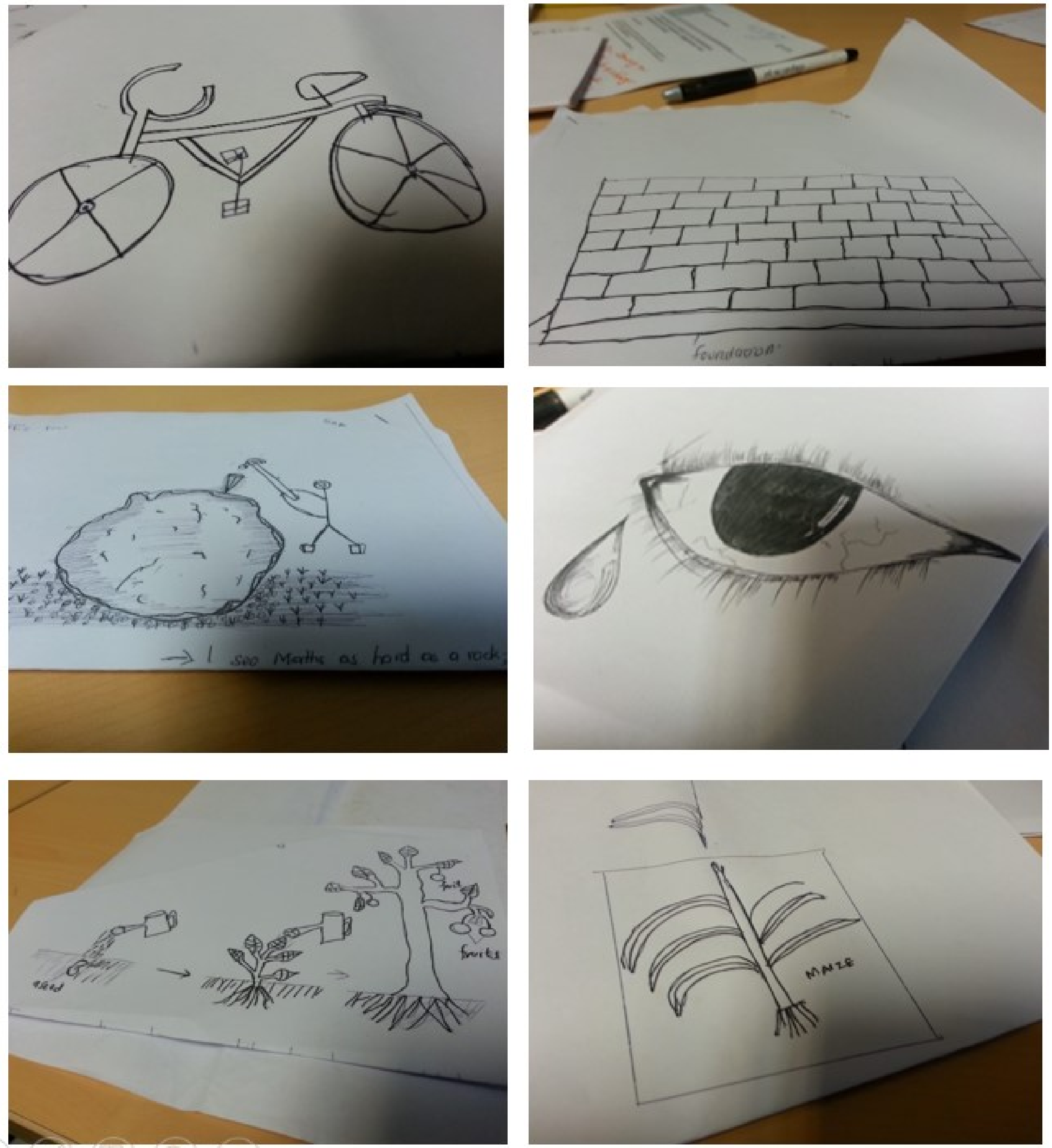
That said, the extent of the shift towards a more constructive view of mathematics seemed to vary amongst the students. In suggesting that she realised that she needed to be more "*open-minded and creative when answering mathematics questions*" Ella (quoted above), a high-attaining mathematics student, seemed to espouse an epistemic view of mathematical activity as complex and dynamic and not restricted to some pre-established procedures. Conversely, the responses from some of the lower-attaining students still had markers of linearity and were focused on procedures and/or formulas:

> …because my perspective of math is that you have to struggle to get the formulas and the concepts that make you understand and calculate math the way it is supposed to be calculated.
> (Simcha, a female student from Ademba).

Nevertheless, even here, some of the passivity and hopelessness seemed to have been mitigated. There was, however, some evidence that observation of a students' approach to learning may not be in itself a valid window to the students' epistemic beliefs:

> I first read the question, think of the topic; try to remember the formulas in that topic. Then I would try this formula, see it is not working, and try another and another…It came to a point I noticed that time was running out…and. …I realised time was not sufficient and that thinking of all that. I wanted to finish the paper. I just had to shift to the normal way of doing things: just look at the question, read the numbers, write them down and start calculating.
> (Ambonya, male student from Ademba).

Further, common association of a constructivist, epistemic view of mathematical activity with a view of the nature of mathematics that is complex, dynamic abstract (cf. Hofer, 2004; Muis 2007; Schoenfeld 1983) of learning mathematics was also challenged by the data collected from the students. Even with the shift towards a more constructivist view of mathematics, a majority of the students, in their drawings, used discrete, tangible, culturally relevant objects and activities (see samples of drawings below) to represent their perception of mathematics and learning mathematics:



Emotions

As was the case with epistemic beliefs, the findings from the study pointed to a bi-directional relationship between self-regulation and students' emotions:

I have a drawn a hyena which is taken as a bad greedy animal. I hate hyenas and so that is how I hate mathematics, I don't listen to them ….if in my study timetable it says math then I will fanya, fanya [superficially engage with maths] and I write a summary for like for 5 minutes.
(Maria, female student from Rayolah).

I was really anxious as time went by since the competition was nearing each time. This made me put a little more effort in the competition.
(Kibaki, male student from Ademba).

A time came when I felt sad. This was particularly the awarding time. I expected that we would win but contrary to my expectation we lost. I was on the verge of tears but I guess there is room for improvement. It touched a switch in my heart that we of a school so blessed could lose and a public school like that win. I could say it was a wake- up call and probably next time I will do better.
(Moi, a male student from Ademba)

> I have drawn a diagram to show how I feel when I find a lot of girls or boys doing math with a lot of joy. And I feel so good when I do math and when I just ask someone to show me and they show me…
> (Auma, female student from Rayolah)

The examples above echo findings (cf. Aiskainen et al. 2015) from mostly experimental research which have linked positive and some of the negative academic emotions like joy, anxiety and sadness to enhanced cognitive engagement and deeper learning strategies and deactivating negative emotions like hate, boredom, hopelessness to superficial attention and surface-level learning strategies. Further, Kibaki's confession of a sense of activation due to anxiety is one stark example that an academic emotion like anxiety, which has generally been found to be deactivating during test-taking conditions, may indeed have activating qualities under different learning contexts. Finally, Odeny's confession of feeling bored as a result of not being able to follow the teachings is in line with findings by Pekrun et al. (2002) that boredom as a negatively deactivating academic emotion was sometimes experienced by low-attaining students in high-demand instructional situations.

The supposition that the influence of self-regulation on students' academic emotions was generally linked to a positive and reciprocal relationship between self-regulation and students' sense of self-efficacy (Baars, Wijnia & Paas 2017; Asikainen et al. 2015) also seemed to be affirmed by some of the students' responses:

> Nowadays coz I am in a group, at least I have started to improve and now I have started to like it. Group imechangia [has contributed] coz with group ',you have to do 'sleeping pills' then in the morning you discuss and then you understand better.
> (Adhis, female student).

> I am progressing really well. Math has become a wow subject to me. It is now enjoyable for me to learn math…before, I did not like doing math. Now I am able to concentrate, I am even able to do questions in front of the class…
> (Maria, female student from Rayolah).

In addition, there was some evidence that part of the relationship between epistemic beliefs and students' emotions may be attributed to the impact of the students' epistemic beliefs (source of knowledge and way of knowing) on the students' sense of self-efficacy.

…before you came, I was not performing well in mathematics, because I used to hate the teacher. I was sleeping in class and I was not attentive either…
(Ado, female student from Rayolah).

It is instructive to note that the suggestion of influence of students' self-regulation on their epistemic beliefs and academic emotions seemed to be linked to their collective engagement with mathematics: From the above excerpts, on instances when the students suggested an improved self-efficacy towards mathematics, they tended to link it to a realization that they, as students could co-construct mathematical knowledge instead of just totally relying on the teacher. In a similar vein, some of the responses suggest that for some of the students, the individual sense of academic emotions towards mathematics as a subject was in part appropriated from a collective sense of academic emotions that characterized their co-engagement with mathematics during their peer learning and teaching sessions.

I have drawn a diagram to show how I feel when I find a lot of girls or boys doing math with a lot of joy. And I feel so good when I do math and when I just ask someone to show me and they show me…(Auma, female student from Rayolah)**.**

As is captured in the sentiments of Auma, from Rayolah, the nature and sense of emotional environment during peer teaching and learning sessions is one avenue through which individual students may gradually foster not just enhanced self-regulation when learning mathematics but also enhanced positive academic emotions towards mathematics as a subject. From the diagrams drawn by students to represent their perception of maths (see preceding section on epistemic beliefs), one may also deduce that finding ways to present mathematics in less abstract ways may also help in invoking a sense of emotional connection with mathematics as a subject.

Overall, from the observations presented in the foregoing discussion one may deduce that tapping into both the "hot" (motivational and affective) and "cold" components (cognitive and metacognitive) of self-regulated learning (Patrick & Middleton 2002) of mathematics provides greater guarantee in it positively influencing the students' long term relationship (positive academic emotions) with mathematics as a subject.

Summary

In this chapter I have discussed the study's findings on the relationship between the students' self-regulation and the students' relationship with mathematics (epistemic beliefs and emotions). The findings suggest that the relationship may be reciprocal and dialectical and may be through interactions of individual components of self-regulation and students' relationship with mathematics. The diagram below is my attempt at providing a summary of possible interaction between self-regulated learning of mathematics and students' relationship with mathematics.

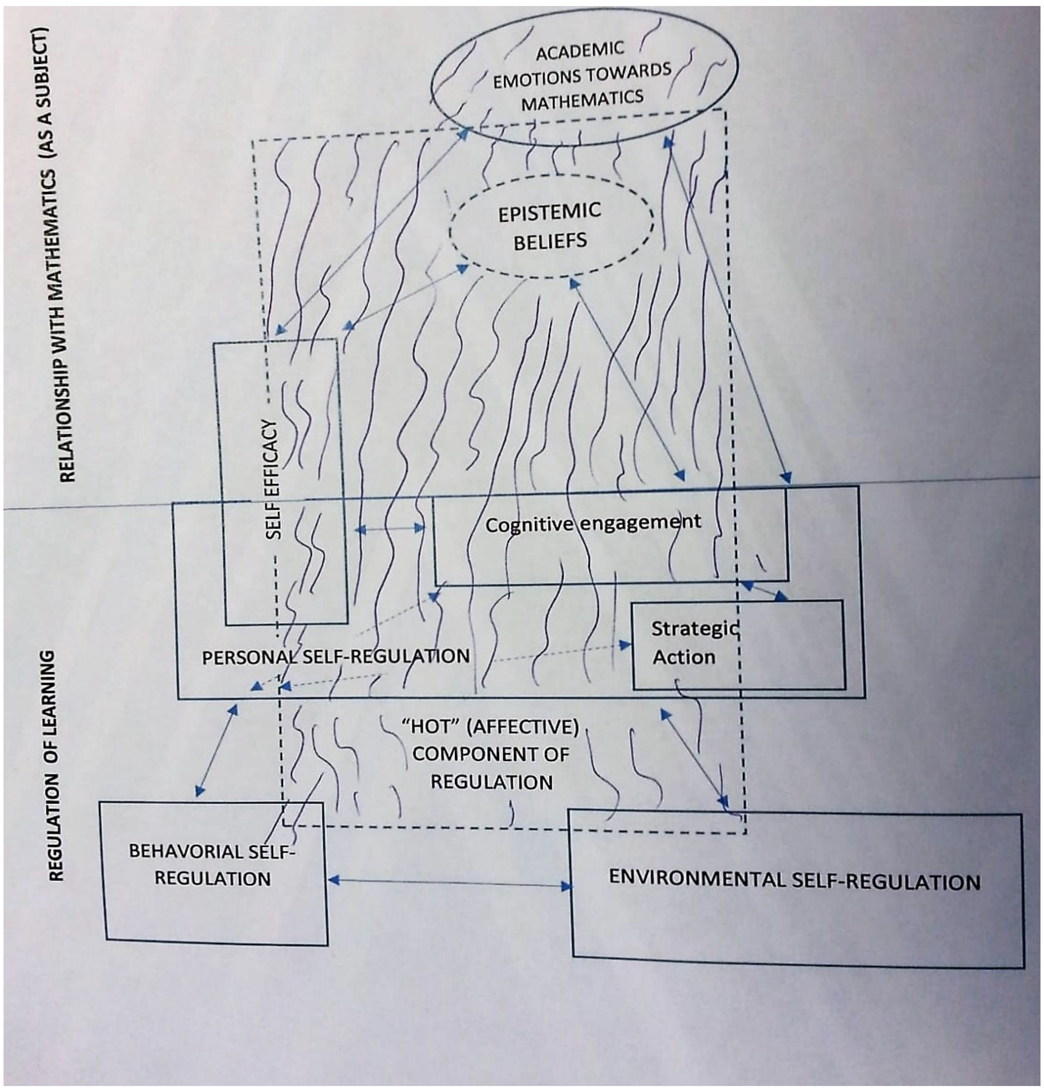


Figure 12. Model depicting interaction between SRL and student relationship with mathematics

In essence the findings provide some important insight on the nature of self-regulated learning that may have a positive influence on the students' relationship with mathematics as a subject. Further the findings also corroborate some of the unconfirmed findings from quanititative studies that have suggested a bidirectional relationship with epistemic beliefs (cf. Muis 2007) and academic emotions (Pekrun et. al 2002) two main components of affect (Di Martino & Zan 2011).

CHAPTER THIRTEEN: STRUCTURAL FACTORS INFLUENCING SELF-REGULATED LEARNING

Introduction

In this chapter, I present an exploration of a number of generative structures that emerged from the data as having some influence on the extent to which the number of contextual factors discussed in Chapter ten influenced the students' self-regulation during the learning of mathematics. The structures discussed include:

- Students' family and school socio-economic status
- Students' subjective culture
- Students' gender
- Postcolonial and neoliberal influence.

Socio-economic status

A number of the students' responses suggested that the social economic status of their parents and schools had some impact on t their mathematics teacher, parents and peers influence on their self-regulation.

For example, the lower teacher to student ratio in Ademba in comparison to Rayolah and Origa made it easier for the mathematics teacher to offer extra help and provide more explicit feedback to the students during and after the formal mathematics lessons.

Similarly, most of the parents of Ademba students were in a better a position than those from Rayolah and Origa to get (and give) feedback from the mathematics teachers. I observed that teacher and parents' interactions in Rayolah and Origa were largely carried out in mother tongue and/or the national language, Kiswahili. My observation during field work was that the interactions between the parents and teachers were mostly teacher-led, with the teachers leading the talks and allowing for some questions at the end while the parents sat back and listened for the better part of the session. It is possible that the implied power relations in favour of the teachers may have affected the capacity of the parents to hold the teachers more accountable for their teaching. In contrast, there seemed to be more equal interactions between the parents and teachers in Ademba and, in certain instances, some of the parents (mostly those who were teachers) were able to step in to provide support lessons and additional teaching resources and to make suggestions for improvements in both teaching and policies.

A difference was also noted in the students' responses from across different categories of socio-economic status on the extent of support for their self-regulation. Those from lower socio-economic status, a majority of whom were from Origa and Rayolah, seemed to offer less strategic direct support to their children:

Me:	Do you talk about school at home?
Odhis:	No…
Me:	Parents don't tell you anything about school?
Odhis:	Sometimes we talk about the report I take at home; both parents talk to me about it…
Me:	During the term nobody asks you about book work, etc?
Odhis:	No; …my mother tells me to work hard in my studies and to go and ask teacher what I have not understood.

…my aunt encourages me just to pull up my socks in maths.
(Atis, female student from Origa)

In contrast those from families of higher socio-economic status (parents could afford paying for boarding schools and observations (own a car; could communicate fluently in English) during my meeting with the parents), especially in terms of education levels and professional engagement, seemed to be able to offer more extensive and strategic support to the students' efforts at self-regulation:

> My dad (a marketing officer with an insurance company), he asks for the timetable to be visible and he will remind me to switch subjects and make sure I don't get interrupted like watching TV…
> (Adhis , female boarding student from Rayolah)

> My mother (a nurse) tells and reminds me to do my 'sleeping pills'…she encourages me about maths…I told her about the training and she told me that is good; so it is a must I show her what I have done-she confirms that I have done-sometimes she wakes me up to do it; if I have not done, I have to do it no matter what the time is;
> (Odeny, male student from Rayolah)

> My interventions towards contributing to my daughters' learning:
> 1.Visit to school to discuss with teachers
> 2. Teaching the girl while at home
> 3. Discussion with her and other family members on how to improve,
> 4. Asking cousins to help
> 5. Ensuring there is a learning environment in the house
> 6. Providing learning materials
> 7. Prayers
> 8. Leading by example
> 9. Setting realist target of C+. She always gets c-
> 10. Among others
> (Anonymous parent from Ademba).

It also emerged from some of the students' responses that the working conditions (demanding long hours away from family), neighbourhood activities and distance from school are some of the home-related factors that had an impact on the students' self-regulation:

> You see like for day scholars (girls), after classes they are just roaming around in the town instead of settling down at home and studying…it maybe that the parents do not know or they are still at work.
> (Maria, female from student from Rayolah)

> One of the things that help me with my study is the fact that there is no noise at home because we are in our own house (fenced compound) not plot (term for set of many rental houses in limited space)…
> (Kish, a female student from Origa).

> Maroundi [walking around the neighbourhood] is very common. You may find a boy leaving their home at say 6:30 p.m., he says he is going to see a friend, instead he goes to the market to watch videos. He stays there probably up to 9 p.m. by this time he is feeling too tired to read.
> (Owino, male student from Rayolah).

> …home is far, I walk almost six kilometres; one thing that makes me not do sleeping pills is that I arrive home late and probably there is no water (comes from an arid area) so I have to go to fetch water (most cases water points are also a considerable distant away) and then come back home and help with some other home chores.
> (Kauku, male student from Origa).

In contrast, the students from families of higher socio-economic status had fewer opportunities to engage in non-academic activities like watching movies or visiting one another during school days, partly because most of their parents opted to take them to boarding schools:

> …being a boarder is important because at whatever time you are able to be in class and study. While another is at home watching a movie.
> (Hellena, female student from Rayolah)

> I like being a boarder, because there are people here who give you psyche to study. Say you are home alone, you just feel you don't want to. When you are at home, you may want to visit your friends. You can say you are studying but once you get there, you just chat and/or watch movies.
> (Kyla, female student from Rayolah)

There was also evidence that some male students from lower socio-economic status families were forced to take up jobs during school holidays and/or weekends. The findings suggest that this negatively impacted some of the male students' engagement with mathematical activity in a number of ways: it reduced the length of time they could dedicate to studying; it bestowed upon them some sense of economic power; and it provided them with the means to access both non-academic activities, like paying for movies, and basic needs, like buying food or even paying the school fees. As a result, some of the male students exuded a sense of independence and deferred less to their parents.

> …during weekend a boy can get a job in the neighbourhood then gets his say, Ksh100-200, that is what you save to buy phones and buy [internet] bundles (girls are generally not allowed by the parents to do the small jobs) …and then I am in my house there is nothing the parent will do to me; I will come when the parent is asleep; Food I will buy for myself. Boys in most cases don't ask for food from the parents, they fend for themselves. They buy food for themselves from the shops or market.
> (Owino, male student from Rayolah).

Having to miss school because of fees arrears was one other factor related to socio-economic status that was noted as affecting efforts towards self-regulation of both the defaulting students and their peers:

> Our group is doing well if not for the interruptions caused by students being sent home for fees. You may find that sometimes we are in the midst of discussions and before we finish, some of the students are called out and sent home for school fees. This disrupts our group because when the students come back after staying home for some days, they are often distracted.
> (Achuku, male student from Origa).

As presented in the section on the profile of schools (Chapter Five: Field work and ethics approval), there was a notable difference in the fluency in English between students from lower and higher social economic status and this (see Chapter eleven: Mathematics textbooks and self-regulated learning) affected, for example, their use of key resources like the mathematics textbooks.

Finally, the availability of resources affected the students' self-regulation in a number of ways, including structuring of the environment to support their learning: Origa, which, of the three schools, may have been considered, to be of lowest socio-economic status at the time of field work, was not able to schedule personal study sessions in the morning and/or evening because it did not have electricity supply.

Culture

Data collected during this study provided evidence that the nature of the impact of the contextual factors (Chapter Ten: Contextual factors influencing self-regulated learning) on the students' self-regulated learning of mathematics was influenced by a number of cultural factors.

Cultural perception of what contributes to successful learning

In common with other cultures, for example- those from the East (cf. Chen & Stevenson 1995), it emerged from the data that as a cultural norm the participants put greater currency on the "will" aspect of self-regulation than the "skill." In other words, primacy was given to the level of effort (e.g. the time the students are engaged in mathematics learning) and not to innate ability.

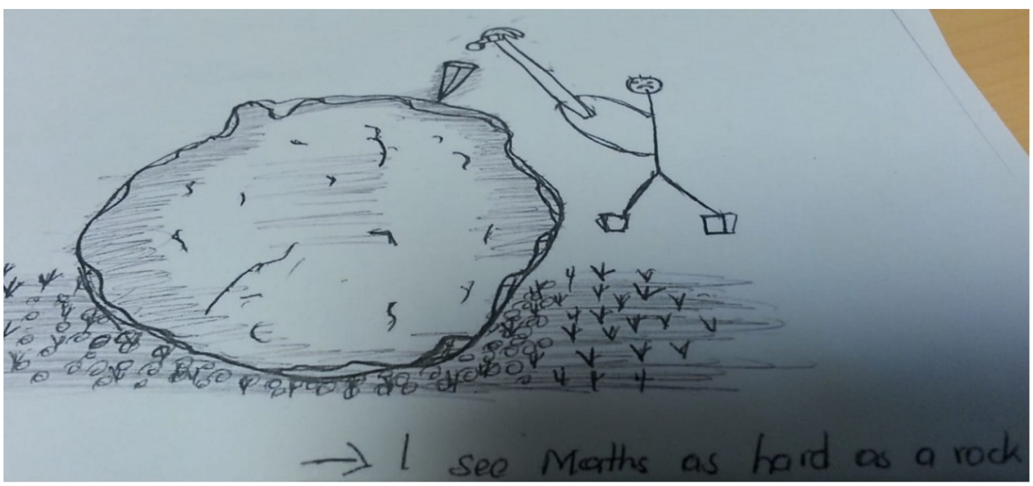
For example, a number of the students confessed that in most cases, their parents seemed to exhort them to work hard to improve their learning. The same kind of feedback was also very common amongst the teachers, who largely associated the levels of performance with the levels of effort exerted by the individual student. For instance, in one of the sessions with Rayolah students, I observed that the mathematics teacher's feedback to the individual students as he handed back their individual examination mark-sheets was restricted to the following three phrases: "work harder, still very low and put more effort".
Similarly, during an exit discussion after a parent academic clinic session at Ademba, most of the parents reported to me that the mathematics teacher attributed their children's low performance in mathematics to inadequate effort by the students:

> Lack of effort on the side of the student is one of the contributing factors to this poor grade…
>
> The student needs to be more participative in class, ask where he doesn't understand and ensure he revises after each lesson.
>
> The child has no personal timetable; child doesn't follow-up (consult) the teacher after school to discuss difficult questions; child doesn't do practice in maths.
>
> The teacher told our daughter that maths is a core subject and she should not be casual about it;
>
> (Exit feedback from a cross-section of parents of Ademba students).

A majority of the students also seemed to value effort (do many sums; practise regularly) over skilful (e.g metacoginitive engagement and or strategic planning) engagement with learning. For example, the feedback from a majority of Ademba students after trying (prior to any training) to use a metacognition outline to scaffold engagement in mathematical activity was fairly negative. The sense of negativity towards paying more attention to aspects like metacognition while engaging in mathematical activity was aptly captured in the following sentiments by one of the students:

> Even though it helped in solving the problem; it slowed them down and made them do only few questions…while in the other one (paying less attention to their thinking during the process) you could do many questions.
>
> (Anonymous student from Ademba)

Also depicting the emphasis of hard work in learning of mathematics is the diagram below by one of the students:



(Hywqal, female student from Rayolah)

In addition, some of the students' responses were indicative of some relationship between the students' focus on "effort" as the key to mathematics learning and their reaction to results from their assessments:

> … but I am asking, you may have been trying (talked earlier of waking up at 3 a.m. to study every day) and doing your best but still you are not improving…; isn't bearing fruit. What do you do?
>
> (Ado, female student from Rayolah).

> But honestly the lowest point is that after all we practised.... The attained marks in examinations weren't as we expected.
> (Ella, female student from Ademba).

That saide, this focus on effort was one of the adaptive motivational patterns (Dweck & Leggett 1988) that inspired some of the peer interactions and efforts to delay gratification for academic purposes:

> …the group that I have it is like, they are not working hard. I tell them to do their 'pills' but they say "even if we do them they will not help." So I just leave them alone.
> (Ado, female student from Rayolah)

> …I have improved since we started this (participating in the study). I am not the way I used to be…I used to like making jokes, doing and participating in things for fun…but I came to realise that they are wasting my time…
> (Odhis, male student from Rayolah)

The social cultural norms espoused by the students and wider community

The emergence of the quality of relationships as critical for peer interactions and student-teacher interactions (see Chapter Ten: Contextual factors influencing self-regulated learning) may have also been attributed in part to relational identity construal (Mcinerney 2012) as a critical cultural attribute for the students from the three schools. Put differently, from across the data, it was evident that the subjective culture (King & Mcinerney 2014) of the students supported an interdependent relational self-construal during learning instead of the independent self-construal that is taken to be predominant in most Western countries (ibid).

Generally, the students from Rayolah, a majority of whom were from the same ethnic community and lived in a more rural setting, seemed more open and willing (than Ademba and Origa) to form mathematics peer groups. One may surmise that the heterogeneity of ethnic orientations amongst Ademba and Origa students and their living in urban settlements away from their native homes may have pushed them more towards imbibing and assimilating aspects of the individualistic culture of the West. Indeed, it was instructive to note that Ademba students (including females), for example, did not seem to report much dependency on their siblings or other members of the family for support in their learning:

> My siblings, they don't help me at all to study; while I am sitting down and studying…you are the only student meanwhile they are on their phones chatting, watching movies, playing instruments, just having fun; you are the only student, you just sit down and read; you want to rest and have fun with them…
>
> (Hywaqal, female student from Ademba).

Another cultural attribute that had an impact on the students' self-regulation was the greater sense of autonomy for the male child, which seemed to be inculcated by some families through cultural practices like having a separate house and granting permission to take paid work. Conversely, the female child was largely kept under closer care of the parents and family members. The different dependency cultural orientations resulted in the female students engendering social concern (cf, King, Mcinerney & Watkins 2012) goals during peer interactions that sought to build intimacy and a sense of responsibility to each other, while the male students approached peer interactions for the sake of affiliation and with a keenness to protect their sense of self-worth.

An authoritarian culture that required reflexive submission to persons in authority like the teachers and parents also had an impact on the extent to which persons in authority (parents, teachers and in Rayolah) played a role in the students' self-regulation. In all the schools the teachers and sometimes school/class prefects played a key role in structuring the learning environment in school to support students' self-regulation, as the extracts below demonstrate. A number of students reported instances where their choice and that of their peers to stay home and study was in most cases done out of respect for and/or fear of their parents:

> I don't go for maroundi (walking around the neighbourhood after school) with my friends a lot because of restrictions by my parents. When my parents are at home, they assign me work and as a respectful child, instead of running away I obey. For girls sometimes they are afraid, because they sleep in the mothers' house. If they went for maroundi the parents would get into trouble …
>
> (Owino, male student from Rayolah)

> I used to argue with my brother about having the radio on, there is part of the remote I had which I used to keep with me… if he puts it off I put it on…; so the parent redirected the wires that takes electricity to the main house so she would switch it off from the main house…so I could not go in to main house to switch on; so I in the process I got used to not having to always listen to music.
>
> (Achuku, male student from Origa)

Further, the evidence provided in earlier chapters suggests that instructional practices by some of the mathematics teachers, for example, intolerance to questions from students, together with parenting practices (for example: “not sparing the rod”), may have been in part due to the authoritarian culture.

From my observations during the field work and from students' responses, the Ademba students seemed to be least tolerant of teachers taking an authoritative stance during lessons. These students appeared more removed from their class sessions, especially those in which the teaching was pre-dominantly teacher-centred, than students from the other two schools. Perhaps, coming from more affluent families which seemed to allow for more self-autonomy (less dependence on siblings for example), the mode of interaction presented by the teachers was less congruent with their familial mode of interactions. Indeed, when at the instigation of the school principal, I reported to the Ademba students that most of the teachers were concerned that they seemed to be detached during class sessions, the Ademba students had this to say in their defence:

> …unlike you who come into class, with a ready smile, and spirit of talking with us, most of our teachers come to class and they just talk at us…

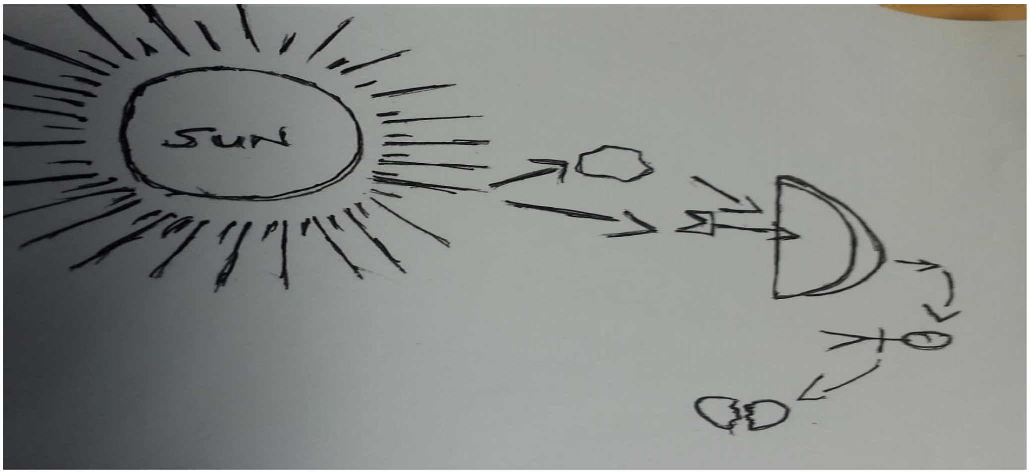
In a similar vein, during another conversation with the students about their time in school, one of the students decried the fact that they had very little freedom in deciding how to use their "free" time like weekends because everything was planned out for them by the school.
The findings on the possible impact of the nature of home interactions (familial habitus) on students' sense of resonance with the mathematics teachers' mode of teaching and overall impact in learning mathematics add credence to the assertions by a number of mathematics education researchers from the West (cf. Lubienski 2002; Jorgensen, Gates & Roper 2011) that students' social background plays an important role in determining their success in learning mathematics. However, the case in Kenya is somewhat in the opposite direction to what has been largely reported of mathematics teachers from the West (cf. Jorgensen, Gates & Roper 2011). The teachers' mode of interaction seemed to be more congruent with the mode of interaction in families with lower socio-economic status than those of higher socio-economic status.

Achievement motivation goals

The students' academic motivation also seemed to be influenced in part by their cultural orientations. In resonance with findings from studies targeting students from other collectivist cultures (cf. King, Mclnerney & Watkins 2012), the students seem to endorse social-oriented achievement goals alongside mastery and performance goals which have largely been associated with students from the West. In other words, the students' motivation for seeking to attain good grades in mathematics was largely connected to their perceived role in facilitating career goals (mostly linked to a desired social status) and for some students a desire not to disappoint their teachers and/or parents.

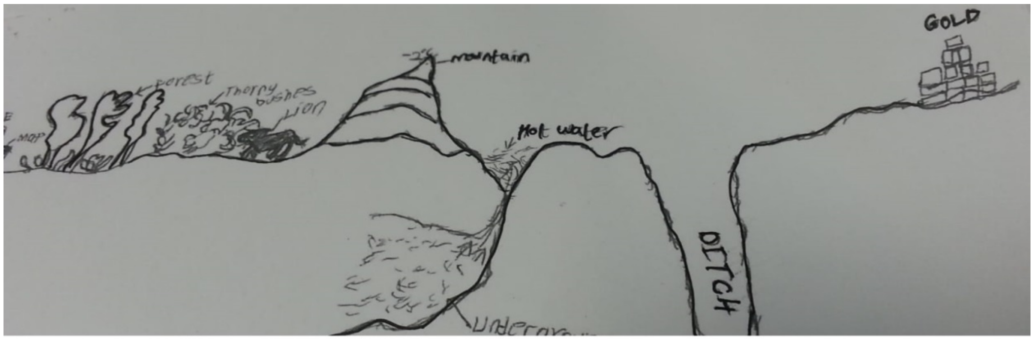
In their responses, a majority of the students intimated that their efforts towards learning mathematics were pegged on their understanding of the importance of their scores in the examination to their progression to tertiary-level learning and ultimately their careers of interest:

> Personally math is my most important subject. I need it and that is a question that keeps running in my head every day. I desire to become an engineer in future but with the way my arithmetic are taking me I don't see me making the dream come true; and to me that is a nightmare I try to avoid. I hope with every minute I will pull myself back up.
> (Ella, female student from Ademba).



The sun is that maths is a bright subject, a pleasant subject and a subject one can't live without but then it becomes harder and harder then I fail the subject then it drops my marks.
(Nyagonyango, female student from Ademba)

I have a friend in class called Bobo, now we just give encouragement because…when she wants to stop doing the ‘pills’ I tell her to just try. Because it will help you…then she will do them…you find another group member taking a book to copy ‘pills’. She says “it won’t help me in future, my parents are rich.” No matter what…my parents are rich…
(Kyla, female student Rayolah).



…the map represents mathematics as a guide to a great thing.
(Ambonya, male student from Ademba)

The training has helped me on how to build -my careers; before you introduced the 'sleeping pills', I could not take time on my own to revise mathematics…mostly I liked to play and then when you came I sat down and thought how I can be something?
(Atis, female student from Origa),

Alongside social status goals, evidence from some of the students' responses also suggested that gaining approval from parents, teachers and peers was also a pertinent achievement motivation goal for them:

My reactions towards the marks I got was kind of that of confusion coz after trying to concentrate during mathematics lessons and trying out some part of my revision I still can't hit those targets and goals set by me, my teachers and my parents.
(Okinyi, male student from Ademba).

During the tournament I was very much worried, since I was afraid of disappointing my teachers, especially madam Adhis_knowing fully well the kind of effort she put to help us acknowledge math, and to love doing the subject.
(Kerubo, female student from Ademba).

Overall, the findings presented in the foregoing section seem to suggest that the Kenyan students' academic achievement motivation is informed by social-related goals instead of mastery and performance achievement goals which are generally associated with their counterparts from the West. The Kenya students' inclination towards socials goals, may be attributed to their Kenyan collective culture which as is the case with other collective cultures, for example Asian culture tend to promote relational self-construal over individual self-construal.

That said, as is captured in the exceprts below there was some evidence from the students' responses suggesting that the motivation to achieve the afore discussed long term social-oriented achievement motivation goals spurred the students in the short term, to aim for mastery through self-regulating strategies such as help-seeking from peers and teachers; elaboration and rehearsals during peer interactions; and embracing positive competition as a means of achieving the goals:

> I take to the teacher, teacher marks for me; if I don't get she explains to me and I get to understand…and when similar questions come in the exams…one finds she can tackle them …
>
> (Kyla, female student from Rayolah).

> Apart from being happy there came a time when I felt sad. This was particularly the awarding time. I expected that we would win but contrary to my expectation we lost. I was on the verge of tears but guess there is room for improvement. It touched a switch in my heart that we of a school so blessed could lose and a public school like that win. I could say it was a wake- up call and probably next time I will do better.
>
> (Jo, male student from Ademba).

> I ask my friend–if he doesn't know I tell him we go and ask the teacher –if he refuses I go myself; and when he shows me he asks me to try a question to see if I understand…this helps me get better, leading me to have a positive attitude towards mathematics. I don't see it like before. Nowadays I can get a score of a B. Before I was scoring a C but now that I can score a B, I will aim to get an A.
>
> (Achuku, male student from Origa).

Equally important to note was the fact that most of the students were also able to positively tap into the competitive aspect of the mathematics tournament as a means of enhancing their own self-improvement, enhancing their social affiliation across the three schools and reaching out for a higher social status amongst their peers and/or as a collective (school).

The observations above lend credence to findings from studies (cf. King et al. 2012) which suggest that performance approach goals may be adaptive in collective cultures. Importantly, the possible positive link between the orientation of the students towards social-oriented achievement goals and self-regulated learning puts into question arguments by some scholars (cf. Callan et al 2017) who partially attributed low achievement by the students from low SES to their being prone to pursuing social goals instead of academic goals.. Perhaps the incongruence of their arguments with the findings of this study may point to the fact that trying to pursue social-oriented achievement goals in a competitive individualistic learning environment may be akin to fitting "a square peg in a round hole."

Gender

Findings from this study resonate with findings from earlier studies (cf. Bembenutty 1999) that have suggested that female students may be more adept at self-regulated learning than their male counterparts. That said, the findings are presented with caution - I seek to avoid overgeneralisation especially given the sample size.

Attitudes to achievement

It emerged from the interviews, observations made during class sessions and content analysis of the “sleeping pills|” excerscise books that the male students exhibited less positive mathematics achievement-related attitudes and behaviours. For example, across the three schools’ the male students seemed to be less open (than their female counterparts) to remaining accountable to their peers and engaging with their mathematics in line with the agreed peer/class norms:

> …the girls are interested in studying but the boys are more into joking around. As a leader of the group, when I remind the group members to come for the group discussions…the boys sometimes tell me to stop disturbing them.
> (Maria, female student from Rayolah).

Boys like jokes and they are not serious with group work…
(Atis, female student from Origa).

Many boys like ignoring things; they encourage each other to do negative things; when you say we do those "sleeping pills" every day they say you should not do it or do just a few because it is a lot of work. When they meet as a group instead of doing the sleeping pills, sometimes they just chat with each other.
(Odhis, male student from Rayolah).

I'll take an example of last night [designated personal study time]. Last night I guess less than ten per cent of the boys were awake. Yet a majority of the girls were awake doing their work.
(Adie, male student from Ademba).

These less positive achievement attitudes and behaviour by the male students extended to the home front:

Many boys in secondary school have negative attitude; peer pressure…there are those who can come to your place, talk to you, tell you story of going to visit another friend or about a movie…so we end up spending time visiting each other or thinking about movies…so even if the person wanted to read; he won't read; we end up disturbing each other…
(Achuku, male student from Origa).

Resilience and persistence

Some of the students' responses suggested a different reaction across the two genders to earlier negative experiences with learning, including low performance in primary school and present learning challenges, including curriculum burden and poor teaching methods. Evidence of these is provided in a sample of responses from some of the students:

…boys seem to be saying that in this school we tend to do a lot of subjects and that is a burden to them. They say that girls can multitask. But for boys it is a burden for us to multitask. Of which I don't know the truth of that. For example, one of them raised an issue; he said that there are many subjects. If we reduce them to like seven, then it will be manageable. We would be able to improve.
(Adie, male student from Ademba).

…one thing last term, I didn't use to understand mathematics… From form one, first term to third term, I started seeing that maths of secondary is difficult to understand…so I didn't use to concentrate – coz I used to think even when he teaches I don't understand.
(Achuku, male student from Origa).

I take a text or exercise book, go back to a topic that I did not understand and try do it, if I'm not able I go to either a form 4, 3 or 2 and they show me. When they do then I come back again and do it. I ask the one who has shown me to remain with the paper for me to go attempt to do it, return it to them and see if I have got it.
(Auma, a female student from Rayolah).

Such were also evident during my class observations and the formal intervention sessions: a majority of the boys seemed to deliberately choose to sit at the back and engage in more disruptive behaviour, including talking and making fun amongst themselves.

Sense of autonomy and willingness to seek help

Arguably, some of the noted gender differences could be attributed to the different levels of desire for autonomy across the two genders. The male students presented a desire for more autonomy in regulating their learning behaviour and/or environment. They were more likely to overlook efforts by peers, teachers and parents to co-regulation:

…Some [boys] are just defiant, they will say "I won't do [sleeping pills]... this is not our maths teacher…
(Kauku, male student from Origa).

…..even if the prefect tell them [boys] they are making noise they will not listen. So you just let them be. It depends on their moods. When they are ready and they need to read, they shall. Sometimes they can read.
(Adie, male student from Ademba).

…most of the girls don't go walking around the neighbourhood in the evening because they are afraid; they sleep in their mother's house; if they leave they would be in trouble with the parents. Me…I am in my house; there is nothing the parent will do to me. I will come when the parent is asleep.
(Odhis, male student from Rayolah).

> I wasn't impressed throughout this week when the teacher came most of the lessons and started with a lecture [talk geared towards correcting some observed behaviour in class]; I hate lectures so much that I always find myself switching off. I don't like lectures plus the teacher is supposed to teach not give lectures.
> (Anonymous male student from Ademba).

In contrast, the female students seemed to be keen to seek for help from their peers and siblings (for evidence see Chapter ten: section on parents and other members of the family).

Parental influence

Difference in the level of parental oversight of some of the male and female students emerged as a key contributing factor:

> …The girl is in mum's house; if she is found using the phone, the mother brings trouble and tells her to get into her books to read. On the other hand, parents rarely come into the boy's house.
> (Owino, male student from Rayolah).

> We boys, in most cases we are not asked so many things by parents. When girls leave school, they go direct to home and attend to their chores; if they have to go somewhere they have to ask for permission and are given time limits…and because they fear the parents they will always try to come back home within the set time. But in most cases we boys don't care [don't give much attention]; the boys, we don't care and the parents don't care; girls are given closer oversight than boys; parents pay more attention to the activities of the girls.
> (Kauku, male student from Origa).

Coupled with this is the fact that the male students seemed to be more vulnerable to distractions from their studies by various entertainment-related activities. And their greater freedom and easier access to work, and therefore money, created opportunities for time-consuming non-academic ventures:

> Saturdays and some of the weekdays, when they [boys] leave school; we agree we meet at some place; we meet till in the evening is when we leave to go to our homes. Most of the times we plan where to go, we contribute money, hire motorcycles to transport us to where we had planned to go. When they get to their destination, they do what they had planned and then leave.
> (Owino, male student from Rayolah).

The findings of this study on gender differences in self-regulation, especially with regard to using specific self-regulated learning strategies such as help-seeking and presenting more adaptive motivational patterns such as resilience and persistence during learning of mathematics somewhat corroborate findings from studies (Bembenutty 1999; Pajeres 2002; Zimmerman & Martinez-Pons 1990) that have been done in other cultures which have also found gender diffrences (in favour of female students) in students' use of self-regulated learning strategies.

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Post-colonial and neoliberal influence

Although post-colonialism and neoliberalism are structural factors influencing the mathematical learning of the participants and therefore find a place in this chapter, most of the related findings have already been discussed in the earlier chapters.

For example, the discussions of findings (observations and interview data) in Chapter Eleven suggest that the colonial legacy, including the use of the English language in the core textbooks and in class by some of the teachers, affected negatively some of the students' engagement with mathematical activity. For example, the findings suggest that the accessibility of the English language in the core mathematics textbook may have contributed to some of the students' sense of disconnect and disaffection with mathematics.

Similarly, individualism, at odds with the generally collective culture of Kenyan society, is currently being promoted through postcolonial and neoliberal-informed (cf. Shizha 2010; Milligan 2011) instructional and assessment practices in Kenyan schools. The findings of this study highlight in part that shunning individualistic assessment and instructional practices such as equating quality of education to the outcome of competitive individual-based tests (cf. Shizha 2010; Milligan 2011) may help in improving the students' engagement and relationship with mathematics. Similarly, the findings suggest that shunning neoliberal capitalist policies such as the performance-based management of teachers with emphasis on students' scores in summative examinations such as KCSE and KCPE may also go a long way in improving the teachers' instructional practices, their relationship with the students and as a result, the students' self-regulation during learning of mathematics (see section on Assessment practices in Chapter ten).

In terms of pedagogical orientation, the domination of the mathematics teacher in the students' learning, as suggested in the findings from this study, mirrors colonial education practices which presented the teacher as the dominant voice in the learning process and bestowed on the teacher status, power and control in the classroom (Shizha 2010). As has been presented in the findings presented in Chapter ten (section on the mathematics teacher), such a pedagogical orientation has a negative influence on the students' self-regulation.

Further, the discussions and findings in the previous chapter on students' self-regulation and epistemic beliefs suggest that the Kenyan secondary school students seemed to identify with a utilitarian view of mathematics (Anderson 1990; Joseph 1987) (see image of students drawings in Chapter Twelve). This is contrary to the abstract representation of mathematics which dominated most of the illustrations in the students' core mathematics textbooks and teachers' explanations during formal class sessions. According to Anderson (1990), such emphasis of mathematics as an abstraction with very little relationship with the students' cultural and subjective experiences, presents a common Euro-centric bias (Anderson 1990; Joseph 1987) which continues to negatively impact learning and teaching of mathematics to students of cultures different to the Western culture.

Collective and individual agency

In line with scholarship (cf. Hays 1994) on sociological theory, findings from this study indicate that the extent of the influence of social structures as discussed in the preceding sections was somewhat limited by the individual and collective choices and decisions made by the students. Individual and/or collective agency may result in either the reproduction or the transformation of social structures depending on the agents' level of power (e.g dispositions, skills) and the cultural milieu (implying the structural constraints and enablers) within which they are operating.

Based on the findings of this study, it is possible to suggest that training on self-regulation is one strategy to enhance the students' power as agents of self-regulation during their learning. A majority of the students' responses pointed to a perceived positive impact of the study interventions on the personal, behavioural and environmental self-regulation during: teacher-led classroom learning sessions; individual study sessions; and test-taking sessions:

> I came to realise through the training that joking around is wasting my time…Before, I could not successfully solve mathematics problems; I used to completely fail. But now as I do the 'sleeping pills', maths has started being easy and now if I find some difficulty in solving a problem, when the teacher is leaving class, I follow her to ask questions.
> (Odhis, male student from Rayolah).

> I may say that you should just continue with the training because it has helped change a lot of people. People were not interested in the subject but now even our teacher can see the difference. We are all very alert now.
> (Maria, female student from Rayolah).

> The most important part of the training is the process of using procedures; the metacognition process; not just getting a question and doing; and as a result there are some questions [from a test] that I got that the rest of the class did not get.
> (Yoga, male student from Ademba).

> So when way you started to coach; I have put into practice the things that you have told us; I start to go up in my grade; when teacher is there I concentrate …I should just tell you thanks; from when you came the grade of mathematics has improved; people have started having a positive attitude; working hard …even the teacher can tell you- when he first came he would only have probably only one person put the hand up-when the teacher comes to that class he is not happy but nowadays-he can even exceed the time coz people seem to be understanding.
> (Achuku, male student from Origa)

> Since the first time that you introduced it [training], I found it [mathematics] easy. And I went on loving math and having that interest. First giving us rules, that has really guided me. Second, the 'sleeping pills' the more you do practice the more you understand maths. You see before people didn't use to do this practice; we used to do the homework and that was it.
> (Adhis, female student from Rayolah).

The examples given above echo findings from related studies (cf. Leidinger & Perels 2012; Dignath & Buttner 2008) that have linked training students in self-regulated learning with improved motivation for learning and increased application of cognitive and metacognitive aspects during learning.

Summary

Based on the data from this study, in this chapter I have discussed the deep generative structures that shape students' self-regulation during learning. The generative structures, which are generally interconnected, included the students' family and schools' socio-economic status; subjective culture; and gender. Postcolonial and neoliberal influence is also discussed as one of the significant generative structures. Alongside these structures, I have also considered the role of the training intervention in fostering student agency.

In sum, the findings as presented in this chapter have some resonance with emergent scholarship (cf. Callan et al. 2017) which has provided an explication of how socio-cultural factors may act as academic enablers. Further, it may be argued that this study's findings provide further insight into the assertions by sociologically oriented mathematics educators (cf. Jorgenson, Gates & Roper 2013) that mathematics education takes place within and is influenced by an ecosystem of social practices.

CHAPTER FOURTEEN: MODEL FOR SELF-REGULATED LEARNING OF MATHEMATICS BY KENYAN SECONDARY SCHOOL STUDENTS

Introduction

In this chapter I synthesise the findings on contextual factors influencing Kenyan secondary school students' self-regulation into a local model of self-regulated learning of mathematics.

Key features of the local model of self-regulated learning

Based on my initial interaction with the data from my field work, I contended that a suitable self-regulated learning model for mathematics for Kenyan secondary school students would have to take into consideration the immediate learning context, the individual differences amongst the students and the macro context. Accordingly, I proposed to use the Zimmerman triadic model (Zimmerman 1989) and the integrated self-regulated learning (iSRL) (Ben-Eliyahu & Bernacki 2015) as the two key self-regulated frameworks for making sense of the data collected during this study.

Indeed, the findings as discussed in Chapter ten to Chapter thirteen corroborate the suggestions by Zimmerman (1989) through his triadic model that self-regulation during learning involves regulation of a bi-directional and reciprocal regulation of personal cognitive and affective attributes (self-efficacy, interest, strategic engagement...), behaviour (self-monitoring/evaluation/judgment) and environment.

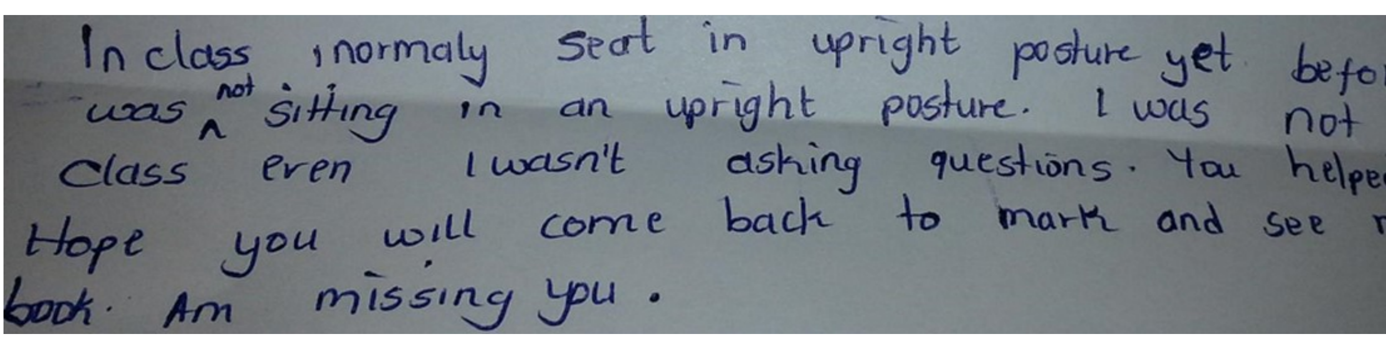
Similarly, in line with the iSRL model, evidence from this study suggests that the students' self-regulation during learning of mathematics is influenced by a number of factors within the macro context, and that self-regulation was a depletable resource: the students' self-regulation during learning of mathematics was in part affected by demands from other subjects and out-of-school activities, including media use, assigned chores and other peer-related activities.

The aforementioned resonance with the findings from this study, with assertions from the both Zimmerman (1989) and iSRL model (Ben-Eliyahu & Bernacki 2015) notwithstanding, there were some additional insights from this study's findings on students' self-regulated learning of mathematics.For example, in addition to corroborating the suggestion by Ben-Eliyahu & Bernacki (2015) that students' self-regulation is also influenced by both proximal (within school/class) and distal factors within the macro context, this study's findings sheds light on the possible interaction and difference in the nature of influence of some the said factors on students' practice of self-regulated learning.

In particular, the findings suggest that some of the factors, such as government policies, culture, students, SES, are structural in nature and as such, play more of a generative role; they influence the extent to which the other contextual factors influence the students' practice of self-regulated learning.Another key insight from the study's findings is the affirmation that indeed (Rogat & Adams-Wiggins 2014; Hadwin & Oshige 2011; McCaslin & Burross 2011) external co-regulatory elements play a critical role in the students' personal, behavioural, and environmental self-regulation.

Findings presented in Chapter ten, suggest thats, teachers and peers played a key role in supporting and influencing the students' self-regulation. For example, the consistency of the students' working on their "sleeping pills" was significantly improved through the collective institution and enforcement of group and class "rules". These findings resonate with assertions by researchers of socially shared regulation who have opined that co-regulation is a key transitional process in students' acquisition of self-regulated learning (cf. Hadwin & Oshige 2011).

A more explicit example suggesting a progression to enhanced self-regulation during learning of mathematics as result of interventions, which supported the students' working as community of learners guided by a collectively agreed upon class norms and group rules, is provided below:


In class i normaly seat in upright posture yet befo
was not sitting in an upright posture. I was not
Class even I wasn't asking questions. You helpe
Hope you will come back to mark and see
book. Am missing you.

The use of the phrase "<u>now I"</u> suggests that the reinforcement of the collective approach towards learning of mathematics during the study provided an opportunity for the learners to gradually appropriate self-regulated learning through interactions.

Note that the statement above points to aspects that can be situated within both personal (not concentrating in class) and behavioural (sit up right; ask questions) self-regulation.

Indeed, the pointers in the above excerpt, associating co-regulation during self-regulated learning to aspects related to both personal and behavoroial self-regulation, may be deemed to be in line with findings from a majority of studies on socially shared regulation during learning that tend to focus on aspects of personal and behavioural regulation (cf. Volet, Vaurus & Salonen 2009; McCaslin & Burross 2011).

That said, some of the evidence and discussions on the section on parents and other family members (Chapter ten: Contextual factors influencing students' self-regulation) suggest that the students' capacity to self-regulate their learning environment tended to evolve out of a process of co-regulating the environment with their peers, teachers, parents and other family members:

> I used to argue with my brother over not having the radio on…there is part of the remote I had outside; if he puts it off, I put it on from outside; so the parent intervened; they directed the electricity wires and the main switch to the main house. So my brother would switch it off from the main house and because of my fear and respect of my parents I could not go in to main house to switch it on. So in the process I got used to not having music during my study time.
>
> (Achuku, a male student from Rayolah)

Critical realist self-regulated learning model

The features of self-regulated learning as summarised in the foregoing section and the resulting relationship between self-regulated learning and students' relationship with mathematics as discussed in Chapter Twelve are captured in the critical realist self-regulated learning model below:

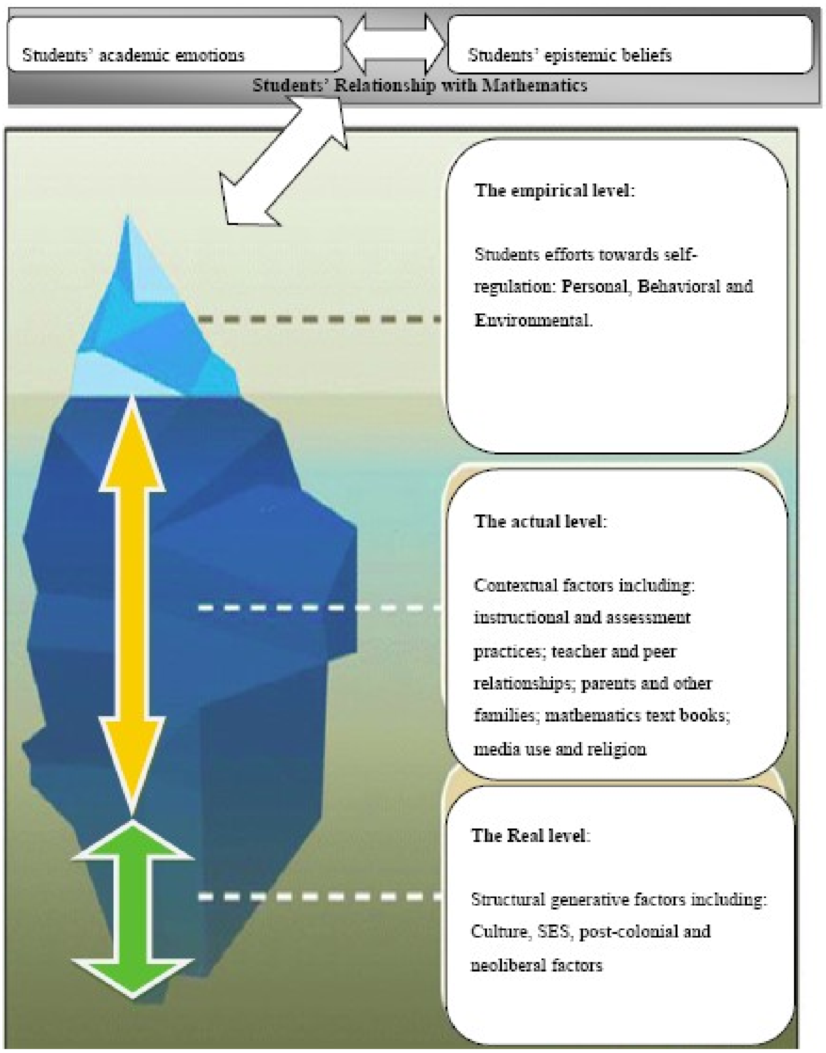


Figure 13 A critical realist model of self-regulated learning of mathematics by Kenyan secondary school students

Key:

Summary

In this chapter, I have presented a critical realist model of self-regulated learning as a synthesis of the interactions of factors that findings from this study (as presented in Chapters 10 and Chapters Thirteeen) suggest have an influence on the students' self-regulated learning of mathematics. The model also depicts the possible bidirectional interaction (as discussed in Chapter twelve) between the students' self-regulation and their relationship with mathematics as a subject.

CHAPTER FIVETEEN: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Introduction

This chapter concludes the study. It provides a synthesised summary of the findings presented in chapters ten to thirteen. The synthesis is based on the considerations of the findings across the five research questions against extant theoretical propositions and empirical evidence on self-regulated learning of mathematics. The synthesis of the findings will be followed by an exploration of the implications of the study's findings for teaching, learning and assessment of mathematics in Kenyan secondary schools. The final section of the chapter will present a brief explanation of this study's contribution to knowledge, its limitations and suggestions of future research.

Findings and Discussion

The broad objective of the study was to explore the possible influences of self-regulated learning of mathematics on Kenyan secondary school students' relationship with mathematics as subject. Students' relationship with mathematics was broadly conceptualised as the sense of beliefs and emotional feelings of the students on their learning of mathematics. To achieve this objective five broad research aims were pursued: exploring the contextual factors affecting the students' self-regulation during learning of mathematics; exploring the influence of gender on students' self-regulation; exploring the adequacy of the core mathematics textbooks in supporting students' self-regulated learning of mathematics and considering the key attributes of a local model for self-regulated learning of mathematics in secondary schools in Kenya and how it relates with some of the already developed SRL models. To guide the process of data collection and analysis, the aforementioned aims were operationalised into corresponding research questions. I present the synthesis of the study's findings under each of these research questions.

Research question one: what are the contextual factors affecting Kenyan secondary school students' self-regulated learning of mathematics?

The findings, which directly respond to this question, are presented in Chapter Ten of this thesis. Overall, the findings from this study seem to agree with some of the findings of the studies (cf: Ryan & Patrick 2001; Wentzel 1998) reviewed in the literature section. Specifically, the study findings suggest that the nature of social relationships between the students and their peers, teachers, parents and other members of the family had a significant direct influence on personal (Zimmerman 1989) self-regulation, given its influence of their sense of self-efficacy, cognitive engagement and affective interest in mathematics. It also seemed to significantly influence aspects of students' behavioural self-regulation (e.g self-monitoring and evaluation) and students' capacity to regulate their environment to support their learning of mathematics. Further, the study findings suggest that the influence of these social relationships on the students' self-regulated learning of mathematicsseemed to vary and to depend on other contextual factors such as the schools' instructional and assessment practices and demographic factors such as the students' socio-economic status. That said, the students' social relationships with their peers in school and at home seemed to have the greatest influence (in comparison to other social relationships) on the students' self-regulation. Indeed, the findings from this study suggest that the influence of other contextual factors, for example students' media use on the students' self-regulation, was in part influenced by the nature of the social relationship they had with their peers.

Similarly, the study findings also suggest that the negative impact of say, the teachers' instructional and assessment practices on the students' self-regulation was, for some students mitigated by the support they got from their peers. For example, the findings suggest that running formative collective assessments supported by well-structured peer teaching and learning can indirectly influence individual students' sense of self efficacy and motivation for learning mathematics positively. This is a significant finding given that the students' self-regulated learning has largely been found to pivot on their sense of self-efficacy towards the subject (Zimmerman 1989; Pajares 2002).

The centrality of social relationships in influencing the students' self-regulation adds credence to and perhaps contributes to understanding findings and assertions from earlier research that learning is inherently social (cf. Ryan 2001; Wentzel 1998).

In the same vein, the emergence of peer relationships as seemingly the most critical form of social relationship in influencing the students' self-regulation may in part be attributed to the fact that the students were of adolescent age. According to Ryan (2001), as learners approach adolescent age, they seem to value their relationships with their peers above relationships with other adults like teachers and parents. Indeed, findings from this study suggest that peer relationships had an influence on the students' self-regulation through the socialisation (Ryan 2000) of their academic motivation and engagement with mathematics. Peer relationships also had a direct impact on aspects of the students' environmental self-regulation: a number of students' reported that they found their peers better than teachers at modelling the learning process to them given their perceived closeness and sensitivity to their learning experiences (Zimmerman 1989).

Some difference was observed on the influence of the aforementioned contextual factors (social relationships, media use and instructional/assessment practices) on the students' self-regulation. The difference seemed to be as a result of structural factors, which fell into three main categories: socio-economic; culture; and postcolonial and neoliberal practices.

It emerged from the findings that the students' family and school socio-economic status may have played a generative role on the level and nature of influence of some of the aforementioned contextual factors on the students' self-regulation. For example, a high student teacher ratio in two of the schools, Origa and Rayolah, was found to have some negative impact on aspects of students' self-regulation such as sense of self-efficacy, strategic engagement and affective interest. The high numbers tended to limit both opportunity for student participation in class and teachers' attention to individual students learning needs in and out of class. In addition, a majority of the parents of students from these two schools, having themselves attained lower levels of education, seemed to be more constrained than most of the parents from Ademba, who generally had higher education qualifications, on the extent to which they could support and inculcate certain skills and dispositions for self-regulation such as the students' strategic engagement with their learning. Further, some of the evidence from the study suggests that the parents from these two schools were more limited in the extent to which they could: provide social assistance through modelling of the learning process; and structure the environment at home to be academically stimulating for their children.

These findings may be taken to agree somewhat with findings from studies done by both mathematics education psychologists (cf. Callan et al (2016) and those who have taken a sociological approach (cf. Lubienski & Stilwell 2003; Gates & Noyes 2014) that suggested that students from higher SES families may culturally be more exposed to dispositions and strategies that are better at supporting learning of mathematics than their counterparts from families with lower SES. The parents' level of income was also found to have had an indirect impact on the nature of social relationship and therefore students' self-regulation, especially for the boys. Specifically, the findings from the study suggested that the relationship and sense of deference of a majority of the boys from Rayolah and Origa seemed to have been negatively impacted by the fact they had to take up menial jobs to help contribute to their daily upkeep. As a result, the boys from the two schools were found to exude more independence, a fact that made them more vulnerable to distractive (from academic activities) practices such as uncontrolled use of media and other "illicit" entertainment-related activities in the neighbourhood.

Alongside students' family and school social economic status, culture emerged as one other structural factor upon and from which the influence of some of the contextual factors on the students' self-regulation depended. For example, the influence of social relationships, especially with parents, other family members and peers on the students' self-regulation was found to be largely hinged on the cultural influence on their identity construal (King & Mcinerney 2014) on the students' academic motivation goals. In particular, it emerged from the findings that the import of interrelationships with peers on the students' self-regulation was largely due to the cultural tendency by the students to espouse a relational self-construal. Indeed, the study findings suggest that the students' adoption of a relational identity self-construal had a significant impact on their use of specific self-regulated learning strategies such as help-seeking (from both peers and family members) and peer-evaluation.

Another cultural aspect that may influence the students' self- regulation was their perception of the place of will and skill in successful learning. As it has been found to be the case with students from other collective cultures (cf. Pillay, Purdie & Boulton-Lewis 2000), the participants (students, parents and teachers) in this study also seemed to place primacy on will (effort) over skill. As a result, in learning mathematics, they seemed to favour self-regulated learning strategies such as memorisations, rehearsals and elaboration over those that emphasised strategic and metacognitive engagement.

The findings also suggested that the influence of persons in authority on the students' self-regulation was in part influenced by the extent to which the students were culturally open to reflexive submission to such authority. In particular, the female students from the three schools seemed more amiable to direction from persons in authority than their male counterparts. That said, it was observable that the students from Origa and Rayolah more than those from Ademba seemed to be subjected to and more amenable to an explicit authoritarian culture from their teachers and other family members, a reality that in part points to some intersectionality between influence of culture and level of affluence (McInerney 2012) on the students' self-regulation.

Another notable finding, which some authors (cf. King & Mcinerney 2014) have distantly linked to culture, was the influence of religion on aspects of students' (especially female students) self-regulation such as sense of self-efficacy and adaptive motivational patterns (Dweck 1986) such as persistence.

A number of postcolonial and neoliberal factors were also found to play a generative role in influencing aspects of the students' self-regulation. Key examples included the use of English as the core medium of instruction and assessment and adoption of neoliberal performance-based practices (Milligan 2011) for evaluating and rewarding quality of teaching and learning in Kenyan schools. Similarly, the tendency by the mathematics teachers to project themselves as the dominant voice during mathematics learning, considered as one of the vestiges of colonial education practices (cf: Shizha 2010), emerged as a significant influence (negative) on a majority of the students' self-regulation.

Research question two: is there gender difference on the Kenyan students' practice of self-regulation?

Throughout Part Three and in particular Chapter Thirteen: Structural factors influencing self-regulated learning, I explored whether there were any gender differences on Kenyan secondary school students' self-regulation during learning of mathematics. While taking note not to overgeneralise, the findings from this study seem to broadly agree with the findings from some of the literature reviewed in Chapter Three (cf. Pajares 2002; Bembenutty 2007). The Kenyan secondary female students seemed to be more strategic about engaging with their mathematics and more open to at use of specific self-regulated learning strategies such as: help-seeking; and elaboration and rehearsals than their male counterparts. The noted gender difference in self-regulation in favour of the female students seemed to be linked to gender differences in: achievement-related attitudes and behaviours; sense of resilience and persistence; parental influence and oversight; and sense of autonomy. Further, the study findings suggest that the extent to which the aforementioned factors contributed to and/or influenced gender differences in the students' self-regulation was largely linked to: some of the gender-based cultural practices in the students' homes; and difference in the impact of socio-economic status-related challenges on the two genders. The findings from this study may be taken to contradict somewhat findings in an earlier study by Githua and Mwangi (2003) which suggested that the female secondary schools students, especially those from mixed secondary schools, had a lower motivation for learning mathematics than their male counterparts. That said, the lack of congruence in the findings from the two studies, may in part be attributed to the differences in the year of study of the participants.

Research question three: how adequate is the core textbook in supporting self-regulated-learning?

Presented in Chapter Eleven: Mathematics textbooks and self-regulated learning, the study findings suggest that significant improvement is necessary for the core mathematics textbooks to equitably support self-regulated learning of mathematics. As has been found to be the case with mathematics textbooks from a number of countries (cf. Pepin & Haggarty 2001; Weinberg & Wiesner 2011; Mesa 2010a), it emerged in the findings that Kenyan secondary school core mathematics textbooks may be more teacher-centred than learner-centred. As a result, a majority of the students reported that they were experiencing a number of challenges in mediating (Pepin & Haggarty 2001) the mathematics knowledge in the textbooks because of specific shortcomings.

The key shortcomings, which according to these students negatively impacted on their efforts at self-instruction, monitoring of their learning and self-evaluation included: comprehensibility and comprehensiveness of explanations and argumentation in its exposition and examples section; accessibility of the English language as used in the textbook; and topical arrangement, variety and cognitive complexity of the questions in its exercise section. The accessibility of the English language as used in the core textbooks varied across different student groups; a majority of the students of Rayolah and Origa, who were from more socio-economically challenged backgrounds, were most affected.

On another note the study findings linking aspects of students' self-regulation such as capacity to self-instruct/evaluate and sense of self efficacy to the accessibility of English as used in the core mathematics textbooks, sheds some light on findings from earlier related studies (cf. Abedi & Lord 2001; Schleppegrell 2007; Clarkson & Idris 2007; Kwasi 2009) which have linked students' mathematics achievement to their language (of instruction).

Research question four: what is the relationship between self-regulated learning and students' relationship with mathematics?

The study findings presented in Chapter Twelve: Self-regulated learning and students' relationship with mathematics suggest a reciprocal and dialectical interaction between students' relationship with mathematics and their capacity to self-regulate when learning mathematics. In part, the observed reciprocal and dialectical interaction could be attributed to the fact that some of the components related to students' academic emotions (Pekrun et al. 2002) qualified as significant features of both students' self-regulation and relationship with mathematics. For example, interest which is a key affective reaction linked to students' relationship with mathematics (Di Martino & Zan 2011) is also deemed as (cf. Zimmerman 1989) a key component of the students' personal self-regulation with significant influence on both personal and behavioural self-regulation practices such as cognitive engagement and self-monitoring/evaluation. It emerged from the study findings that as the students became more open to using some of the self-regulated learning strategies such as help-seeking, elaboration and rehearsal, they seemed to express more interest and express greater enjoyment in engaging in mathematical activity.

The students' epistemic (Hofer 1997), intelligence (Dweck & Master 2008) and self-efficacy beliefs, all key components of students' relationship with mathematics (Di Martino & Zan 2011), were also found to be influenced by their sense of and capacity for self-regulation during learning of mathematics. In the case of the students' epistemic beliefs, the findings suggested that the students' beliefs towards the nature of knowing mathematics rather than the nature of mathematics were more malleable and given to the influence of the students' self-regulation during learning of mathematics. Specifically, the findings seem to imply that as the students became more adept at self-regulation their epistemic beliefs towards the source of mathematical knowledge shifted from perceiving the teacher as the key source of knowledge to embrace more constructivist views that allowed them to consider themselves and peers as credible sources of mathematics knowledge.

Conversely, no significant change was observed on the students' epistemic beliefs on the nature of mathematical knowledge: even as their self-regulation was enhanced, a majority seemed to have remained inclined towards a view of mathematics knowledge that is largely static, tangibly connected to cultural objects and activities and not abstract.

Overall, the students' responses seemed to suggest a complex interplay between self-regulation, epistemic beliefs and emotional connection towards mathematics. They corroborate unconfirmed findings from some of the extant experimental studies (cf. Muis & Franco 2009), that intimated a dialectical and bidirectional relationship between self-regulated learning and aspects of students' relationship with mathematics (epistemic beliefs, self -efficacy and emotions). This finding is important because it points to perhaps a more accessible and observable means of strengthening elusive and abstract (Di Martino & Zan 2011) components (beliefs, emotions) of students' affect towards mathematics: fostering self-regulated learning through training (cf. Leidinger & Perels 2012).

Research question five: what are the unique features of a local model of self-regulated-learning?

The findings of this study on Kenya secondary school student's self-regulation during learning mathematics have been summarized into a critical realist model of self-regulated learning. The model underscores the role of contextual factors including gender and other structural factors such as culture, students' SES and post-colonial/neo-liberal factors on the students' self-regulation. Importantly, the model also highlights the fact that the Kenyan secondary school students' skill at self-regulation tend to be as a result of appropriation from the co-regulatory processes that characterize their learning of mathematics. These co-regulatory process were also found to be significant in invoking the 'hot' (motivational and affective) aspects of self-regulated learning (Patrick & Middleton 2002). From the discussions presented in Chapter Twelve on the interaction between self-regulated learning of mathematics and students' relationship with mathematics it emerged that failure to invoke the motivational and affective components of self-regulated learning may hinder the possible influence of self-regulated learning of mathematics on students' relationship with mathematics as a subject. In other words, the findings from this study suggest that a positive influence of self-regulated learning of mathematics on the students' long-term relationship with mathematics as a subject is more likely to happen if the process of regulation during learning involves both cognitive and positive affective (and motivational) processes. This finding resonates with assertions by mathematic education researchers in the field of affect (cf. Di Martino & Zan 2011) that learning of mathematics involves a complex interplay of cognition and affect.

Implications for policy and practice in Kenyan education system

The study findings imply and point to a need for change in some of the current policies and practices in teaching and learning of mathematics in Kenyan secondary schools:

Social goals

From the discussion in Chapter Thirteen, one of the key findings of this study suggest a general inclination by the students towards relational interdependent self-construal (Kings & Mcinerney 2014) and a resulting critical role of social goals in influencing their achievement motivation goals and self-regulation. This finding puts into question the current individualistic and competitive orientation of learning in Kenyan secondary schools (see section on features of learning in Kenyan secondary schools in Chapter One) and calls for a shift towards policies in teaching, learning and assessment that promote, support and tap into students' social goals to enhance their self-regulation and successful learning of mathematics. Such shifts may require reorientation of both pre- and in-service teacher training programmes in the country to empower teachers with knowledge and skills of tapping into the students' social goals to enhance learning. For example, the training may orient teachers towards embracing and shaping teaching strategies and practices that promote an identity of schools and classrooms as community of learners (Beishuzen 2008).

Further, the orientation of assessment of mathematics in Kenyan secondary schools should also be shifted from its current individualistic and competitive nature to one that is more collective and geared towards improving teaching and learning.

Textbooks

These study findings presented in Chapter eleven on Mathematics Texbooks and self-regulated learning, provide important pointers of what needs to be done to make Kenyan mathematics textbooks more learner-centred. As such, the considerations of the deficiencies of the core textbooks as suggested by the findings have implications for the mathematics teachers; the textbook publishers and Kenya Institute of Curriculum Development (KICD), which plays a key role in vetting and approving textbooks used in Kenyan schools. For the teachers, the findings suggest that they may have to develop strategies to compensate for some the identified deficiencies in the core textbooks. For example, the concerns raised by some of the students on the comprehensiveness of the explanations in the exposition section and accessibility of the English language used in the textbooks should push the teachers towards strategies for scaffolding the students' use of the textbooks and ensuring that they create learning environments that allow for students to ask questions and seek clarifications.

The study findings also provide valuable information for mathematics textbook authors on aspects they need to pay attention to for the textbooks to afford better opportunities for self-regulated learning by the students. Similarly, this study's findings provide pointers of standards and attributes of textbooks that the KICD should consider during vetting to ensure the core mathematics textbooks not only support the teaching of mathematics but also support "all" Kenyan secondary school students' self-regulation during their learning of mathematics.

Overall, taking steps such as the ones suggested in the foregoing discussions to improve the core mathematics textbooks adequacy in supporting self-regulated learning, will in the short term enhance students' mathematics textbook relationship and in the long term make significant contribution to the current effort by the country to make learning mathematics in secondary schools more student-centred (Sifuna & Kiame 2007).

Media Use

The study findings on the influence of media use on students' self-regulation which is presented in Chapter Ten point to a need for concerted effort amongst different stakeholders to tap into the opportunities brought by, and work at reducing the constraints of, the increased media-technology adoption by the Kenyan public. For example, it emerged from the study findings that the possibility of the students tapping into the increased access to both mobile technology and internet connection to support the efforts at self-regulated learning is currently hampered by the limited availability of online educational content that is aligned to the Kenyan curriculum at the secondary school level. This points to a gap that the Kenyan government and other stakeholders need to work together to fill.

On the other hand, the increased technology adoption across the country was found to be a key distracting factor for many of the students, especially the male students. In particular, access to local media outlets akin to cinemas in neighbourhoods, was signalled as a red flag for the male students' learning (especially those from lower SES families). The government, through its relevant administrative units at the local level, needs to put in place and/or enforce regulations to protect the students from such distractions.

Training students on self-regulated learning

This study's findings in Chapter Thirteen under the section on Collective and individual agency, corroborate findings from other studies that have demonstrated that the students' sense of agency and skilfulness in self-regulated learning can be enhanced through training (Hattie, Biggs & Puddie 1996; Dignath & Buttner 2008; Leidinger & Perels 2012).

The evidence from this study on how self-regulated learning of mathematics may be successfully fostered amongst secondary school students has significant implications for parents, teachers and education policy makers.

For both the parents and teachers, the overall findings of this study point to the need for a deliberate investment in time and other resources in training to hone the students' skills and inculcate dispositions that can enhance their capacity for self-regulation.

On the other hand, the government and policy makers may add value to this process of "skilling" by including capacity building for teachers during pre- and in-service training to shift their instructional philosophy and practices from focusing on content teaching (Otieno 2018) to one that mainstreams training of students on aspects of self-regulation in their teaching.

In addition, the government could invest in developing accessible informational resources for all parents to support their efforts towards imbuing their children with skills and dispositions that may support their self-regulation during their learning of mathematics

Macro-level implications

At a macro level, the study findings have two broad implications for education policy making in Kenya. Firstly, a need for the review of the current education system to establish the extent to which it engenders equal access to quality teaching, learning and assessment of mathematics. For example, policy makers need to address the unequal opportunities for mathematics learning by Kenyan secondary school students that is currently orchestrated by the use of English as the medium of instruction and assessment.

Secondly, the emergence in this study's findings of culture as a key core structural influencer of the students' self-regulation together with other related constructs such as academic achievement goals and epistemological beliefs should act as point of caution on blanket adoption (Milligan 2004) of education policies from the West. Indeed, the findings help reiterate the fact that Western knowledge should not be deemed as universal knowledge. To paraphrase the words of (Watkins 2000), our policy makers should, for example, wake up to the fact that Western dichotomies did not just fail to travel as far as Orient, they also did not find their way to Kenya and perhaps the wider African continent. It behoves the policy makers and other education stakeholders to shape and evaluate new policies with a view of making them culturally sensitive and grounded on key aspects such as our self-construal. Such a move will require some innovative thinking given that the cultural orientation of the students and their families is not homogenous across the Kenyan population.

Given the general similarities across education systems and of contextual/cultural factors influencing learning of mathematics in the African continent, the relevance and policy implications of this study extends somewhat to other countries in the African continent. Indeed, in my current role as a Director of Teacher Training (maths and sciences) with a Pan-African Institution-African Institute for Mathematical Sciences (AIMS), I have found myself extensively referring to and reflecting on the findings of this study to shape, the interventions under the program and to inform policy dialogue on mathematics and science education both with education policy makers in Rwanda and within the continental organisations such as the African Union Commission.

Further contributions to Knowledge

In this section I highlight the contribution of this study to theoretical understanding of self-regulated learning and related constructs. I also present this study's contribution to knowledge on aspects related to methodology and data analysis.

Self-regulated learning

This study makes a contribution to knowledge on self-regulated learning in a number of ways. First it provides a window for exploring the extent of generalisability (to African context) of existing theoretical assertions on self-regulated learning, related constructs (e.g. epistemic beliefs, self-efficacy beliefs, academic emotions, achievement motivation goals) and factors, including textbooks, that have been found to influence self-regulated learning through earlier studies.

Notably, the study contributes additional evidence that the abovementioned constructs are cultural specific (King & Mcinerney 2014) and helps to emphasise the need for culturally sensitive application and analysis of study findings based on models whose origins are from cultural contexts different from the present study.

Second, the resulting model of self-regulated learning from this study's findings is one that includes features from both socio-cognitive and socio-cultural models. Accordingly, it may be considered to extend the discussions and insights on the attributes and working of hybrid models of self-regulated learning (cf. Hadwin & Oshige 2011; McCaslin & Burross 2011). Specifically, the study answered the call for attention to 'external coregulatory elements in the self-regulation' (Volet, Vaurus & Salonen 2009, p. 217). More importantly, the study findings provide empirical evidence and extend the theoretical understanding on how co-regulation and self-regulation cross-fertilises during self-regulated learning in a naturalistic context (Volet, Vaurus & Salonen 2009). For example, it provides some novel insight and makes an original contribution to knowledge on possible interactions between collective efficacy and self-efficacy in enhancing self-regulation: From the study's findings, it emerged that an individual's sense of self-efficacy towards mathematics may be gradually appropriated from a collective sense of self-efficacy during collaborative learning activities.
Third, being amongst the very few studies (if not first of its kind) to explore self-regulated learning from a critical realist perspective, the study also presents novel evidence on the different levels of manifestation and interactions of the contextual factors that have been found to influence students' self-regulated learning of mathematics.

Fourth, this study adds to the current limited evidence from mostly quantitative research (cf. Muis 2004; Muis &Franco 2009) that has suggested that enhancing students' self-regulation during learning may contribute to a shift of the students' epistemic beliefs. Perhaps the findings also help clarify that the suggested shift in the epistemic beliefs may in the short term be limited to the epistemic beliefs about knowing and the source of knowledge and not include the epistemic beliefs about the nature of mathematical knowledge. In so doing, it challenges the common assertions from mostly Western-based research (Muis 2004; Schoenefeld 1982) that tend to over-privilege and overplay the link between abstraction of mathematics and constructivist epistemic view of learning of mathematics. Further, the finding that the Kenyan secondary school students seem to identify more with a utilitarian nature of mathematics and not an abstracted nature of mathematic as is currently presented in their curricular resources and teaching provides a spark of inspiration for mathematics education researchers and academics to join their counterparts mostly from the US (cf. Joseph 1987) to interrogate and consider ways of reducing the Eurocentric biases in the current stance on teaching and learning mathematics in Kenyan schools.

Textbooks

A majority of the research on mathematics textbooks have focused on either getting feedback from the teachers or desk-based content analysis of the content as presented in the textbooks (Fan Zhu & Miao 2013). Even so, hardly any of these studies have employed a self-regulated learning lens to explore the quality of the mathematics textbooks. Moreover, very little if any of research on mathematics textbooks is on mathematics textbooks as used in an African context. Therefore, one can surmise that the study findings on textbooks extend the present theoretical understanding on mathematics textbooks on more than one level. For one, it provides empirical evidence for and expands the theoretical understanding on the relationship of mathematics textbooks and students' learning outcome (Fan Zhu & Miao 2013).

Methodology

The third area of contribution of this study is methodological: Overall, my applying of a number of data collection methods in an integrated way for dual purpose of collecting data and as interventions is not a common practice in social research.

More importantly, in using both metaphoric drawings and reflective narratives as two of my key data collection methods, I provide insight on how the two methods may be used to provide insightful understanding of the affective component of learning mathematics. Such an illustration is important given the growing 'discomfort' amongst a number of mathematics education researchers (Di Martino & Zan, 2011) with the normative approach as the traditional approach for the field of affect. Further my discussions on and illustrations (Chapter Eight) of the use of metaphoric drawings as data provides insight on the opportunity that exists in using drawings as an additional creative approach in investigating the affective domain of mathematics learning and teaching. In particular, such an understanding and use of metaphoric drawings may help unlock some challenges that may arise when collecting data from adolescent students who may not be comfortable talking about their feelings because of the cultural orientation and/or limited proficiency in speaking English.

Finally, my discussions (Chapter Nine: Overall approach to and process of data analysis) on how I used abduction and retroduction inferences as key tools for analysing my data also is a key knowledge contribution. According to Fletcher (2017), critical realist qualitative researchers often find themselves without methodological guidelines because very few critical realist authors have provided a systematic demonstration on how the critical realist ontology and epistemology informed both their data collection and data analysis.

Study limitations and recommendations of future research

The first limitation of this study arises from the fact that as a multiple case study, it involved only three schools and targeted students only from one of the streams in each of the schools. Further, some of the data such as those collected through interviews only involved a number of the students from each of the schools.

Given the diversity of contextual realities in the different Kenyan communities and secondary schools and learning at different stages of secondary education, caution should therefore be taken in generalising the findings to all the students in Kenya. To get a closer picture of some of the emerging findings from this study such as the students' perception of the adequacy of the core mathematics textbooks in supporting their learning, may necessitate carrying out a survey using a tool developed from this study's findings.

It should also be noted that the time within which this intervention was carried out may have been too short to systematically track and collect evidence of success in fostering self-regulation in the students and/or explore the long-term impact of the interventions on the students' relationship with mathematics. In future it may be valuable to carry out a longitudinal study that would track the students' practice of self-regulation and their relationship with mathematics through the period of their four years of learning in secondary school. Such a longitudinal study may make it possible to also explore the intersectionality of students: self-regulation, relationship with mathematics and achievement in standard examinations.

An implicit third limitation to this study that may have had some impact on the transferability and confirmability (Creswell 2013) of some of the findings was the sense of "closeness" I had with some of the study participants. In the case of Ademba for example, where I was not only one of the parents of the school but also part of the community of the which founded and managed the school, there is a sense that perhaps, this may have influenced the school communities' interaction with me during the study. Someone completely new to this school, may perhaps not have had the same kind of interactions with the students and therefore in some instances may have arrived at different conclusions or insights from the data collected during the fieldwork.

To reduce the impact of this limitation on the findings of the study, I have provided very thick descriptions not just in presenting data but also in discussing how I employed the various data collection methods during my fieldwork. Further I took great care to employ creative data collection methods such as metaphoric drawings and written reflective narratives to instigate the "bottom up" emergence of data and reduce instances of participants giving responses that they may have considered socially desireable. For example, it is important to note that the data on possible influence of religion (spirituality) on the students' self-regulation did not first emerge out of direct interview questions on the same but from some of the students' citation of the same in the group rules that they set for themselves. Such bottom up emergence was important in reducing the biases and or doubt of credibility of such data which may have emerged because of my being of similar faith as the students.
The finding that the girls in this study seemed to be more adept at self-regulated learning and manifested greater motivation for learning mathematics presents a puzzle that needs to be explored further. It goes against the current understanding that secondary female students in Kenya generally score lower grades in mathematics (cf. Githua & Mwangi 2003; Njoka et al. 2013) than their male counterparts. Future research may interrogate whether gender differences in mathematics achievement in Kenyan secondary schools vary across schools, year of study, in usual class work and/or just in high-stakes examinations. Such exploration would be important in shaping more targeted interventions to address the current gender gap in mathematics achievements amongst Kenyan secondary school students.

The indication from the findings that formative-based collective-assessment may enhance students' interest and efforts towards learning and ultimately achievement in mathematics should also be explored further in future research.

Finally, the study findings provides some broad pointers of areas of research that should be pursued by mathematics education researchers in Kenya (Africa): the impact of use of English as medium of teaching and learning on the students' performance in standard- tests such as KCSE; some of the Eurocentric biases in the present teaching and learning of mathematics in Kenya; current practice of peer learning and teaching of mathematics; and the impact of cultural differences and level of affluence between students and teachers on students' learning.

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APPENDICES

Appendix 1: Request for Ethical Approval of Research Project

Sheffield Hallam University

Our Ref AM/KW/D&S-70
7 October 2015

Herine Otieno
Sheffield Institute of Education
Faculty of Development and Society
Howard Street
Sheffield
S1 1WB

INTERNAL

Dear Herine,

Request for Ethical Approval of Research Project

Your research project entitled "**Improving students' relationship with mathematics through self-regulated learning in Kenya secondary schools.**" has been submitted for ethical review to the Faculty's rapporteurs and I am pleased to confirm that they have approved your project.

I wish you every success with your research project.

Yours sincerely

Ann Macaskill

Professor A Macaskill
Chair
Faculty Research Ethics Committee

Office address :
Business Support Team
Faculty of Development & Society
Sheffield Hallam University
Unit 4, Sheffield Science Park
Howard Street, Sheffield, S1 1WB
Tel: 0114-225 3308
E-mail: DS-ResearchEthics@shu.ac.uk

Appendix 2: Formal Approval of Research Project

INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE (IREC)

MOI TEACHING AND REFERRAL HOSPITAL
P.O. BOX 3
ELDORET
Tel: 33471//2/3

MOI UNIVERSITY
SCHOOL OF MEDICINE
P.O. BOX 4606
ELDORET

Reference: IREC/2015/205
Approval Number: 0001542

28th January, 2016

Ms. Herine Otieno,
Sheffield Hallam University,
Faculty of Development and Society,
Howard Street,
SHEFFIELD S1 1WB

INSTITUTIONAL RESEARCH & ETHICS COMMITTEE
28 JAN 2016
APPROVED
P. O. Box 4606-30100 ELDORET

Dear Ms. Otieno,

RE: FORMAL APPROVAL

The Institutional Research and Ethics Committee has reviewed your research proposal titled:-

"Improving Students' Relationship with Mathematics through Self-Regulated Learning in Kenya Secondary Schools."

Your proposal has been granted a Formal Approval Number: ***FAN: IREC 1542*** on 28th January, 2016. You are therefore permitted to begin your investigations.

Note that this approval is for 1 year; it will thus expire on 27th January, 2017. If it is necessary to continue with this research beyond the expiry date, a request for continuation should be made in writing to IREC Secretariat two months prior to the expiry date.

You are required to submit progress report(s) regularly as dictated by your proposal. Furthermore, you must notify the Committee of any proposal change (s) or amendment (s), serious or unexpected outcomes related to the conduct of the study, or study termination for any reason. The Committee expects to receive a final report at the end of the study.

Sincerely,

For

PROF. E. WERE
CHAIRMAN
INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE

cc	Director	-	MTRH	Dean	-	SOP	Dean	-	SOM
	Principal	-	CHS	Dean	-	SON	Dean	-	SOD

Appendix 3: Parents' Information Sheet

Research Title: Improving students' relationship with mathematics through self-regulated learning in Kenya secondary schools.

Name of Researcher: HERINE OTIENO

Introduction:

I am Kenyan, currently doing a research degree (PhD) in mathematics education at Sheffield Hallam University in the United Kingdom (UK).

I am doing a piece of research whose main aim is to contribute to efforts to improve mathematics education in Kenya secondary schools. As explained in our brief seminar today, the study will involve trying out specific solutions with form two students of a few schools in the district. This document has summary information on the study and also an invitation for you to enlist your interest in allowing your son/daughter to participate in the research. If you are interested in your child participating in the study, I will ask that you read and sign the study's consent form after formally reviewing this information sheet.

The consent form may contain words that you do not understand. Please ask me to stop as we go through the information and I will take time to explain. If you have questions later, please feel free to ask me before you sign the consent form.

Purpose of the research

Low achievement in mathematics in KCSE is a key concern for parents, teachers and students across the country. Even though the government is putting in a lot of effort to improve the situation through programs like the SMASSE program the country's mean grade in mathematics is yet to rise above the 50% mark. For the district schools in this district in particular, the current mean grade stands at below 40%. This has hampered the progression for most of the students into higher education since most higher education institutions have set their minimum mathematics (KCSE) entry requirement for admission at 40%.

Research done in mathematics education in other countries has shown that in the long term students' relationship (attitude, interest, confidence) and achievement can be improved by training the students on how to become better mathematics learners. The main purpose of this study is to establish whether training the students to be more skilful and responsible learners can indeed help in improving their relationship with mathematics. I am also interested to find out the nature of training that would work out for the Kenyan secondary school students and what role the teachers and parents may have to play.

Type of Research Intervention

The preliminary part of the research will involve gathering data on parents, teachers and students' pre-intervention mathematical beliefs and training the students on certain strategies for improving their learning of mathematics. A core part of the training will focus on helping the students become more active in their learning of mathematics during usual class sessions and in designed peer activities. The proposed solutions will be discussed (and improved subject to contribution) with the teachers from the participating schools in a half day seminar before implementation. Feedback will be collected from the students and teachers to improve the solutions before administering the improved versions in subsequent stages. Data, part of which will be in the form of the regular feedback from students and teachers, will be collected. I will participate in some of the class sessions and collect data during the sessions. I will take care to ensure that my presence does not obstruct learning. The students and teachers may also be asked to keep reflection diaries on their mathematics learning activities during the implementation period. I may organise sessions to discuss the reflections with the students and separately with the teachers during the implementation process. At the end of the implementation period, I plan to carry out semi-structured interviews and focus group discussions with a cross-section of the participating students and teachers. These interviews and parts of students' discussions during group work will be audio-taped, recorded and transcribed.

Participant Selection

The study was designed to target students in Sub-County secondary schools (district secondary schools) in Kenya who in my consideration are faced by more challenges (compared to students in County and National schools) in their quest to learn mathematics. This, plus other practical reasons like accessibility, formed the basis of the selection of your school to participate in the study.

Voluntary Participation

Your school's interest in the study does not in any way obligate you to participate in this study: Your participation (allowing your child to participate) in this research is entirely voluntary and will in no way affect your child's learning in the school. Please note that your school will only be able to participate in the study if most parents' consent to the study. We will also seek assent from the students before we carry out the study. Also note that you may change your mind later and stop your child from participating even if you agreed earlier.

Duration

The research takes place over a period of 10 months beginning February 2016.The pre-intervention data from parents, teachers and students will be gathered in February 2016.The pre-intervention data from the parents will be in the form of a focus group discussion of a select number of parents from the participating schools. The first training for the students will be done in the month of March 2016. I intend to have around six sessions across the first two weeks. The sessions will last about an hour and preferably will be done during non-official class time. The training time will be chosen in consultation with the school. After the training, I will spend at most two days per week (May-July) in the school, observing the mathematics classes and interacting with the students and other members of the school community. These interactions will be done in the open and will be guided by your school regulations and the convenience of the participants.

Risks

There are no risks associated with this study.

Benefits

It is our hope that through the study, the students will have a better relationship with mathematics which in the long term should have a positive effect on their mathematics achievement. Further it is our hope that your interaction with your child during the study will enhance your understanding on how you can support your child's learning process in school.

Reimbursements

The school (students, teachers and parents) will not be provided with any incentive to take part in the research.

Confidentiality

Given that the research is being done in the school community, it will generally draw attention from other members of the school community who may ask questions about the study and its related activities. Any personal information collected from this research will be kept private. Any information about an individual participant will have a number on it instead of the individual's name. The numbers will only be known to the researcher and any information related to that will be kept under lock and key.

It should be noted that there will be particular challenge in keeping information shared in the focus groups confidential. We will however encourage the group participants to respect confidentiality. It will however be made clear to the participants before their participation in the focus group discussions that the researcher cannot stop or prevent participants in the focus groups from sharing things that should be confidential.

Sharing the Results

The knowledge that we get from this research will be shared with the participants before being shared with the wider school community. Each participating school will receive a summary of the results. We may also share it in the professional development of mathematics teachers in the Sub-County, other parts of the country and related international seminars. Outcomes may be reported in professional and research journals and in book chapters and the overall study will form part of my doctoral thesis. At the end of the research, we will publish the results so that other interested people may learn from the research.

Right to Refuse or Withdraw

You do not have to take part in this research if you do not wish to do so, and choosing not to participate will not affect your relationship with the school administration. At the end of interviews(and end of study), the participants will be given an opportunity to review their remarks(preliminary findings) with a view of modifying or asking for the removal of portions of the notes that they do not agree with or that are not accurate representation of their views.

Funding for the study

The researcher's PhD study is funded through a UK government scholarship administered by the Commonwealth Scholarship Commission (CSC)-*cscuk.dfid.gov.uk*

Who to Contact

The research proposal for this study has been reviewed and approved by the Kenya National Commission for Science Technology and Innovation (NACOSTI), which is a Kenya government entity charged with the responsibility of ensuring that the research participants are protected from harm. It has also been reviewed by the Ethics Review Committee of Sheffield Hallam University -UK which is the institution where the researcher is undertaking her PhD research study in Mathematics Education. If you have any question about the study (now or later) you can contact either NACOSTI at P.O Box 30623-00100 Nairobi ; Tel number: 020310571/0713788787/0735404245; email: info@nacosti.go.ke *or my research supervisor, Prof. Hilary Povey at* Mathematics Education Centre, Sheffield Hallam University, City Campus, Sheffield S1 1WB h.povey@shu.ac.uktel +44 114 225 6017

Appendix 4: Consent Form

School_________________________Student's name_________________

Research Title: **Improving students' relationship with mathematics through self-regulated learning in Kenya secondary schools.**

I have read the participant information sheet and I hereby consent to my son/daughter's participation in the intervention research aimed at fostering self-regulated learning amongst my schools' form two students;

• I have been given clear information, both written and verbal, about the study, and understand what is required ofmy child and me.

• I understand that mychild's participation is voluntary. I may object to his/her participation in any of the research activities and may withdraw him/her from the study without any explanation.

• I am aware that part of the activities and interviews in which my child/Iwill participate in will be audiotaped, recorded and transcribed.

• I understand that all information from the observations of the classroom sessions and related research activities will remain confidential to the research team and that all information will be securely stored with all identifying information removed and stored separately under lock and key.

• I understand that none of the information that is gathered from the study's participantswill be described or portrayed in any way that will identify themin any report on the study.

Name of Principal______________________ Signature ___________________Date_______

Name of Sponsor_______________________Signature_____________________Date_______

Statement by the researcher

I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily. A copy of this ICF has been provided to the participant.

Researcher________________________Signature__________________Date

Appendix 5: Consent Form for School

School:_______________________________

Research Title: **Improving students' relationship with mathematics through self-regulated learning in Kenya secondary schools.**

I have read the participant information sheet and I hereby consent to my school's participation in the intervention research aimed at fostering self-regulated learning amongst my schools' form two students;

• I have been given clear information, both written and verbal, about the study, and understand what is required of the participants from my school.

• I understand that my schools' participation is voluntary. I may object to my school's participation in any of the research activities and may withdraw the school from the study without any explanation.

• I am aware that part of the activities and interviews in which my school will participate will be audiotaped, recorded and transcribed.

• I understand that all information from the observations of the classroom sessions and related research activities will remain confidential to the research team and that all information will be securely stored with all identifying information removed and stored separately under lock and key.

• I understand that none of the information that is gathered from participants from my school will be described or portrayed in any way that will be identify me in any report on the study

Principal__________________Signature___________________Date_____________

Sponsor/BOG___________________Signature_______________Date______________

Statement by the researcher

I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily. A copy of this ICF has been provided to the participant.

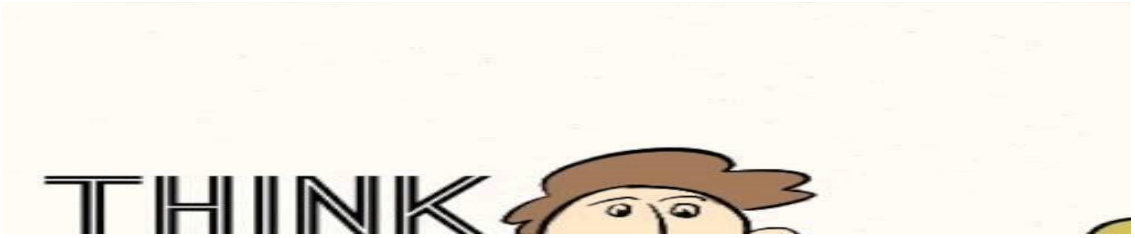
Researcher________________________Signature__________________Date______________

Appendix 6: Student Reflectional Manual

Learning How to Learn

THE LEARNING EXPERIENCE®

ACTIVITY ONE:




What does it take to learn something?


What and who contributes to:

- successful learning of mathematics?

- unsuccessful learning of mathematics

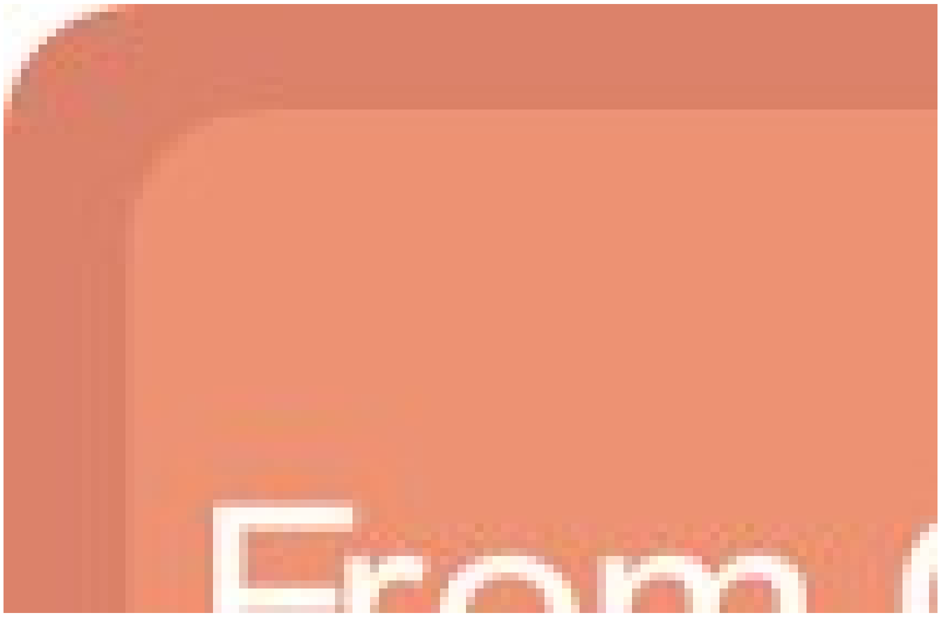

How do you know (prove) you have learnt a maths concept (what are the different ways one can use to show they have learnt some mathematics concept?)

MY PERFECT CLASSROOM TO LEARN MATHS IS WHERE

I AM

THE OTHER STUDENTS ARE…

THE TEACHERS IS…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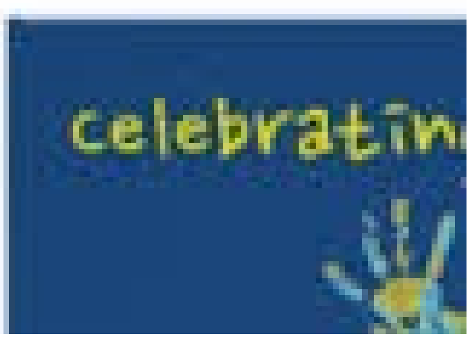

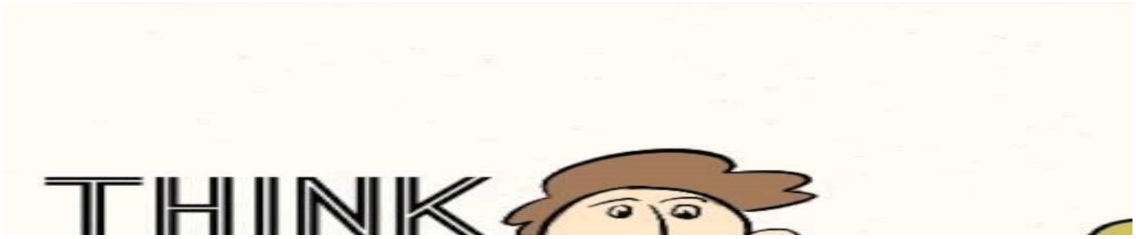

As the teacher teaches in class or during group sessions;

 What role do the class members have in your learning of mathematics?

 How can the class members hinder your learning of mathematics?

 How can the class members support your learning of mathematics?

 GROUP ACTIVITY: CREATING OUR CLASSROOM –COMMUNITY NORMS:

 If we are to strengthen the class as a community of mathematics learners what should we improve in…?

 Design a creative chart of our class community-mathematics norms

REFLECTION

REFLECTION ACTIVITY ONE: MY CLASS AS A COMMUNITY OF MATHEMATICS LEARNERS


WHAT?

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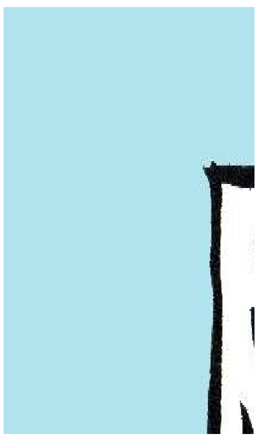

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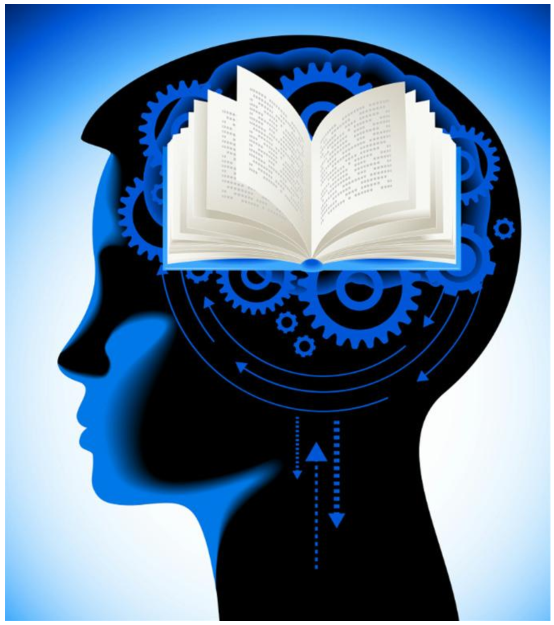

What aspects of **me** contribute to my learning or not learning of mathematics:

- Parts of me as a human

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  Skills and dispositions(‘characteristics’)

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Discuss and write down three things you know/believe about the human brain and learning of mathematics….

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From our discussions so far and the video what new understanding have you drawn about learning/learning of mathematics

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REFLECTION

REFLECTION ACTIVITY TWO:

My brain and my learning of mathematics…


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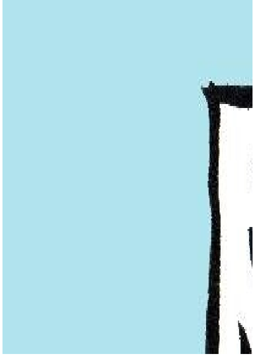

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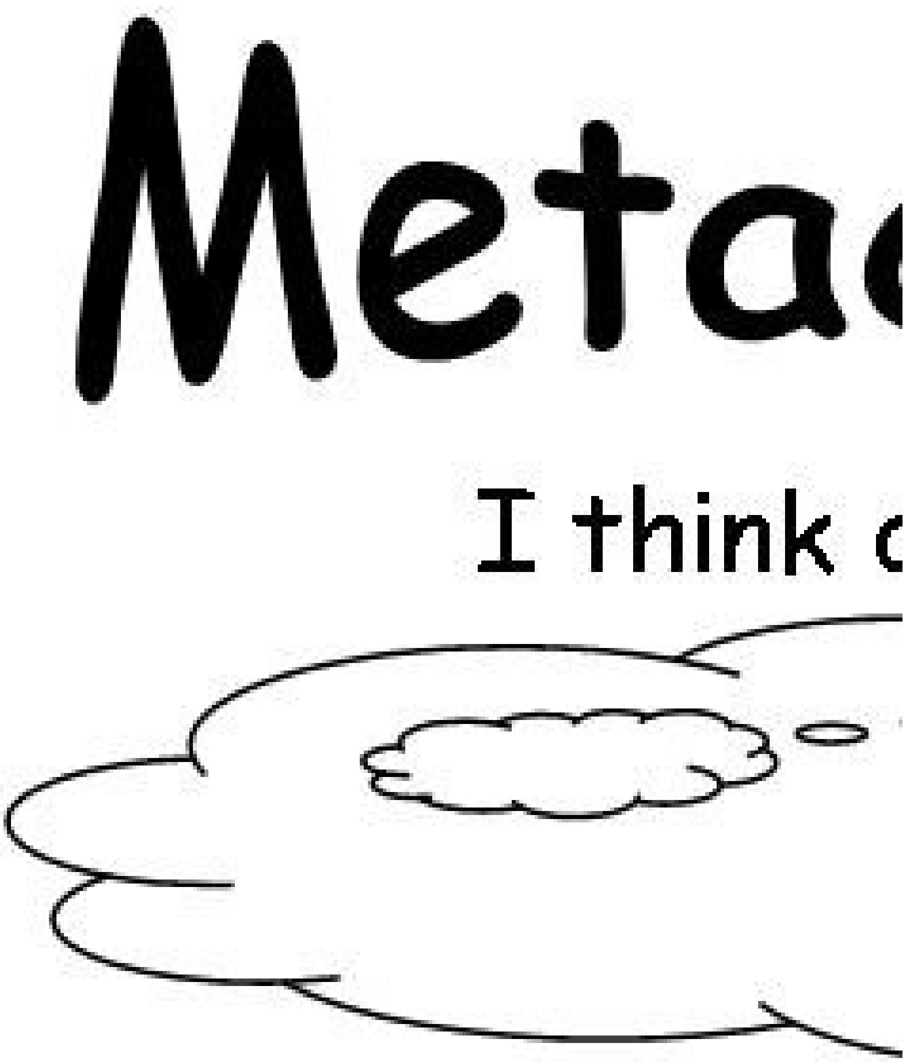
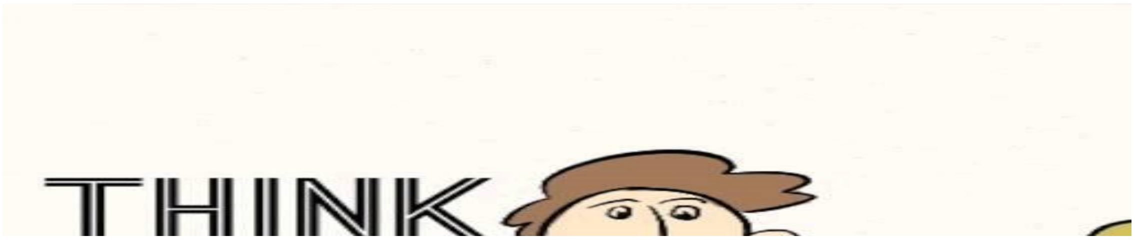

Meta
I think



 You are applying for a job as a safari rally driver list down key qualities that you have that you think make you the best candidate for the job;

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 As a human resource manager, draft a job advertisement for a safari rally driver…the advertisement should list out the key qualifications and qualities that you will be seeking out from the suitable candidate;

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List down the key qualifications and attributes of a good safari rally driver….

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How do the attributes of ***a good*** safari rally driver compare with attributes of **a *good*** student?

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REFLECTION


WHAT?

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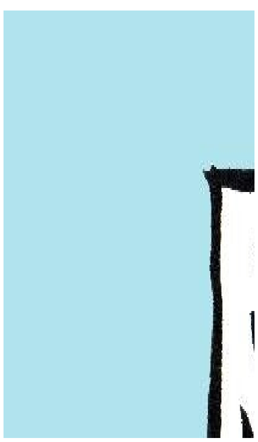

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METACOGNITION OUTLINE FOR MATHEMATICS PROBLEM SOLVING (self or group)

 **what do I know about this question(e.g what is the main topic that it is drawn from; any formulas come into mind?)**

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 **what are the key concepts (mathematical relationships) and understandings that I may need to apply;**

- **what do I know about the key concepts;**
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  ……………………………………………………………………………………………
  ………………………………………………………………………….
- **what don't I know about the key concepts…;**
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  ……………………………………………………………………………………
- **where can I get the information**

- ………………………………………………………………………………
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- **what are the different ways in which I can solve this mathematical question**
- ………………………………………………………………………………
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 **which do I think will be the most suitable strategy and why**

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 **so what is my plan for carrying out the questions –outline of steps; …**

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 **what do I need to checking to avoid making mistakes in the process of solving this problem or similar problems**

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what can I do to check how well I have solved the problem…

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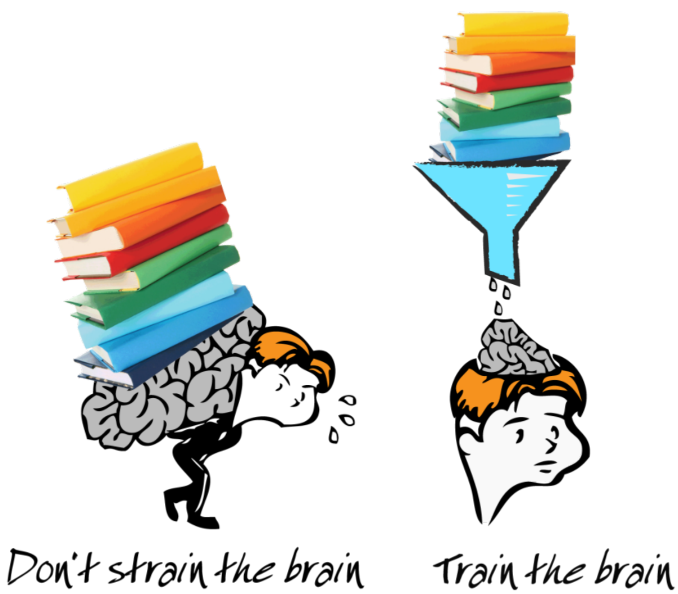
Question and its working	Metacognitive process	feelings
What is not /clear/understood out of the problem solving process…		
I have understood…		
I have not understood…		

REFLECTION: METACOGNITIVE PROBLEM SOLVING OF MATHEMATICS




WHAT?

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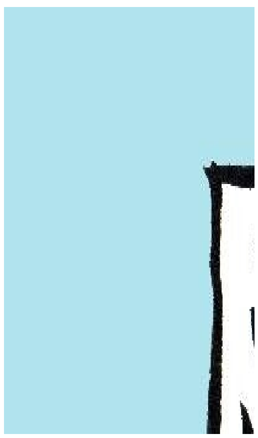

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METACOGNITIVE OUTLINE FOR LISTENING DURING CLASS – SESSION OR SELF STUDY /OR GROUP SESSION AFTER SELF/CLASS SESSION:

The lesson/topic is about understanding….

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What I know….

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What I want to know or still trying to figure out

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What I have learnt…

What I am feeling…

CREATING

LEARNING NORMS….

Reference websites for images used in the manual:

Brain images for students: https://www.google.com/search?sa=G&hl=en-RW&q=brain+images+for+students&ved=0ahUKEwjHu_XxzP3cAhUFLBoKHeGGA6oQvQ4IJigE

Calligraphy - Wikipedia: https://en.wikipedia.org/wiki/Calligraphy

Cartoon network: https://www.cartoonnetwork.com

Chobots: https://www.google.com/search?sa=G&hl=en-RW&q=chobots&ved=0ahUKEwjr77K2zf3cAhVIvxoKHbPACAIQvQ4IigA

Examples of Reflection Questions based on the "What? So What? Now What?" Model: https://www.hilbert.edu

"The What," "The How," And "The Why" Of Native App Preloads ...: https://www.digitalturbine.com

English Learning Made Easy- Strategies and Approaches: https://www.amazon.com/English-Learning-Easy-Strategies

Graphic design: https://www.google.com/search?sa=G&hl=en-RW&q=graphic+design&ved=0ahUKEwidv96N0P3cAhVFUxoKHeS_AWcQvQ4IJSgD

Habits of mind metacognition: https://www.google.com/search?sa=G&hl=en-RW&q=habits+of+mind+metacognition&ved=0ahUKEwjp8vXBzP3cAhUGNhoKHSWuC1gQvQ4IJigE

Label: https://www.google.com/search?sa=G&hl=en-RW&q=label&ved=0ahUKEwj4mtb9zf3cAhXEy4UKHdoGBP0QvQ4IigA

Learning experience: https://www.google.com/search?sa=G&hl=en-RW&q=learning+experience&ved=0ahUKEwjZtaakzv3cAhUQHxoKHUU6DxEQvQ4IigA

Mathematics of general relativity: https://www.google.com/search?sa=G&hl=en-RW&q=mathematics+of+general+relativity&ved=0ahUKEwj56pKqz_3cAhWJ4YUKHfl-C7AQvQ4IJigE

Math heart: https://www.google.com/search?sa=G&hl=en-RW&q=mathematics+of+general+relativity&ved=0ahUKEwj56pKqz_3cAhWJ4YUKHfl-C7AQvQ4IJigE

Maira name: https://www.google.com/search?sa=G&hl=en-RW&q=maira+name&ved=0ahUKEwi49bvBzv3cAhVNx4UKHTXqAxAQvQ4IJigE

***Meta cognitive*:** https://www.google.com/search?sa=G&hl=en-RW&q=meta+cognitive&tbm

My learnings: https://www.google.com/search?sa=G&hl=en-RW&q=maira+name&ved=0ahUKEwi49bvBzv3cAhVNx4UKHTXqAxAQvQ4IJigE

My little pony trixie gifs: https://www.google.com/search?sa=G&hl=en-RW&q=my+little+pony+trixie+gifs&ved=0ahUKEwjd2_7jz_3cAhUPLBoKHR74DloQvQ4IJigE

Organizatoinal develpment: https://www.google.com/search?sa=G&hl=en-RW&q=organizatoinal+develpment&ved=0ahUKEwiKuIDizf3cAhWS4IUKHWD0CwEQvQ4IJigE

Teamwork Clip Art: https://www.gograph.com/vector-clip-art/teamwork.htm:

Vormingplus: https://www.google.com/search?sa=G&hl=en-RW&q=vormingplus&ved=0ahUKEwipnqGGz_3cAhUQ1RoKHYXHBnoQvQ4IJygF