Universitetet i Stavanger

DET HUMANISTISKE FAKULTET

MASTEROPPGAVE

Studieprogram: Utdanningsvitenskap - matematikkdidaktikk	Vårsemesteret, 2017 Åpen/~~konfidensiell~~
Forfatter: David Andreas Swan	……………………………………… (signatur forfatter)
Veileder: Arne Jakobsen	
Tittel på masteroppgaven: En undersøkelse av malawiske skolebarns holdninger til matematikk Engelsk tittel: An investigation of Malawian schoolchildren's attitudes towards mathematics	
Emneord: - Holdninger til matematikk - Holdningsfaktorer - Malawisk skolekontekst - Matematikkdidaktikk - Matematikkundervisning	Antall ord: 26911 + vedlegg/annet: 2258 Stavanger, 12. juni 2017

Preface

The study of educational science, focusing particularly on mathematics didactics, has taught me a whole lot that I look forward to applying to my work as a teacher. Though the study has felt rough on occasions, I am grateful for my mistakes and the challenges I have met. My mistakes have given me the opportunity of learning, and without the challenges I would not have learned anything. My curiosity and engagement in mathematics have motivated me through my studies and while writing my master's thesis. For my thesis, I wanted to study something close to my heart. I sought a deeper understanding of why some students are very eager to learn mathematics, while others detest the subject. I therefore decided to study students' attitudes towards mathematics. When I received the opportunity, I decided to study attitudes towards mathematics in a Malawian context.

Although not designed as a comparative study, the study has taught me a lot regarding differences and similarities in attitudes towards mathematics in different contexts. I believe that what I have acquired through my research in Malawi will be valuable for me in my future work. I also believe that I will continue to learn for as long as I live, and I look forward to pass on to others what I have learned and to learn from other peoples' experiences. I would love to continue with my research on attitudes towards mathematics in the near future, and I hope to visit Malawi again and discuss my findings with local teachers and professors.

Completing this master's degree would not have been possible had it not been for the tremendous help I have received along the way. Raymond Bjuland, Reidar Mosvold and Cato Tveit deserve a special thanks for making my studies interesting and relevant to my work. You have shown me many of the great pleasures of teaching mathematics, and I look forward to passing on my positive attitudes towards the subject. To Arne Jakobsen, who has guided me through the work with this study, thank you very much for the great support, guidance and good advice along the way. To Mercy Kazima, thank you very much for your kind guidance and accommodation for me to study in Malawi. To my fellow "mzungu", Stine Rusten, thank you very much for an enjoyable and memorable trip to Malawi. To my parents, Astrid and Brian Swan, thank you very much for your constant support and help through my studies, and thank you for proofreading my thesis. Finally, I would like to thank my beautiful wife, Ane Swan, for believing in me and never giving up on me. I could not have done this without you.

David Andreas Swan

Stavanger, June 12th 2017

Abstract

This study investigated Malawian schoolchildren's attitudes towards mathematics. The following research questions were investigated in a Malawian context:

1. Which factors affect children's attitudes towards mathematics in Malawi?
2. To what extent can the factors *gender*, *age* and *grade/standard* be used to generalize claims regarding students' attitudes towards mathematics in Malawi?
3. How can teachers in Malawi facilitate various motivational factors in their mathematics teaching?

This study viewed how different attitudes appear and how attitudes can affect learning outcomes. With a purpose of understanding attitudinal factors and how teachers can facilitate positive attitudes towards mathematics, this study investigated students' attitudes towards mathematics in relation to their self-concept in mathematics, how they valued the subject of mathematics, how they enjoyed the subject of mathematics, and how their motivation towards the subject of mathematics was. By investigating differences in attitude in relation to gender, age and grade/standard, the research brought forward possible reasons for students' differing attitudes towards mathematics. Students across grade/standard five, six, seven and eight at an urban school in Malawi participated in the study (N = 403). With a cross-sectional design, this study used a quantitative- and a qualitative approach. A questionnaire measuring students' attitudes towards mathematics was used in accordance with an open ended question survey, interviews of the mathematics teachers, and observation of classroom lessons. Results revealed several factors affecting children's attitudes towards mathematics. Gender was found not to affect students' attitudes towards the subject, and age appeared to have a negative correlation with students' enjoyment of mathematics. There were little statistically significant differences in the mean scores across the standards, but students labelled as "gifted" and "not gifted" revealed highly differing attitudes towards mathematics.

Sammendrag (Norwegian abstract)

Denne studien undersøkte malawiske skolebarns holdninger til matematikk. Følgende forskningsspørsmål ble undersøkt i en malawisk kontekst:

1. Hvilke faktorer påvirker elevers holdninger til matematikk i Malawi?
2. Til hvilken grad kan faktorene *kjønn*, *alder* og *klassetrinn* bli brukt for å generalisere påstander omkring elevers holdninger til matematikk i Malawi?
3. Hvordan tilrettelegger Malawiske lærere for ulike motivasjonsfaktorer i matematikk?

Denne studien analyserte hvordan holdninger fremtrer og hvordan holdninger kan påvirke læringsutbytte. Med en hensikt om å forstå holdningsfaktorer og hvordan lærere kan tilrettelegge for positive holdninger i matematikk, undersøkte denne studien elevers holdninger til matematikk i relasjon til elevenes selvbilde i matematikk, hvordan de verdsetter matematikkfaget, hvordan de liker faget, og hvordan deres motivasjon til faget er. Ved å undersøke forskjeller i holdninger i forbindelse med kjønn, alder og klassetrinn foreslo denne undersøkelsen mulige årsaker til elevers ulike holdninger til matematikk. Elever i femte, sjette, sjuende og åttende klasse i en byskole i Malawi deltok i undersøkelsen (N = 403). Gjennom en tverrsnittsundersøkelse benyttet studien en kvantitativ- og en kvalitativ fremgangsmåte. Et spørreskjema for å måle elevers holdninger til matematikk ble benyttet sammen med et spørreskjema med åpne svar, intervju av matematikklærere og observasjoner i matematikktimer. Resultatene viste at flere ulike faktorer påvirker elevers holdninger til matematikk. Kjønn viste seg å ikke påvirke elevenes holdninger, og alder så ut til å ha en negativ sammenheng med hvordan elevene likte matematikkfaget. Det var få statistisk signifikante forskjeller i elevenes gjennomsnittscorer på tvers av klassetrinnene, men elever kategorisert som «begavede» og «ikke-begavede» viste store forskjeller i holdninger til matematikk.

Contents

List of tables

List of figures

List of abbreviations

ATMI	attitude towards mathematics inventory
ATT	attitude as a whole
SC	self-confidence
ENJ	enjoyment of mathematics
LMIC	low and middle-income countries
MODE	motivation and opportunity as determinants of behaviour
MOT	motivation towards mathematics
Norad	Norwegian agency for development cooperation
NORHED	Norwegian programme for capacity development in higher education and research for development
NSD	Norwegian centre for research data (norsk senter for forskningsdata)
PATM	positive attitudes towards mathematics
SACMEQ	the Southern and Eastern Africa consortium for monitoring education quality
SCM	self-concept in mathematics
Std.	standard (grade/form)
TIMSS	trends in international mathematics and science study
UiS	University of Stavanger
UNIMA	University of Malawi
VAL	value of mathematics

1. Introduction

This study investigates schoolchildren's attitudes towards mathematics in a Malawian context. The study looks at how different attitudes appear, and the study also discusses how attitudes can affect learning outcomes. The present chapter gives the background for why the topic of attitudes towards mathematics was selected for research, and the chapter outlines the intended audience for the study. The chapter further presents the purpose of the study along with the research questions. Finally, the chapter introduces the structure of and limitations to the thesis.

This research is rendered possible by two projects linking the University of Stavanger (UiS) and the University of Malawi (UNIMA). Through the Norwegian agency for development cooperation (Norad), UiS participates in a programme that aims to

> (…) strengthen capacity of higher education institutions in Low and Middle-Income Countries (LMIC) to educate more and better qualified candidates, and to increase quality and quantity of research conducted by the countries' own researchers (Norad, n.d.).

According to the UiS's home page (Torheim, 2017), the UiS continues to receive project funding together with the UNIMA. The projects are run and funded through the Norwegian programme for capacity development in higher education and research for development (NORHED). The UiS and the UNIMA currently work together on the two projects "Improving quality and capacity of mathematics teacher education in Malawi" and "Strengthening numeracy in early years primary education through professional development of teachers".

1.1 Rationale behind the topic

Studies point to the importance of generating positive attitudes towards mathematics in school (Tapia, 1996; Mullis et al., 2001; Lim & Chapman, 2013). Zan, Brown, Evans and Hannula (2006) propose that understanding the relation between cognition and affect is immensely important in the research on attitudes towards mathematics. They proclaim that "attitude toward mathematics is related to achievement, and affective outcomes (such as liking mathematics)" (Zan, Brown, Evans, & Hannula, 2006, p. 113). Tapia (1996) underlines the importance of positive attitudes in mathematics and points to how attitudes affect students' participation and achievement in mathematics.

Lim and Chapman (2013) point to several studies (Anttonen, 1969; Atkinson & Raynor, 1974; Ball, 1977; Bouchey & Harter, 2005; Fiore, 1999; Minato, 1983; Minato & Yanase, 1984; Samuelsson & Granstrom, 2007) that show strong connections between achievement in mathematics and different factors of attitudes. These factors include "enjoyment of mathematics; motivation to do mathematics; self-confidence in mathematics; and perceived mathematics achievement" (Lim & Chapman, 2013, p. 146). The mathematics benchmarking report from Trends in International Mathematics and Science Study (TIMSS) 1999, emphasises that an important goal of mathematics education is to generate positive attitudes towards mathematics (Mullis et al., 2001, p. 134). As Lim and Chapman (2013) point out, attitudes towards mathematics may have many implications for children's future. Students who finish primary school (and those who progress even further) are reported to have an economical advantage over dropouts. Absenteeism is just one of the many reasons why studying attitudes is important.

There appears to be a research gap on attitudes towards mathematics in developing countries. Research on attitudes towards mathematics is predominantly conducted in developed countries, but attitudes are arguably equally important regardless of countries' economic status. Google trends (2017) shows that the five countries that search most frequently for the term "attitudes" on Google are in fact LMIC. Three of these countries (Ghana, Kenya and Nigeria) are found in Africa (Google, 2017), and there is therefore reason to believe that research on attitudes in Malawi can be a positive contribution to the research on attitudes towards mathematics.

Reflection upon my own personal experience with mathematics has led me to further inquire into how attitudes towards mathematics can affect learning outcomes. During teacher training at the UiS, the subject of attitudes is discussed to some extent, but not in a Malawian context. Studying this subject in a new context may give insight into innovative ways of thinking about attitudes. In addition, research in a school context highly different from what one is used to gives room for a wider reflection upon one's own teaching.

I have personally noticed how changes in my attitudes towards the subject of mathematics have influenced my mathematical results. As a teacher, I wish to be able to motivate my students so that they develop a genuine wish of achieving good results in the subject of mathematics.

Further, I want the students to develop positive attitudes so that they themselves believe that they can take on mathematical tasks and that they enjoy doing so. In order to lay a foundation for positive attitudes towards mathematics, I must first understand which elements are important in influencing the students' attitudes.

When I learned about the NORHED projects at the UiS and the possibility of doing field research in Malawi, I quickly became interested. The idea of conducting research in an unfamiliar context appealed strongly to me. With great motivation for studying attitudes towards mathematics in a different context, I therefore decided to take advantage of this opportunity and conduct my research in Malawi. The combination of my personal interest in attitudes towards mathematics and the opportunity of studying this in a different context led me to the start of investigating schoolchildren's attitudes towards mathematics. I further decided to look at what the attitudes are and attitudes can affect learning outcomes.

1.2 Audience

This research primarily targets mathematics teachers. Although the main audience is teachers who teach mathematics, teachers who teach other subjects might also find this research interesting. The thesis should be an interesting read for teachers in Malawi and in less-developed countries, but also for teachers in the western world. Anyone who wants to gain more knowledge on attitudes towards mathematics and/or attitudes in general might profit by reading this study. This thesis is written in English rather than in Norwegian as an attempt to reach a wider audience.

1.3 Purpose and research questions

The purpose of this thesis is to give teachers in less-developed countries (and those specified in the target group above) an insight into students' attitudes towards mathematics in a Malawian context. The study aims to see if the factors *gender*, *age* and *grade/standard* are factors that allow for generalization of claims regarding students' attitudes towards mathematics. In addition, the study will consider how Malawian teachers allow for students' various motivational factors by viewing how the teachers plan for and organize their classroom lessons. Although a great amount of research has been done on the topic of attitudes towards mathematics, less research has been done in less developed countries, as explained in the rationale. To properly understand the research context, a separate chapter on the Malawian context is added to the theoretical framework.

This research is designed as a supplement to the existing research on attitudes towards mathematics. By looking at how students perceive the subject of mathematics in a different culture, this study aims to contribute with original research. Hopefully, the research can contribute to further research on the subject in less developed countries. As the socioeconomics are completely different in Malawi from the western world, it might be interesting to investigate attitudes considering the country's socioeconomics. Perhaps the socioeconomic information can hold some explanations to students' attitudes and how attitudes are affected by society and economics. Keeping the socioeconomic status in mind while investigating attitudes might also help understand why teachers and students act in the way they do.

In the investigation of schoolchildren's attitudes towards mathematics in the Malawian context, the following research questions are addressed:

1. Which factors affect children's attitudes towards mathematics in Malawi?
2. To what extent can the factors *gender*, *age* and *grade/standard* be used to generalize claims regarding students' attitudes towards mathematics in Malawi?
3. How can teachers in Malawi facilitate various motivational factors in their mathematics teaching?

1.4 Limitations of the study

The study is limited by numerous factors. The study is limited to investigating attitudes towards mathematics. A cross-sectional design is selected, as there is limited/no chance of recording changes in attitude over time in this study. Since recording change in attitude must be done in a longer time span, change in attitude has not been recorded in this study. In a later study, it would however be interesting to investigate whether there is a change in attitude towards mathematics over time.

Another factor limiting the study is the physical aspects covered. The research is limited to a Malawian context, and thus limits the scope of the investigation to be about attitudes in Malawi. As the study only takes place in a certain district within Malawi, in a specific school, the thesis is limited to studying one school. As only one school is studied, the information gathered is limited to the school in question, and generalization to other schools in Malawi cannot be done. Although the study cannot be generalized for all of Malawi or in a Norwegian context, it can nonetheless be considered a contribution to the field of research on attitudes towards mathematics.

The sample of students selected for the study is limited to students in grade/standard five to eight as all lessons are taught in English from grade/standard five. The sample of teachers selected for the study is limited to those who teach mathematics. In a later study, it would be interesting to research the perceptions on attitudes from teachers who teach different subjects than mathematics. It would also be interesting to compare the Malawian sample to a Norwegian sample, but comparing people across diverse cultures has its difficulties and would be too comprehensive for this study.

1.5 Thesis structure

This thesis is structured into several chapters dealing with various aspects of the research. Firstly, the theoretical framework is laid out. In the chapter dealing with the theoretical framework (chapter 2), necessary background theory and definitions are explained to clarify important concepts used in the thesis. Secondly, the methodological approach is thoroughly explained (chapter 3). Proceeding from the methodology, findings from the study are presented (chapter 4). The findings are then analysed and discussed in a separate chapter (chapter 5). Finally, a concluding chapter sums up and presents the most important findings from the research (chapter 6). The very last chapters include references (chapter 7) and appendices (chapter 8).

2. Theoretical framework

This chapter takes a closer look at the theoretical foundation of the study. In addition to clarifying definitions of important concepts, this chapter outlines important theory regarding attitudes towards mathematics and it introduces an instrument used to measure attitudes towards mathematics. The framework sheds light on theory from previous studies on attitudes, although most this research is carried out in developed countries. The cultural contexts of the studies are discussed, and they are compared to that of the Malawian context. Furthermore, theory of Malawi and its socioeconomics is presented to properly understand the Malawian context of the research.

2.1 Attitudes

Numerous definitions of the term *attitude* exist, and different research often use various descriptions of the term. The descriptions often vary in the level of detail. According to Perloff (2010), attitude is a psychological construct which "is both a mental and emotional entity that inheres in, or characterizes a person" (p. 42). That implies that attitudes describe how people perceive things, and how they might act, with background in emotional and mental experiences. Perloff defines attitude as "a learned, global evaluation of an object (person, place or issue) that influences thought and action" (Perloff, 2010, p. 43). In this case, the attitude is the students' "learned, global evaluation of" mathematics, which influences how the students perceive mathematics through thoughts and actions. Perloff further argues that attitudes steer people's behaviour towards predictable outcomes, although not necessarily rationally (Perloff, 2010). Therefore, by understanding the attitude of students, one might be able to anticipate how the majority of students might act, although some students are likely to deviate from the majority.

2.2 Models of attitudes

Several models are developed to better comprehend the concept of attitude and its various factors ("e.g., enjoyment of mathematics; motivation to do mathematics; self-confidence in mathematics; and perceived value of mathematics" (Lim & Chapman, 2013, p. 146)). In this case, two models dealing with attitude are presented. One model suggests certain factors (sometimes referred to as components in the literature) of attitudes and how they influence change in attitudes. This model is referred to as the multicomponent model of attitude. Further, a model for motivation and opportunity as determinants of behaviour (MODE), is presented.

2.2.1 Multicomponent model of attitudes

The multicomponent model of attitudes (Zanna & Rempel, 1988) suggests that three components affect the development of attitudes. Attitudes are considered as evaluations of objects that contain these three components. These components are referred to as the cognitive, affective and behavioural components of attitudes (Haddock & Maio, 2012, pp. 174-178). Haddock and Maio (2016) describe these three components and how they affect the development of attitudes. Figure 1 illustrates the three components of information that form the bases of attitudes. The evaluation of objects containing cognitive, affective and behavioural information is considered the foundation of attitudes.

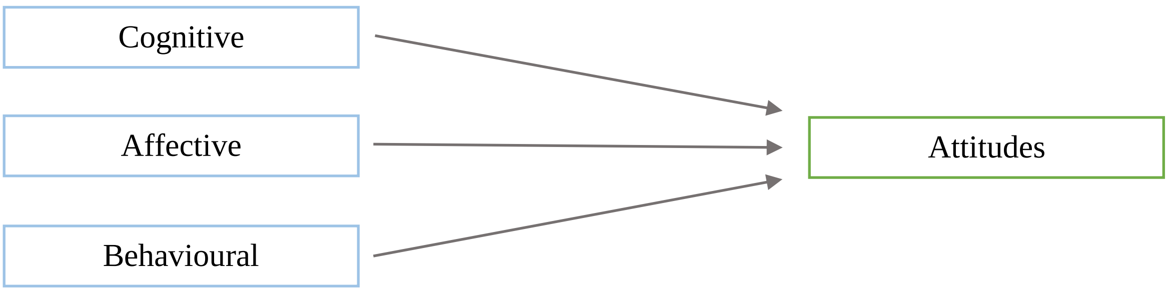

Figure 1: The multicomponent of attitude (Haddock & Maio, 2012, p. 174)

According to Haddock and Maio (2016), the *cognitive* component denotes the mental action of a person, i.e. peoples' beliefs, their thoughts and what they associate with an attitude object. In relation to this, it might be good for a teacher to map students' beliefs, associations and experiences of certain objects. In this way, they can prepare for how to meet the students' attitudes.

The *affective* component refers to peoples' emotions/feelings towards a certain attitude object, i.e. whether they like/dislike something, and to what extent (Haddock & Maio, 2012). Haddock and Maio (2016) present two ways in which attitudes may be influenced through affect. The first way is the "Evaluative conditioning" in which one repeatedly pairs a stimulus with a positive/negative contrasting stimulus. By contrasting the stimuli, the original liking (the affective information) often changes, and thereby the attitudes change. Thus, by contrasting stimulus, the teachers might be able to affect the students' liking of mathematics. The second way of influencing the affective component of attitudes is the "mere exposure effect". By simply increasing the exposure of an object, this effect is supposed to increase the liking for an object. This does not necessarily mean that more exposure to mathematics is the way to go, but that people may react positively to repetition and familiar objects. In addition, teachers should be aware when introducing new, unfamiliar objects. While introducing new and unfamiliar objects, teachers need to consider students' attitudes. Ideally, the teachers should draw parallels between new and existing information (Haddock & Maio, 2012).

The *behavioural* component denotes how people's attitudes are influenced by past behaviours (Haddock & Maio, 2012). This component might serve as an antecedent of attitudes. A persons' past behaviour might explain/steer the attitudes of a person simply based on previous experience/associations. The "self-perception theory" assumes that if one's inner states are equivocal, one may understand them by perceiving one's own behaviour. If one simply believes that one has a certain behaviour, this might be enough to shape one's attitudes. This could be an interesting factor regarding how teachers influence students' behaviour. If the teachers lead the students to believe that the students have a certain behaviour, the teachers might affect the students' behaviour in a positive direction (Haddock & Maio, 2012).

2.2.2 The MODE-model

Haddock and Maio (2016) present Fazio's (1990) "motivation and opportunity as determinants of behaviour" (MODE)-model (p. 195-199). The model is designed to describe how attitudes predict behaviour (Fazio, 1990; Haddock & Maio, 2012). If teachers can predict how students will behave based on the attitudes of the students, teachers might facilitate learning. If the teachers know how the students will behave, it should be easier to plan the teaching lessons.

The MODE-model describes how both motivation and opportunity may determine a person's behaviour (Fazio, 1990). Baumeister and Vohs (2007) give brief explanations of opportunity and motivation regarding the MODE-model. The opportunity factor includes the time, energy and ability of overcoming the influence of one's attitudes (Baumeister & Vohs, 2007). Based on a person's opportunities, a person might behave in a different manner from what their attitudes might imply. In a broad sense, the motivational factor refers to "any effortful desire one might have to behave in a certain way or reach a certain conclusion" (Baumeister & Vohs, 2007, p. 584). Motivation is further explained in the next chapter (chapter 2.3).

Strong attitudes often steer behaviour, but motivation and opportunity might result in different behavioural outcomes. The attitudes might direct people in a certain behavioural direction. Strong attitudes might steer people in positive directions and away from negative situations, that is, positive/negative directions for the person holding the attitudes. When both motivation and opportunities are present, the individual might behave in different manners. The actions of an individual are based on deliberate consideration of the information available. Both motivation and opportunity must be considered before deciding one's course of action.

The MODE-model can be used when analysing students' behavioural patterns concerning their attitudes, preferably in a combination with the multicomponent model of attitudes. As an example, a student might dislike mathematics so that he is not particularly motivated to do their homework. Still, his opportunities might lead him to do his homework regardless. His motivation towards the mathematics might be low, but other motivational factors (see chapter 2.3.1 regarding intrinsic/extrinsic motivation) might cause him/her to disregard his attitudes towards mathematics. For the behaviour not to be a direct result of one's attitude, opportunity must be present. Thus, teachers' facilitation of good opportunities and incentives (for the students) is important.

Haddock and Maio (2016) sum up the MODE-model as "a model of attitude-behaviour relations in which motivation and opportunity are necessary to make a deliberative consideration of available information" (p. 198).

2.3 Motivation

Motivation is presumably one of the major factors influencing the attitudes of students, and together with opportunities, it lays the foundation of students' behaviour. Motivation is distinguished between intrinsic and extrinsic motivation (explained in 2.3.1). This chapter briefly presents research on a combination of "motivation, affective constructs and students' achievement" (chapter 2.3.2), and the concepts "self-regulation" (chapter 2.3.3) and self-efficacy (chapter 2.3.4).

2.3.1 Intrinsic vs. extrinsic motivation

Intrinsic motivation is distinguished from extrinsic motivation in the ways people are motivated. Intrinsic and extrinsic motivation are sometimes referred to as inner and outer motivation, corresponding to the source of motivation. Intrinsic/inner motivation comes from a person's interest in the matter, their enjoyment in relation to the matter and their challenge associated with it. Activities performed on grounds of intrinsic motivation are said to be done "for the sake of the activity itself – for the fun of it" (Morf & Koole, 2012, p. 126). Intrinsically motivated behaviour requires no external rewards, as opposed to extrinsic motivation. Morf and Koole (2012) debate that external rewards, such as economic incentives/rewards, are more likely to diminish peoples' intrinsic motivation.

Extrinsic/outer motivation is the opposite of intrinsic/inner motivation. It can be described as the desire of rewards. Extrinsic motivation is based on praise, esteem or economic reasons. Activities performed on the grounds of extrinsic motivation are said to be done "as means to an end – in order to obtain tangible rewards or to avoid punishment" (Morf & Koole, 2012, p. 126).

2.3.2 Motivation, affective constructs and students' achievement

Pantziara and Philippou (2015) studied reasons for and consequences of students' motivation in mathematics. In their research, they applied achievement goal theory (Elliot, 1999) in order to investigate whether there is a model which can represent the relationship between motivation, other affective constructs and students' achievement in mathematics. Using structural equation modelling, Pantziara and Philippou investigated correlation between affective constructs, motivation and to what extent these influence students' achievement and interest in mathematics. They found that students' achievement and interest in mathematics is influenced by fear of failure, self-efficacy beliefs and achievement goals (Pantziara & Philippou, 2015).

2.3.3 Self-regulation

The concept of self-regulation is important regarding motivation and opportunities. To control one's fear of failure, achievement goals and self-efficacy, self-regulation is important. High self-regulated learning can increase students' interest and thereby their achievement in mathematics. Morf and Koole (2012) describe self-regulation as the procedure one performs to control and guide one's behaviour (p. 159). Self-regulation is a "control 'of the self by the self" and it is important for achieving one's "desired thoughts, feelings and goals" (Morf & Koole, 2012, p. 159). Personal goal orientation is important for a person not to be swayed blindly by his emotions. Self-regulation is important in decision-making, and teachers can affect students' self-regulation through different incentives. The way in which teachers motivate the students, intrinsically and extrinsically, is important.

Through Hannula's characterization of self-regulation, one may observe several control systems that teachers can focus on when trying to guide students' self-regulation in a positive direction (Hannula, 2006). Hannula (2006) characterizes self-regulation as "a system concept that refers to the overall management of one's behaviour through interactive processes between these different control systems (attention, metacognition, motivation, emotion, action, and volition control)" (p. 168). Boekarts (1999) presents a tree-layer model for self-regulated learning (Figure 2), based on research on "learning styles", "metacognition and regulation styles" and "theories of the self, including goal-directed behaviour" (p. 447). When analysing students' motivation and their behaviour, teachers can consider Boekarts' model. To boost self-regulated learning, the learning environment should allow for regulation of the self, the learning process itself as well as regulation of processing modes. Optimally, the students should have their choice of resources and a wide range of goals. The students should be able to set their own goals, and not feel like they are being indoctrinated. The teachers should facilitate use of metacognitive knowledge and different methods of learning. In this way, students should individually be able to regulate their use of cognitive strategies.

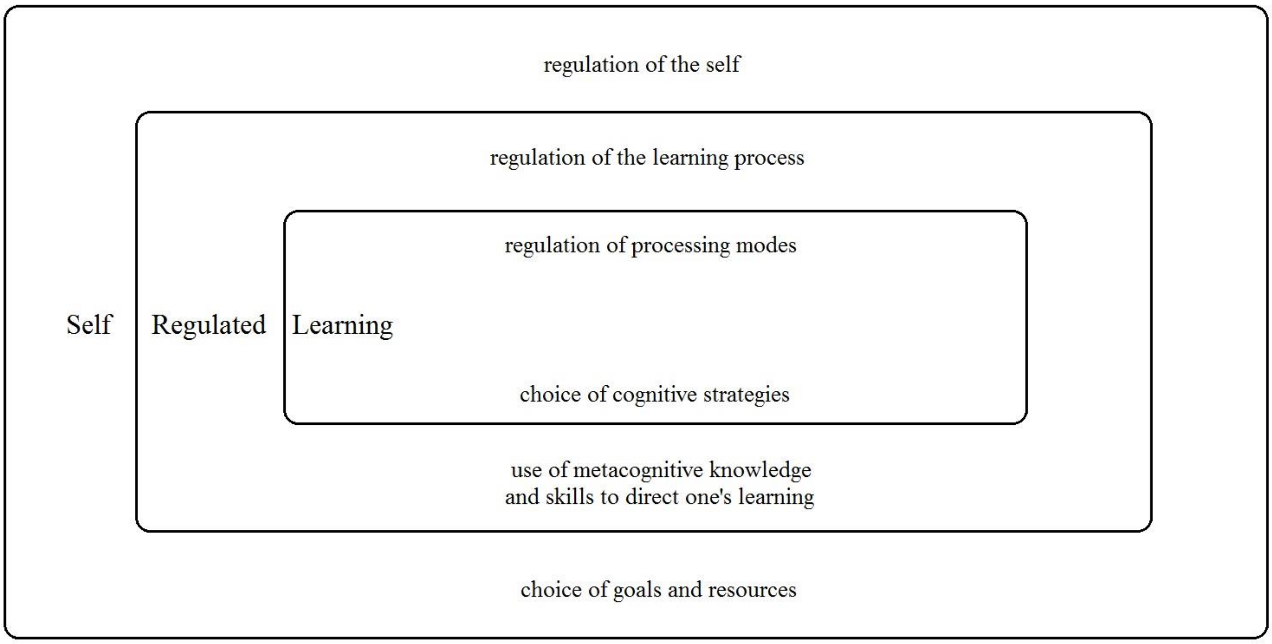

Figure 2: Three layer-model of self-regulated learning, with a slightly modified design. (Boekaerts, 1999, p. 449)

2.3.4 Self-efficacy

Self-efficacy is one of the most important factor for students' performance and interest in mathematics (Pantziara & Philippou, 2015). Closely linked to the self-regulation, self-efficacy is, according to Bandura, 1997, "when students believe that they can do well in the educational settings, they feel confident, tend to try hard, persist more, and perform better" (as cited in Pantziara & Philippou, 2015). In other words, a strong self-efficacy in mathematics will influence a student's attitude so that he strives to perform well in the subject. Teachers can facilitate strong self-efficacy beliefs by encouraging their students and by giving them praises. As Haddock and Maio (2016) outline, the beliefs hold potential to "carry out certain actions required to attain a specific goal (e.g. that one is capable of following a diet, or to help someone)" (p. 196).

Over time, interest for students' self-efficacy has prompted many researchers to investigate the factor in relation to attitudes and performance. In a study published in 1990, Pintrich and De Groot discovered that self-efficacy and intrinsic value has a positive coherence with cognitive engagement and performance (Pintrich & De Groot, 1990). Pintrich and De Groot discuss how differences in motivation can influence cognitive participation and self-regulation in the classroom. Analysis revealed that the best predictors of performance includes self-regulation, self-efficacy and test-anxiety. The research also found that intrinsic value does not have a direct impact on the students' performance, but it is strongly related to self-regulation and cognitive strategy use, regardless of the students' prior performance (Pintrich & De Groot, 1990).

2.4 Self-concept in mathematics (SCM)

The self-regulation and self-efficacy intertwine and form the self-concept. TIMSS 1999 Mathematical Benchmarking Report (Mullis et al., 2001) gives an international perspective on the students' selves and their attitudes towards mathematics. In the TIMSS-report, Mullis et al. (2001) investigated how eighth-grade students across various countries perceive their competence in mathematics. TIMSS 1999 composed an index handling students' *Self-concept in mathematics*, SCM. The students answered five statements relating to their perception of their own ability to do mathematics. Mullis et al. (2001) went on to compare the students' SCM with their results in the subject.

The results from TIMSS 1999 Mathematical Benchmarking report do not include LMIC such as Malawi, but the results are expected to be similar in some ways. However, understanding the background of the students in the study is important. As the research of this study is a cross-sectional design, comparing attitudes with students' performance would be too extensive. It is however interesting to observe results from other studies in this context. The research presented by Mullis et al. indicated a clear correlation between students SCM and their achievement in mathematics. The study also revealed similarities and dissimilarities across developed countries.

The TIMSS-study of 1999 revealed that for some countries where the mathematical results were generally above average, fewer students score in the category with the highest SCM (Mullis et al., 2001). Mullis et al. (2001) explain that cultural traditions of modesty are likely to be the underlying factor. The research in Malawi is likely to encounter cultural variance, which in turn would influence the data. The TIMSS-study revealed that there were only a few significant cases where girls and boys scored differently (Mullis et al., 2001).

2.5 Positive attitudes towards mathematics (PATM)

In addition to the SCM-index, TIMSS 1999 developed an index to map students' *positive attitudes towards mathematics* (PATM) across all participating countries (Mullis et al., 2001). Students were asked to respond to each of the following items "I like mathematics", "I enjoy learning mathematics", "mathematics is boring", "mathematics is important to everyone's life" and "I would like a job that involved using mathematics" (Mullis et al., 2001, p. 134). The students answered in a Likert scale format with options ranging from strongly positive to strongly negative. The research showed a clear connection between the students PATM and their performance in mathematics. However, they did not find a clear distinction between girls and boys in relation to their PATM and their results. Despite the missing link between gender, PATM and students' results in TIMSS 1999, this study will seek to understand if the same condition applies to the Malawian case.

2.6 Attitudes toward mathematics inventory (ATMI)

Several scales and instruments to measure attitudes towards mathematics exist. The Fennema-Sherman mathematics attitudes scales (Fennema & Sherman, 1976) has long been regarded as the most popular instrument to measure attitudes towards mathematics. Due to its age and the fact that this scale consisted of 108 items and took approximately 45 minutes to complete, Tapia decided to develop her own instrument to measure attitudes towards mathematics (Tapia, 1996). She developed the *attitudes toward mathematics inventory* (ATMI) instrument as she wanted a shorter instrument with a direct factor structure. Tapia based her instrument on previous research and investigated the links between *confidence, anxiety, value, enjoyment, motivation* and *parent/teacher expectations*. The ATMI has become a popular instrument, and is used in multiple studies (Lim & Chapman, 2013; Tapia, 1996; Tapia & Marsh, 2004).

According to Tapia and Marsh (2004), the *confidence* aspect is intended to measure the confidence of students alongside how they perceive their own mathematical performance. The aspect of *anxiety* is intended to measure how students experience anxiousness and the following consequences of these experiences regarding mathematics. *Value* is supposed to measure how students perceive the practicality, significance and value of mathematics, now and in the future. The enjoyment aspect is intended to measure the extent of how students appreciate mathematics. The aspect of motivation is supposed to measure students' interest in mathematics. Finally, the aspect of *parent/teacher expectation* was omitted due to a low item-to-total correlation. The aspect was supposed to measure how beliefs and expectations of parents and teachers affected the attitude of the students, but due to the low item-to-total correlation, Tapia and Marsh decided to remove this aspect from the ATMI. Although the factor was omitted, research suggests that parents affect students' attitude.

The ATMI-instrument measures four factors that influence students' attitudes towards mathematics. The ATMI is designed in a Likert-scale format ranging from one to five. The options contained are "strongly disagree", "disagree", "neutral", "agree" and "strongly agree". Comprised of 40 statements, sometimes referred to as *items* in the literature, the ATMI deals with students' self-confidence (SC), how students value the nature of mathematics (VAL), how they enjoy mathematics (ENJ) and their motivation regarding work with mathematics (MOT).

The ATMI originally consisted of 49 items, but the version of the instrument used in this study was reduced to 40 items. To ensure internal consistency, the items with item-to-total correlations below .50 were deleted. Thus, Tapia and Marsh were left with a shortened ATMI with 40 items that all contributed significantly. The test items were homogenous and indicated that they measured a common feature. In the coding and analysis, eleven items with negative wording were reversed. As some items were worded positively and some negatively, the reversal was necessary. The comprised items/statements for each factor are displayed in Table 1. The item numbers correspond to the number in the ATMI (appendix 1).

Factor	Number of items in the ATMI	Items in the ATMI
VAL	10	1, 2, 4, 5, 6, 7, 8, 35, 36, 39
ENJ	10	3, 24, 25, 26, 27, 29, 30, 31, 37, 38
MOT	5	23, 28, 32, 33, 34
SC	15	9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 40

Table 1: Comprised items/statements for the factors VAL, ENJ, MOT and SC

The ATMI was selected because it could easily be applied in the Malawian case, and because of its brevity and high validity/reliability. Tapia and Marsh argue that the ATMI "may be an efficient and effective research tool to assess factors that influence expectations and performance in math because of its content validity, reliable factor scores, test-retest reliability, and brevity" (Tapia & Marsh, 2004, p. 20). They further state that personal beliefs determine students' success or failure in mathematical performance. Tapia and Marsh argue that students' self-concepts steer their effort in mathematics, regardless of how a subject is being taught. The ATMI seeks to reveal students' beliefs, and register "the importance they attach to mathematics, enjoyment of the subject matter, and the motivation to succeed" (Tapia & Marsh, 2004, p. 20).

2.7 Cultural context

Stigler and Hiebert (1999) define teaching as a cultural activity. Together, they collect "the best ideas from the world's teachers for improving education in the classroom" (Stigler & Hiebert, 1999, p. v). They argue that teaching is contextually dependent, although good concepts for teaching can be transferred to teaching in other cultural contexts. The theory in this chapter all comes from western studies, but the general ideas can still be applied to this study. However, when comparing studies and applying existing theory into action in a new context, one must take careful consideration. It is therefore essential that one tries to understand the research on attitudes towards mathematics in the right (Malawian) context.

Differences across countries contain cultural differences, as well as differences in socioeconomics, demographics, language and much more. The TIMSS 1999 Mathematical Benchmarking Report states that “there is no shortage of evidence that students from homes with extensive educational resources have higher achievement in mathematics and other subjects than those from less advantaged backgrounds” (Mullis et al., 2001, p. 109). As Malawi is one of the LMIC, Malawian students generally have a lot less resources than those in the various cultural contexts of the TIMSS study for instance. Since resources affect students’ achievement, it is also bound to affect the students’ attitudes. This can shape the students’ attitudes, both positively and negatively. As an example, resources might have a negative impact on students relying too much on their parents’ economy. The students with extensive resources might be too comfortable in their current situation, so that they do not see the need of education and obtaining jobs. Positively, students with little/no resources might be extrinsically motivated as they see the need of progressing in the school system and obtaining jobs.

Analysing attitudes towards mathematics in diverse cultural contexts gives an insight into different perspectives on matters such as motivation, teaching and learning. Positive aspects from these perspectives might be transferred into one’s own teaching. Reflection upon one’s own cultural context compared to that of others might result in valuable insight into one’s own learning. Therefore, the study in Malawi should bring forward interesting information in research on attitudes towards mathematics. As Mullis et al. (2001) state, “international assessments provide an excellent basis for gaining multiple perspectives on educational issues and examining a variety of possible reasons for observed differences in achievement.” (Mullis et al., 2001, p. 17).

2.8 The Malawian context

As the research is conducted in Malawi, which is among the LMIC and certainly a less-developed country compared to the countries where most research articles report from (about attitudes towards mathematics), an introduction to the Malawian culture and school system is in order.

In a culture highly different from western culture and with a school system where the majority of students fail to complete the full primary education (Kadzamira, 2014), one can ask what is being done in order to raise the quality of the school system in Malawi. Many factors come into play. Following the introduction of the free Primary school education in 1994 (Kazima, 2014), one can see a school framework that has changed dramatically. As enrolment shot through the roof, the schools were not prepared for the impact. Malawi's ministry of education reported an increase in enrolment by nearly 50% from 1994 to 1995 (as cited in Kazima, 2014). The intensive increase in students was not met by an equivalent increase in teachers and schools, and the schools still experience repercussions following the new reform. Although the situation appears to have become better through the years, the school classes are still much bigger than they were before, and many schools cannot afford to maintain the physical aspects of their school. Looking at these factors affecting the Malawian school system and in turn the Malawian people, Malawian children's' development of attitudes towards mathematics are investigated.

2.8.1 Socioeconomics of Malawi

According to *General History of Africa*, the Republic of Malawi, formerly called Nyasaland, gained its independence from Britain in 1964 (Mazrui, Wondji, & Unesco International Scientific Committee, 1993). From 1890 to 1964, Nyasaland (now Malawi) was a British colony (Mazrui et al., 1993). In 1966; two years after independence from Britain, Malawi became a republic (Kazima, 2014). In 1994, after 30 years under a dictatorship, Malawi had their first presidential and multiparty elections (Kazima, 2014). A new presidency led to the introduction of free primary schooling in 1994. From 1994 to 1995, Malawi's ministry of education reported a national increase in primary school students from 1.9 million to 2.8 million (as cited in Kazima, 2014). Although Malawi is still dealing with the effects of the increase of free primary education, the country has started to stabilize more than before. However, schools still experience a shortage of teachers. In addition, the teacher to pupil ratio (in 2015) is still very high, with a ratio of 1:70 (The World Bank, 2016). This ratio is often much higher in urban areas, and lower in rural areas (Susuwele-Banda, 2005).

Malawi is often recognized as one of the poorest countries in the world. The country has a GDP per capita of 381 USD (2015) (United Nations Association of Norway, 2017). The country has approximately 17.3 million inhabitants, and is one of the world's most densely populated countries (2015). Malawi's main industry is agriculture, but they also rely heavily on foreign aid. In 2014, Malawi received more than 930 million USD in foreign aid. The life expectancy in the country is very low. On average, people in Malawi are expected to live 55 years. HIV/AIDS is one of Malawi's main health issues that has a deep impact on the life expectancy, and many children often become orphans. Children with one or more deceased parent must often contribute more at home, which in turn often leads to giving a lower priority to school, or complete withdrawal.

2.8.2 The Malawian school system

The school system in Malawi is divided into primary- and secondary school. The primary grades are called standards, and primary schools contain standards one to eight. Primary schooling is free, as of 1994. Yet, primary schooling is not mandatory. Secondary school consists of four years, divided into junior/lower secondary school and senior/upper secondary school. The lower and upper secondary school consist of two years each (Susuwele-Banda, 2005). Although the official language of Malawi is English, the recognized national language, Chichewa, dominates the lower part of primary school. In standards one through four, subjects are taught in Chichewa. Starting from standard five and upwards, subjects are taught in English.

Children normally start at primary school (standard one) at the age of six, although it is common that some start earlier or later. To progress to the next standard, students must pass exams at the end of the school year. If they fail, they must repeat the standard they were in. The average exam results across all subjects determine whether a student passes the exam or not. This means that a student can fail mathematics completely and still pass on to the next standard because of high results in the other subjects. If a student scores exceptionally high on an exam, he may be given the possibility of progressing more than one standard. When finishing standard eight, students must complete national exams. The results from the exams are published freely. Parents and other interested parties can view the results upon request (Soko et al., 2008, p. xiii). The students are ranked within each class, and therefore everyone knows who had the best and worst scores. The students can also see how they ranked compared to the other students in the class. The results can serve as boosters for motivation (or demotivation), but they serve an important function. The results of the national exams help determine who gets to go to secondary school. Not all students receive the opportunity to attend secondary school, as only a limited number of students are accepted into these schools. Secondary school is not free. Due to the school fees and the limited capacity of students in the secondary schools, many people start working instead of attending further education past their primary education (Susuwele-Banda, 2005).

Not all students complete all eight years of primary school. Schools in Malawi suffer from high numbers of absent students. Absenteeism is a problem already from standard one, and there are many reasons for students being absent. Susuwele-Banda (2005) highlights some of the main reasons why students are absent. He mentions “lack of interest on the part of the students, sickness, hunger, poverty, domestic chores, child labour, and attending funerals” as the main reasons for absenteeism (Susuwele-Banda, 2005, p. 31). Susuwele-Banda (2005) goes on to explain that girls are often more absent than boys are. This is not necessarily a case of differing attitudes, but a cultural phenomenon. Females are expected to do more housework, and helping around the home is more expected from girls than boys (Susuwele-Banda, 2005). The older the students become, the higher the percentage of girl absenteeism becomes in relation to the level of absenteeism of boys. Because of student absenteeism and students failing their exams, many students repeat standards. This leads to huge age gaps in the standards, which again affects the teaching. This is challenging for the teachers, but the students also suffer. Students have various levels of cognition depending on their age, and their experience gives them diverse frames of reference.

The curriculum is the same for the whole of Malawi, and it gives little room for artistic freedom. Teachers have limited options of providing adapted education, and it might be difficult to organize teaching for a large group of students that differ greatly in age, cognition and frames of reference. Susuwele-Banda (2005) states that binding the teachers to the same curriculum results in the students being undermined. In addition, Susuwele-Banda believes that this undermines the creativity of the teachers, which might in turn affect the students’ attitudes. In terms of physical aspects, the teachers also must make do with what they have. Public schools often lack resources, which can be observed in most schools across the country (Kadzamira & Rose, 2003).

In terms of the physical aspects, the Malawian government strives to improve their situations in public schools. Physical aspects that are taken for granted in developed countries, are not matters of course in Malawi. The Southern and Eastern Africa consortium for monitoring education quality (SACMEQ), set benchmarks they wanted to reach by 2007. SACMEQ set select indicators of quality and status for certain countries to reach by 2007. Malawi, Botswana and Zambia were compared, and benchmarks were set. Table 2 (modified from Kazima (2014), p. 850) shows the benchmarks set for Malawi, along with the actual numbers for 2007.

Selected indicator	Description of the indicator	Benchmark	Actual
Basic learning materials	Pupil has at least one exercise book, a pencil or a pen, and a ruler	100%	73%
Mathematics textbooks	Pupil has sole use of a mathematics textbook during mathematics lesson	100%	24%
Pupil-teacher ratios	Total number of pupils in a school divided by number of teachers in the school	60:1	88:1
Standard 6 class size	Average number of Standard 6 pupils per class	60	66

Table 2: Benchmarks and actual numbers for Malawi 2007 (Modified from Kazima (2014), p. 850)

In comparison to the Malawian school system and its resources, one can observe huge differences in developed countries. For instance, Norway has a pupil to teacher ratio of 16.8:1 (Utdanningsdirektoratet, 2016), compared to Malawi’s ratio of 88:1 (Table 2). There are often huge difference across different school systems, and outlining the country’s situational context is therefore essential.

Since 2007, the Ministry of Education in Malawi has kept setting new benchmarks (Ministry of Education & UNESCO, 2008). New benchmarks were set for 2015, with a pupil to teacher ratio of 40:1, but this has still not been met. However, striving to reach specific benchmarks should certainly push the Malawian school system in a positive direction.

3. Methodology

This chapter deals with the methodology of the thesis. The methodology chapter is divided into subchapters dealing with the approach of gathering information for the thesis. The subchapters highlight the different research methods used in the study, the physical framework of the study, the data sample, research ethics and reliability/validity.

All empirical data in this study was collected through field research in a cross-sectional manner. During the investigation of students' attitudes and the investigation of factors affecting students' attitudes towards mathematics in Malawi, several research methods were utilized. To gather substantial amounts of data regarding attitudes and motivation in mathematics, questionnaires were distributed, interviews were conducted and lessons observed.

3.1 Research methods

3.1.1 Questionnaires

Two different questionnaires were distributed. Both questionnaires were distributed with both English and Chichewa translation. Foremost, the ATMI-questionnaire was distributed (appendix 1). The ATMI-questionnaire was distributed to each student in standards 5A, 6A, 7A, 8A and 8B. The survey consisted of 40 statements regarding the students' attitude towards mathematics. Each student was asked to answer each statement by selecting the corresponding answer to how each statement best described their feelings on a Likert-scale with the options "strongly disagree", "disagree", "neutral", "agree" and "strongly agree". These answers were later coded into numbers for analysis. The answers were also sorted by gender, age and standard to see if there were any clear differences in motivation based on these factors.

Secondly, the first boy and girl to finish the ATMI-questionnaire in each standard were asked to complete an additional survey. The additional survey consisted of four open-ended questions regarding motivation (appendix 2). They got the option of writing in English or Chichewa, and later it was all translated to English. This survey was conducted to see what some students thought could increase their motivation towards mathematics. As only a few students answered this survey, it would only serve to give voice to a few student ideas and not for generalization of all the students in the respective standards.

The same person administered all the surveys in this study. This was done as an attempt to maintain consistency and to secure that all classes were given the same information. The teachers in the respective classes also helped administer the surveys, though they were not the ones providing the instructions. However, they translated the instructions to the local language (Chichewa). In other research the ATMI has often been teacher-administered (Lim & Chapman, 2013, p. 149). As this study was only carried out in one school, there were no difficulties in taking part in each survey. By personally taking part, other observations about the physical framework could be made. The creators of the instrument estimated 10-20 minutes to complete the questionnaire. In this case, completion took between 30-60 minutes. As the Malawian students were unfamiliar with questionnaires in general, a highly detailed explanation was necessary for them to understand the procedure.

The questionnaires were translated to Chichewa to make the instrument more comprehensible and to avoid misinterpretations. The Chichewa translations were added as a supplement to the English text. To adapt the instrument to Malawian students, certain wordings were modified. Modifying the items/response options was also done in about half of the countries participating in the TIMSS 1999-study (Mullis et al., 2001). Independent professionals at the UNIMA performed the translation to Chichewa for the ATMI. In order to avoid students understanding the items differently when completing the ATMI, the students were asked to read the statements both in English and in Chichewa. They were also asked to reflect upon each statement before they answered.

3.1.2 Interviews

A selection of teachers were interviewed concerning their understanding of the term "motivation". They were given the opportunity of portraying their own perspective on attitudes and education. The teachers were further questioned about their facilitation for different methods of learning in the classroom. They were then asked what role they believed attitudes play in the role of learning mathematics.

The teachers selected for interviews were the ones who taught mathematics in standards five through eight, in addition to the head teacher. The interviews were not a main source for gathering information for this study, but were supposed to serve as a supplement to the other gathered data (questionnaires and observation). The interview guide is attached (appendix 7), although many follow up questions deviated from the written questions.

3.1.3 Observation

To understand the Malawian school system and culture, a lot of time was spent observing lessons prior to, during and after the questionnaires and interviews. Lessons were observed across all standards (one through eight) over a period of four weeks, although most of the hours spent observing were spent in standards five through eight. This helped shed light on areas that might not otherwise have been covered. In addition, the observations prior to the interviews gave inspiration to topics of conversation for interviewing the teachers. The observation in the lower standards helped shed light on how lessons in the lower standards were taught, and gave valuable information about differences and similarities compared to the higher standards in focus.

Although observations done in this study were not organized in a specific manner, they gave good insight into how lessons were taught and how students and teachers reacted to various aspects of the lessons. This study can only generalize for the particular school. Observations can therefore be of interest for other schools to see if they have the same basis. If they do, the results might in some way be transferrable to them, i.e. they might experience similarities to the results of this study.

3.2 Physical framework

The subchapter regarding the Malawian school system (chapter 2.8.2) outlines current situations of the physical framework across schools in Malawi. However, it is necessary to give an outline of the present school's physical framework and the sample selected for this study. The subchapter regarding the school (chapter 3.2.1) gives information on the aspects of the school, e.g. number of students, the condition of the physical building, and the resources available to the students. Subchapter 3.2.2 gives descriptive statistics of the sample selected for the study, along with factors affecting the sample size.

3.2.1 The school

The school consisted of approximately 1060 students in standards one through eight. In addition to the ordinary standards, there was also one class dedicated to students with special needs.

Although the school sought to integrate all students in the ordinary classes/standards, some lessons were taught in the special needs classroom for a select group of students across various standards. The class for students with special needs included students with hearing impairments, vision impairments in addition to other learning difficulties. Students with other learning difficulties were characterized with loss of concentration or as having a "problem with the brain".

Only a few of the classrooms had desks and benches. Chairs were reserved for the teachers. The available desks were prioritized in the higher standards, perhaps as an incentive. From the classes that answered the questionnaires, only standards seven and eight had desks. In the classrooms without desks, students would sit on the ground. Some classrooms had rugs/carpets for the students to sit on, and in some classrooms students had to make do with sitting on a concrete floor. All the classrooms had broken windows, and no electrical appliances. The only lighting came from the sunlight through the broken windows. In several classrooms, the doors were either missing or they would not close. The situation for the teachers was not any better than for the students, and the students did not have breakrooms or offices available for use.

The lack of resources was so pressing that some students had to write on advertising leaflets, as they did not have exercise books. In addition, some students did not have pens/pencils, so they had to share. It was repeatedly observed that up to three students shared a single pen. Even so, students did not seem to mind sharing. The culture for sharing appeared quite fundamental, and everyone seemed to try to help one another. Another example of sharing and helping one another was found in connection between the local community and the school. In opposition to many schools, this school gave students a free meal once a day. This was locally sponsored by a private initiative, and it helped encourage students to come to school. This incentive, along with free drinking water, meant that children who might normally have to stay home in order to feed themselves, got the opportunity of attending school.

3.2.2 The sample – descriptive statistics

The sample selected for the questionnaires was chosen from standards five to eight because their subjects were taught in English. These students spoke English more fluently than the younger students did. Several standards were chosen so that possible changes in motivation across the standards could be observed. One group was selected from each standard in standards five to seven, and two groups (8A and 8B) were selected from standard eight. In standard eight, the school divided the students into A or B depending on their results, categorizing the students in 8A as “gifted” and students in 8B as “less/not gifted”. The students with the best results were placed in 8A, but results through the school year could lead to a student being transferred from A to B or vice versa.

In total, 403 students responded to the ATMI-questionnaire. Out of these 403 students, 208 were boys and 195 were girls. The distribution of boys and girls responding in each standard can be seen in the table below (Table 3). As can be seen, the distribution amongst the respondents is close to 50/50, with a slightly greater share of boys.

Standard	Gender		Total
	Boy	Girl	
5	46	37	83
6	42	35	77
7	49	51	100
8A	33	33	66
8B	38	39	77
Total	208	195	403

Table 3: Distribution of boys and girls responding in each standard

The age of the respondents differed greatly across the standards. There were many reasons for this. School was not compulsory, some students were away for some time before they came back, and some had to repeat standards if they had not passed their exams with satisfactory results. The ages ranged from eight to 19 years old, with the mean age being 12.56 years old with a standard deviation of 2.00. From the following cross-tabulation (Table 4), one can see a great age span within each standard. The cells indicate how many students of each age there are in the different standards. Blank cells indicate that there are no students of the specified age in the standard.

Age	Standard					Total
	5	6	7	8A	8B	
8	1	1				2
9	16	3				19
10	35	11	3			49
11	15	19	15	6	1	56
12	12	19	20	14	3	68
13	4	13	28	18	19	82
14		4	22	16	21	63
15		3	10	8	16	37
16		2	2	3	11	18
17		1			2	3
18		1		1	1	3
19					3	3
Total	83	77	100	66	77	403

Table 4: Age/Standard – cross-tabulation

3.2.2.1 Factors affecting the sample size

The sample size was affected by a range of factors. A key factor affecting the sample size was the climate. Other reasons for absenteeism can be found in subchapter 2.8.2. As the research was conducted during the rainy season in Malawi, some students were hindered in attending classes on multiple occasions. Because of this, the sample size from the various standards varied depending on which day the ATMI-questionnaire was conducted. In standards one through seven, the school sought to maintain an even distribution of students in the respective standards A and B. In standard eight, where they differentiated based on the achievement level of the learners, a lot more students were placed in standard 8B than in 8A.

3.3 Research ethics

To safeguard and protect the privacy of the participants in this study, different measures were taken. Before the field research took place, the project was reported to the Norwegian centre for research data (Norsk senter for forskningsdata (NSD)). NSD approved the plan for the research and the handling of personal data. The letter of approval is attached, in Norwegian (appendix 4).

Before the questionnaires and interviews were conducted, the students were given information about the study (appendix 5) along with consent forms (appendix 6) to review and sign. They were informed that all participation in the research was voluntary. In addition, they were informed that all collected data would remain anonymous. No personal information was collected, and no information could be traced back to the individual participants.

3.4 Reliability and validity

3.4.1 Reliability

Tapia noted a high reliability in the ATMI. She noted a Cronbach's alpha of .96 in her original ATMI with 49 items (Tapia, 1996). Although initially highly reliable, the deletion of some items resulted in an even more reliable version of the instrument. With the deletion of some items, to a total of 40 items, she increased the Cronbach's alpha to .97. Across the four factors (ENJ, MOT, SC, VAL), she reported a mean Cronbach's alpha of .90 (Tapia, 1996).

The "IBM SPSS Statistics 21"-software was used to conduct reliability analysis for this study. The measured Cronbach's alpha value across the ATMI in this study, with 40 items, was .86. Although not as high as that reported by Tapia, the value showed a very good internal consistency reliability (Pallant, 2013). The Cronbach's Alpha value measured across the four factors (ENJ, MOT, SC, VAL) was .84, which was also not as high as reported by Tapia, but it can still be regarded as having a good internal consistency reliability (Pallant, 2013). The fact that the ATMI was originally designed for American students (Tapia, 1996), might be a reason for why the reliability was reportedly different in the Malawian case. However, the reliability reported was regarded as having good internal consistency reliability, and it is likely that the quantitative research results could be reproduced. For the quantitative part of the study, the generalization was more problematic. Though the school and teachers were said to be typical for urban districts in Malawi, the qualitative research would be impossible to reproduce.

3.4.2 Validity

With the high number of participants in the sample (N = 403), the statistical validity and reliability in the study should have been satisfactory with regard to the number of participants. With many students in each standard, more quantitative information was obtained, and a higher quantitative validity was obtained. The qualitative validity was more debatable however. Though the qualitative results (open question survey, interviews and observations) would be impossible to reproduce, they arguably measured what they were supposed to measure. The results appeared to correspond well with theory and previous research on the topic, but the information was not strong enough to generalize to other schools.

4. Results

This chapter looks at the structured results of the study. Firstly, results from the ATMI are presented. The data is structured into subchapters that link the roles of gender, age and standard to the four attitudinal factors measured in the quantitative part of the study (SC, VAL, ENJ and MOT). Secondly, the students' answers to the open-ended questions survey are presented and analysed. Thirdly, results from the interviews are presented. A few select transcripts are presented and analysed with regard to the teachers' view of their own teaching and facilitation of positive attitudes. Finally, results from the observations are presented. The supplement of observations is needed to properly understand the context for the other results.

4.1 The ATMI

The results determine which roles gender, age and standard play regarding how students answer the ATMI. Within each case, the roles (gender, age and standard) are looked at through the four factors measured in the ATMI; self-confidence (SC), value of mathematics (VAL), enjoyment of mathematics (ENJ) and motivation towards mathematics (MOT). In addition, a combined factor of the four preceding factors has been added to look at attitude as a whole. This is referred to as *attitude as a whole* (ATT).

The presented scores are average scores. The results were scored from one to five, corresponding to the Likert-scale answering format. The higher the score, the more positive the result is. A score of three indicates neutrality. Scores below three are negative, and scores less than two are considered strongly negative. Scores above three are positive, and scores above four are considered strongly positive. The reversal of certain items based on negative wording ensures that all scores are more positive the higher they are, regardless of whether the statements are worded positively or negatively.

4.1.1 The role of gender in the ATMI

Boys and girls answered in a similar manner, independent of gender. The independent-samples *t*-tests show that boys in the sample scored higher in the SC-, VAL-, MOT- and ATT-scale than girls. Girls only score higher in one category, namely the ENJ-scale. Here, the differing scores are so marginal that they are not visible in Table 5.

Analysis of independent-samples *t*-tests revealed that there was very little statistical significance to determine that gender played any role in how the students answered the ATMI-questionnaire. There was no statistical significance in SC, VAL, ENJ, MOT or ATT. Table 5 presents the data from the tests, showing no statistical significance across any of the factors.

	N		Mean		Std. Deviation		*t*	*df*	Sig. (2-tailed)
	Boys	Girls	Boys	Girls	Boys	Girls			
SC	208	195	3.99	3.93	.72	.84	.72	401	.472
VAL	208	195	4.09	4.04	.64	.72	.78	401	.435
ENJ*	208	195	4.09	4.09	.64	.84	-.05	401	.958
MOT	208	195	3.83	3.71	.72	.85	1.55	401	.123
ATT	208	195	16.00	15.77	2.12	2.76	.93	401	.356

Table 5: Group statistics and independent-samples t-tests for gender

*The girls' mean scores are marginally higher than the boys', but this is not shown in table because of only two decimal places.

The differing scores between girls and boys were not statistically significant to generalize any claims. The scores could simply be a matter of mere coincidence. One can observe that the mean values for boys and girls were approximately equal to each other across all factors (Table 5), but due to the lack of statistical significance it cannot be concluded that gender plays a role in how students answer in regard to the factors in the ATMI-questionnaire.

Statements 9 and 30 in the ATMI show slight statistical significant differences between genders. The significant difference for statement 9, "mathematics is one of my most dreaded subjects", *t* (389) = 2.19, *p* = .029, shows that boys (*M* = 3.83, *SD* = 1.42) score significantly higher than girls (*M* = 3.51, *SD* = 1.48). The scoring for this statement was reversed, so this signifies that girls experience mathematics as a more dreaded subject (compared to other subject) than what boys experience. However, the magnitude of the differences in the means (mean difference = .32, 95% *CI:* .032 to .061) was small (eta squared = .012). Only 1.2 percent of the variance in dreading mathematics (statement 9) is explained by gender. The significant difference for statement 30, "I am happier in a mathematics class than in any other class", *t* (381) = 2.08, *p* = 0.038, shows that boys (*M* = 3.93, *SD* = 1.22) score significantly lower than girls (*M* = 4.18, *SD* = 1.08). However, the magnitude of the differences in the means (mean difference = -0.245, 95% *CI*: -.477 to -.014) was small (eta squared = .011). The results show that girls are happier in mathematics class than in any other class, compared to boys. However, one must keep in mind that only 1.1 percent of the variance in this statement is explained by gender. With such small magnitudes of the differences in means in statements 9 and 30 explaining gender, there might be other possible explanations for the results. Perhaps the wordings of the statements trigger boys and girls differently. Though the differences are observed, one cannot conclude based solely on two single statements.

Another indication of gender not influencing students' attitudes towards mathematics is found when analysing the composition of standard 8A and 8B. The standards had an equal distribution of boys and girls. Standard 8A consisted of 33 girls and 33 boys, and standard 8B consisted of 39 girls and 38 boys. As the students in these standards were separated by achievement in mathematics, it is interesting to see that the distribution of boys and girls were equal. That indicates that boys and girls had equal results, and if results are linked up against attitudes, there should not be any/much difference in attitudes based on gender.

To sum up, the results show little/no statistical significant differences in gender in regard to students' attitudes towards mathematics. No significant results are found across SC, VAL, ENJ, MOT or ATT. The only differences are found in the statements "mathematics is one of my most dreaded subjects" and "I am happier in a mathematics class than in any other class", but these differences might be fortuitous.

4.1.2 The role of age in the ATMI

Considering the great age difference across the standards (Table 4), the role of age in regard to students' attitudes towards mathematics was investigated. With six to 11 different ages present in each standard, the role of age was considered in regard to whether age affects students' attitudes towards mathematics.

One-way ANOVA testing for the role of age in the ATMI revealed various results (Table 6). In the table, the between-groups of freedom are separated from the within-groups of freedom by a comma in the df-column. The SC-, VAL- and MOT-scale did not provide a statistical significance to determine any differences across age in the ATMI. The ENJ-scale did however have a statistical significance and showed a clear decline in enjoyment of mathematics (Figure 3). Apart from minor differences, the scale shows a negative trend in enjoyment of mathematics across the age of students. The lowest point in ENJ is found for 17 year olds, but as this accounts for only .7 percent of the data one must be cautious before generalizing. As for attitude as a whole, the total attitude measured across the four factors seem to decline with age (Figure 4). As this is a cross-sectional study, differences across time have not been recorded, but the results give an indication of how the attitudes might progress negatively with age. One must however take into account that the oldest students often are the ones who have had to retake one or more standards, which is bound to affect their attitude in general.

	df	*F*	Sig.
ENJ	11, 391	2.49	.005
MOT	11, 391	1.75	.061
SC	11, 391	1.54	.114
VAL	11, 391	.97	.478
ATT	11, 391	1.82	.050

Table 6: Age – One-way ANOVA

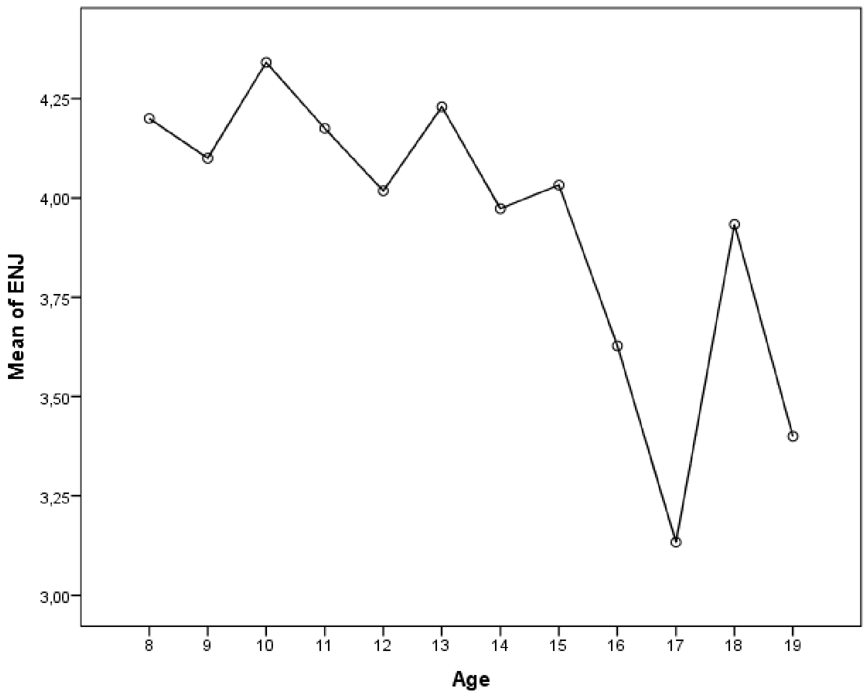

Figure 3: Age – Mean of ENJ

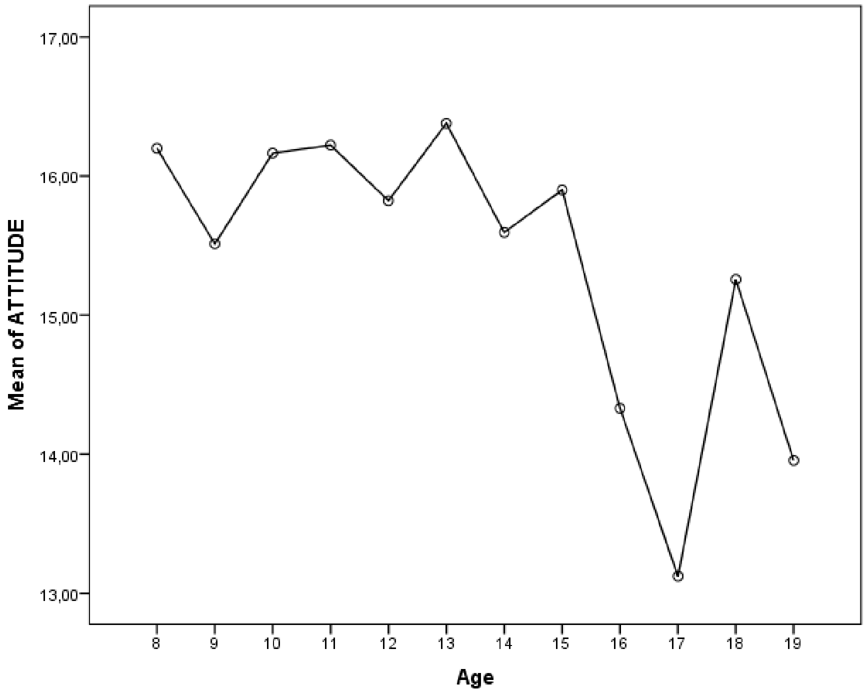

Figure 4: Age – Mean of ATT

Four statements in the ATMI showed a statistical significance for how students responded in regard to their age. There was a significant difference in how students responded to the statements "Mathematics makes me feel uncomfortable" (statement 12), F (11, 373) = 2.77, p = .002, "I really like mathematics" (statement 29), F (11, 369) = 2.04, p = .024, "I am comfortable expressing my own ideas on how to look for solutions to a difficult problem in mathematics" (statement 37), F (11, 374) = 2.36, p = .008, and "I believe I am good at solving mathematics problems" (statement 40), F (11, 381) = 2.36, p = .008. Though the differences in results for these four statements were statistically significant, there did not appear to be a clear trend across the results.

Looking at the sample in standard eight, we find a median age of 13 years for standard 8A (M = 13.30, SD = 1.43) and a median age of 14 years for standard 8B (M = 14.45, SD = 1.59). The higher median and mean age of students in standard 8B compared to standard 8A give an indication that age might affect students' attitudes towards mathematics. Based on the premise that students with good results have more positive attitudes than those with worse results, this could be an indication that age does in fact affect students' attitudes towards mathematics. However, one must keep in mind that there are possibly more factors affecting students' attitudes and results than just their age. Also, students repeating standards become older, and as an effect of this, their attitudes are likely to worsen. The role of standard in the ATMI is further discussed in the next subchapter (chapter 4.1.3).

4.1.3 The role of standard in the ATMI

This subchapter starts by presenting the results of standard in the ATMI through various variables for standard (chapter 4.1.3.1). Further on, the subchapter presents results of standard by comparing standard 8A and 8B (chapter 4.1.3.2). Finally, the subchapter presents results of standard in regard to the ENJ-, MOT-, SC- and VAL-factor, statement by statement, in regard to the statements in the ATMI (chapter 4.1.3.3).

4.1.3.1 Comparing standard with various variables

When examining the results in regard to standard, different groups/variables were created and considered. Initially the data was considered as a whole for all students across the standards. As presented in table 4, there was a big age span within the standards, due to several reasons. The data was considered with standard eight combined and separated, i.e. in one case standard 5, 6, 7 and 8 were considered, and in another case 5, 6, 7, 8A and 8B were considered. Variables based on the "ideal/standardized" age for each standard were also created, and the students within and those outside this grouping were considered. The variables were created to analyse students who were unlikely to have repeated or skipped (several) standards. The ideal/standardized age was decided based on what age they should have started school, and what age they should be in the different standards if they had not repeated/skipped any standards. An average ideal/standardized age for each standard was found, and those who were up to two years older/younger in each standard were included. The reason for this was that being outside the ideal/standardized age could (possibly) affect students' attitudes negatively. For example, it might affect a student's motivation if he is 16 years old while the majority of students in his class are 10 years old. Based on this assumption, the variables that only included respondents from students within the ideal/standardized age were created and analysed.

For standard five, six, seven and eight, the standardized age range were 9 to 12, 10 to 13, 11 to 14 and 12 to 15 respectively. As an example, there were 66 students in standard 8A, but only 56 (85%) of these were within the "ideal/standardized" age. Six students were younger, and four students were older. Similarly, in standard 8B, 59 of 77 (77%) students were regarded as being within the "ideal/standardized" age. One student was younger, and 17 students were older. A much higher percentage of students in standard 8B (23% versus 15%) were outside the "ideal/standardized" age group, and most of these students were older, which likely meant that more students in standard 8B had repeated one or more standards.

In the following tables, the between-groups of freedom are separated from the within-groups of freedom by a comma in the *df*-column. Table 7 shows if there are any significant differences in the measured factors (ENJ, MOT, SC, VAL and ATT) between the standards, using the initial 'standard'-variable (5, 6, 7, 8A and 8B), Table 8 shows the same as Table 7, results for the 'standard combined'- variable (standard 5, 6, 7 and 8), Table 9 shows if there are any significant differences in the measured factors (ENJ, MOT, SC, VAL and ATT) results for the 'standard ideal'-variable (those within the standardized/ideal age in standard 5, 6, 7 and 8) and Table 10 shows results for the 'standard not ideal'-variable (those outside the standardized/ideal age in standard 5, 6, 7 and 8).

	df	*F*	Sig.
ENJ	(4, 398)	2.49	.043
MOT	(4, 398)	2.26	.062
SC	(4, 398)	2.07	.084
VAL	(4, 398)	.857	.490
ATT	(4, 398)	1.68	.153

Table 7: 'Standard' – One-way ANOVA

	df	*F*	Sig.
ENJ	(3, 399)	2.53	.057
MOT	(3, 399)	1.62	.185
SC	(3, 399)	.93	.427
VAL	(3, 399)	.90	.442
ATT	(3, 399)	.78	.507

Table 8: 'Standard combined' – One-way ANOVA

	df	*F*	Sig.
ENJ	(3, 336)	1.85	.138
MOT	(3, 336)	2.18	.090
SC	(3, 336)	.42	.738
VAL	(3, 336)	1.30	.275
ATT	(3, 336)	.73	.537

Table 9: 'Standard ideal' – One-way ANOVA

	df	*F*	Sig.
ENJ	(3, 59)	1.51	.221
MOT	(3, 59)	.13	.942
SC	(3, 59)	1.88	.144
VAL	(3, 59)	.52	.673
ATT	(3, 59)	.88	.456

Table 10: 'Standard not ideal' – One-way ANOVA

Table 7 reveals that there was a statistical significant difference across the ENJ-category for the 'standard'-variable. Considering the mean scores, one could observe a considerably higher reported enjoyment of mathematics in standard 5 and 8A, compared to the other standards (Figure 5).

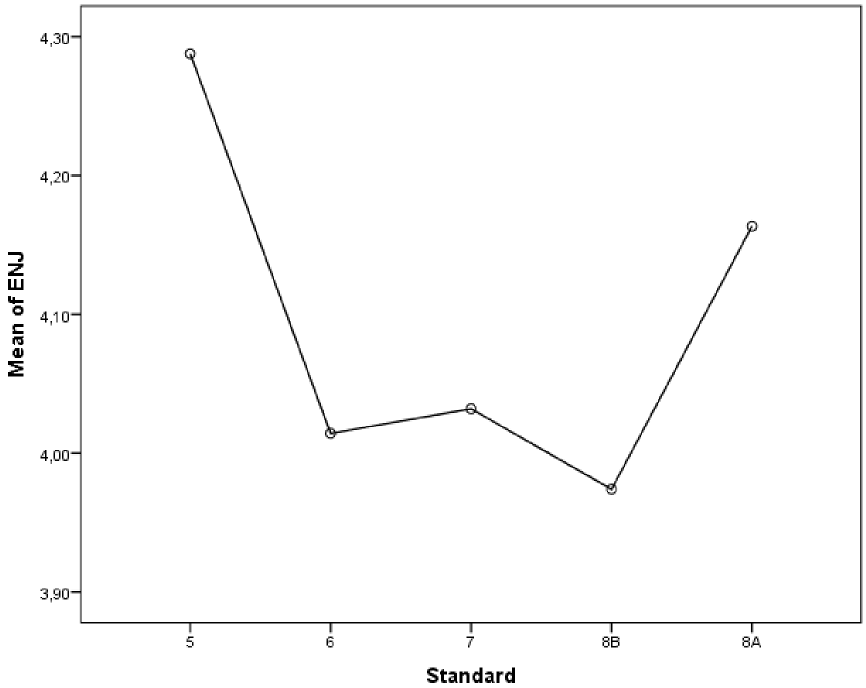

Figure 5: Standard – Mean of ENJ

For the MOT-, SC-, VAL- and ATT-categories, there were no significant statistical differences of scores between the standards. However, one-way ANOVA-testing for the different statements of the ATMI revealed statistically significant differences across 21 out of the 40 statements. Table 8 reveals that there were no statistically significant difference across any of the ENJ-, MOT-, SC-, VAL- or ATT-categories for the 'standard combined'-variable. When testing each statement in the ATMI, results showed that there were statistically significant differences between the mean scores for 18 of the 40 statements between standards (8A and 8B now considered as one group). Table 9 reveals the same results as Table 8; that there were no statistical significant differences in mean scores across any of the ENJ-, MOT-, SC-, VAL- or ATT-categories, but this time for the 'standard ideal'-variable. Like the 'standard combined'-variable, the 'standard ideal'-variable also showed statistically significant differences in mean scores for 18 of the 40 statements in the ATMI, and 15 of these were the same statements. Table 10 reveals no statistical significance in mean scores across any of the ENJ-, MOT-, SC-, VAL- or ATT-categories for the 'standard not ideal'-variable, which is the same as for Table 8 and Table 9 ('standard combined' and 'standard ideal'). Only 9 of the 40 statements in the ATMI were statistically significant in regard to the mean scores for the 'standard not ideal'-variable. Perhaps a possible explanation for this was that there was too little data for some of the standards.

The preceding information gives little statistically significant differences for how students answer in regard to what standard they are in. It does however reveal that the only statistically significant information is found between the ‘standard’-variable and the ENJ-category (apart from the single statements in the ATMI). As a consequence of this, the rest of the results for the role of standard in the ATMI focuses on the ‘standard’-variable, namely where standard 8A and 8B are separated. Like for the different standard-variables (‘standard’, ‘standard combined’, ‘standard ideal’ and ‘standard not ideal’), the students in standard 8A and 8B were analysed in different ways. When compared against each other, three variables/factors were used. One factor included all students, while the others either included all the “ideal” students/those who were within the “standardized age”, or all those who did not fit the ideal/standardized criteria.

4.1.3.2 Comparing standard 8A and 8B

For the variable containing all students in standard 8A and 8B, Table 11 shows statistically significant difference for the MOT-, SC- and ATT-category. The table shows that students in standard 8A scored higher than students in standard 8B across all categories, but the difference in results is not significant. Students in standard 8A also scored higher on all 40 statements in the ATMI, although only 11 of these had statistically significant differences. However, it gives a clear indication of how things might be. It is known that the students were separated in the standards based on their performance in mathematics, and it appears that the attitude-factors might well be linked to the performance level of the students, at least for standard eight.

	N		Mean		Std. Deviation		*t*	*df*	Sig. (2-tailed)
	8A	8B	8A	8B	8A	8B			
ENJ	66	77	4.16	3.97	.81	.70	-1.50	141	.136
MOT	66	77	3.98	3.71	.88	.74	-1.98	141	.050
SC	66	77	4.16	3.86	.79	.61	.62	141	.011
VAL	66	77	4.18	4.09	.88	.64	-.77	141	.443
ATT	66	77	16.49	15.63	2.87	2.13	-2.05	141	.043

Table 11: Group statistics and independent-samples t-tests for ‘standard 8A and 8B’

The variable containing only the students within the “standardized/ideal” age, is referred to as ‘standard 8A-ideal and 8B-ideal’, and can be found in Table 12. The table shows that there are statistical significances for the MOT-, SC- and ATT-category, but not for the ENJ- and VAL-category. This is the same as for the variable containing all students. Again, the students in standard 8A had a higher mean score across all categories, but they do not score higher than students in standard 8B in all the statements in the ATMI. Students in standard 8A score higher in 38 of the 40 statements (9 statements had statistically significant differences), which is still very high, but students in standard 8B score higher in statement 6 (*M* = 4.53, *SD* = .80) than standard 8A (*M* = 4.50, *SD* = .77) and higher in statement 36 (*M* = 3.90, *SD* = 1.26) than standard 8A (*M* = 3.89, *SD* = 1.23). Although the differences are very small and not statistically significant, it is interesting to note that students in standard 8A do not score higher in all statements when only comparing the ones of "ideal/standardized" age. Both statement 6 and 36 are measured in the VAL-category, which indicates that students in standard 8B also value mathematics highly.

	N		Mean		Std. Deviation		*t*	*df*	Sig. (2-tailed)
	8A	8B	8A	8B	8A	8B			
ENJ	56	59	4.23	4.00	.67	.68	-1.79	113	.076
MOT	56	59	4.05	3.78	.82	.66	-2.00	113	.048
SC	56	59	4.21	3.87	.72	.60	-2.76	113	.007
VAL	56	59	4.26	4.11	.71	.61	-1.24	113	.220
ATT	56	59	16.75	15.76	2.33	2.04	-2.44	113	.016

Table 12: Group statistics and independent-samples t-tests for 'standard 8A-ideal and 8B-ideal'

The results for the group of students outside the "ideal/standardized" age are referred to as "Standard 8A NOT ideal vs 8B NOT ideal". Results are found in Table 13. As can be seen, there are very few students in this group to account for any statistically significant differences in the set of data. No statistically significant differences in mean scores of the five various categories of the ATMI were found when comparing the two groups, and only four of the 40 ATMI-statements provided a statistically significant difference in the mean scores between the two groups.

	N		Mean		Std. Deviation		*t*	*df*	Sig. (2-tailed)
	8A	8B	8A	8B	8A	8B			
ENJ	10	18	3.79	3.87	1.34	.79	.21	26	.839
MOT	10	18	3.58	3.51	1.13	.94	-.17	26	.864
SC	10	18	3.89	3.81	1.14	.66	-.22	26	.825
VAL	10	18	3.77	4.02	1.49	.75	.60	26	.553
ATT	10	18	15.03	15.22	4.85	2.43	.14	26	.890

Table 13: Group statistics and independent-samples t-tests for 'standard 8A not ideal and 8B not ideal'

There were statistical significant differences in mean scores for statement 9, “mathematics is one of my most dreaded subjects”, t (25) = -2.21, p = .037, statement 16, “mathematics does not scare me at all”, t (25) = -2.25, p = .033, statement 25, “mathematics is dull and boring”, t (25) = -4.20, p < .001 and statement 37, “I am comfortable expressing my own ideas on how to look for solutions to a difficult problem in mathematics”, t (23) = -2.22, p = 0.036. Although only four statements in the ATMI were significant for those outside the “ideal/standardized” age in standard eight, the magnitude of the differences in the means had large effect (Table 14). Between 16 and 18 percent of the variance for statements 9, 16 and 37 was explained by standard. For statement 25, 41 percent of the variance was explained by standard. For these four statements, the students outside the “ideal/standardized” age scored much higher in standard 8A than in 8B (Table 14).

	N		Mean		Std. Deviation		Mean difference	95% CI		Eta squared
	8A	8B	8A	8B	8A	8B		Lower	Upper	
Statement 9	9	18	4.11	2.89	1.05	1.81	-1.22	-2.36	-.08	.16
Statement 16	9	18	4.67	3.94	.50	1.16	-.72	-1.38	-.06	.17
Statement 25	9	18	4.89	3.44	.33	1.38	-1.44	-2.16	-.73	.41
Statement 37	9	18	4.75	3.76	.71	1.15	-.99	-1.90	-.07	.18

Table 14: Group statistics and magnitude of the differences in the means for ‘standard 8A not ideal and 8B not ideal’

4.1.3.3 Comparing standard statement by statement

This subchapter is divided further subchapters in regard to the ENJ-, MOT-, SC- and VAL-factor. The numbers in front of the statements refer to the number they appear as in the ATMI-questionnaire. The italic results in the tables indicate that the statements were not statistically significant in regard to standard (5, 6, 7, 8A and 8B). Only a few selected statements for each category are explained further.

4.1.3.3.1 Enjoyment of mathematics (ENJ)

Table 15 gives information on how the different standards (including all students in the standards regardless of age) responded to statements within the ENJ-scale.

	Std. 5	Std. 6	Std. 7	Std. 8A	Std. 8B	*p*
3. I get a great deal of satisfaction out of solving a mathematics problem	4.09 (1.28)	4.35 (1.02)	4.39 (.73)	4.68 (.47)	4.48 (.88)	.005
24. I have usually enjoyed studying mathematics in school	*4.49 (.87)*	*4.21 (1.24)*	*4.36 (.84)*	*4.43 (.94)*	*4.39 (.88)*	*.457*
25. Mathematics is dull and boring *	4.25 (1.16)	3.88 (1.48)	4.31 (1.13)	4.17 (1.26)	3.63 (1.37)	.003
26. I like to solve new problems in mathematics	4.47 (.90)	3.99 (1.40)	4.16 (1.12)	4.22 (1.06)	3.93 (1.17)	.028
27. I would prefer to do an assignment in mathematics than to write an essay	4.22 (1.05)	4.15 (1.28)	3.60 (1.27)	4.20 (1.16)	4.12 (1.21)	.003
29. I really like mathematics	4.81 (.45)	4.67 (.82)	4.46 (.99)	4.65 (.73)	4.35 (1.10)	.008
30. I am happier in a mathematics class than in any other class	*4.09 (1.10)*	*4.09 (1.34)*	*3.94 (1.13)*	*4.23 (.96)*	*3.95 (1.21)*	*.526*
31. Mathematics is a very interesting subject	*4.33 (.98)*	*4.29 (1.15)*	*4.41 (.78)*	*4.60 (.69)*	*4.40 (1.06)*	*.363*
37. I am comfortable expressing my own ideas on how to look for solutions to a difficult problem in mathematics	*4.23 (.94)*	*3.90 (1.34)*	*4.17 (.93)*	*4.26 (1.12)*	*3.99 (1.12)*	*.203*
38. I am comfortable answering questions in mathematics class	*4.57 (.89)*	*4.31 (1.21)*	*4.28 (1.02)*	*4.41 (1.01)*	*4.18 (1.11)*	*.178*
ENJ	4.29 (.54)	4.01 (.81)	4.03 (.80)	4.16 (.81)	3.97 (.70)	.043

Table 15: ENJ in the ATMI – statement for statement. Mean scores for each standard. SD in parenthesis. Statements in italic show no statistical difference in the means between standards.

*Reversed. The higher the number, the better.

The ENJ-factor was the only factor where there was found a statistically significant difference in the mean scores between the different standards. As the only factor statistically significant for standard, Table 15 shows that the ENJ-factor showed a positive increase in students' satisfaction from solving mathematics problems (statement 3) across the standards. The higher the standard, the higher the satisfaction. All standards reported scores above four (with five being the maximum possible score), and one can observe that students in standard 8A scored higher than students in standard 8B.

Students in standard 8B were the ones who reported that they found mathematics the dullest and most boring (statement 25). The results for the students in standard 8B might not come as a surprise given their situation. Despite scoring above four, students in standard 8A scored below both standard five and seven.

In response to the direct statement whether students liked mathematics (statement 29), all standards scored very highly. All standards scored well above four, and the mean score across the standards was the second highest in the ATMI, only exceeded by results from statement 1 (mathematics is a very worthwhile and necessary subject). It may appear that there was a negative correlation between standard and results, but standard 8A and 8B combined, scored higher (4.49) than standard seven.

Although not statistically significant, results indicated/showed that students in standard 5 were the most comfortable answering questions during lessons in mathematics (statement 38). Disregarding standard 8A, there appeared to be a negative trend through standard/age. The higher standard the students were in, the more uncomfortable they reported to be when answering questions during mathematics lessons. However, one cannot simply disregard standard 8A. Standard eight combined had a score of 4.29, which was slightly higher than that of standard seven. Even though the differences in these scores were not statistically significant, one must keep in mind that students in the other standards were mixed in standards A and B regardless of results. Thus, one must always remember to look at standard eight combined and separately when analysing the results.

Overall, students in standard five reported the highest enjoyment of mathematics (ENJ). Students in standard 8A scored the second highest on average, with students in standard 8B scoring the lowest. Students in standard 8B were the only ones with a mean score below four. Combining results from standard 8A and 8B, a mean score of 4.06 for standard eight was observed, which shows that students in standard eight in fact scored second highest in terms of how they enjoyed mathematics.

4.1.3.3.2 Motivation towards mathematics

Table 16 gives information on how the different standards responded to statements within the MOT-scale.

	Std. 5	Std. 6	Std. 7	Std. 8A	Std. 8B	*p*
23. I am confident that I could learn advanced mathematics	4.61 (.76)	4.51 (.96)	4.13 (1.05)	4.44 (1.09)	4.41 (.98)	.018
28. I would like to avoid using mathematics in college *	4.31 (1.00)	3.69 (1.62)	4.15 (1.15)	4.56 (.92)	4.00 (1.22)	.001
32. I am willing to take more than the required amount of mathematics	3.65 (1.40)	4.05 (1.35)	3.83 (1.24)	4.29 (1.01)	3.95 (1.22)	.029
33. I plan to take as much mathematics as I can during my education	*4.05 (1.05)*	*4.19 (1.16)*	*4.17 (.85)*	*4.43 (.80)*	*3.92 (1.20)*	*.054*
34. The challenge of mathematics appeals to me	*2.77 (1.41)*	*3.14 (1.66)*	*3.04 (1.41)*	*3.36 (1.45)*	*2.96 (1.45)*	*.201*
MOT	*3.83 (.63)*	*3.76 (.71)*	*3.63 (.91)*	*3.98 (.88)*	*3.71 (74)*	*.062*

Table 16: MOT in the ATMI – statement for statement. Mean scores for each standard. SD in parenthesis. Statements in italic show no statistical difference in the means between standards.

*Reversed. The higher the number, the better.

Statement 28 shows that students in standard six were the ones who would most like to avoid using mathematics in college. Looking at students' confidence of abilities of learning advanced mathematics (statement 23), students in standard six scored second highest. Hence, the students' beliefs of being able to learn advanced mathematics did not seem to affect whether they wanted to study mathematics in college or not.

Three standards reported scores of less than four in regard to willingness to take more than the required amount of mathematics (statement 32). Standard five, seven and 8B scored below four. However, both standard five and seven reported mean scores of above four in their plans to take as much mathematics as they could during their education (statement 33). These scores (statement 33) were not significantly different, but they might give an indication of what the situation was like. Standard 8B was the only standard which reported mean scores below four in both statement 32 and 33. A reason for this might be that these students (in standard 8B) were the students who were told/knew that they were not likely to attend secondary school. In contrast, standard 8A scored above four in both statements, and judging by their performance in mathematics, these were the students most likely to attend secondary school.

In the statement regarding how the challenge of mathematics appealed to students (statement 34), the lowest scores in the entire ATMI were found. Although the mean scores were not statistically significant for the standards, the statement gives an indication of what the situation might be like. This was the only statement where the average scores for some standards were below three. Only 10.8 percent (valid percent) of the students responded neutrally to the statement. The valid percent of the other answer options was quite evenly distributed across the answers, with valid percentages ranging from 20.6 to 23.3 percent. In other words, students perceive the challenge of mathematics quite differently.

Students' overall motivation towards mathematics (MOT) was below four across all standards. Standard eight combined, 8A and 8B, scored the highest with a mean score of 3.84. Not surprisingly, students in standard 8A scored the highest on average, with students in standard 8B scoring second lowest. Only standard seven scored below standard 8B. There seemed to be a possible connection between students' motivation towards mathematics (MOT) and the number of students in each standard, but there were no further data to support this claim. However, it was observed that 8A scored the highest, with 70 students enrolled. In addition, standard seven scored the lowest, and they had 128 students enrolled.

4.1.3.3.3 Self-Confidence

Table 17 gives information on how the different standards responded to statements within the SC-scale.

Results from statement 9 show that there was a big difference in how the students perceived the subject of mathematics. The biggest difference was found between standard six and standard 8A. If the students felt like they were struggling with mathematics, it was reasonable that this lowered their self-confidence. As a result of this, the students might have started dreading the subject. This statement had a reversed scoring, and while all the average results were above three, multiple students across the standards expressed that mathematics was one of their most feared subjects. More than 37% of students in standard 6 expressed that mathematics was one of their most dreaded subjects, compared to less than 9% of students in standard 8A. More than 31% of students in standard 8B recognized mathematics as one of their most dreaded subjects. By comparing the numbers for standard 8A and 8B, a correlation between their perception of the subject of mathematics and their results (the students with the best results were put in standard 8A) was noted.

	Std. 5	Std. 6	Std. 7	Std. 8A	Std. 8B	*p*
9. Mathematics is one of my most dreaded subjects *	3.55 (1.14)	3.33 (1.73)	3.82 (1.37)	4.33 (1.00)	3.44 (1.47)	< .001
10. My mind goes blank and I am unable to think clearly when working with mathematics *	3.77 (1.13)	3.70 (1.58)	4.19 (1.12)	4.02 (1.21)	3.37 (1.37)	.001
*11. Studying mathematics makes me feel nervous **	*3.96 (1.13)*	*4.10 (1.29)*	*4.28 (.92)*	*4.44 (.89)*	*4.20 (.91)*	*.087*
*12. Mathematics makes me feel uncomfortable **	*4.07 (1.07)*	*4.24 (1.27)*	*4.29 (.96)*	*4.25 (1.22)*	*3.88 (1.37)*	*.161*
13. I am always under a terrible strain in a mathematics class *	3.82 (1.37)	4.03 (1.34)	4.29 (.89)	4.43 (1.01)	4.09 (1.00)	.013
14. When I hear the word mathematics, I have a feeling of dislike *	4.04 (1.13)	4.01 (1.39)	4.40 (.86)	4.62 (.70)	4.14 (1.03)	.002
15. It makes me nervous to even think about having to do a mathematics problem *	4.01 (1.14)	3.42 (1.66)	4.03 (1.05)	4.32 (.95)	3.88 (1.18)	< .001
16. Mathematics does not scare me at all	*4.36 (1.03)*	*4.38 (1.21)*	*4.26 (1.01)*	*4.39 (1.02)*	*4.07 (1.29)*	*.349*
17. I have a lot of self-confidence when it comes to mathematics	*4.46 (.83)*	*4.39 (1.15)*	*4.16 (1.15)*	*4.45 (.97)*	*4.13 (1.20)*	*.142*
18. I am able to solve mathematics problems without too much difficulty	*4.17 (1.05)*	*4.32 (1.12)*	*4.05 (1.09)*	*4.14 (.91)*	*4.03 (1.10)*	*.442*
19. I expect to do fairly well in any mathematics class I take	*4.49 (.95)*	*4.24 (1.15)*	*4.53 (.81)*	*4.54 (.95)*	*4.34 (1.08)*	*.258*
*20. I am always confused in my mathematics class **	*4.12 (1.05)*	*3.94 (1.33)*	*4.17 (.90)*	*4.21 (1.07)*	*3.86 (1.24)*	*.257*
21. I feel a sense of insecurity when attempting mathematics *	3.94 (1.13)	3.47 (1.60)	4.03 (1.09)	4.15 (1.18)	3.70 (1.27)	.011
22. I learn mathematics easily	*4.53 (.82)*	*4.20 (1.25)*	*4.16 (.96)*	*4.42 (.97)*	*4.15 (1.13)*	*.073*
40. I believe I am good at solving mathematics problems	4.60 (.74)	4.45 (1.08)	4.36 (.75)	4.59 (.79)	4.17 (1.11)	.021
SC	*3.99 (.68)*	*3.83 (.85)*	*3.99 (.87)*	*4.16 (.79)*	*3.86 (.61)*	*.084*

Table 17: SC in the ATMI – statement for statement. Mean scores for each standard. SD in parenthesis. Statements in italic show no statistical difference in the means between standards.

*Reversed. The higher the number, the better.

An indication of a trend progressing through the standards in regard to how students' studying of mathematics made them nervous (statement 11), was observed. However, the difference in mean score across the standards were not statistically significant. Considering standards 8A and 8B combined, one could see an indication that the higher standard the students were in, the more nervous they felt while studying mathematics. Older students generally reported that they felt more nervous while studying mathematics. A few younger students also reported that they experienced that studying mathematics made them feel nervous, but a much higher proportion of the older students reported nervousness than the younger ones did. The data suggested that the older the students became and the higher standards they were in, the more nervous they would feel when studying mathematics. However, as the data was collected from a cross-sectional study and because of the lack of statistical significance, the data from this case could not be used to prove the preceding hypothesis.

The statement which addressed self-confidence directly (statement 17), indicated a negative trend across the standards (the results were not statistically significant). Disregarding standard 8A, there seemed to be a negative correlation between standard and students' perception of self-confidence. The higher standard the students were in, the lower their perception (of their self-confidence in mathematics) seemed to be. It appeared that the students' self-confidence declined with age, but the dataset did not give enough information to prove this hypothesis.

The degree to which students rated their ease of learning of mathematics (statement 22) seemed to decline with age/standard (the results were not statistically significant). With an exception of standard 8A, the results showed that the students learned mathematics more easily in the lower standards. However, all standards scored are above four, which indicated that the great majority of students experienced that they learn mathematics easily.

Statement 40, regarding students' beliefs about solving mathematics problems, indicated the same as statement 22. The students in the lower standards believed that they were better at solving mathematics problems than the students in the higher standards did, with 8A as an exception. Students in 8A knew that they were amongst the best students in standard eight, and it was therefore understandable that they also believed that they were good at solving mathematics problems.

Overall, students in standard 8A scored the highest in the Self-Confidence (SC) scale. These were contrasted with the students in standard 8B who scored the second lowest. Overall, there was no correlation between which standard students were in and their reported self-confidence.

4.1.3.3.4 Value of mathematics

Table 18 gives information on how the different standards responded to statements within the VAL-scale.

	Std. 5	Std. 6	Std. 7	Std. 8A	Std. 8B	*p*
1. Mathematics is a very worthwhile and necessary subject	*4.75 (.43)*	*4.67 (.58)*	*4.65 (.56)*	*4.87 (.34)*	*4.68 (.60)*	*.062*
2. I want to develop my mathematical skills	4.21 (1.06)	4.49 (.83)	4.56 (.61)	4.85 (.36)	4.49 (.66)	< .001
4. Mathematics helps develop the mind and teaches a person to think	4.14 (1.11)	4.33 (1.10)	4.61 (.67)	4.74 (.57)	4.55 (.79)	< .001
5. Mathematics is important in everyday life	3.69 (1.33)	3.96 (1.35)	4.01 (1.06)	4.42 (.76)	4.09 (1.16)	.007
6. Mathematics is one of the most important subjects for people to study	*4.31 (1.17)*	*4.34 (1.20)*	*4.47 (.86)*	*4.52 (.76)*	*4.48 (.81)*	*.608*
7. Secondary school mathematics courses would be very helpful no matter what I decide to study	*3.29 (1.48)*	*3.52 (1.62)*	*3.55 (1.20)*	*3.79 (1.18)*	*3.43 (1.14)*	*.256*
8. I can think of many ways that I use math outside of school	3.09 (1.43)	3.78 (1.52)	3.67 (1.21)	4.00 (1.19)	3.86 (1.14)	< .001
35. I think studying advanced mathematics is useful	4.60 (.86)	4.39 (1.05)	4.22 (.99)	4.47 (.95)	4.15 (1.12)	.032
36. I believe studying mathematics helps me with problem solving in other areas	4.14 (1.14)	4.07 (1.37)	3.48 (1.24)	3.91 (1.17)	3.83 (1.29)	.006
39. A strong mathematics background could help me in my professional life	*4.59 (.77)*	*4.40 (1.09)*	*4.48 (.99)*	*4.57 (.84)*	*4.33 (.99)*	*.413*
VAL	*3.98 (.58)*	*4.04 (.70)*	*4.05 (.62)*	*4.18 (.88)*	*4.09 (.64)*	*.490*

Table 18: VAL in the ATMI – statement for statement. Mean scores for each standard. SD in parenthesis. Statements in italic show no statistical difference in the means between standards.

A positive trend in students wanting to develop their mathematical skills (statement 2) was observed. From standard five to eight, it appeared that the higher standard the students were in, the more they wanted to develop their skills in mathematics. Students in standard 8A had the highest desire to develop their mathematical skills and students in standard 8B had as low desires as students in standard six. However, when students in standard eight (8A and 8B) were combined as a whole, standard eight combined had the highest desire to develop their mathematical skills of all the standards.

Students' beliefs that mathematics helps develop the mind and teaches a person to think (statement 4) also appeared to progress positively with standard/age. The higher standard the students were in, the higher their beliefs towards this statement were. As in statement 2, students in standard 8A had the highest beliefs, and students in standard 8B were in this case ranked below standard seven. Nevertheless, students in standard eight combined as a whole (8A and 8B) were the ones who scored the highest.

The mathematics in everyday life (statement 5), was regarded as more important by the students in the higher standards. Perhaps the students understood the importance of mathematics better with age. In contrast from results in statement 2 and 4, students in standard 8B generally scored higher than students in all the lower standards. Although students in standard 8B scored higher than the lower standards, students still scored higher in standard 8A than in standard 8B.

There appeared to be general agreement that mathematics was one of the most important subjects to study (statement 6) (the results were not statistically significant). The results from all standards were above four, which was very high. The differences in the results from the different standards were minimal, but there was a slight increase in results for the higher standards. Again, standard 8A scored the highest and standard 8B scored above all the lower standards. Although not statistically significant, the results might give an indication of how the situation was.

Results from statement 7 indicated that there might be a positive correlation between students' standard/age and students' beliefs about mathematics courses and their usefulness (the results were not statistically significant). Combining the results for standard 8A and 8B gave a mean score of 3.59. The results show that students perceived secondary school mathematics courses as more helpful the higher the standard they were in. Students in standard 8B were less positive than students in standard six and seven, and all results/averages were between three and four.

Few students in standard five could think of ways to use mathematics outside of school (statement 8), compared to students in the higher standards. Students in standard six, seven and 8B scored quite similarly, and students in standard 8A scored the highest once again. Students in 8A were the only ones to score above four on average for this statement.

All standards reported that they thought studying advanced mathematics was useful (statement 35). However, a negative correlation with standard was observed. The higher the standard the students were in, the lower they scored (students in lower standards believed studying mathematics to be more useful than students in higher standards believed). Standard 8A was the only exception, and students in standard five were the only ones who reported higher scores than students in standard 8A.

Overall, all standards, except standard five, had an average VAL-score of more than four. An increase in the value of mathematics along the standards was observed. The higher the standard, the higher the students reported to value mathematics. Students in standard 8A scored the highest, with students in standard 8B following closely behind.

4.2 The open question survey

The first boy and girl who finished the ATMI-questionnaire in each standard were asked to complete an additional survey. The additional survey consisted of four open-ended questions regarding motivation (appendix 2). The results from the open question survey are presented in different tables for each question (Table 19 – Table 22).

The students who answered the open question survey were of different age, and in different standards. All but one of the students were within the standardized age in relation to the standard they were in. The boy in standard 8B stood out in regard to age, as he was five years above the standardized age. It is likely that the students within the standardized age had followed a standardized progression without having to repeat standards. It is also likely that the boy in standard 8B had repeated several standards and/or started school at an older age than others. However, there was no data as to when the students started going to school, and no information about how many years/standards the students had repeated (if any).

Std.	Age	Gender	How can the school or teachers increase your motivation towards mathematics?
5A	9	Boy	Teachers can motivate us in various ways, for example they can encourage us in mathematics lessons and also give us advice on how to solve problems
5A	10	Girl	They can distribute mathematics books
7A	13	Boy	The school or teachers they should agree with us that we should work hard so we can understand the subject of mathematics and we can pass the examination because of maths
7A	13	Girl	By encouraging students when solving mathematics problems
8A	13	Boy	(Blank answer)
8A	13	Girl	They have to do revisions each and every day
8B	19	Boy	Mathematics is very important subject therefore teachers should encourage us in class
8B	13	Girl	Teachers should be interested in every student and make sure they all understand in class

Table 19: Question 1 from the open question survey: "How can the school or teachers increase your motivation towards mathematics?"

In response to how the schools/teachers could increase the students' motivation towards mathematics, the students expressed several motivational factors, both intrinsic and extrinsic. Some of the students expressed that they might be motivated (intrinsically) if they received help with understanding the subject, if they got enough revisions, and if they got advice on how to solve problems. The students also expressed that they might be motivated (extrinsically) by encouragement from the teachers, if they were given books, and if the teachers helped them pass their exams. The students seemed concerned with the motivation of others, which was expressed further with the students' request for teachers to show interest in every student and assuring them that everyone understood what was being taught.

Std.	Age	Gender	How can you as a student increase your motivation towards mathematics?
5A	9	Boy	By paying attention to what our teachers and parents tell us, and not missing school
5A	10	Girl	By paying attention when learning mathematics
7A	13	Boy	I can solve the mathematics and understand that I have to hear the mathematics subject. Also I should work hard for mathematics
7A	13	Girl	By paying attention to teachers when teaching, and practicing to solve mathematics problems that we find difficult
8A	13	Boy	We can be motivated if the teachers like us students and teach us well. They should also encourage us all the time.
8A	13	Girl	I as a student can increase my motivation towards mathematics by making mathematics groups.
8B	19	Boy	I can motivate myself by working hard and practicing to solve mathematics at home after school
8B	13	Girl	We can increase our motivation by learning mathematics because it improves our reasoning

Table 20: Question 2 from the open question survey: "How can you as a student increase your motivation towards mathematics?"

When asked what the students could do in order to increase their own motivation, they mostly responded that they should increase their effort in mathematics. The students reported that they could increase their motivation if they paid more attention and worked harder. If they got a better understanding of the subject, they would get an increase in motivation. They also stated that presence in school, working in groups, as well as doing one's homework was important in regard to staying motivated and increasing one's own motivation towards mathematics.

Std.	Age	Gender	Is it important to stay motivated towards mathematics? Why/why not?
5A	9	Boy	It is important to be motivated because if motivated then learning is interesting
5A	10	Girl	Because I want to get a job that involves or uses mathematics
7A	13	Boy	Yes it is important to stay motivated towards mathematics because it helps us to realizing it fast to work when we are working.
7A	13	Girl	Yes, because mathematics is very important because it helps us to think good. It helps us to account and many more. Yes because mathematics is very useful and improves our reasoning, and also makes us good in calculating and counting money and many other things
8A	13	Boy	It is important to stay motivated towards mathematics because it helps in everyday life.
8A	13	Girl	Yes. It is important to stay motivated towards mathematics because it helps one to think fast and critically
8B	19	Boy	It is important to be motivated because if I am good in mathematics then I will be good in many things and nobody can cheat me
8B	13	Girl	Mathematics helps us reason properly

Table 21: Question 3 from the open question survey: "Is it important to stay motivated towards mathematics?"

The students gave miscellaneous responses as to whether it was important to stay motivated towards mathematics or not. They all agreed that it was important, but they listed different reasons for why it was important. While some argued that being motivated helped in regard to job prospects regarding mathematics, others argued that being motivated could make learning interesting. The students gave reasons based on both intrinsic and extrinsic motivation. Students reported that staying motivated helped with fast/critical thinking, better reasoning and that motived students had an advantage ahead of other students.

Std.	Age	Gender	Do you have anything to add?
5A	9	Boy	I can only add that I am very thankful
5A	10	Girl	I want visitors to be coming regularly
7A	13	Boy	Yes there is one thing we should also tell the government to build more schools so that more children will know the importance of school.
7A	13	Girl	No.
8A	13	Boy	I can add that we should always work hard in school.
8A	13	Girl	Yes the teachers have to train us for example giving us homework, mental sums I think that will work.
8B	19	Boy	I have nothing to add but I just pray that God gives me more ability to reason logically
8B	13	Girl	No

Table 22: Question 4 from the open question survey: "Do you have anything to add?"

The last question, "Do you have anything to add?" gave valuable information. Firstly, it showed that the students were excited to take part in the study with people visiting their school. The students were happy to have visitors at their school, and one must keep in mind that this might have resulted in response bias in the questionnaires. Secondly, students' concern for other peoples' well-being was once more noticed. The students remarked the importance of school and wanted everyone to share the same benefits. When they remarked the importance, they also showed appreciation of what they already had. Thirdly, the students' positive mentalities were noted. The students proclaimed that they should always work hard in school, and this showed a positive attitude towards school in general.

4.3 The interviews

The interviews with the teachers gave information regarding attitudes and surrounding factors from the teachers' perspectives. More specifically, the interviews gave insight into the teachers' opinions and views upon their own teaching and facilitation of positive attitudes. They served as a supplement to the other gathered data (questionnaires and observations). Based on a certain level of interest, only a few selected transcripts are included

The interviews are sorted by the interview subjects – the head teacher, the mathematics teacher in standard five, and the mathematics teacher in standard six. In the transcripts, "(…)"

symbolized omitted text. Text was omitted in cases where it was regarded as superfluous and/or irrelevant.

4.3.1 The head teacher

When the head teacher was asked about his understanding of the word motivation, he started talking about extrinsic motivation. He described motivation as an incentive to keep working with mathematics.

Interviewer	What is motivation?
Head teacher	Motivation means the way (…) you give praises or give something so that he should not stop whatever he was doing (…)
Interviewer	Ok. Thank you. What do you know about student motivation?
Head teacher	(…) if two or three learners are doing good, they have performed good in class, you give them something, a token, (…) in order to encourage them you give them something. You praise them, you buy some exercise books. If at all there are some learners who have maybe one dress, (…) if you have money, you can buy a dress for her so that she'll keep on coming to school daily.

The head teacher spoke of encouragement of those who were doing well, but he did not mention any motivation for the struggling students. His prime way of motivating students who were doing well was to give them physical rewards. When he was asked about training in student motivation, he informed that they focused mainly on external rewards.

Interviewer	Do they tell you how to motivate the students in any way?
Head teacher	(…) at school level, in order to motivate somebody, a learner, the people, a child, you need to give them something in their class whenever they are doing good.

The head teacher never mentioned intrinsic motivation. Perhaps this could be because he as a head teacher was responsible for the economy of the school and felt inclined to answer in regard to physical rewards. He knew that other teachers were also being interviewed, and perhaps he from his stance only handled physical aspects of motivation at the school.

Interviewer	So do you think the students at this school are motivated to learn?
Head teacher	(…) Sometimes we sit down, the teachers, and discuss what are we going to do with those learners who have scored positions one, two, three and we discuss – "ok, let us give them exercise books" in the presence of all the learners. Then we call them, for example number one and we mention their name, and she or he comes forward to receive the exercise books or pencils.

The head teacher kept talking of extrinsic motivational factors, and motivation based on who had the best results in each standard. It was interesting to learn that the school publically listed the students by results from their exams.

When asked about the motivation of the teachers, the head teacher once again talked of extrinsic motivation. He explained that he was scared of failing to see when teachers were doing a good job, and he was afraid of jealousy amongst the colleagues. Because of this, he informed that he tried to give praises in secret.

Interviewer	How are the teachers motivated to teach?
Head teacher	All right, sometimes we discover that there are certain teachers who are hard workers and in order to motivate them, sometimes we assemble, but sometimes it seems we are favoring a group of people. So we just maybe call them individually, secretly, and tell him or her that "I feel you are doing good. Your class is performing well. Have these exercise books and give them to your learners who are learning some."

4.3.2 The teacher in standard five

As opposed to the head teacher, the teacher in standard five talked of intrinsic motivation (as well as extrinsic motivation). The teacher noted that being aware of one's teaching method was important, and that praising students and talking to them was important for them to stay/become motivated. The most important motivational factor, that students should be aware of what they were doing, showed that the teacher valued intrinsic motivation above extrinsic motivation.

Interviewer	Is there a way teachers can motivate their students?
Teacher, std. five	Yes, there are some ways that we can motivate them in terms of how we teach, how we praise and how we talk to them.
Interviewer	What do you think is the most important factor for students to become motivated?
Teacher, std. five	I think the most important issue to motivate the learners is that the teachers and students should be aware of what they are doing in class

4.3.3 The teacher in standard six

The teacher in standard six mentioned that he wanted to give the student gifts and praises (extrinsic motivation), but he also spoke highly of pairing the students in groups for them to become/stay motivated. He wanted the students to understand the subjects being taught, and he reflected upon advantages and disadvantages occurring through group work.

Interviewer	What do you believe are motivational factors that help increase students' motivation towards mathematics?
Teacher, std. six	Giving them gifts and praising them are one of the motivation factors. The other one is if the learner has got problems. You can put them in groups. Those who can not do the thing, slow learners, you have to choose someone who is a fast learner to lead that group.
Interviewer	Ok, so you combine slow learners and fast learners?
Teacher, std. six	Yes, so that they do the things together. In so doing, the others may have a chance of catching up. (…)
Interviewer	Do you think that can also be good for the fast learners in any way?
Teacher, std. six	Yes, it's good because they are able to, they feel like they are leading and teaching their friends. So it is a booster to them. (…)

Teacher, std. six	Although somehow, those who are lazy become lazy. They are motivated, but they don’t have the instinct to do the thing. Some, they have got maybe negative attitudes towards mathematics. They think “I can not do well in mathematics”.

The teacher also mentioned counseling the students, and together with prizes, he underlined the importance of both intrinsic and extrinsic motivational factors. While some factors might work for some, a teacher should always know of different ways of motivating his students.

Interviewer	How will you try to change their attitude so they think they are able to do it?
Teacher, std. six	We council them, and somehow, in the presence of others, if you give a prize to someone, the others do have the will to maybe work hard so that “tomorrow I receive that”.
Interviewer	When a student has to retake a year because they fail their exams, do you think they are more or less motivated?
Teacher, std. six	Yes, they are motivated because they are able to catch up with, and they are able to; let me say, they improve. Their standard improves. When he is repeating he is able to rectify some of the mistakes that he made. He or she made.

The teacher in standard six (and teachers in other standards) often used the term “slow and fast learners”. They were not afraid of using the terms in front of students. Perhaps this was thought of as a way of motivating students to work harder, but it might just as well have served as a demotivating factor. Being labeled as a “slow learner” by the teacher in front of others might have been regarded as humiliating and degrading and as a negative extrinsic motivational factor (fear of failure), whilst being labeled as a “fast learner” in front of others might have served as a positive extrinsic motivation.

When asked about the teachers’ motivation to do their job, the teacher gave a negative response. This prompted further consideration as to whether teachers were able to motivate their students if the teachers themselves were not motivated, whether they could facilitate intrinsic motivation if they lacked interest themselves, and what was needed for teachers to motivate students. Perhaps a possible explanation for the lack of motivation in teachers was a result of the head teacher motivating teachers secretly.

Interviewer	Are you as a teacher motivated in your work?
Teacher, std. six	Not really. Not really.
Interviewer	So you're not motivated to teach?
Teacher, std. six	We are, but not really. We don't have any incentives which we are given, apart from the salary which we get.

4.4 Observations

The following observations were general observations that were observed repeatedly unless stated otherwise. The subchapter is divided into further subchapters concerning lessons in the classrooms (chapter 4.4.1), students with special needs (chapter 4.4.2) and available resources (chapter 4.4.3).

4.4.1 Lessons in the classrooms

There were often two teachers in the classroom at a time. However, the lessons often started a lot later than scheduled. It was not uncommon that the teachers arrived late, and it was observed on multiple occasions that the teachers were up to 30 minutes late. When the teacher finally arrived, he started teaching right away without giving any reason for his late coming. At the start of the first lesson of each day, the teachers noted the number of students present/absent on the chalkboard. These numbers also showed the number of students enrolled in each particular class with the distribution of boys and girls. This was likely done to uncover absenteeism and was likely performed as a measure to avoid students being absent.

New lessons usually started right after the end of a lesson, with the exception of two breaks each day. The breaks lasted 15 and 20 minutes. Most lessons started with the teachers giving examples on the chalkboard. The lesson then proceeded to individual task solving, where many students were observed copying their neighbours' work (this was difficult for the teachers to prevent when the students sat so densely). During the lessons, the teachers often let students answer problems in plenary. Sometimes the students had to answer in front of the class regardless if they volunteered or not. When a student showed his solution on the chalk board, the teacher often went on to ask the class whether the student was right. The whole class collectively shouted yes or no. Perhaps this could serve as a motivating/demotivating factor when the students answered yes or no. If the student showed a correct solution, the teacher made the class clap for the students. This praise was extrinsic, but served as a motivating factor in the classroom. If any students laughed at, or disrespected students in other ways, the teachers put the disrespecting students in place. The teachers did not tolerate any disrespecting students in the classroom.

Teachers corrected students' homework and schoolwork at the same time as students did individual task solving. The teachers asked the students who had completed task one and so on. The teachers received the students' books and assessed them continuously. It was observed that the teachers never managed to correct all the students' homework, so some students had to hand in their homework at the end of the lesson. This was problematic for some students, as they only had one exercise book. If they handed it in at the end of the day, they could not perform any written homework assignments that day. Because of this, and possibly because they wanted to be seen by the teacher, the students were always eager to show their work/books.

The teachers repeatedly asked the students if they understood, and it appeared that they wanted everyone to follow what they were doing before proceeding. However, it did not seem like the teachers took notice of those not responding "yes". This method of including all students seemed more like a rehearsed routine than a practical tool. In some classes the students dared to ask a lot of questions, while students in some classes seemed to fear the teachers. Perhaps the students were afraid of being labelled as "slow learners" if they expressed that they did not understand what was being taught. Teachers repeatedly said things like "if you don't understand the question, you are not a mathematician" and "are you in standard one?". These examples were overheard while observing a mathematics lesson in standard eight.

On multiple occasions, the teachers disappeared from the lessons without warning while the students were doing individual tasks. On one occasion, one teacher (who was the only teacher in class at that time) disappeared half an hour without giving reasons for his absence to his students. The students did not comment on the teacher's absence. It appeared that this happened regularly, and the students did not express that they minded the teacher being absent.

Interestingly enough, the noise in the classroom seldom increased a lot with one or two teachers missing in the lessons. On two occasions, students were observed sleeping during the lessons. The reason for this was unknown, but it was an interesting observation.

4.4.2 Students with special needs

Most classes had some students with special needs. The students with special needs were placed in classes with "normal" students to be integrated. While observing lessons, students with special needs were presented in front of the whole class. Having special needs was not presented as a negative feature, but merely a different characteristic. A teacher specializing in special needs at the school stated that "we are all born different", and he tried to put forward good attitudes amongst the students as he tried to include everyone. This teacher also did follow-ups of the students and tried to accommodate them in school.

The special needs teacher at the school expressed that they (the school) did not want students to be in the same standard three years in a row, as this could cause negative attitudes towards the subjects and towards attending school in general. Sometimes they had to make exceptions. If a struggling student knew the basics, he might be given the opportunity to proceed to the next standard even if he did not meet the requirements from the examinations. The teacher informed that repeaters had a lower threshold to proceed to the next standard so that the school did not end up with more "slow learners", often regarded as students with special needs. However, being able to repeat a standard was thought of as the school giving a student extra lessons and was seldom regarded as negative.

4.4.3 Available resources

There was observed a huge lack of resources at the school, both for the students and for the school in general. No students were observed with a ruler, and many students shared a single pen. Several students did not have notebooks (often referred to as exercise books), and many students had to write on advertising leaflets.

Not only was the school in a poor condition and needed maintenance, but they could also have benefited from more learning materials. For example, they did not have abaci/counting frames. Instead, they had pictures of abaci, and the students were asked to draw their own abacus as a supporting material (the teachers thought this visualization would help the students). The school had a few self-produced clay abaci, but these were in bad shape, and they had only three or four beads on each wire. The clay abaci possessed by the school were not good for learning the decimal system. The lack of adequate resources affected the students’ attitudes, but the students appeared to be content with what they had. They cherished what they had and did not complain of any lack of resources.

5. Analysis and discussion

In this chapter, the data from the previous chapter (chapter 4) is analysed and discussed in regard to the theoretical framework (chapter 2). The discussion should not be considered a solution that can be applied to all schools, teachers and students. It should merely be used as a matter for reflection upon one's own facilitation/acquirement of positive attitudes towards mathematics. It is worth noticing that while this is from a perspective of a Malawian school system and culture, the analysis can be used as a tool to compare attitudes towards mathematics across differing cultures.

The research questions are addressed and discussed in separate subchapters. Although this discussion cannot be said to hold all answers, it can hopefully contribute to a tiny part of understanding students' attitudes towards mathematics in a Malawian context.

1. Which factors affect children's attitudes towards mathematics in Malawi? (chapter 5.1)
2. To what extent can the factors *gender*, *age* and *grade/standard* be used to generalize claims regarding students' attitudes towards mathematics in Malawi? (chapter 5.2)
3. How can teachers in Malawi facilitate various motivational factors in their mathematics teaching? (chapter 5.3)

Within the subchapters, the findings are also discussed in regard to expected and unexpected results, comparison to previous research, possible implications for future research, and potential needs for future research.

5.1 Factors affecting children's attitudes towards mathematics in Malawi

The research data in this chapter is mainly from the qualitatively collected data (open question survey, interviews of the teachers and observations). Multiple factors seem to affect children's attitudes towards mathematics in Malawi. This chapter does not discuss the effect of the factors gender, age or grade/standard as they are discussed thoroughly in subchapter 5.2. While some factors are likely to affect students' attitudes towards mathematics across multiple geographical/cultural contexts, a few results appear to be contextually dependent for Malawi and the LMIC. Knowing that attitudes are related to achievement and affective outcomes (Zan et al., 2006), one can notice how important the motivation for students are in regard to how positive their attitudes are towards mathematics.

While there is a huge difference in how students regard the subject of mathematics, they are motivated to work hard in different ways, as evidence in the qualitative data from question two of the open question survey (chapter 4.2) and the observations (chapter 4.4) present. Some students work hard because of their high interest in the mathematical activities themselves, while others are more extrinsically motivated. Students' desires of rewards and praises from the teachers might make them work harder. However, hard work is not necessarily always related to positive attitudes towards mathematics. This is debatably partially in conflict with the findings of Mullis et al. (2001), that there is a clear connection between students' PATM and their performance in mathematics. Though hard work often pays off in regard to obtaining better results, resulting in more positive attitudes, many external factors also affect the students' attitudes towards mathematics. The way students value the subject is important in regard to how much effort they decide to put into working with mathematics.

Extrinsic factors, such as a lack of resources (pens, exercise books et cetera) can be expected to affect the students' attitudes negatively, but results from the observations (chapter 4.4) in the Malawian context indicates that the lack of resources also seems to affect students' attitudes positively in some ways. Though having more resources available is certainly preferable, the students seem content with what they have. That does not mean that they do not wish for more, but they hardly ever seem to complain. From results in question 3 in the open question survey (chapter 4.2), it appears that working hard can be a way of compensating for the lack of resources. By working hard, students increase their future opportunities, such as future education and jobs, which in turn will likely benefit the students financially, and thus they obtain more resources. Striving to reach certain goals is not unique for Malawians, but as Malawi is one of the LMIC, Malawians are more likely to experience lack of basic resources than those in richer countries. Thus, students' motivation to obtain certain goals and attain certain resources might increase in comparison to those who experience that they have all the basic resources that they need.

Understanding the subject of mathematics or certain areas within mathematics should increase a student's attitude towards mathematics, according to the interviews (chapter 4.3). With an increased attitude, the student is likely to spend more time doing what he likes. In time, this should increase the performance of the student, and perhaps even increase his attitude even further. Students who do not understand the subject or areas within the subject might also decide to spend more time on the subject to catch up. However, if their increased amount of work does not result in better understanding and performance, their attitude is likely to worsen. The observations (chapter 4.4.) indicate that positive self-concepts appear essential for positive attitudes. This fits well with the findings of Mullis et al. (2001), i.e. that there is a clear correlation between students' SCM and their achievement in the subject.

Self-conception is closely linked to self-efficacy. When students believes that they can perform well and/or reach a certain goal, they are likely to strive harder to perform well in the subject. Making the students believe in themselves is therefore very important. Perhaps students and teachers could set fitting achievement goals together. However, doing this for every individual student would demand a lot of resources (time and money). Whether schools decide to set individual achievement goals for their students or not, it is still their job to ensure that students' confidence and interest in mathematics increases. If the students lack confidence, their fear of failure is likely to result in negative attitudes towards the subject.

Surprisingly, the degree of how students enjoy working with mathematics (from the quantitative data in chapter 4.1) does not seem to have a very big effect on attitudes for those who dislike the subject. Although the results indicate that there is a decrease in the enjoyment of mathematics in regard to students' age (chapter 4.1.2), most students in the Malawian context still appear positive towards mathematics. Their attitudes are likely positive because they value the opportunity of being able to attend school. While teaching is said to be a cultural activity (Stigler & Hiebert, 1999), attitudes towards mathematics might be as well. Perhaps the enjoyment of performing mathematics does not need to trigger the same attitudes in people in different contexts. While enjoyment (or the lack of it) certainly trigger attitudes in *some* ways, one must remember that one factor never solely explains the students' attitudes.

Finding that the attitudes of the students in Malawi appeared as they did, was unexpected. The attitudes seemed a lot more positive than anticipated by the researcher before the study started. Having believed that the attitudes would be deeply affected in a negative way by the country's socioeconomic situation, it was surprising to see so many students with positive attitudes towards mathematics. Through the qualitative data (open question survey, interviews and observations) and the quantitative data (the ATMI), it seemed that liking mathematics was trendy. This differed vastly from personal experience and led to further questions in regard to making mathematics trendy in other contexts. Investigating whether one can learn anything from a Malawian case that is transferrable to other contexts in regard to making mathematics trendy would be an interesting area of investigation for another study.

In Malawi it appears that people are proud of their results and their attitudes, based on the open question survey (chapter 4.2), the interviews (chapter 4.3) and the observations (chapter 4.4). As explained by Mullis et al. (2001), many cultures have cultural traditions of modesty. The open question survey, the interviews and the observations conducted in this study indicate the contrary. Sandemose (1933), suggests an unspoken law (law of Jante) that exists in Nordic culture on how students criticize each other. For the Malawian context and the students observed in this study, it appears that Malawi and possibly other LMIC could reverse this law to relate to their own context. Anyway, in a reversed form it can serve as a motivational law.

The reversed law of Jante would be:

1. You are to think *you* are special.
2. You are to think *you* are as good as *we* are.
3. You are to think *you* are as smart as *we* are.
4. You are to imagine yourself as better than *we* are.
5. You are to think *you* know more than *we* do.
6. You are to think *you* are more important than *we* are.
7. You are to think *you* are good at everything.
8. You are to laugh with *us*.
9. You are to think everyone cares about *you*.
10. You are to think *you* can teach *us* anything.

Modified and reversed form from the original (Sandemose, 1933, p. 85)

Using the law of Jante as a motivational law can serve as a factor to increase students' self-concept and self-efficacy beliefs. If the students believe in themselves, they will be better suited for competing for the few places in secondary school. As a limited amount of students are accepted into secondary school (Susuwele-Banda, 2005), the competition aspect is pressing, and students are required to compete and rise above each other. Letting other people push you down is not an option, and it appears that the competition aspect is closely linked to students' attitudes towards mathematics.

This study has only shed light on some of the many factors affecting children's attitudes towards mathematics in Malawi, from one particular school. If this study was to be repeated, it would be interesting to measure attitude over time and determine which factors were the most important in regard to attitude. It would also be interesting to measure attitudinal factors in regard to students' performance in mathematics and see whether there was a change in attitudes in regard to results over time. A comparative analysis with other schools or contexts would also be highly interesting. Would the results be the same, or would different attitudinal factors appear?

5.2 Generalizing claims regarding students' attitudes towards mathematics in Malawi through gender, age and grade/standard

The ATMI gives a quantitative material analysis of the factors gender, age and standard, and it gives a different understanding from the factors analysed qualitatively in subchapter 5.1. This subchapter is divided into further subchapters in regard to gender (chapter 5.2.1), age (chapter 5.2.2) and grade/standard (chapter 5.2.3). Age and standard are often closely linked, but they also have their differences. Students are at different levels of cognition and experience, and because some students are repeating standards, the ideal/standardized age becomes important in the analysis.

5.2.1 Generalizing claims regarding gender

The lack of statistically significant differences in attitude between genders corresponds well with the findings of the mathematics benchmarking report from TIMSS 1999 (Mullis et al., 2001). From this study, there is no indication that gender plays a significant role in students' attitudes towards mathematics in Malawi. In correspondence with TIMSS 1999 (Mullis et al., 2001), there are only a few significant cases within the ATMI (statement 9 and 30) where boys and girls score differently. However, because less than two percent of the variance is explained by gender in these cases, there may be other underlying causes for the statistically significant differences.

Assuming that there are no other underlying causes for the statistically significant differences other than gender, one can ask why girls appear to perceive mathematics as a more dreaded subject than what boys do (statement 9 in the ATMI). Perhaps there are other subjects being taught at the school that appeal stronger to girls than boys? Perhaps boys are expected to like mathematics more than girls? Perhaps the girls are simply more honest than boys? There are many possible reasons for girls reporting to dread mathematics more than boys, and it could be interesting to investigate this factor further in future research. The same applies to how girls report that they are happier in mathematics classes than in other classes (statement 30 in the ATMI). One can ask why girls are reportedly happier than boys in mathematics classes and how this compares to dreading the subject. Perhaps the difference lies in the students' self-confidence? There are many possible explanations, and the differences in result might just be a result of response bias from how the statements are formulated.

The lack of difference in gender in regard to attitudes can give researchers valuable information. The results are in coherence with previous research on the topic of attitudes towards mathematics (Mullis et al., 2001). The fact that the students' attitudes do not appear to differ based on their gender might be because they are treated equally at school and in society. One might think that equal attitudes can mean little discrimination based on gender at school and in society in general, but the research in the Malawian context is not substantial enough to support this claim. While gender discrimination was not observed in the Malawian case, it is clear however, that other countries experience gender discrimination in certain areas. It can therefore be understood that the similar attitudes of boys and girls are not likely to be linked to gender discrimination. However, it may be interesting for teachers to know that students' attitudes are no different based on gender when the teachers plan on how to facilitate positive attitudes amongst the students.

5.2.2 Generalizing claims regarding age

The wide age range across the standards give a good basis for understanding differences in attitudes across students' age. While the ATMI suggests that students' enjoyment of mathematics and attitudes towards mathematics in general might stagnate with age, this may be because of the students having to repeat one or more standards. The older the students are compared to the rest of the students in their standard, the more likely they are of having repeated one or more years/standards. Perhaps a possible explanation can be that repeating standards might affect students' attitudes towards mathematics negatively. Perhaps age is not the sole factor for the decrease in enjoyment of mathematics and attitudes towards the subject in general. If it is so that repeating standards affect the students' attitudes negatively, it might be that students' enjoyment of mathematics and overall enjoyment towards mathematics only stagnates with age for those who are repeating standards.

While there is an indication (with no statistical significance, $p = .061$) that motivation stagnates with age (chapter 4.1.3.3.2), there might be a connection between students repeating standards and loss of motivation. Perhaps the motivation can be seen in regard to the enjoyment of mathematics. If the students have less enjoyment of the subject, this might reduce their motivation to work with the mathematics. Pintrich and De Groot (1990) discuss how motivational differences can influence self-regulation and students' participation cognitively, and it may appear that the effects of motivation works both ways in the Malawian case. While students have different levels of cognition depending on their age and their experiences (positive and negative), their motivation is likely to be affected. This is seen in the apparent stagnation of motivation with age, in regard to students repeating standards (chapter 4.1.3.3.2).

The previous examples argue that being older than the standardized age might be negative in regard to students' attitudes, but what about those who are below the standardized age? It is easy to believe that these students are more motivated as they are likely to have better results than other students of their own age, but it is important that they are not forgotten. With the wide age range in the classroom (Table 4), it might be a problem to fit in socially, which in turn will affect a student's attitude towards school in general, and perhaps towards mathematics. The wide age range appears to be problematic in various ways, but with a good facilitation of positive attitudes in the classroom, the students might put their age aside and work happily with the mathematics together. Pairing students of different ages in groups might be beneficial in order to overcome differences, but pairing the students should be done with caution. A teacher should know his students and have a plan for how he organizes group work. Knowing how and which students can be of help to others is important in order to benefit from working together. When working on the same subject, age does not have to be a hindrance for good learning. If the students function together cognitively, the age aspect does not have to be an issue.

5.2.3 Generalizing claims regarding grade/standard

Many variables seem to affect the different standards and the students' attitudes within the standards. While investigating the effects of standard in regard to students' motivation towards mathematics, it seems essential to divide the students into groups according to what age they are and what age they should be in the different standards (chapter 4.1.3.1). Another factor which is unique for each standard is their mathematics teacher. Perhaps this is one of the reasons why the enjoyment of mathematics is reportedly different across the standards. Although the students follow the same curriculum, the teachers might facilitate learning and positive attitudes in different ways. This might lead to differences in enjoyment across the standards. However, the enjoyment-factor is only statistically significant different when viewing standard 8A and 8B separately. There might be many factors contributing to the differences, but the data shows that there is a significant difference in the enjoyment of mathematics between standard 8A and 8B, and they have the same mathematics teacher. Because of this, a deeper investigation into the differences of standard 8A and 8B is in order.

In correspondence with previous research and the anticipations for this study, the students who know that they have the highest results also report the most positive attitudes towards mathematics (Mullis et al., 2001). In addition to scoring the highest in all the different categories (VAL, ENJ, MOT, SC and ATT), it is interesting to observe that students in standard 8A score higher than students in standard 8B in all 40 statements of the ATMI (chapter 4.1.3.3). A higher self-confidence in standard 8A is to be expected when the students are repeatedly told that they are the best students. This should motivate them towards mathematics, as being the best increases their chance of attending secondary school. The fact that the differences are not statistically significant in how students value the subject of mathematics and how they enjoy it, might be an indication that even though the students have differing results, they still see the value of learning mathematics and experience the satisfaction associated with it.

Though the group of students outside the standardized age did not reveal significant differences across the different categories (VAL, ENJ, MOT, SC and ATT), the major differences in statement 9, 16, 25 and 37 witness of students perceiving mathematics very differently depending on their performance (chapter 4.1.3.2). It appears that students' attitudes are more positive when they are told that they are amongst the cleverest students. Perhaps their higher performance in mathematics gives them hope for a brighter future.

Comparing the results to TIMSS' mathematical benchmarking report of 1999 (Mullis et al., 2001), one finds similar results. Although not measuring students' results in mathematics directly, standard 8A and 8B indicate that there is in fact a positive relation between students' mathematical achievement and their attitudes towards mathematics. While TIMSS' 1999 benchmarking report (Mullis et al., 2001) was mainly carried out across developed countries, this study indicates that the results presented in the benchmarking report corresponds well to that of Malawi, and possibly other LMIC.

In future studies, it could be interesting to see whether data from other schools yield the same results from the ATMI. In a longitudinal study it could also be interesting to do follow up of students and investigate change in attitude over time. Finally, a comparative analysis across different contexts could be interesting in order to investigate how differences in socioeconomics and culture effect students' attitudes towards mathematics.

5.3 Malawian teachers' facilitation of various motivational factors in their mathematics teaching

This chapter is based exclusively on the associated theory and the qualitative data of the study (open question survey, interviews and observations). Attitudes towards mathematics are perhaps as contextually dependent as teaching. As teaching is said to be a cultural activity (Stigler & Hiebert, 1999), teaching to support positive attitudes towards mathematics in Malawi is bound to be contextually dependent in some way. The results from the open question survey, interviews and observations, confirm ways in which teachers can motivate their students. Praising and encouraging the students in their work, giving the students feedback in class and on their work, pairing the students in groups, and using appropriate resources, all seem like important factors for motivating the students. These factors are in correspondence with previous research on teachers' facilitation of positive attitudes in Malawi in regard to what teachers do in order to avoid students falling out of school (Holkamp, 2009).

Considering the multicomponent model of attitudes (Zanna & Rempel, 1988), teachers should map their students' beliefs, associations and experiences, for the teachers to be able to meet their students' attitudes in the best ways possible. When introducing new and unfamiliar objects in mathematics, teachers should consider the students' attitudes and previous knowledge. Knowing how the students might react to new information can be important in regard to knowing when to introduce new topics. If teachers introduce a new object before the students are comfortable with the previously introduced object, students might become demotivated, but if it happens too late after students have become comfortable, students might become demotivated and bored. With many students in each class, it appears difficult for teachers in Malawi to take students' individual attitudes into consideration. Perhaps teachers can affect students' behaviour if they can convince the students that they are ready for the introduction of new objects (self-perception theory). Ideally, teachers should always try to link new and existing information closely together in order for the students to comprehend the information and because students are more likely to be positive to something that they already have a relation to.

If the teachers can predict students' attitudes and their behaviour in relation to their attitudes, the teachers might facilitate better learning. Tapia (1996) argues that attitudes affect students' participation and achievement in mathematics. Like in the case of standard 8A and 8B, teachers should in some way be able to predict how students would react to new information in mathematics, and know what motivates them. As motivation and opportunity determine how students act (MODE-model), the teachers must also consider what opportunities their students have. If no opportunities seem present, and the students' behaviour is only a result of their attitude, their behaviour towards mathematics is likely to be negative if they have a negative attitude towards the subject. With the case of standard 8A and 8B in mind, teachers must make sure that the students have opportunities. Students must see (and be given) other opportunities for their future than just attending secondary school. Attending secondary school is certainly one of the best opportunities towards a better prospect for the students' future, but the 90% of students who do not proceed to secondary education (Susuwele-Banda, 2005) also need appealing opportunities.

An important goal of mathematics education is to generate positive attitudes towards mathematics (Mullis et al., 2001), and it is therefore important that the students experience mathematics as valuable and entertaining. The observations showed that the structure of the classroom lessons were always rather identical, which corresponds well with previous research on Malawian classroom lessons (Bergtun, 2015; Bjørnø, 2016). If the students experience the teaching as tedious, their attitude towards school and the various subjects might worsen, and they might become demotivated. However, if teachers are not motivated themselves, as seen from the interviews (chapter 4.3), it is less likely their effort to increase students' attitudes is very high.

Teachers are not solely responsible for motivating students though. Economics play a central role in many aspects concerning motivation and absenteeism, and the topic of motivation may therefore also be regarded as a political topic in need of discussing. As can be seen from the statistics from Malawi (chapter 2.8.1 – 2.8.2), the country is still in need of more teachers and schools. Many schools require maintenance, and the teachers should optimally receive regular opportunities for follow-ups and further teacher training. The government should keep striving towards reaching the benchmarks set for Malawi. The interviews show that the teachers also request and lack more training in how to motivate students (chapter 4.3). The teachers should receive incentives themselves (in addition to the salary they are already given), in order for them to motivate others. In this case, the salary does not seem to serve as enough motivation for the teachers to strive for motivating their students.

6. Conclusion

In this chapter, the findings from the research are concluded. The research questions are answered and the findings are linked to previous research on attitudes towards mathematics. Finally, possible implications for future research are presented. The research questions were as follows:

1. Which factors affect children's attitudes towards mathematics in Malawi?
2. To what extent can the factors *gender*, *age* and *grade/standard* be used to generalize claims regarding students' attitudes towards mathematics in Malawi?
3. How can teachers in Malawi facilitate various motivational factors in their mathematics teaching?

Arguably, this research does not provide enough evidence needed for generalizing outside the school in question of the study, but the results may be considered for reflection and future research on the topic of understanding students' attitudes towards mathematics, both for a Malawian context, but also for other contexts. The quantitative data from the ATMI had a high reliability and it should be possible to produce similar results with a new test, but the qualitative data from the other methods of research would be impossible to duplicate. As the results are consistent with a lot of previous research on attitudes towards mathematics, it is however likely that similar results to this research can be found within other schools in Malawi.

Understanding which factors affect children's attitudes towards mathematics in Malawi can help the teachers focus on certain factors in their facilitation of positive attitudes towards mathematics. Through the open question survey, the interviews, and the observations, the first research question showed that students' attitudes towards mathematics were found to be individually affected by different factors. While some were mostly intrinsically motivated towards the subject, others required extrinsic motivational factors. The extrinsic factors found to affect students' attitudes towards mathematics included praise of the students and their work, physical rewards (e.g. exercise books), fear of failure, and competition amongst students. The praising of students appeared to be important for students' self-concept in mathematics, enjoyment of mathematics, and their motivation towards the subject. The physical rewards seemed to be important for how students valued mathematics as a subject and for students' motivation towards mathematics. Students appeared to work harder in order to receive physical rewards, and also in order to increase their future opportunities. The fear of failure appeared to affect students' self-confidence in mathematics and also their enjoyment of the subject. Linked to the fear of failure, students' self-concepts and self-efficacy beliefs appeared to be important in regard to the students' attitudes towards mathematics. The competition aspect appeared to be important in regard to students' motivation towards the subject, as they all strived to achieve the best results in order to retrieve praise, prizes and to be able to attend secondary school.

The affecting factors found for children's attitudes towards mathematics correspond well with previous research. The clear connection between students' positive attitudes towards mathematics and their performance in the subject, and the link between positive attitudes and students' self-concept and self-efficacy beliefs, corresponds well with TIMSS' mathematics benchmarking report of 1999 (Mullis et al., 2001). In the same way that teaching is a cultural activity (Stigler & Hiebert, 1999), it appears that the factors affecting students' attitudes towards mathematics are also culturally dependent.

Considering the second research question through the ATMI and the quantitative results, differences were found in how gender, age and standard/grade affected the students' attitudes towards mathematics. No statistically significant differences in the mean scores based on gender in attitudes towards mathematics, were found. From this study, there is no indication that gender plays a significant role in students' attitudes towards mathematics in Malawi. This corresponds well with previous research on differences in attitudes towards mathematics based on students' gender (Mullis et al., 2001).

Age is closely linked to the standards the students are in, though the statistics show a wide age gap within the standards. It appears that students who have followed an ordinary progression at school without having to repeat standards, have more positive attitudes than students who have repeated standards, missed out on school, and/or have started school at an older age than recommended. The evidence from the ATMI suggests a decrease in the enjoyment of mathematics and attitudes towards mathematics in general, along with students' age. There appears to be a big difference in attitudes towards mathematics between those of ideal/standardized age, and those outside that age. A possible explanation for this could be that students' attitudes decrease when they have to repeat standards. However, age does not need to be a hindrance for good learning. Students of different ages can work well with each other, but they might be on different cognitive levels based on experience.

Two standards of the same year (standard eight), who shared the same teacher in mathematics, allowed for a comparison between a standard with "gifted" students and a standard with less "gifted" students. The class with the "gifted" students reported higher mean scores for all statements in the ATMI while considering all students in the standards. Statistically significant differences for the mean scores were found in the categories of self-concept in mathematics, motivation towards mathematics, and attitudes towards mathematics in general. For the remaining categories, value of mathematics and enjoyment of mathematics, the differences in means were not statistically significant, though the students in the "gifted" standard reported higher mean scores than those in the less "gifted" standard. A possible reason for the lack of statistically significant differences in the means for this category might be that students in both standards value and enjoy mathematics similarly, regardless of the students' performance in the subject. While considering only the students within the ideal/standardized age in standard eight, the same results were found.

While considering only the group of students outside the ideal/standardized age in standard eight, no factors were found to be statistically significantly different for the students' mean scores. The number of respondents was very small, which might explain why no statistically significant differences were found in the mean scores. If there had been a higher number of respondents, statistically significant differences for the means might have been discovered. However, *standard* explained between 16 and 41 percent of the variance for four statements in the ATMI despite the small number of respondents. The results from these statements indicated a big difference in the two standards.

As the "gifted" students had statistically significantly higher mean scores across the entire ATMI than the less "gifted" students, there appeared to be a clear link between students' performance and their positive attitudes towards mathematics, which corresponds well with previous research on the subject of attitudes towards mathematics (Mullis et al., 2001). While TIMSS' mathematics benchmarking report of 1999 (Mullis et al., 2001) was mainly carried out across developed countries, there is a big consistency in results within this study. The quantitative results of this study indicate that the results presented in the benchmarking report corresponds well to that of Malawi, and possibly other LMIC.

The third research question, regarding teachers' ways of facilitating motivational factors in their lessons, can shed light on important factors for teachers when they plan on how to promote positive attitudes towards mathematics. To facilitate motivational factors in the teachers' mathematics teaching, there are many measures to consider. The measures identified in this study, were observed and suggested through the interviews and observation. They corresponded with previous research into which measures teachers use in order to avoid students falling out of school (Holkamp, 2009). Amongst other measures, this study found that teachers may praise their students and encourage them in their work, give feedback to the students on their work, pair the students in groups and letting them help each other and/or give the students prizes and other resources (e.g. exercise books). Other important ways of facilitating positive attitudes towards mathematics seem to be based on how teachers present new topics. The teachers should consider their students' knowledge and progression of the various topics presented, and they should introduce new topics at the right time. If the teachers introduce new topics too early, the students might lose interest if they cannot link their previous knowledge to the new knowledge. If the teachers wait too long to introduce new topics, students might become bored and lose motivation towards the subject. While it may be difficult to get an overview of different students' progression in the subject, it seems important to have a good communication with the students. If the teachers communicate well with their students, they are likely closer to generating positive attitudes towards mathematics, which is said to be an important goal of mathematics education (Mullis et al., 2001).

6.1 Possible implications

In order to better Malawian schoolchildren's attitudes towards mathematics, more research should be conducted into the effect of various factors affecting students' attitudes. Future research could investigate which of the attitudinal factors are the most influential regarding students' attitudes towards mathematics. Future research could also measure whether the factors influencing students' attitudes towards mathematics stay the same or if they change over time. With this information, teachers could refocus their energy on the most important attitudinal factors for facilitating positive attitudes towards mathematics.

In addition, more government funding and resources for the schools should result in more motivated teachers and students. The interviews reveal that the teachers ask for better training in regard to facilitating positive attitudes towards mathematics, and if the teachers receive this, they are likely to become more motivated. If the teachers themselves have positive attitudes towards mathematics, it is more likely that they will communicate positive attitudes towards mathematics to their students.

7. References

Anttonen, R. G. (1969). A longitudinal study in mathematics attitude. *The Journal of Educational Research, 62*(10), 467-471.

Atkinson, J. W., & Raynor, J. (1974). *Motivation and achievement*. Washington, DC: Winston.

Bandura, A. (1997). *Self-efficacy: the exercise of control.* New York: Freeman.

Ball, S. (1977). *Motivation in education*. New York: Academic.

Baumeister, R. F., & Vohs, K. D. (2007). *Encyclopedia of Social Psychology*: SAGE Publications.

Bergtun, I. (2015). *Malawian teachers selection and use of manipulatives in mathematics teaching* (Master's thesis). University of Stavanger, Stavanger, Norway.

Bjørnø, M. (2016). *Teaching fractions in a Malawian context. - What is governing a Malawian teacher's choices when it comes to teaching fractions?* (Master's thesis). University of Stavanger, Stavanger, Norway.

Boekaerts, M. (1999). Self-regulated learning: Where we are today. *International Journal of Educational Research, 31*(6), 445-457.

Bouchey, H. A., & Harter, S. (2005). Reflected Appraisals, Academic Self-Perceptions, and Math/Science Performance During Early Adolescence. *Journal of Educational Psychology, 97*(4), 673-686. doi: 10.1037/0022-0663.97.4.673

Elliot, A. J. (1999). Approach and avoidance motivation and achievement goals. *Educational Psychologist, 34*(3), 260-267.

Fazio, R. H. (1990). Multiple processes by which attitudes guide behavior: The MODE model as an integrative framework. *Advances in Experimental Social Psychology, 23*, 75-109.

Fennema, E., & Sherman, J. A. (1976). Fennema-Sherman mathematics attitudes scales: Instruments designed to measure attitudes toward the learning of mathematics by females and males. *Journal for Research in Mathematics Education, 7*(5), 324-326.

Fiore, G. (1999). Math-abused students: Are we prepared to teach them? *Mathematics Teacher, 92*(5), 403-407.

Google. (2017). Google Trends. Retrieved 01.05.17, from https://trends.google.com/trends/explore?date=2007-01-01%202017-01-01&q=attitudes

Haddock, G., & Maio, G. R. (2012). Attitudes. In M. Hewstone, W. Stroebe & K. Jonas (Eds.), *An Introduction to Social Psychology* (pp. 171-200). Chichester: Wiley.

Hannula, M. S. (2006). Motivation in mathematics: Goals reflected in emotions. *Educational Studies in Mathematics, 63*(2), 165-178.

Holkamp, G. (2009). *Researching the girls drop-out rate in Malawi* (Master's thesis). Hogeschool Windesheim, Zwolle, Netherlands.

Kadzamira, E. C. (2014). *Chronic Under-Completion in Malawi's Primary Schools: Its Trends and Determinants*. Paper presented at the Education Access - Opening Spaces for the Marginalised, Lilongwe, Malawi.

Kadzamira, E. C., & Rose, P. (2003). Can free primary education meet the needs of the poor?: evidence from Malawi. *International journal of educational development, 23*(5), 501-516.

Kazima, M. (2014). Universal basic education and the provision of quality mathematics in Southern Africa. *International Journal of Science and Mathematics Education, 12*(4), 841-858. doi: 10.1007/s10763-013-9434-8

Lim, S. Y., & Chapman, E. (2013). Development of a short form of the attitudes toward mathematics inventory. *Educational Studies in Mathematics, 82*(1), 145-164.

Mazrui, A. A., Wondji, C., & Unesco International Scientific Committee. (1993). *General history of Africa : 8 : Africa since 1935* (Vol. 8). London: Heinemann.

Minato, S. (1983). Some mathematical attitudinal data on eighth grade students in Japan measured by a semantic differential. *Educational Studies in Mathematics, 14*(1), 19-38.

Minato, S., & Yanase, S. (1984). On the relationship between students attitudes towards school mathematics and their levels of intelligence. *Educational Studies in Mathematics, 15*(3), 313-320.

Ministry of Education, S. a. T., & UNESCO, M. N. C. f. (2008). The development of education. National Report for Malawi. Presented at the 48th session of the International Conferance of Education, Geneva.

Morf, C. C., & Koole, S. L. (2012). The Self. In M. Hewstone, W. Stroebe & K. Jonas (Eds.), *An Introduction to Social Psychology* (pp. 121-170). Chichester: Wiley.

Mullis, I. V., Martin, M. O., Gonzalez, E. J., O'Connor, K. M., Chrostowski, S. J., Gregory, K. D., . . . Smith, T. A. (2001). Mathematics benchmarking report: TIMSS 1999—Eighth grade. *Chestnut Hill, MA: International Study Center*.

Norad. (n.d.). NORHED. Retrieved 10.04.17, from https://www.norad.no/en/front/funding/norhed/

Pallant, J. (2013). *SPSS survival manual : a step by step guide to data analysis using IBM SPSS* (5th ed. ed.). Maidenhead: McGraw-Hill.

Pantziara, M., & Philippou, G. N. (2015). Students' motivation in the mathematics classroom. Revealing causes and consequences. *International Journal of Science and Mathematics Education, 13*(2), 385-411.

Perloff, R. M. (2010). *The dynamics of persuasion: communication and attitudes in the twenty-first century*: Routledge.

Pintrich, P. R., & De Groot, E. V. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology, 82*(1), 33.

Samuelsson, J., & Granstrom, K. (2007). Important Prerequisites for Students' Mathematical Achievement. *Journal of Theory and Practice in Education, 3*(2), 150-170.

Sandemose, A. (1933). *En flyktning krysser sitt spor : fortelling om en morders barndom*. Oslo: Tiden.

Soko, C., Nkhwangwa, H., Yekha, J., Makwecha, J., Mbulo, K., Mwale, L., . . . Saka, T. (2008). Mathematics. Teachers' guide for Standard 7. Domasi, Malawi: Malawi Institute of Education.

Stigler, J. W., & Hiebert, J. (1999). *The teaching gap : best ideas from the world's teachers for improving education in the classroom*. New York: Free Press.

Susuwele-Banda, W. J. (2005). *Classroom Assessment in Malawi: Teachers' Perceptions and Practices in Mathematics.* Virginia Tech.

Tapia, M. (1996). *The Attitudes toward Mathematics Instrument*. Paper presented at the Annual Meeting of the Mid-South Educational Research Association, Tuscaloosa, AL.

Tapia, M., & Marsh, G. E. (2004). An instrument to measure mathematics attitudes. *Academic Exchange Quarterly, 8*(2), 16-22.

The World Bank. (2016). Pupil-teacher ratio in primary education (headcount basis). *UNESCO Institute for Statistics.* Retrieved 13.05.17, from http://data.worldbank.org/indicator/SE.PRM.ENRL.TC.ZS

Torheim, M. G. (2017, 10.03). Skal styrke matematikkunnskapen i malawisk grunnutdanning. Retrieved 10.04.17, from https://www.uis.no/om-uis/nyheter-og-presserom/skal-styrke-matematikkunnskapen-i-malawisk-grunnutdanning-article111600-8108.html

United Nations Association of Norway. (2017). Malawi. Retrieved 13.05.17, from http://www.globalis.no/Land/Malawi/(show)/indicators

Utdanningsdirektoratet. (2016). Statistikk om grunnskolen. Retrieved 14.04.17, from https://www.udir.no/tall-og-forskning/finn-forskning/tema/elever-og-ressurser-i-grunnskolen/

Zan, R., Brown, L., Evans, J., & Hannula, M. (2006). Affect in Mathematics Education: An Introduction. *An International Journal*, *63*(2), 113-121. doi: 10.1007/s10649-006-9028-2

Zanna, M. P., & Rempel, J. K. (1988). Attitudes: A new look at an old concept.

8. Appendices

Appendix 1: Attitudes towards mathematics inventory (ATMI)

Appendix 2: Open question survey

Appendix 3: Invitation to visit the University of Malawi (UNIMA)

Appendix 4: Approval from the Norwegian centre for research data (Norsk senter for forskningsdata (NSD))

Appendix 5: Information letter

Appendix 6: Consent form

Appendix 7: Interview guide for teachers

Appendices

Appendix 1 – Attitudes towards mathematics inventory (ATMI)

ATTITUDES TOWARD MATHEMATICS INVENTORY
(*MAGANIZO PA MASAMU*)

Age (*Zaka zakubadwa*)__________ Standard__________ Girl/Boy__________

Instructions: This inventory consists of statements about your attitude toward mathematics. There are no correct or incorrect responses. Read each item carefully. Please think about how you feel about each item. Mark the corresponding answer to how each statement best describes your feelings. Please answer every question.
Malangizo: Mndandawu ndi wa maganizo anu pankhani ya masamu. Palibe mayankho okhoza kapena olakwa. Werengani ganizo lililonse mosamala. Ganizirani ganizo lililonse mozama. Chongani ganizo lilionse mofanana ndi mmene mumaganizira.

		Strongly Disagree *Sindikugwirizana nazo kwambiri*	Disagree *Sindikugwirizana nazo*	Neutral *Ndilibe maganizo*	Agree *Ndikugwirizana nazo*	Strongly Agree *Ndikugwirizana nazo kwambiri*
1.	Mathematics is a very worthwhile and necessary subject (*Masamu ndi aphindu ndipo ndi phunziro lofunika*)					
2.	I want to develop my mathematical skills (*Ndikufuna kupititsa mtsogolo luso langa la masamu*).					
3.	I get a great deal of satisfaction out of solving a mathematics problem (*Ndimakhutitsidwa kwambiri ndikamasova masamu*)					
4.	Mathematics helps develop the mind and teaches a person to think (*Masamu amathandiza kuganiza mozama ndipo amaphunzitsa munthu kuganiza.*).					
5.	Mathematics is important in everyday life (*Masamu ndi wofunika pa moyo wa tsiku ndi tsiku*).					
6.	Mathematics is one of the most important subjects for people to study (*Masamu ndi phunziro lofunika kwambiri kuti anthu aziphunzira*).					
7.	Secondary school mathematics courses would be very helpful no matter what I decide to study (*Masamu a ku sekondale ndi wofunika kwambiri wosaganizira zomwe ndikufuna kudzaphunzira mtsogolo muno*).					
8.	I can think of many ways that I use math outside of school (*Ndikhoza kuganizira njira zambiri zomwe ndingagwiritsire ntchito masamu kunja kwa sukulu*).					
9.	Mathematics is one of my most dreaded Subjects (*Masamu ndi limodzi mwa maphunziro amene ndimawaopa kwambiri*).					

		Strongly Disagree *Sindikugwirizana nazo kwambiri*	Disagree *Sindikugwirizana nazo*	Neutral *Ndilibe maganizo*	Agree *Ndikugwirizana nazo*	Strongly Agree *Ndikugwirizana nazo kwambiri*
10.	My mind goes blank and I am unable to think clearly when working with mathematics (*Mutu wanga umasokonezeka ndipo sindiganiza bwino ndikamasova masamu).*					
11.	Studying mathematics makes me feel nervous (*Kuphunzira masamu kumandipatsa mantha*).					
12.	Mathematics makes me feel uncomfortable (*Masamu amandipangitsa kukhala wosamasuka*).					
13.	I am always under a terrible strain in a mathematics class (*Ndimakhala womangika kwambiri nthawi zonse m'kalasi ya masamu).*					
14.	When I hear the word mathematics, I have a feeling of dislike (*Ndikamva mawu oti masamu sindikondwa*).					
15.	It makes me nervous to even think about having to do a mathematics problem (*Zimandidetsa nkhawa ndikaganizira za kusova masamu*).					
16.	Mathematics does not scare me at all (*Masamu sandiopsa mpang'onong'ono pomwe*).					
17.	I have a lot of self-confidence when it comes to mathematics (*Ndimadzidalira pankhani ya masamu*).					
18.	I am able to solve mathematics problems without too much difficulty (*Ndimakhoza kusova masamu popanda mavuto ambiri).*					
19.	I expect to do fairly well in any mathematics class I take (*Ndimayembekezera kuchita bwino m'kalasi ya masamu).*					
20.	I am always confused in my mathematics Class (*Ndimakhala wosokonezeka nthawi zonse m'kalasi ya masamu*).					
21.	I feel a sense of insecurity when attempting mathematics (*Sindikhala wodzidalira ndikamasova masamu).*					
22.	I learn mathematics easily (*Ndimaphunzira masamu mosavuta).*					
23.	I am confident that I could learn advanced mathematics (*Ndili ndi chikhulupiliro kuti tikhoza kuphunzira masamu kusukulu zapamwamba*).					
24.	I have usually enjoyed studying mathematics in school (*Nthawi zambiri ndakhala ndikusangalala ndi kuphunzira masamu kusukulu*).					
25.	Mathematics is dull and boring (*Masamu ndi wobowa ndiponso wosasangalatsa*).					

		Strongly Disagree *Sindikugwirizana nazo kwambiri*	Disagree *Sindikugwirizana nazo*	Neutral *Ndilibe maganizo*	Agree *Ndikugwirizana nazo*	Strongly Agree *Ndikugwirizana nazo kwambiri*
26.	I like to solve new problems in mathematics (*Ndimakonda kusova masamu atsopano ndikamachita masamu.*).					
27.	I would prefer to do an assignment in mathematics than to write an essay (*Ndingakondwe kusova masamu kuposa kulemba chimangirizo*).					
28.	I would like to avoid using mathematics in college (*Ndingakonde osaphunzira masamu ku koleji*).					
29.	I really like mathematics (*Ndimakonda masamu kwambiri)*.					
30.	I am happier in a mathematics class than in any other class (*Ndimasangalala m'kalasi ya masamu kuposa kalasi ina iliyonse*).					
31.	Mathematics is a very interesting subject (*Masamu ndi phunziro lopatsa chidwi kwambiri)*.					
32.	I am willing to take more than the required amount of mathematics (*Ndine wokonzeka kuphunzira masamu ambiri kuposa mlingo womwe ukufunikira*).					
33.	I plan to take as much mathematics as I can during my education (*Ndikukonza zophunzira masamu momwe ndingathere pamaphunziro anga*).					
34.	The challenge of mathematics appeals to me (*Kuvuta kwa masamu kumandipatsa chidwi*).					
35.	I think studying advanced mathematics is useful (*Ndikugandiza kuti kuphunzira masamu pamaphunziro apamwamba ndi kofunika)*.					
36.	I believe studying mathematics helps me with problem solving in other areas (*Ndikukhulupilira kuphunzira masamu kumandithandiza kuthana ndi mavuto m'madera ena)*.					
37.	I am comfortable expressing my own ideas on how to look for solutions to a difficult problem in mathematics (*Ndimakhala womasuka kunena maganizo anga pofuna kupeza yankho ku funso lovuta la masamu)*.					
38.	I am comfortable answering questions in mathematics class (*Ndimakhala womasuka kuyankha mafunso m'kalasi ya masamu)*.					
39.	A strong mathematics background could help me in my professional life (*Kuphunzira masamu kungandithanize pantchito yanga*).					
40.	I believe I am good at solving mathematics problems (*Ndikhulupilira kuti ndimakhoza kusova masamu*).					

Appendix 2 – Open question survey

OPEN QUESTION SURVEY
(*MAFUNSO A MAYANKHO OFUNA KUFOTOKOZERA*)

Age__________ Standard__________ Girl/Boy__________

Please read and consider the following questions carefully before answering. Feel free to write what you want. There are no wrong answers.
(Werengani ndi kuwaganizira bwinobwino mafunsowa musanayankhe. Khalani womasuka polemba zomwe mukufuna. Palibe yankho lolakwa).

1. How can the school or teachers increase your motivation towards mathematics?
(*Kodi sukulu ndi aphunzitsi angachite chiyani kuti alimbikitse chidwi chanu pamasamu?*)

2. How can you as a student increase your motivation towards mathematics?
(*Kodi inu monga wophunzira mungalimbikitse chidwi chanu pamasamu motani?*)

3. Is it important to stay motivated towards mathematics? Why/why not?
(Kodi ndi kofunika kukhala ndi chidwi ndi masamu? Ngati ndi choncho chifukwa chiyani? Ngati sichoncho chifukwa chiyani?)

4. Do you have anything to add?
(Muli ndi zoti muonjezere?)

Appendix 3 – Invitation to visit the University of Malawi (UNIMA)

UNIVERSITY OF MALAWI

PRINCIPAL
Richard Tambulasi, B.A (Pub Admin), BPA (Hons), MPA, Ph.D

CHANCELLOR COLLEGE
P.O. Box 280, Zomba, Malawi
Telephone: (265) 524 222
Fax: (265) 524 046
E-mail: principal@cc.ac.mw

OFFICE OF THE DEAN OF EDUCATION

20th December, 2016

David Andreas Swan
Stine Bergset Rusten
University of Stavanger, Norway.

INVITATION TO VISIT FACULTY OF EDUCATION, UNIVERSITY OF MALAWI

On behalf of Faculty of Education of the University of Malawi, I formally invite you to visit the Faculty in Zomba for a period of four weeks. This invitation follows the successful collaboration between University of Stavanger and University of Malawi. I hope that you can make this visit and arrive in Malawi by 5 January 2017.

During the visit you will have the opportunity to work with teachers and students in Malawi primary schools as part of your research projects. You might also meet other master students at University of Malawi. I will be your contact person and my contact numbers are given below. You will be accommodated T & D guesthouse, along Chirunga Road in Zomba, contact numbers (265)111952281 and (265)999507079.

Upon arrival at Chileka airport in Blanytre, you will be met by a driver and taken to Zomba. The driver's name is Rafla and his cell number is (265)888977990. I will meet you at the guest house to welcome you and discuss the programme for your visit.

I look forward to having you in Malawi and the Faculty of Education.

MERCY KAZIMA
Associate Professor of Mathematics Education
Tel: (265)111955767 (office), (265)1525364 (home), (265)888580208 (cell)

Appendix 4 – Approval from the Norwegian centre for research data (Norsk senter for forskningsdata (NSD))

NSD

Arne Jakobsen
Institutt for grunnskolelærerutdanning, idrett og spesialpedagogikk Universitetet i Stavanger

4036 STAVANGER

Vår dato: 12.01.2017 Vår ref: 51327 / 3 / AGL Deres dato: Deres ref:

TILBAKEMELDING PÅ MELDING OM BEHANDLING AV PERSONOPPLYSNINGER

Vi viser til melding om behandling av personopplysninger, mottatt 28.11.2016. Meldingen gjelder prosjektet:

51327	*Motivasjonsfaktorer for Malawiske barns innstilling til matematikk*
Behandlingsansvarlig	*Universitetet i Stavanger, ved institusjonens øverste leder*
Daglig ansvarlig	*Arne Jakobsen*
Student	*David Andreas Swan*

Personvernombudet har vurdert prosjektet og finner at behandlingen av personopplysninger er meldepliktig i henhold til personopplysningsloven § 31. Behandlingen tilfredsstiller kravene i personopplysningsloven.

Personvernombudets vurdering forutsetter at prosjektet gjennomføres i tråd med opplysningene gitt i meldeskjemaet, korrespondanse med ombudet, ombudets kommentarer samt personopplysningsloven og helseregisterloven med forskrifter. Behandlingen av personopplysninger kan settes i gang.

Det gjøres oppmerksom på at det skal gis ny melding dersom behandlingen endres i forhold til de opplysninger som ligger til grunn for personvernombudets vurdering. Endringsmeldinger gis via et eget skjema, http://www.nsd.uib.no/personvern/meldeplikt/skjema.html. Det skal også gis melding etter tre år dersom prosjektet fortsatt pågår. Meldinger skal skje skriftlig til ombudet.

Personvernombudet har lagt ut opplysninger om prosjektet i en offentlig database, http://pvo.nsd.no/prosjekt.

Personvernombudet vil ved prosjektets avslutning, 30.09.2017, rette en henvendelse angående status for behandlingen av personopplysninger.

Vennlig hilsen

Kjersti Haugstvedt

Audun Løvlie

Kontaktperson: Audun Løvlie tlf: 55 58 23 07
Vedlegg: Prosjektvurdering

Dokumentet er elektronisk produsert og godkjent ved NSDs rutiner for elektronisk godkjenning.

NSD – Norsk senter for forskningsdata AS Harald Hårfagres gate 29 Tel: +47-55 58 21 17 nsd@nsd.no Org.nr. 985 321 884
NSD – Norwegian Centre for Research Data NO-5007 Bergen, NORWAY Faks: +47-55 58 96 50 www.nsd.no

Appendix 5 – Information letter

Request to participate in the research project

"Motivational factors for students' attitude towards mathematics in Malawi"

Background and purpose
The aim of this study is to understand which factors motivate students towards learning mathematics. In addition, the study aims to analyse whether there is a difference in motivation across gender (boys/girls), the students' age and in which standard the students are. Finally, the study will investigate how teachers take advantage of these motivational factors in their classroom instruction and teaching.

The collected data will be used in my master's thesis at the University of Stavanger in Norway. All participants in standard 5, 6, 7 and 8 at your school are invited to participate in the questionnaires in this research project. A few students and teachers will also be personally invited to participate in a group interview where we discuss motivation in regards to mathematics.

What does participation in the study imply?
You are requested to participate in two anonymous questionnaires, each lasting between 15-30 minutes. The questions will be about your personal attitude towards mathematics. Some people will also get the opportunity to participate in a group interview where we discuss motivational factors towards mathematics. The group interview will be videotaped, but the information collected will be handled confidentially and no personal information will be shared with others.

If you are a parent consenting for your child, you may access/see the questionnaires and interview guides upon request.

How is the information about you handled?
All personal information will be handled confidentially and secure. Only I will have access to the material, and the material will be stored encrypted.

The participants in this study will in no way be recognizable in the published study.

The project is set to end 30.09.17. The video recordings will be deleted by the project end.

Voluntary participation
Participation in this study is voluntary, and you can withdraw your consent at any time without giving any reason for this. If you withdraw your consent, all information about you will remain/be made anonymous.

If you have any questions towards the study, please feel free to contact me, David Andreas Swan, at david.andreas.swan@gmail.com or my supervisor, Arne Jakobsen, at arne.jakobsen@uis.no.

The study is admitted to the data protection commission, NSD – Norwegian centre for research data AS.

Appendix 6 – Consent form

Consent to participation in the study

(Kuvomereza kutenga nawo mbali pakafukufuku)

I have received information about the study, and I am willing to participate

(*Ndikuvomereza kujambulidwa poyankha mafunso pagulu, ngati ndapemphedwa*).

____

Signed by participant, date. (*Saini ya wotenga nawo mbali, Tsiku*)

[ ] I agree to participate

(Ndamva za kafukufukuyu, ndipo ndili wokonzeka kutenga nawo mbali).

[ ] I agree to participate in the questionnaires

(*Ndikuvomereza kuyankha mafunso*)

Appendix 7 – Interview guide for teachers

Interview guide for teachers

Teaching standard_______________ Man/Woman________________

How do you define motivation? Please specify.

What do you know about student motivation? Please specify.

Have you had any training in motivation? Have you learned anything in teacher training? Please specify.

How do you think students can become more motivated towards mathematics? Please specify.

How do you motivate your students in mathematics? Please specify.

Why do you think some strategies for motivation work for some students while they fail to work for others? Please specify.