STUDENTS' ATTITUDES TOWARDS SCIENCE SUBJECTS IN COMMUNITY DAY SECONDARY SCHOOLS: CASE OF THREE SCHOOLS IN BLANTYRE, MALAWI

MASTER OF TECHNICAL AND VOCATIONAL EDUCATION

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STUDENTS' ATTITUDES TOWARDS SCIENCE SUBJECTS IN COMMUNITY DAY SECONDARY SCHOOL: A CASE OF THREE SCHOOLS IN BLANTYRE, MALAWI.

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DECLARATION

I, **Livison Levis Msonthe** declare that this thesis is my own original work. Where other sources of information have been used, they have been acknowledged. I hereby certify that this work has not been submitted before in part or full for any other degree or examination.

SIGNATURE :

DATE :

CERTIFICATE OF APPROVAL

We, the undersigned, certify that we have read and hereby recommend for acceptance by the University of Malawi a thesis entitled ***"Students' Attitudes Towards Science Subjects in Community Day Secondary Schools: Case of Three Schools in Blantyre, Malawi".***

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DEDICATION

I dedicate this project to my mother Agness Msonthe and my brother Isaac for always encouraging me and believing in my abilities.

I love you so much and may God Almighty bless you all, I would have not made it this far without your support.

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Firstly, I am so grateful to God Almighty for His continuous supply of knowledge, wisdom and understanding that has made me to prevail and complete this thesis.

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ABSTRACT

The investigation of students' attitudes towards studying science has been an essential feature within the science education research community for the past years. However the study of Students' Attitudes Towards Science Subjects (SATSS) in Malawi is unavailable. Most community day secondary schools (CDSSs) register high failure rates in science subjects during national examinations and the trend could be attributed to students' attitudes towards science among other factors since without positive attitudes, students have little chance of learning proficiently. The study used a 130-item questionnaire ($\alpha = 0.893$) to measure students' attitudes towards science subjects in CDSSs in Malawi. The data were obtained from 273 CDSS students in Blantyre, Malawi. A sample of 160 boys and 113 girls sampled based on stratified randoming using Taro Yamane's formula was used to collect the data. Results show that over 54.9% of the students ($n = 273$) in CDSSs have a positive attitude towards science subjects. Results of the study also showed that gender had a significant effect on students' attitudes towards science subjects. Girls [Mean = 2.53, and SD = 0.983] had significantly higher attitudes towards science subjects than boys [Mean = 2.28 and SD = 0.883] on total attitude scale and on all sub-scales of the questionnaire. This is perhaps because of girl child education campaign in CDSSs that is encouraging girls to like science and aspire to undertake scientific careers. The following were the underlying factors influencing SATSS: Self-efficacy (SE), Science Learning Value (SLV), Stimulating Learning Environment (SLE), Teacher Factors (TF), and Active Learning Strategies (ALS). However, Self-efficacy, Science Learning Value, and Stimulating Learning Environment were noted as predominant factors influencing SATSS since they had higher percentage of the total variance explained than the rest of the factors. This is because the SLV has the power to determine students' motivation and readiness to learn whereas the SLE have a direct impact on the learner and the learning process. Finally, findings reveal a significant positive relationship between SATSS and performance/academic achievement ($r = 0.720$ and $p = 0.001$). This means that students with high attitude levels towards science subjects registered high levels of achievement in science. The findings have wide implications on learning of science.

Key terms: SATSS, attitude, gender, Self-efficacy, Teacher factors, stimulating learning environments, active learning strategies, science learning value, academic achievement**.**

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ACCRONYMS

SATSS	Students' Attitude Towards Science Subjects
SS	Science Subjects
SATB	Students' Attitude Towards Biology
SATPS	Students' Attitude Towards Physical Science
SATM	Students' Attitude Towards Mathematics
KMO	Kaiser-Meyer-Oklin
SA	Students' Attitude
CDSSs	Community Day Secondary Schools
CSS	Conventional Secondary Schools
DECs	Distance Education Centres
JCE	Junior Certificate Examinations
MSCE	Malawi School Certificate of Education Examinations
MOEST	Ministry of Education, Science and Technology
UNDP	United Nations Development Program
TRF	Text Book Revolving Fund
S&T	Science and Technology
MANEB	Malawi National Examinations Board

CHAPTER ONE

INTRODUCTION

1.0. Background

The investigation of students' attitudes towards studying science has been an essential feature of the work of the science education research community for the past 30–40 years (Osborne, 2003). Its current importance is emphasized by the now mounting evidence of a decline in the interest of the young people, mostly in secondary schools, and early levels of higher education in pursuing scientific careers (Department for Education 1994; Smithers and Robinson 1988). Increasingly, most community day secondary schools registers high failure rates in science subjects during results of national examinations (Malawi National Examination Board (MANEB), 2014; Mlangeni & Chiotha, 2015). However, "Attitude is the key to success" is an age-old saying that most people have ever heard of and it has a lot yet to be explored through research (Abu-Hola, 2005; Akpinar, Yildiz, Tatar, & Ergin, 2009). Some research has been carried out to measure student's attitude towards science education at all levels of education, primary school through secondary school to tertiary level. As such, research has revealed that a person's attitudes are learned, as opposed to being hereditary. There are many factors that can influence a person's attitude including prior experiences and social interactions (Craker, 2006; Fonsea & Conboy, 2006). The type of science subjects taken, previous science experiences, science teachers, teaching strategies, person's self-efficacy, peer performance, parental guidance, models and various other dynamics can influence these attitudes toward science (Morell & Lederman, 1998). Therefore, the impact of a student's attitude is incredibly important in the learning process and performance of science subjects. In psychology, an attitude refers to a set of emotions, beliefs, and behaviours toward a particular object, person, thing, or event (Hockenbury & Hockenbury, 2007). Myers (1999) stipulates that:

- Attitudes are often the result of experience or upbringing.
- They can have a powerful influence over behaviour and various achievements.
- While attitudes are enduring, they can also change.

Generally speaking, science subjects like mathematics, physical science and biology, is a field that is often disliked by students and records more failures at both Junior Certificate of Examinations (JCE) and Malawi School Certificate of Examinations (MSCE) results by most students in the Community Day Secondary Schools (CDSS) in Malawi, begging researchers to investigate

students' attitude towards science subjects. This is because no attitude studies have been done to explain the extreme failure rates in national examinations in CDSSs in Malawi. This therefore justifies the motivation for this study on "students' attitudes towards science subjects in CDSSs".

The Education Sector Implementation Plan (ESIP) in line with the Malawi Growth and Development Strategy (MGDS) endorse the vision for education as a

> catalyst for socio-economic development, industrial growth and an instrument for empowering the poor, the weak and the voiceless. Education enhances group solidarity, national consciousness and tolerance of diversity. It facilitates the development of a culture of peace which is conducive and critical for socio-economic, political and industrial development. Hence, education is critical and necessary for economic and industrial growth and development. (Ministry of Education Science and Technology (MoEST), 2009 pg 20).

The formal education system in Malawi follows an 8 – 4 – 4 structure: 8 years of primary, 4 years of secondary and typically 4 years of university level education. At the end of primary school, pupils write the Primary School Leaving Certificate Examination (PSLCE), which determines their eligibility for entry into secondary school. The secondary school education is offered mainly through five types of schools, namely: conventional secondary schools (CSSs), CDSSs, Open schools, grant aided secondary schools, and private secondary schools. CSSs are government supported day schools and are the most privileged with regard to educational infrastructure and human resources. There are 109 CSSs enrolling 56,601 students (De Hoop, 2010; MoEST, 2009). Increasingly, Ministry of Education Science & Technology report that the CSSs enrols 18% of the secondary school population whilst the CDSSs, previously known as Distance Education Centres (DECs), are the most disadvantaged. These are schools mostly established with the help of local communities. In total, there are 596 CDSSs with an enrolment of 140,522 students. The CDSSs enrols 46% of the students at the secondary level, which is 71% of the students in the government run schools. The third group of schools is open schools, sometimes known as night schools which enrol 27,058 students representing 9% of the total secondary school enrolment. Increasingly, the fourth type is grant-aided schools. These schools are owned by non-profit organizations, religious groups, but are also supported by government and are of similar quality as CSSs, in some cases better. There are 141 grant aided schools enrolling 37,175 students. The students in the grant aided

schools make about 12% of the secondary school enrolment. These offer secondary school learning opportunities by distance learning to those that for one reason or another could not be enrolled in other types of education. The fifth category is that of private schools managed by individual entrepreneurs with no subsidy from government. There are two categories of private schools: the designated schools, mostly catering for foreign students and therefore following on European syllabus and those following the Malawi curriculum. The majority of these private schools are comparable to CDSSs from the point of view of the available teaching/learning resources but others even worse than the CDSSs. There are 209 registered private secondary schools enrolling 45,860 students. Students in the registered private schools make up 15% of secondary.

Access to formal primary and secondary education was limited until 1994 when universal primary school education was pioneered during the early days of Malawi's democratic independence (Kadzamira, 2003). This increased access as primary school education became accessible to Malawians of all backgrounds. This swelling in enrolment in primary schools led to a reciprocal pressure in secondary schools and the limited few secondary schools could not absorb all the primary school graduates. To withstand the pressure and increase to secondary education beyond that provided in conventional schools at a limited cost, the government started to provide secondary education in so-called "Distance Education Centres", which later came to be known as Community Day Secondary Schools (CDSSs) most of which face critical shortage of resources (Al-Samarrai & Zaman, 2007). The government, in cooperation with various donor organizations and the African Development Bank, is currently working to get the quality of community day schools up to par with conventional schools.

Despite all government efforts to increase access to education by introducing CDSSs, quality of the education in CDSSs remain challenged. Examination results, taken as one of the standard measurements of quality, reveal that the overall students' performance in science subjects is poor (Lungu, 2009; MANEB, 2013d, 2013g; Mlangeni & Chiotha, 2015). For instance, in the 2013 JCE Physical Science examinations, a bulk of students over 58% scored 10% and below, whereas over 35% of the students scored between 10%-30%, representing 7% of the students getting above 30% (MANEB, 2013d).

MANEB chief examiner's reports reveal that most Community Day Secondary School students lack sound knowledge of subject matter and continue to perform poorly in both the JCE and MSCE science subjects examinations (MANEB, 2013a, 2013d, 2014c). It seems most of these candidates do not understand tasks in the test items. As such, candidates from CDSS mostly just write the options from multiple choice questions in section A as answers to the structured questions in section B (MANEB, 2014c). Furthermore, candidates in CDSSs display poor reasoning ability and poor skills in interpretation of graphs (MANEB, 2014b, 2014d). Most students failed questions that demanded to justify their reasoning. This has been largely due to the deteriorating standards of secondary education over the years. Most of the CDSSs do not have proper structures to facilitate learning and this has adversely affected performance in this sub sector (MANEB, 2014e, 2014f). Increasingly, the inadequate provision of teaching and learning materials also negatively impacts on the education provided. Most CDSSs are critically short of textbooks, which make up over 71% of the secondary school enrolment in government-run secondary schools (MANEB, 2014a, 2014e; MoEST, 2013).

1.1. Problem Statement

National examination reports indicate that results in science subjects like Mathematics, Biology, and Physical Science remain poor especially in CDSSs despite these subjects being prerequisites for entry into tertiary education (MANEB, 2013a, 2013b, 2013c, 2013d, 2013e, 2013f; Mlangeni & Chiotha, 2015). For instance, in 2013 and 2014 JCE examinations, number of students who passed grades A and B in CDSSs were very few than in CSSs and CDSSs recorded higher failure grades of D and F in physical science, Mathematics and Biology than CSS. In some rural CDSSs the pass rate was even as low as 2% in physical science in 2014. This may affect the performance of our young scientists in scientific field at higher education. Although the government has now assumed greater responsibility for the financing of the community day secondary schools in an attempt to create a unified public secondary school system, the quality of education offered in these schools remains poor and below minimally acceptable standards (Kadzamira, 2003). Recent studies (Dzama, 2006; Lungu, 2009; Mlangeni & Chiotha, 2015) stipulates that most CDSSs continue to suffer from lack of resources like teaching and learning materials, inadequate teaching and learning materials, inadequate number of teachers and unavailability of library and laboratory facilities. As a result, academic accomplishment levels are extremely low. Furthermore, Kadzamira (2003) observed that very few CDSS students pass the MSCE, with a bigger magnitude

of failures recorded in science subjects. However, studies to relate the students' attitudes towards science subjects and the higher failure rates in CDSSs are unavailable. This is not good as learner's personal attributes determine his motivation, enthusiasm, and readiness to learn and perform (Santrock, 2011). As such students' attitudes must be taken into perspective when evaluating the learning process and explaining students' performance.

1.2 Purpose of the study

The purpose of this study was to investigate the CDSSs students' attitude towards science subjects and explore causes of students' attitude towards sciences in CDSSs.

1.3 Specific Objectives

The specific objectives of this study were the following.

1. To measure student's attitude towards science subjects in CDSSs.
2. To explore factors that influence student's attitude towards science subjects in CDSSs.
3. To assess if gender influences students' attitudes towards science subjects.
4. To relate student's attitudes towards science subjects and academic achievement.

1.4 Hypotheses

This study was guided by the following hypotheses:

1. CDSS students have poor attitudes towards science subjects
2. Boys have significantly more positive attitude towards science subjects than girls.
3. Teachers and learning environment influences SATSS
4. There is a positive relationship between SATSS and academic performance

1.5 Significance of the Study

The study was expected to advance knowledge and provide basis for further research on similar topical issues. That is, the study aimed at bridging the gap on literature between the SATSS and the extreme failure rates in CDSSs. The results would also provide the reader (students) with some knowledge on their attitudes towards science subjects and how their attitudes affect their performance in class. Hence, help learners improve their attitudes and consequently their academic achievement since SATSS have positive correlations with performance. The findings would also guide the teacher and other stakeholders as a reader on what to do to improve the SATSS so that they have students' performance in science subjects improved. The teachers would be able to

understand on why some students skip or avoid science subjects' classes and later on, help them accordingly.

1.6. Thesis Organisation

This section presents a brief overview of the important features discussed in this thesis. The material is presented with a view to allow readers at different levels to quickly locate areas of interest. This thesis has six chapters. Chapter one presents background of the study, problem statement, purpose of study, research objectives, the research hypotheses and the significance of study. Chapter two presents the literature review and the conceptual map. Chapter three presents the research methodology. This chapter discusses the philosophical assumptions and also the design strategies underpinning this research study. In addition, the chapter also discusses the sampling strategies, instruments, data collection and analysis methods, reliability and validity of the study while explaining the issues of ethics involved in the study. Chapter four presents the findings whereas chapter five presents the discussion of the findings. Chapter six presents the recommendations based on the findings. Last in the thesis is the list of references as cited in the study and necessary appendices used.

CHAPTER TWO

LITERATURE REVIEW

2.0. Introduction

To have an enhanced understanding of students' attitudes towards science subjects in CDSSs, the literature review captures latest research in the following areas: Perspective on students' attitudes towards science subjects, factors influencing students' attitudes, then students' attitudes and academic achievement.

2.1. Students' Attitudes Towards Science Subjects

Literature refers to attitude as a learned predisposition or tendency of an individual to respond positively or negatively to some object, situation, concept or another person (Nicolaidou & Philippou, 2003). This positive or negative feeling may be of moderate intensity and reasonable stability; sometimes it is especially resistant to change.

Prominent psychologist Allport (1935) once described attitudes, "the most distinct and indispensable concept in contemporary social psychology", as an expression of favour or disfavour toward a person, place, thing, or event (the attitude object). However, his original definition which is still influential and widely quoted, dates from 1935 and is as follows: *"*An attitude is a mental or neural state of readiness, organized through experience, exerting a directive or dynamic influence upon the individual's response to all objects and situations with which it is related*"* (Allport, 1935).

As such, attitudes are an expression of inner feelings that reflect whether an individual is favourably or unfavourably disposed to some 'attitude object (Fishbein and Ajzen, 1985). Studies reveal that overall, attitudes consist of three domains namely; Cognitive, Affective, and Behavioural components (Alhmali, 2007; Reid, 1978; Bagozzi and Burnkrant, 1979; McGuire, 1985). These components are also known as taxi CAB.

- **Cognitive component**: This refers to the beliefs, thoughts, and attributes that we would associate with an object. Many times a person's attitude might be based on the negative and positive attributes they associate with an object.
- **Affective component**: This refers to personal feelings or emotions linked to an attitude object. Affective responses influence attitudes in a number of ways. For

example, many people are afraid/scared of spiders. So this negative affective response is likely to cause you to have a negative attitude towards spiders.

- **Behavioural component**: This refers to past behaviours or experiences regarding an attitude object. The idea that people might infer their attitudes from their previous actions.

Figure 1 shows these major components of attitudes and how attitudes influence and are influenced by behaviour and the external environment.

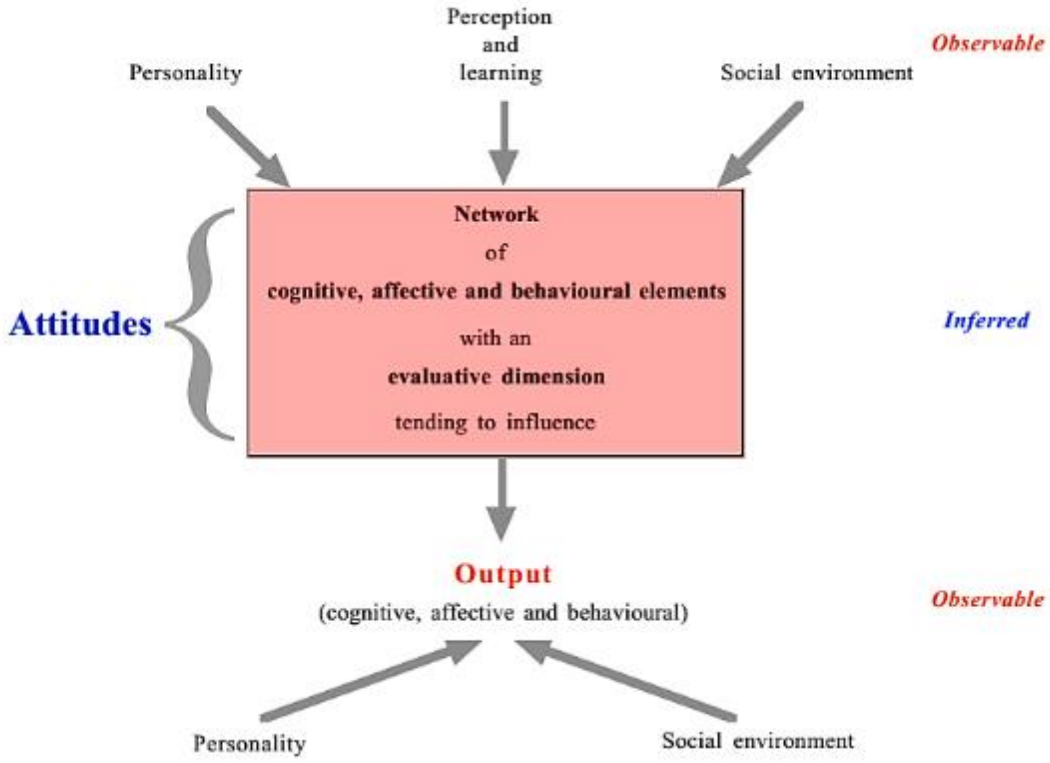

Figure 1: A Model for an Attitude as in Alhmali (2007) but developed from Reid (1978).

As such attitudes may be considered as a control system with observable input, the system itself and observable output. Hence attitude must have targets from a set of inputs. A person has an attitude towards something or someone. For instance, in an educational setting, a student may have attitudes towards learning, teachers, school, and study. It can also be very precise: for example, laboratory work in biology, the Arabic teacher, the mathematics, biology, agriculture, language subjects, humanities, or even towards science subjects (Alhmali, 2007).

Considerable research has been conducted on attitudes towards a subject like mathematics, chemistry, science and technology (Afzal, Saleem, & Ul Islam, 2015; Akpinar, et al. 2009; Anwer, Iqbal, & Harrison, 2012; Mata, Monteiro, & Peixoto, 2012; Mohamed & Waheed, 2011; Nicolaidou & Philippou, 2003; Sanchez, Zimmerman, & Ye, 2004; Sarjou, 2012; Schibeci, 1984; Simpson & Oliver, 1985).

McLeod (1994) defined attitudes towards science as a positive or negative emotional disposition toward science. This stipulates that students have some inclinations or preferences or likings towards science subjects. This is where students have well established feelings towards science subjects. If the students have positive likings, then they have positive attitudes and if they have negative likings then they have negative attitudes towards sciences.

On the other spectrum, studies have revealed that attitude towards science comprises of three components: a positive or negative emotional response to science subjects, a notion about science subjects, and a behavioural tendency with regard to science subjects (Akbas & Kan, 2007; Hart, 1989; Azodo, 2017). Attitude towards science' looks at in built and well-structured concepts of why students think science is simple or difficult and what signs do the students show to demonstrate his or her liking or disliking of the subject. For instance, some students are classically conditioned not to pay attention during science lessons. This is because the learners have preconceived ideas of science as they have deep disliking features towards the subject or other attributes attached to the subject. Afzal, et. al., (2015) agrees with Ma and Kishor (1997) that SATSS may be defined as "an aggregated measure of a liking or disliking of science subjects, a tendency to engage in or avoid mathematical and scientific activities, a belief that one is good or bad at science subjects, and a belief that science subjects is useful or useless" (p. 27).

Gardner (1975) perceived SATSS as a set of propositions related to science subjects. These tendencies lead to established feelings, beliefs and values held about an object that may be the enterprise of science subjects, school science subjects, the impact of science subjects on society or scientists themselves. Therefore, collectively, 'attitude toward science' can be defined as a belief system or a set of values that are towards an object that is a product of science, science lesson or reflections of science on the society (Prokop, Tuncer, & Chuda, 2007). Attitudes related to science

are connected to student participation in science lessons and exhibition of effective performance (Farooq & Shah, 2008).

2.2. Factors Influencing Students' Attitude Towards Science Subjects

Research studies have identified a number of factors influencing attitudes towards science in general. These can be broadly defined as gender, personality, structural variables, curriculum variables, the level of teachers' own sense of efficacy, teachers' ATSS, teaching style and behaviour, teaching techniques, achievement, assessment, and parent attitude, student's past experiences, teachers and the education system, gender, environmental factors, and many others (Anderson, 2006; Asante, 2012; Fonsea & Conboy, 2006; Mata, et al., 2012; Osborne, 2003).

2.2.1. Gender

Many studies that have been carried to relate students' attitudes towards science subjects against gender report contradictory findings. Some studies (Abu-Hola, 2005; Akpinar, et al., 2009; Morell & Lederman, 1998; Chen & Howard, 2010; Hoang, 2008; Najafi, M., Ebrahimitabass, E., Deghani, A., & Maryam, R., 2012) show a positive correlation between gender and SATSS while other studies show no correlation at all. Positive correlation occurs when either male are more positive than female students or females are more positive than male students. For instance Yilmaz and Timur (2011) reported that male students or boys have a stronger or positive ATSS and hence boys outperform girls in most areas of the science subjects, and that it is rare to identify areas of the science subject in which girls outperform boys. On a similar note, Arslan, H., Canl, M., & Sabo, M. H. (2012) carried out a study to determine whether any differences exist between female and male students' attitudes and successes of middle school toward mathematics. The findings of this research indicate that attitude of the students toward mathematics and achievement scores in Mathematics have a significant difference in terms of their gender. Female students performed more positive attitudes than male students toward Mathematics and female students had higher grades than male students. This means that female students' attitudes toward mathematics were more positive than male students.

Another study by Akpinar, et al., (2009) whose purpose was to examine differences by gender and grade level in primary school students' attitudes toward science and technology (SATST) and to explore relationship between students' attitudes toward science and technology (S&T) and academic achievement. The findings of the study showed that there were significant differences

between female and male students in terms of "interest in science" in favour of female. However there were no significant gender differences in terms of other factors "enjoyment of science", "anxiety", "enjoyment of science experiments" respectively. This shows that girls develop more positive attitudes towards science when compared to the boys. Similar results were obtained by (Alkan, 2006: Abu-Hola, 2005). In his study, Abu-Hola (2005), the purpose was to compare the effects of three types of learning approaches on students' achievement and attitudes towards science in primary schools in Jordan. He found that seven females in the experimental groups had more positive attitudes towards science after the experiment than males who were taught either by the demonstration approach or through the more traditional methods. Again in grade nine there were no statistically significant differences between groups and between males and females, but all females in the different treatment groups exhibited more positive attitudes towards science than males.

On the other hand, examination of students' attitudes toward science and technology on the basis of grade level, it was observed that female students' attitudes tended to decline while grade level increased and that a considerable decline was recorded in the attitudes of particularly 8th grade students compared to other grade levels. Some studies on attitude and grade level have also produced similar results (George, 2006; Weinburg 2000). As such, lower female attitudes in the secondary school are highly expected while that of boys tends to increase. George (2006) stated that the decline in attitudes could be related to the type of science courses taken by students in each grade. In the upper grades, science is often taught as a group of facts and vocabulary words that are to be memorized and not as a way of investigation (Weinburg, 2000).

Other studies on gender and attitude have produced different results some other studies have put forward statistically significant difference in favour of boys (Jones, Howe, & Rua, 2000). Jones, et. al., (2000) noted that beginning as early as elementary school; boys have typically possessed more interest in studying science than girls. The results of these studies show significant gender differences in SATSS. For instance, the data from the subtest "Things to Learn About" showed that males reported having more interests in the physical sciences than their female peers. Males indicated they are interested in atomic bombs, atoms, cars, computers, x-rays, and technology. These areas include many of the fundamental areas of applied physics and engineering. Females, on the other hand, continued as in the past, to report more interest than males in science aesthetics

and biology, including animal communication, rainbows, and healthy eating (Jones, et. al., 2000). The most pronounced reason for female students' interest is that they are interested in dealing with live animals and plants during biology lessons (Prokop, et. al., 2007).

Another research by (Vrcelj & Krishman, 2008) showed no correlation between gender and SATSS. This is because the quantitative data for all factors under the microscope in the study were equally important for boys and girls. For instance, both boys and girls strongly agreed/agreed to the assertion that "there is a need for more females in engineering" this is in agreement with Catasabis (as cited in Yilmaz & Timur 2011) who published that gender does not affect attitudes towards science.

2.2.2. Personality/ Internal Factors

Literature reveals that learners are a critical element in the teaching and learning of science subjects. While teachers are the arbiters of the classroom practice, the learners hold the key to what is actually transmitted and adopted from the official curriculum (Chikumbu & Makamure, 2000; Posner & Rudnitsy, 2006). Thus learners are a central figure of the learning process. As such, learner related factors are very important in studying SATSS in CDSSs. Learners come to class with different personalities that may accelerate or retard their learning speed. Personality can be defined as: "A pattern of characteristic feelings, thoughts, and behaviours that persists across time and situations-it is the distinctive and relatively enduring ways of thinking, feeling and acting that characterize a person response to life situations" (Matlin, 1995; Passer, et. al., 2009).

Research has led to a number of perspectives on personality that includes: psychodynamic, humanistic, trait, and socio-cognitive approaches (Matlin, 1995). Psychodynamic is based on Sigmund Freud and it emphasizes on childhood experiences and unconscious motivations that shape personality. Such childhood experiences and unconscious motivations may affect the learners' predispositions in a science classroom. Secondly, humanistic emphasizes that humans have an enormous potential for growth. This means that each person, in different ways, seeks to grow psychologically and continuously enhance themselves. This has been captured by the term self-actualization, which is about psychological growth, fulfillment and satisfaction in life. As such, that desire to achieve may affect the learning process of the students. Trait approach proposes that human personality is a combination of specific stable, internal characteristics such as shyness

or aggressiveness. This shyness or aggressiveness may influence learners' own beliefs of their abilities and their learning value for science. Finally, social cognitive approach emphasizes on observational learning and the central importance of cognitive factors.

A recent study by Felder, R. M., Felder, G. N., & Dietz, E. J. (2002) explored the effects of personality type on engineering student performance and attitude. Felder, et. al., (2002) pointed out that relevance of using a continuum of learning styles in teaching is not designed to identify each student's preferred learning approach (visual or verbal, concrete or abstract, etc.) and teach exclusively in that manner. It is rather to "teach around the cycle," making sure that every style is addressed to some extent in the instruction. If this is done, then all students will learn in their comfort zone. Henceforth, as long as each category students' needs and learning styles are met, the teaching and learning is certain to be more effective than it is when some categories are routinely ignored.

Similarly, positive students' attitudes are met as students feel welcomed and involved in the lesson. But those whose needs are not met become disruptive and develop a negative attitude towards the subjects. This may even apply to science subjects which are under the microscope in this study.

2.2.3. Environmental Factors

These are students' external factors that influence SATSS. These factors are beyond the reach of the student but have a direct impact on him. These may include teachers, classroom environment, curricular factors, physical structures and the student's social background. However this study will only explore teachers and the learning/classroom environment as these are the major external factors for every student. This is in agreement with Oselumese, I. B., Omoike, D., & Andrew, O. (2016) and Hannah, (2013) who stipulate that the school environment, which includes the classroom, school location, school facility, school climate and technology, teachers available etc, is a variable that affects students' academic performance and students' attitudes. Hence the school environment remains an important area that should be studied and well managed to enhance students' academic performance (Ado, 2015). The extent to which students' learning could be enhanced depends on their location within the school compound, the structure of their classroom, availability of instructional facilities and accessories. It is believed that a well-planned school will

gear up expected outcome of education that will facilitate good social, political and economic emancipation, effective teaching learning process and academic performance of the students.

The teacher is regarded as the bridge between the subject matter and the students. Thus, any study involving SATSS cannot underestimate the impact of teachers in building up students' attitude towards the subject under discussion. A significant amount of research has been carried out with the purpose of identifying personality, beliefs and behavioural characteristics of effective teachers, to understand the magic that makes some individual teachers exceptional and others less effective (Tuckman & Monetti, 2011). In an idea of taking these aspects into the teaching ground, Danielson (1996) developed a frame for effective teachers. She regards planning and preparation as very important. This is where the teacher designs instruction and develops and organizes the content of lesson. This requires the teacher to know the content, the techniques in teaching the content, teaching aids relevant for the lesson, goals and objectives for teaching the lesson, and methods of assessment to be applied. Increasingly, the classroom/learning environment created by the teacher is influential in developing SATSS. How the teacher manages non instructional interactions with the students can either make a student develop a positive or a negative attitude towards science subjects. This requires the teacher's ability to establish rapport between teacher and students as well as among students. The teacher should manage the classroom procedure, and student behaviour and organizing the physical space. When it comes to instruction, the teacher should engage the students in learning using a variety of teaching methods. The teacher should be a good communicator but also a good listener, must listen, analyse and provide feedback and extra clarifications wherever needed.

Another study by Gourneau (2005) postulates that effective attitudes and actions employed by teachers within the classroom setting can ultimately make a positive difference on the lives of their students. This includes building a positive students' attitude towards a subject. Gourneau (2005) collected valuable information on students' attitudes and actions that was summarized in a statement:

> A genuine, caring and kindness of the teacher, a willingness to share the responsibility involved in a classroom, a sincere sensitivity to the students' diversity, a motivation to provide meaningful learning experiences for all students, and an enthusiasm for stimulating the students' creativity (Gourneau, 2005, pg 1).

Therefore the impact of teachers on SATSS cannot be ignored as the teacher is the vehicle through science curriculum activities is implemented. Teachers have the opportunity to leave a permanent impression on their students' lives. School experiences mould, shape, and, can influence how children view themselves inside and outside of school.

The classroom environment is the setting in which student learning takes place. It concerns the classroom's physical environment, the social system, the atmosphere, and norms and values (Woolfolk, et. al., 2009). Studies conducted in different regions of the world have shown that classroom climate is one of the most important predictors of SATSS and hence achievement levels (Brophy and Good, 1986; Mortimore, Sammons, Stoll, Lewis, and Ecob, 1988; Muijs and Reynolds, 1999; Wang, Haertel and Walberg, 1997). Hoang (2008) in his study concluded that classroom environment relates positively with both academic efficacy and attitude to science. Previous research reported by Anwer, Iqbal, and Harrison (2012) has shown similar positive associations between classroom environment dimensions and attitudinal outcomes, especially attitude to science. Science teachers should therefore consider these results as confirming long held anecdotal views that the learning environment affects students' attitudes towards a particular subject. Teachers who provide support, demonstrate equity in the classroom, ensure that students complete learning activities and engender student cohesion in science classrooms are more likely to enhance their students' academic efficacy at science and attitude to science (Arends, Winitzky, & Tannenbaum, 2001). Strong evidence of associations between students' attitudes and the learning environment was found. The *direct transmission* view of student learning implies that a teachers' role is to communicate knowledge in a clear and structured way, to explain correct solutions, to give students clear and resolvable problems, and to ensure calm and concentration in the classroom (Nath & Sajitha, 2010). In contrast, *a constructivist view* focuses on students' not as passive recipients but as active participants in the process of acquiring knowledge. Teachers holding this view emphasize facilitating student inquiry, prefer to give students the chance to develop solutions to problems on their own, and allow students to play active role in instructional activities. Here, the development of thinking and reasoning processes is stressed more than the acquisition of specific knowledge (Tuckman & Monetti, 2011). All in all, a productive learning environment should be conducive, making the student motivated, safe, welcomed, respected, comfortable, and thus have more desire and enthusiasm towards the subject. It is therefore paramount that teachers should strive to create a very productive environment that increases

SATSS. This draws back from the perspective that learners are different and thus they learn differently. As such, the teacher must provide a cordial environment for each individual student despite having multiple intelligences. The teacher must create a good environment for verbal/linguistic intelligence, logical/mathematical, auditory, or musical, visual, and kinesthetic intelligences (Santrock, 2011). This would make each learner feel attracted and hence have a strong self-efficacy in science subjects. The following pedagogical strategies could initiate a productive environment in a science class: science game, experiments, deductive reasoning, problem solving, build models, discovery learning, field visits, dramatize events, audio visual displays. Woolfolk, et. al., (2009) regards that a productive learning environment should not be threatening to learners but should promote students' sense of ownership and minimize distractions. Increasingly, teachers who want to promote positive SATSS must: physically arrange classrooms in a way to minimize distraction but increase teacher-student interaction, create a climate in which students feel the belongingness and are intrinsically motivated to learn, sets reasonable limits for behaviours, plan activities that encourage on-task behaviour, continually monitor what students are doing, and modify instructional strategies when necessary.

2.3. Attitude and Academic Achievement

Results from many studies (Abu-Hola, 2005; Mata, et al., 2012; Semukono, Orobia, & Arinaitwe, 2013; Simpson & Oliver, 1985; Weinburgh, 1995) are inconclusive as some other studies have shown a positive correlation while others have found no correlation between the two variables. For instance, Abu-Hola (2005); Mata, et al., (2012) offered more support for a strong relationship between attitude and achievement whereas Weinburgh (1995) suggested a moderate correlation between attitude towards science and achievement. The correlation is stronger for high and low ability girls indicating that, for these groups, 'doing well' in science is closely linked with 'liking science' whereas 'poor performance' is also closely linked with 'disliking of science'. For instance, Gbore and Daramola (2013) investigated the relative contributions of selected teachers' variables and students' attitude towards academic achievement in biology among senior secondary schools in Ondo State, Nigeria. The results showed that significant relationships existed among the independent variables and students' academic achievement in biology. Also 62.5% of the variance observed in students' achievement in biology was explained by linear combination of the five predictor variables. Students' attitude was the most potent contributor to the prediction. Oppositely, Simpson and Oliver (1985) argued that there is no any relationship between students'

attitudes towards science and their achievement in science. They suggested the relationship to be non-linear and not proportional.

2.4 Conceptual Map

Social psychologists have defined *attitude* as an enduring evaluation of people, objects, or ideas. These evaluations can be positive or negative. The positive evaluations form positive attitudes whereas the negative evaluations form negative attitudes. As such, it should be understood that attitudes involve the categorization of a stimulus along an evaluative dimension, based on affective, behavioural, and cognitive information (the "ABC" of attitudes). Such attitudes may originate from one's genetic background and from one's social experiences. This is in agreement with Albert Bandura's Social Learning Theory that stipulates that attitudes are learned through imitation and modelling as well as person's inner cognitions (Bandura 1977). Hence, teachers, parents and society influence attitude and the individual learner himself also influence his own attitudes. Therefore, attitudes can be formed, and be changed frequently due to social influences.

The most common and long-standing assumption is that learning drives attitude change (Hovland, Janis, & Kelley, 1953). The first case to be considered is propositional learning, which can be conceptualized as the acquisition of new propositional information about an attitude object. We then turn to associative learning, which can be described as the formation of new associative links in memory on the basis of mere co-occurrences between objects and events. In each case, the underlying assumption is that learning new information (whether acquired vicariously or via new experiences with an attitude object) is the critical determinant of any observed change in evaluation (Petty, Haugtvedt, & Smith, [as cited in R. E. Petty & J. A. Krosnick], 1995; Petty & Krosnick, 1995). The Figure 2 is a Yale model (conceptual map) adopted for the study showing how these attitudes change.

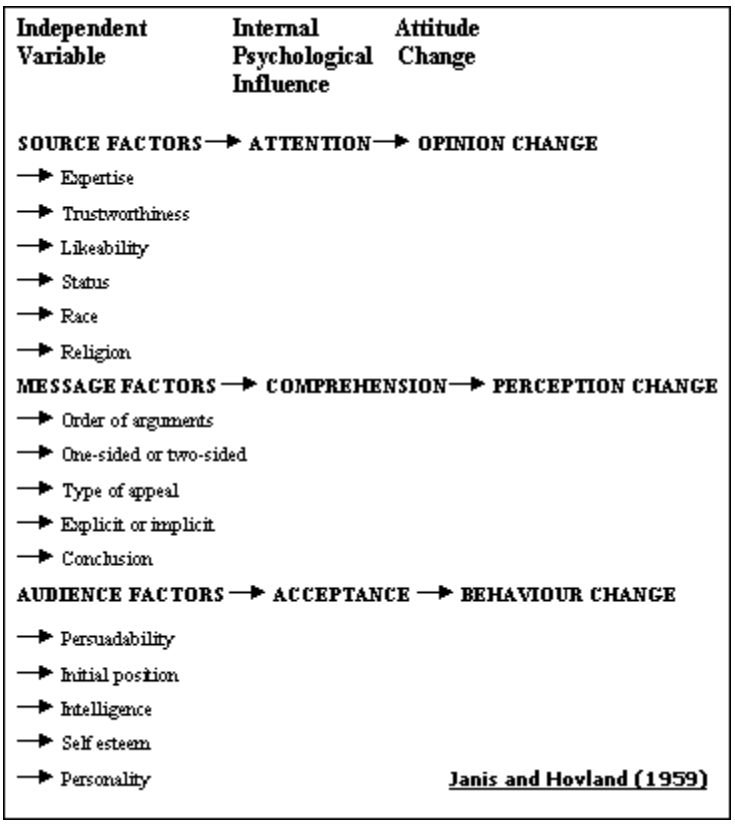

Figure 2: The Yale attitude change model

The Yale Attitude Change Approach (Hovland, et. al. 1953), also known as the Yale attitude change model, is the study of the conditions under which people are most likely to change their attitudes in response to persuasive messages (Hovland, Janis, & Kelley, 1953). This approach to attitude change by persuasive communications was first studied by Carl Hovland and his colleagues at Yale University. The basic model of this approach can be described as "who said what to whom": the source of the communication, the nature of the communication and the nature of the audience.

According to this approach, attitude change/persuasion is always influenced by three factors:- Source – originator of communication, Message – features of communication itself, and Audience – characteristics of who is receiving the message. The characteristics of source include, credibility, expertise, trustworthiness, attractiveness, similarity, and appearance of the source. People are more likely to be persuaded when a source presents itself as credible, for example Bochner and Insko found that people were more likely to trust a sleep expert than a non-sleep expert, on matters surrounding sleep (Petty & Brin˜ol, 2006). It should be clear that in Bandura's social cognitive

theory, the teacher is also another valuable source of information. As such the influence of the teacher in attitude formation and change cannot be downplayed.

The Message Factors include whether the message is one-sided (teacher centered) or two-sided message (student centered), order of messages, primacy effects or recency effects, and the repetition of main concepts (Janis & Hovland, 1959). Allen's (1991) meta-analysis of research on one-sided and two-sided messages found that two-sided messages influence attitudes more than one-sided messages. It should be clarified that at this juncture, the learning styles and the teaching methods deployed are under scrutiny. Furthermore, the logical sequence of the content delivery may affect the learners' attitudes too. The Yale Attitude Change Approach (Hovland, C. I., Janis, I. L., & Kelley, H. H. (1953)) emphasizes that the methods have a powerful impact on formation and change of students' attitudes towards a particular subject. Thence, message factors like, active learning strategies could not just be ignored in this study.

The characteristics of audience include distraction, intelligence, and self-esteem/self-efficacy. As such these factors also formed an important part in this study since they have a great contribution towards attitude formation and change.

Finally, the model emphasizes that the source of the message influence students' attention level which is a catalyst of opinion change. The message factors influence how the students comprehend the message. Hence causing change in his perception of the particular subject or concept. The audience factors influence acceptance of the content which further brings about a change in behaviour. As such, the collective changes in students' opinions, perception and behaviour brings about a change in attitudes or formation of new attitudes.

2.5 Conclusion

The literature reviewed above has shown that understanding of the SATSS helps in effective designing and implementation of a science subject curriculum. Worldwide studies conducted on SATSS have shown that students have positive attitudes towards science. However on the factors that influence SATSS, the factors are diverse, most of which are not universal but limited to its geographical area of the study. As such factors that influenced SATSS in Maldives, were not exactly the same that influenced SATSS in Cyprus. Nevertheless, the following factors were more common in many studies; self-efficacy, learning environment, teacher attitudes, gender, academic

performance, science learning value, and teaching methods. From these factors, it has been observed that students' negative attitudes towards science could be a hindrance to effective teaching. Positive attitudes create a good atmosphere for the teaching and learning process. Students would therefore benefit from programmes that improve their attitudes and also widen their understanding of science subjects through teaching and learning that emphasizes on scientific literacy. The teachers' level of ability to use effective teaching methods is very critical in attitude studies as it has been revealed through literature that teaching methods used determines the general atmosphere of the classroom that is also proportional to SATSS. Literature has shown that teachers are supposed to be a role model to the students, and if teachers' attitude towards studying biology is positive, such teacher(s) should device all methods entice students to develop positive attitudes to learning the subject. This suggests that teachers should not bring into the teaching/learning situations behaviour that can jeopardize the development and acquisition of positive attitudes towards the learning by the students. Literature to relate SATSS and gender have been inconclusive as other studies have shown that girls hold more positive attitude levels than boys, whereas other studies have shown that boys have more positive attitude levels than girls. Yet other studies have found no any statistical significant attitude difference in gender. On a similar note, studies on SATSS and academic performance present different results. Others have found a significant linear relationship whereas others have found no relationship at all.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Introduction

This chapter presents choice of research methodology used to achieve the objectives of the study. The chapter lays out the research design, research approach, and its philosophical orientation taking into consideration the epistemological and methodological choices, research time frame, population and study site, sampling, data collection and analysis techniques relevant for measuring SATSS in CDSSs. The chapter also presents measures used to ensure validity and reliability. Ethical issues have also been discussed.

3.1 Research Design

This study employed a descriptive quantitative research design since it emphasized on quantification in the collection and analysis of data. The study was descriptive in nature because the main aim was to describe the SATSS in CDSSs and provide an accurate and valid description of the factors or variables that pertain / are relevant to the SATSS. The research was a survey because it quantitatively described specific aspects of a given population (CDSSs) in Malawi. Furthermore, it involved examining the relationships among variables informing SATSS. Finally, it was a survey research as it used a selected portion (3 schools) of the population from which the findings were later generalized back to the population.

The study was cross-sectional in nature since it surveyed a specific population at a given point in time. Thus, a 'snapshot' approach was used where the data were collected at one point in time. Therefore, the study was short-term mainly because of the pressure of time and resources.

Positivism paradigm was adopted for this study to clarify the structure of inquiry, the nature of knowledge and methodological choices. This is so because the study assumed that there is only one view of reality on SATSS. That is, the measurement would either reflect positive or negative SATSS. This is why the study was also underpinned by the objectivism as its epistemological viewpoint.

3.2 Research Approach

This study adopted a deductive approach since it involved hypotheses testing, after which some of the hypotheses were accepted and some rejected. The first stage was the elaboration of a set of

principles or ideas allied to SATSS and academic achievement, which was then tested through analysis of the collected data. Secondly, a learning theory to attitude formation and attitude change was chosen to pin the study. This theory was most appropriate to SATSS. This is because psychologists have defined attitudes as a learned tendency to evaluate things in a certain way. Thus, attitudes can be formed and can be changed. Thirdly, a hypothesis, a testable proposition about the SATSS in CDSSs, factors that influence SATSS in CDSSs, the relationship between SATSS and academic achievement were produced. Fourthly, Likert scaled questionnaire was specified as an instrument for measuring SATSS concept. Furthermore, the data collected was compared with the theory of attitude formation and change. Upon corroboration, the learning theory is assumed to have been established. Increasingly, the results were examined in order to accept or reject the hypothesis from the outcome. Lastly, the theory was confirmed that attitudes of students in CDSSs can be formed and can change.

3.3 Population and Study Site

The study was done at three schools in Blantyre namely; Chimwankhunda CDSS, Joshua CDSS and Lirangwe CDSS. Chimwankhunda CDSS had 321 students and 13 teachers. Lirangwe CDSS had a total of 285 students and 15 teachers while Joshua CDSS had 260 students and 18 teachers. As such, the population for the study was 866 students. The schools had a similar structure as shown in Figure 3.

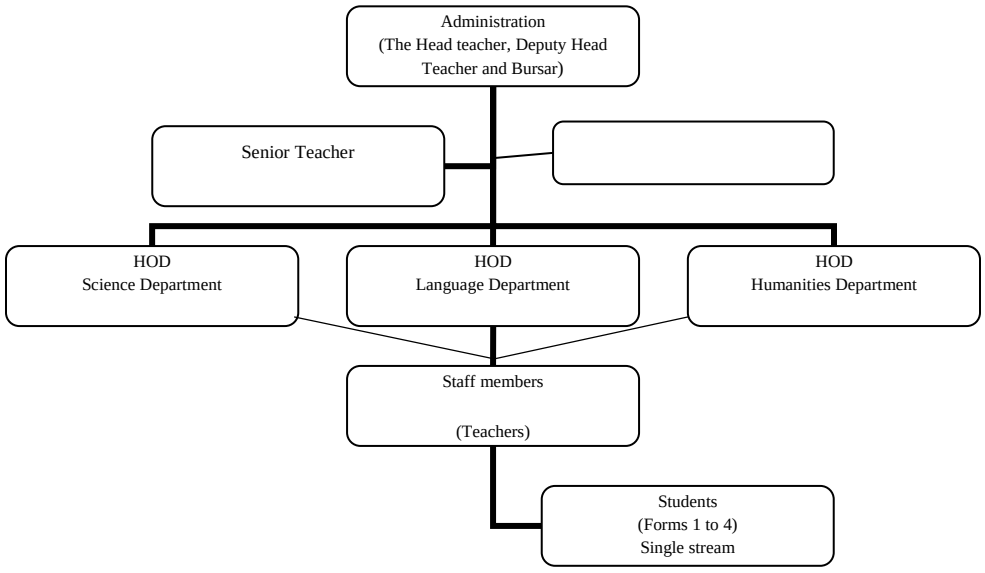

Figure 3: School structure of Chimwankhunda CDSS, Joshua CDSS and Lirangwe CDSS.

3.4 Sampling

The sample size for this study was a total of 273 students from Chimwankhunda CDSS, Lirangwe CDSS and Joshua CDSS as based on Yamane's (1967:886) formula:

$$n = \frac{N}{1 + N(e)^2}$$

Where n is the sample size, N is the population size, and e is the margin error. A 95% confidence level and P = 0.05 were used for the sample size calculation.

The study used stratified simple random probability sampling because the population was partitioned into groups, called strata based on school, class level, and gender, and sampling was performed separately within each stratum using simple random probability sampling. This sampling technique was ideal because each student of the each subpopulation had the same chance of being selected as other members in the same group.

As such the sample size for Chimwankhunda was 101 students, Lirangwe CDSS was 90 and Joshua CDSS 82 as shown in Table 1 below:

Table 1: Population size for each site and its sample size calculated based on Yamane's formula.

School name	**Form**	**Population per gender**		**Total population**	**Sample size based on gender**		**Total sample size**
		Boys	Girls		Boys	Girls	
Chimwankhunda	1	37	34	321	12	11	101
	2	56	40		17	13	
	3	44	23		14	7	
	4	55	32		17	10	
Lirangwe	1	46	46	285	15	15	90
	2	50	29		16	9	
	3	40	14		13	4	
	4	38	22		11	7	
Joshua	1	41	30	260	13	9	82
	2	37	35		12	11	
	3	32	25		10	8	
	4	33	27		10	9	
TOTAL		**509**	**357**	**866**	**160**	**113**	**273**

The random sampling was considered ideal as it increases validity and reliability of data by avoiding bias which is more common in non-probability sampling. To ensure credible sampling, the students in each site were assigned consecutive numbers from 001 to 350 of which was followed by generation of random numbers as per each site. Students with numbers within the range of 001 to 350 were selected.

3.5 Data Collection

This study used 273 questionnaires to collect the data needed to measure SATSS. The questionnaire was drafted from the SMTSL questionnaire for measuring Students' Motivation towards science learning designed by Tuan, Chin and Shieh (2005). The major reasons for using questionnaire were that questionnaires are economical, can be anonymous (hence increases ethical conduct of the study), questions and procedures are uniform and standard, easy to score quantified data, and has the ability to give subjects time to think before responding (McMillan & Schumacher, 2014). Closed questions on a Likert scale were used to generate data for easy analysis and to allow fair and accurate assessment of the SATSS since students' attitude is thought of in terms of gradations and levels. Therefore quantitative data was easily obtained and analysed. Respondents were offered a choice of five point ordinal scale which allowed the participants to express how much they agreed or disagreed with a particular statement. A clear sample of the questionnaire reflecting all these considerations is attached in the appendices (Appendix E). The subjects were also provided with open ended questions for more detailed individual answers. The data from open ended questions helped to explain the quantitative data obtained. For example on page 55 data from open ended questions elaborated that students highly prefer biology and physical science than mathematics and computer studies. In their justification of preference most students said "biology and physical science explain real life things useful in their lives and more of biology explain living things (people too) how they behave and adapt in their immediate environment". This increases their interest in these subjects. When asked what hinders them from learning science subjects effectively, students mentioned the following problems: few equipment in the laboratories, other students failed to understand why they learn particular subject, teachers' failure to motivate the students and teachers' inadequacies in handling science subjects.

To overcome inadequacies of Likert scale, rank-order attitude scale was used as an additional attitude scale. This is where the students were required to rank the four subjects-Mathematics,

Physical science, Biology and computer studies, listing from the most preferable to the least preferable. Preference ranking was simple to use and the results of such research were easily presented, analysed and interpreted. For academic achievement, mean for SATSS was correlated to the measure of academic performance on the Likert scale.

3.6 Data analysis

Data were analysed using Statistical Package for Social Sciences (SPSS) to come up with descriptive statistics as it intended to find correlation between SATSS and achievement. Furthermore, it was easy to relate SATSS of other factors like gender, classroom environment and personal factors using factor analysis as it provided an index to determine underlying factors of SATSS. Mean scores of respondents on Likert scale were calculated to measure SATSS. Analysis of Variance (ANOVA) test was used to test the significance level of the hypotheses to see the statistical significant differences in attitude levels among boys and girls.

Subject preference inventory was also adopted to distinguish attitude difference across the subjects. Attitude was obtained by asking students to rank science subjects in order of their decreasing preference. The subject [biology] with highest number of preference indicated students' positive attitude whereas that with least level of preference indicated negative attitude towards science subjects.

3.7 Validity and Reliability

This study ensured validity of data collected in four categories. Firstly, face validity was observed so that the questionnaire items looked to measure the intended variables. This was done by proof reading the questionnaire items. Secondly, content validity was also checked. This involved making of logical analysis of the content to determine how well it covered the domain being measured. The items were clear, short, simple, relevant, and purposeful. A pre-test was conducted to ensure clarity, checking in grammar and spellings of the items so that it measured what it had to measure. This involved choosing a few thoughtful students to read and respond to the questions. Some adjustments were made as per their evaluation of the questionnaire. Construct validity was also considered**.** This involved checking if the items were measuring the intended construct. Exploratory Factor Analysis (EFA) – Principal Components Analysis – was applied to the data to examine the construct validity of the instrument. The Kaiser-Meyer-Olkin measure of sampling adequacy indicated that the strength of the relationships among variables was high (Biology KMO

= 0.667; Physical science KMO = 0.662 and Mathematics KMO = 0.611), thus it was valid to proceed with the analysis. Bartlett's test of sphericity, which tests the overall significance of all the correlations within the correlation matrix, was significant across all subjects

Hence, results revealed items measured the intended construct. Lastly the questionnaire was given to some specialists [supervisors] to review it before being administered to ensure it measured what it ought to measure.

To check the reliability of the instrument, reliability test was done using Cronbach's alpha which is defined as a measure used to assess the strength of internal consistency of a set of test items (Pallant, 2001). The results were as shown in Table 2:

Table 2: Cronbach's alpha showing reliability of the questionnaire.

Reliability Statistics

Variable	**Cronbach's Alpha**	**Number of Items**
Science Learning Value-SLV	0.770	12
Active Learning Strategy-ALS	0.688	17
Teacher Factors-TF	0.802	24
Self-Efficacy-SE	0.752	43
Stimulating Learning Environment-SLE	0.734	11
Male/Female domain	0.701	10
Students' Attitude Towards Science-SATSS	0.833	3
Overall	**0.893**	**130**

Some items were deleted from the questionnaire as it tended to decrease the reliability of the instrument. The observed alpha coefficients ranged between 0.688 and 0.833. Hence I was satisfied that these alpha coefficients are sufficiently high to indicate scale reliability since many methodologists recommend alpha value above 0.65 (Pallant, 2001). Overall, it was given a "good" for this study.

3.8 Ethical Considerations

The study ensured that the rights, dignity, privacy, and sensitiveness of the respondents were respected. Participant's had the right to decide on whether or not to participate in the study without any element of force, fraud, deceit, duress, coercion or undue influence on the subject's decision. Surety was given that any data collected will be used securely for the sole reason of measuring the SATSS, and analysed under anonymity as students' identity. The entire respondents shall have clear informed consent of the study before participating in the research. The respondents were informed of the nature and purpose of the study. Finally, the respondents were given a copy of the signed and dated consent form and the extra copy of the consent form was given to them to keep for legal applications if their rights were infringed in any form.

3.9 Conclusion

This chapter has presented the research design as a quantitative survey informed by positivism paradigm to clarify the structure of inquiry, the nature of knowledge and methodological choices whereas objectivism was hired as its epistemological philosophy underpinning the study. The population and sample size was determined by stratified simple random sampling techniques based on Yamane's formula. The validity and reliability were employed at every stage of the study and that legal and ethical considerations for respondents taking part in the study were observed.

CHAPTER FOUR

FINDINGS

4.0 Introduction

This chapter present findings of the study. The data collected were analysed quantitatively using parametric statistics in SPSS. The first section present the findings followed by summary of the findings.

4.1 Findings

This study investigated students' attitudes towards science subjects (Biology, Physical Science, Mathematics and Computer Studies) from Community Day Secondary Schools (CDSSs) in Malawi. The primal focus of the study was to measure students' attitudes towards science subjects (SATSS) in CDSSs and relate this SATSS to their academic performance. This chapter presents the SATSS, factors that influences SATSS and relationship between SATSS and academic performance. Key findings will also be presented.

4.1.1 SATSS in CDSSs.

Table 3 shows the results of the measure of SATSS in CDSSs. The items that measured students' attitudes towards science subjects were analysed using descriptive statistics. The measure (Mean = 2.38, Mode = 2 and SD = 0.932) showed 54.9% of students (n = 273) in CDSSs to have a positive Attitude Towards Science Subjects whereas 11.4% have a very strong positive attitude towards science subjects. It should be emphasized that all negatively coded items were reversed before means were computed to measure the attitudes.

Table 3: Percentage of the measure of SATSS.

	Percentage
Strongly Agree	11.4
Agree	54.9
Undecided	22.3
Disagree	7
Strongly Disagree	4.4
Total	100

It can be concluded that 54.9% of the total sample had positive attitudes towards science subjects where as 11.4% had a very strong positive attitude towards science subjects. Hence, cumulatively, majority (66.3%) of the students in CDSSs have a positive SATSS. Figure 4 is a histogram that shows the distribution of scores of respondents.

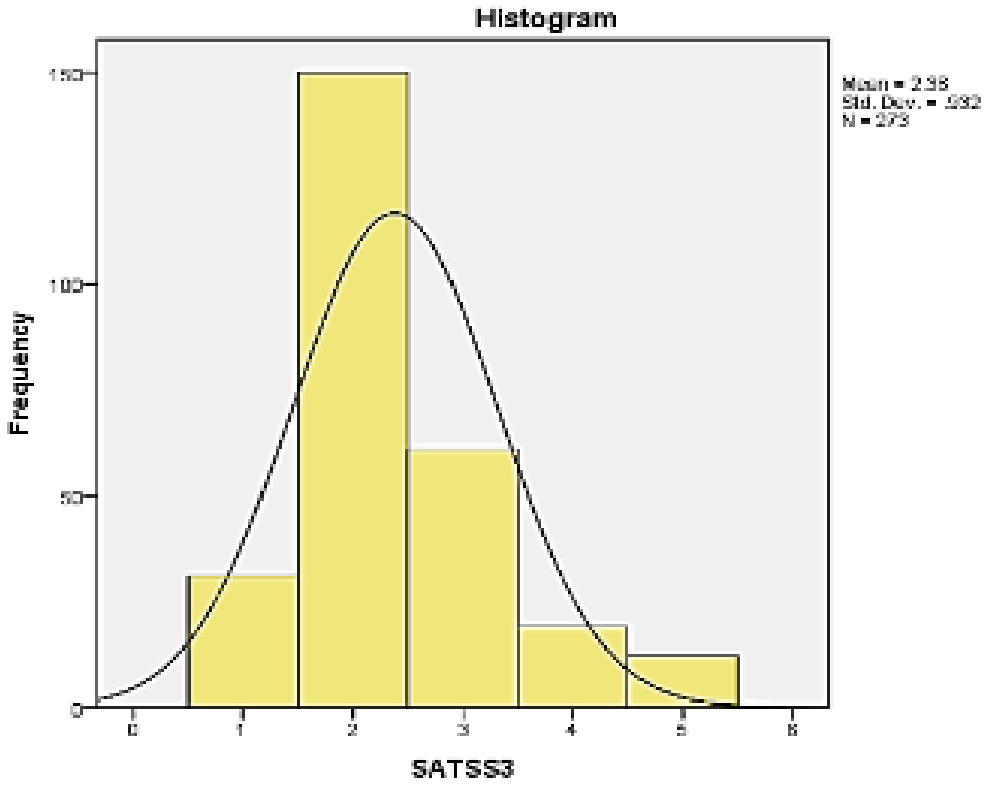

Figure 4: Distribution of scores of SATSS.

The figure suggests a reasonably symmetric set of data. Hence, the curve has more frequency on the scores of 1 and 2, indicating a positive measure of SATSS. As seen from the graph, it can be explained that few students have low SATSS in CDSSs. Studies (Anwer, Iqbal, and Harrison (2012); Osborne (2003); Najafi, et. al., (2012); Azodo (2017)) have revealed a range of components that explain attitudes to science. These include: Leisure interest in Science, curiosity towards science, anxiety toward science, the value of science, science teacher factors, self-efficacy towards science, self-esteem at science, motivation towards science, enjoyment of science, attitudes of peers and friends towards science, attitudes of parents towards science the nature of the classroom environment, and achievement in science.

4.1.2 Factors that influence SATSS in CDSSs.

Initially, the factorability of the data set was examined as per subject, that is, mathematics, biology and physical science. A factor analysis of the current results was performed using the Principal Component Analysis (PCA) method of extraction as well as both Varimax and Oblimin rotation with Kaiser Normalization. The factor analysis results are shown in Appendices F, G, H, I and J. The Oblimin rotation would not be ignored as the interdependency (correlation) among the factors cannot be ruled out. Bartlett's test of sphericity, which tests the overall significance of all the correlations within the correlation matrix, was significant across all subjects (biology: $\chi 2$ (253) = 1001.820, p<0.000: physical science: $\chi 2$ (351) = 1271.504, p<0.000: Mathematics: $\chi 2$ (378) = 1398.290, p<0.000), indicating that it was appropriate to use the factor analytic model on this set of data. The Kaiser-Meyer-Olkin measure of sampling adequacy indicated that the strength of the relationships among variables was high (Biology KMO = 0.667; Physical science KMO = 0.662 and Mathematics KMO = 0.611), thus it was acceptable to proceed with the analysis.

Table 4: SATB-KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.661
Bartlett's Test of Sphericity	Approx. Chi-Square	1001.820
	Df	253
	Sig.	.000

a. Based on correlations

Table 5: SATB-KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.662
Bartlett's Test of Sphericity	Approx. Chi-Square	1271.504
	Df	351
	Sig.	.000

a. Based on correlations

Table 6: SATM-KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.611
Bartlett's Test of Sphericity	Approx. Chi-Square	1398.290
	Df	378
	Sig.	.000

a. Based on correlations

In addition to KMO and Bartlett's tests, the scree plot and anti-image correlation matrix were used. Hence, supporting the inclusion of each item in the factor analysis. Finally, the communalities were all above 0.3, further confirming that each item shared some common variance with other items. Given these overall indicators, factor analysis was conducted with all satisfaction.

Initially, 10 factors with eigenvalues greater than one were extracted representing 65% of the total variance. A series of factor analyses were conducted which indicated that seven factors gave the most interpretable solution (see Appendix K). An Oblimin rotation was performed since factors were expected to be correlated. The obtained structure matrix is displayed in Table 10 as attached in the appendices. Only items with factor loadings of above 0.3 are shown.

Two items loaded onto Factor 1 whose total eigenvalue is 4.508 representing 16.097% of the total variance. It is clear from the structure table that these two items all relate to students' belief in their own abilities in science subjects. This factor loads onto reported level of easiness in understanding scientific concepts and interpreting assignment questions in science subjects. This factor was labelled, "Self-efficacy (SE) towards science subjects". Seven items load onto a second factor related to students' inclinations of science learning value. The eigenvalue of factor 2 is 3.751 with variance as 13.281% of the total variance. This is related to students' eagerness to learn more about sciences, to get a job that needs sciences and their belief on the importance of science subjects for their country, belief that science makes most things work better, students' time to read science related materials, and their rate on general importance of science subjects. This factor was labelled, "Science Learning Value (SLV)". The five items that load onto Factor 3 (eigenvalue 3.357 and 11.989% of the total variance) relate to the conducive learning environment for science subjects. This factor was labelled, "Stimulating Learning Environment (SLE)". This incorporates learning

environment where students do not misbehave in a science class, everyone feels loved in the science class, and noise free science classrooms.

The two items that load onto Factor 4 identify the effective learning strategies in science subjects that includes; discussions, peer teaching and discovery learning and group work. This was labelled, "Active learning Strategies". Items loaded for Factor 5 (eigenvalue 1.309 and variance 4.673%) related to teacher attributes that influence students' attitudes towards science subjects. This was labelled, "Teacher Factors (TF)". Factor 6 had items related to gender. As such items loaded to factor 6 were named "Gender". In total all the factor loadings shared a cumulative total variance of 65%.

Similar factor loadings for physical science and biology were obtained and similar results were obtained. The rotated component matrix showing the results of factor loadings of students' attitudes in Biology and Physical science as attached in Appendix F, G and H.

4.1.3 Gender versus SATSS.

Using ANOVA a comparison was made between students' gender and their attitude toward science subjects.

Table 7: Descriptives carried out to find out any significant differences of SATSS by gender

Descriptives								
SATSS								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Male	160	2.28	.883	.070	2.14	2.41	1	5
Female	113	2.53	.983	.092	2.35	2.71	1	5
Total	273	2.38	.932	.056	2.27	2.49	1	5

Table 8: ANOVA statistics carried out to find out any significant differences of SATSS

ANOVA					
SATSS					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	4.339	1	4.339	5.068	.025
Within Groups	232.042	271	.856		
Total	236.381	272			

As seen from the Table 8, the results showed that there is a statistical significant difference between female and male students in terms of their attitudes toward science subjects ($P = 0.025 < 0.05$). Mean of female students' scores [Mean = 2.53, and SD = 0.983] was higher than male students' [Mean = 2.28 and SD = 0.883]. In other words, female students had more positive attitudes than male students towards science subjects in CDSSs.

4.1.4 SATSS and Academic Achievement.

To explore possible relationship between SATSS and Academic achievement, Pearson's correlation was adopted and the results were recorded as shown in Table 9:

Table 9: Relationship between SATSS and performance/academic achievement

Correlations			
		SATSS	Performance
SATSS	Pearson Correlation	1	.720**
	Sig. (2-tailed)		.000
	N	273	273
Performance	Pearson Correlation	.720**	1
	Sig. (2-tailed)	.000	
	N	273	273
**. Correlation is significant at the 0.01 level (2-tailed).			

As seen, results in the table showed a statistical significant positive relationship between SATSS and performance/academic achievement. This means that students with high attitude levels towards science subjects registered high levels of achievement in science. Similar results were also obtained in the other studies (Abu-Hola, 2005; Mata, Monteiro, & Peixoto, 2012; Semukono, et. al., 2013; Simpson & Oliver, 1985; Weinburgh, 1995). In the light of these results, it can be suggested that students with high science achievement develop positive attitudes towards science as well. However the direction of impact was not examined. This is to say whether high attitude causes high performance or high performance causing high attitude levels. This may be considered as an area for further research in the recommendations as most of the results are inconclusive (Aydeniz & Kotowski, 2014).

4.2 Summary of Findings

This study investigated SATSS in CDSSs in Malawi. The results revealed that students in CDSSs have positive attitudes towards science subjects. Specifically, students showed more positive attitudes towards biology than the rest of the subjects. Findings explained a positive correlation between SATSS and academic performance. It was also discovered that there were significant differences in SATSS in relation to gender as girls had more positive attitude levels than boys. The following were found to be the underlying factors of SATSS: gender, performance, science learning value, self-efficacy, and active learning strategies. Unexpectedly, teacher factors and stimulating learning environments had a weak relationship to SATSS if they remained unintegrated with the other factors. Otherwise, the interdependency of the factors makes each and every factor a powerful determinant of SATSS

CHAPTER FIVE

DISCUSSION

5.0 Introduction

This section has two fundamental aims: to explain the results of the study, and to explore the implication of the study's findings.

The purpose of this study was to investigate students' attitudes towards science subjects in CDSSs by gender and to explore relationship between students' attitudes towards science subjects and academic achievement among other factors.

5.1 SATSS in CDSSs

It is evident from the results of this study that majority (over 54.9%) of the students (n = 273) in CDSSs have positive attitudes towards science subjects. This is because the analysis shows a score of 2 as the mode and a mean of 2.38 for the items analysed to measure SATSS. According to Pallant (2001), a mode is a score with the greatest frequency or a score that appears most. Thus, it can be deduced that for all CDSSs 11.4% strongly like science subjects, 54.9% like science representing a cumulative percentage of 66.3% of all students in CDSS to have a positive attitude towards science subjects. On the other hand, 22.3% of the students were not sure whether they like science subjects or not. Hence leaving only 7% and 4.4 percentage that clearly expressed their hatred towards science subjects. Therefore, it can be comprehended that within the population of students in CDSSs, almost 11.4% have a negative attitude towards science subjects. The histogram (Figure 2) proofs that a large population of students in CDSSs have a positive attitude towards science subjects.

5.2 SATSS VS. Gender

Results by gender showed that there was a significant difference between female and male students in terms of "SATSS" in favour of female. Considering other factors ("Self-efficacy", "teacher factors", "science learning Value", "stimulating learning environment", and "performance"); compared with boys, girls tend to have more positive attitudes toward science subjects across all factors. This shows that girls develop more positive attitudes towards science when compared to the boys. However, results showed that in terms of academic achievement, girls slightly failed to

outscore the boys with a deficit score of 2.28 percent from the average score of boys in a science subject test. Boys scored averagely 56.78% in a test whereas girls scored averagely 54.50%.

This discovery is similar to the findings of some contemporary studies which conveyed that girls overtook boys in their attitude levels towards science (Abu-Hola, 2005; Akpinar, et al., 2009; Morell & Lederman, 1998) but on the contrary, other studies recorded that boys have more positive attitude levels towards science (Chen & Howard, 2010; Hoang, 2008; Najafi, et al., 2012) where as other studies found no difference in attitude levels by gender (Mohamed & Waheed, 2011; Nambikkai & Manoharan, 2014; Neathery, 1997; Yilmaz & Timur, 2011; Nicolaidou & Philippou, 2003).

5.3 Factors Influencing SATSS in CDSSs

The study tells us that SATSS had the following underlying factors: teacher factors, self-efficacy, class level, gender, science learning value, active learning strategies and stimulating learning environments.

5.3.1 SATSS and Science Learning Value (SLV)

It can be seen from Table 10 (Appendix F) that the analysis indicated a statistical significant relationship (eigenvalue 2.642: variance as 9.434%) between SATSS and SLV. The SLV scale was seen as a very important underlying factor in determining students' attitudes and motivation to learn how relevant the subject is, determines the level of liking. The rate at which students regard a concept or subject as important determines his/her predispositions towards that subject. If students regard that particular subject as very important and relevant to personal ambitions, then the students have more arousal to learn the subject. Related studies (Akbas & Kan, 2007; Andressa, Mavirikaki, & Dermitzaki, 2015; Bedel, 2016; Yilmaz & Timur, 2011) have drawn some links among science learning value, motivation and academic achievement. Hence positive attitudes towards the subject that influences the academic achievement. Cavas (2012) revealed that as science learning value increases from low to high, students mean scores of science attitude and achievement also increases. For both variables, students who were labelled as at a high motivation level had more positive attitude levels and had higher scores. The SLV scale consists of crucial values aspects such as acquiring problem-solving competency, experiencing inquiry activities, stimulating their own thinking and finding the relevance of science in daily life (Tuan, et. al., 2005).

5.3.2 SATSS and Self-Efficacy

As seen from appendix F, G, H and I, the results show a strong positive relationship [eigenvalue 3.199: total variance explained 11.424%] between SE and SATSS. This means SE in science is the greatest underlying factor for overall SATSS as it contributes more to the total variance than other factors. Hence, students with high SE tend to have high attitude towards science subjects and perhaps students with high SATSS have high SE. Thus, the contribution of SE on SATSS for CDSSs students cannot be disputed. Related studies (Abbit & Klett, 2007; Bedel, 2016; Cavas, 2012; Li, 2012) indicated strong significant relationship between attitudes, efficacy and achievement. However, efficacy was a more powerful predictor of attitudes that influenced students' level of academic achievement. This stipulates that students that have high self-efficacy towards a subject, tend to have positive attitudes which also lead to high academic performance. However if the students have low self-efficacy, their attitude levels towards a subject are also low. In this study, it is found that when students' attitude towards science subjects in CDSSs are positive, their self-efficacy is also higher. Indeed, such a finding is consistent with past researches. For instance, in a study conducted by Delcourt and Kinzie (1993); Li (2012), they found that if students held positive attitude towards an academic subject (e.g. they found it comfortable and motivated to study the subject and they thought the subject was of high value to their studies and future career, and they tended to possess higher self-efficacy in studying the subject.

5.3.3 SATSS and Active Learning Strategies (ALS)

In Table 8 (Appendix F), the results indicated that ALS is also another great underlying factor of SATSS [eigenvalue 1.973 and variance 7.045%]. This is contradictory to the null hypothesis that stipulates no statistical significant relationship between the two variables, SATSS and ALS. This can be explained perhaps because of the close relationship of ALS with other predominant (SE, SLE and SLV) underlying factors that influence students' overall predispositions over the learning of science subjects. These results can be interpreted that the teaching methods deployed by science teachers, solely or placed in a vacuum, do not influence the students' attitudes towards science subjects. This is perhaps because teacher factors and science learning value are the predominant factors influencing SATSS. As such, what the learner regard as irrelevant despite how good it is presented, it is very difficult to convince the leaner to develop positive attitudes towards that particular subject. Furthermore, even if the subject is regarded as relevant to the learner, but negative attitudes towards the subject teacher forces the learners also to develop negative attitude

towards the subject. Similar findings were obtained by (Akinsola & Olowojaiye, 2008; Liu, 1999; Mcleish, 2009; Susan, David, & Juliette, 2003). For instance, Susan, et. al., (2003) study results showed that students generally held very positive views of student-centred learning like case study, problem based learning, field visits, discovery learning, group work, role play and stimulation. Susan, et. al., (2003) further explain that education is to be truly student-centered, students should be consulted about the process of learning and teaching. Moreover, it is imperative that institutions move from an 'inside out' approach, where those on the inside 'know' what is best, to an 'outside in' approach where customers' expectations are researched and serviced. However, some studies (Cox, 2008; Wiggins, 1984; Zhao & Ting, 2013) showed no significant relationships between the SATSS and ALS. But the point should be emphasized that the model of delivery is very proportional to students' attitudes. Good models form positive attitudes and bad models form bad attitudes.

5.3.4 SATSS and Teacher Factors (TF)

In this study the relationship between SATSS and TF was statistically significant (eigenvalue1.384 and variance 4.944%), indicating that good TF creates positive students' attitudes towards science subjects in CDSSs. On the contrary, poor TF creates negative students' attitudes towards science subjects. The study reveals the goodness of a teacher lies in friendliness of the teacher to learners, teacher's reliability, trustworthiness, likeability, mastery of the content, ability to coach, encourage and mentor the students in a science subject class. This creates a mutual positive working environment between the students and the teacher. As such, the teacher is committed to scaffold the learners and the learners feel free and welcomed to ask challenging scientific concepts. Hence, teacher attitudes can help or hurt students' motivation, achievement and well-being. Recent studies found out that negative teacher attitudes can impair achievement and increase students' psychological disorders and physical symptoms of stress. Teachers who use humiliation, sarcasm, intimidation, and discipline by fear are harsh in display of their authority and mostly they end up having most students hurting them and the subject they teach. This even forces some students to withdraw themselves from that particular subject. Furthermore, it was discovered that the success of teacher factors cannot be absolutely delinked from the effectiveness of active learning strategies and students' level of self-efficacy.

5.3.5 SATSS and Stimulating Learning Environments (SLE)

Table 8 showed that SLE is one of the underlying factors of SATSS [eigenvalue 1.497 and 5.346% of the total variance]. However, the percentage of contribution is slightly lower than Self efficacy and science learning value. This is perhaps because there are other predominant factors (SE and SLV) that have overshadowed the influence of the learning environment on the development of SATSS. As such, solely, SLE has insignificant influence on students' attitudes assuming that minimal standards are attained for the students' comfortableness to learn. Otherwise, throughout my dealings, physical elements in the classroom improve comfort, well-being and probably attitude and so, perhaps, improve achievement. As such without these minimal standards, the physical environment/facilities affects general classroom atmosphere. Hence poor attitudes towards science. Similar results were found by (Afzal, et. al., 2015; Semukono, et. al., 2013). For instance, Afzal, et. al., (2015) explains that it was also found out that classroom learning environment has a feeble effect on students' attitude towards Mathematics. On the other hand some studies (OECD, 2009; Radovan & Makovee, 2015) explained a strong significant relationship between the two factors.

5.4 SATSS and Academic Achievement/Performance

Analysis of the relationship between achievement and attitude exposed a positive relationship. Similar results were also obtained in the other studies (Abu-Hola, 2005; Mata, et al.,2012; Semukono, et. al., 2013; Simpson & Oliver, 1985; Weinburgh, 1995). In the light of these results, it can be suggested that students with high science achievement develop positive attitudes towards science as well. However the direction of impact was not examined. This is to say whether high attitude causes high performance or high performance causes high attitude levels. This may be considered as an area for further research in the recommendations as most of the results are inconclusive (Aydeniz & Kotowski, 2014).

CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

6.0 Introduction

This chapter presents the deduction and suggested recommendations to teachers, students, and areas of further studies in order to increase students' attitudes towards science subjects in Malawian secondary schools.

6.1 Conclusion

Contrary to the expected results, the study showed that students in CDSSs have positive attitudes towards science subjects. However, results of the study illustrated a significant effect of gender on students' attitude towards science subjects. Girls had significantly more positive levels of attitude towards science than boys on total scale and on all sub-scales of revised SMTSL questionnaire. In terms of underlying factors of SATSS, results showed that the following: self-efficacy, teacher factors, gender, stimulating learning environment, science learning value, performance, and active learning strategies deployed in the teaching and learning of science subjects in CDSSs. It should also be known that some other unexpected factors influenced SATSS. These are: grade level and locality of the school. It was shown that SATSS increased with increase in grade level of the student. Thus form four students had more positive attitudes than form one students. This could be attributed to high sense of maturity and prospected career ambitions in scientific fields. Figure 6 shows a summary of the key findings on the underlying factors of SATSS.

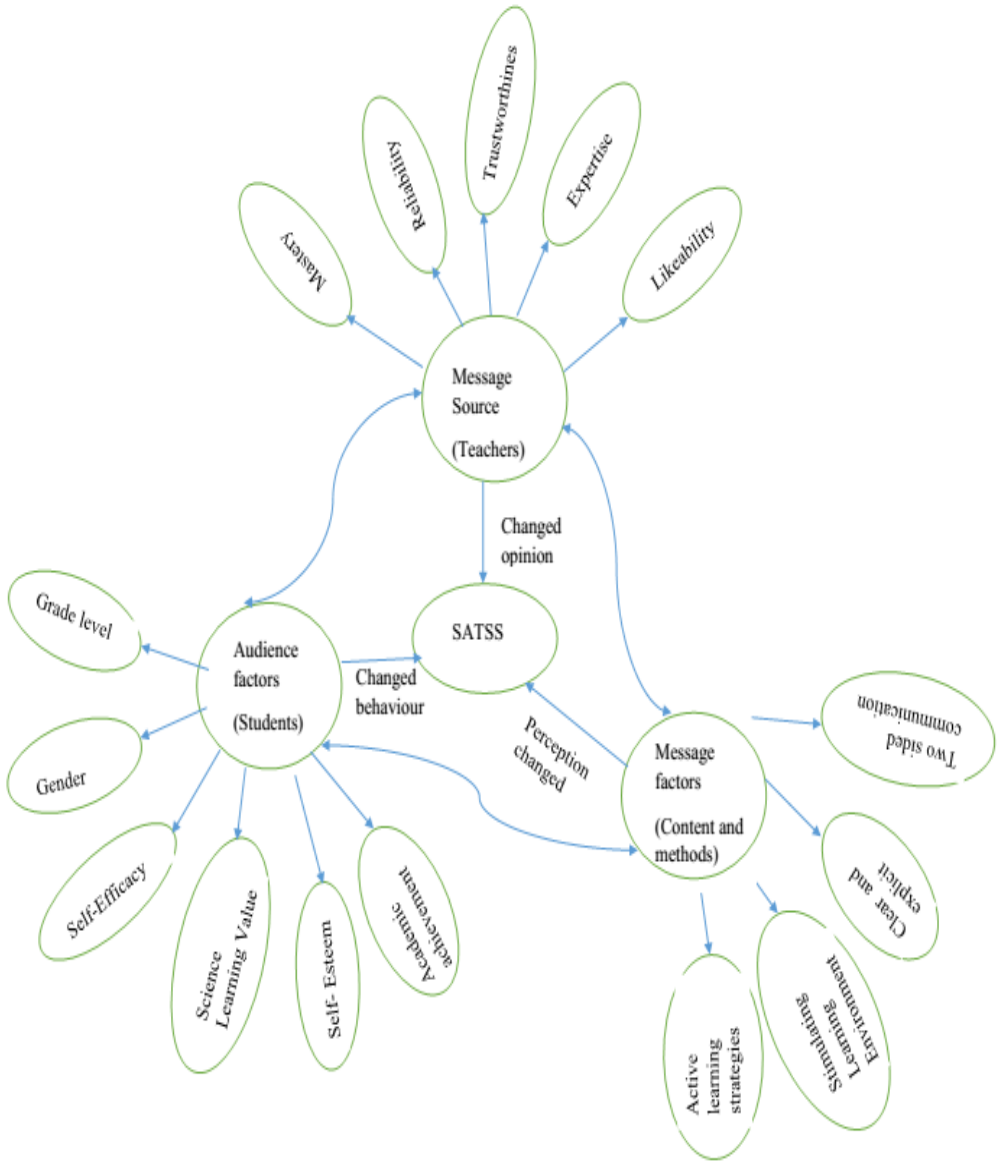

Figure 5: Yale attitude change model (conceptual map) as applied in learning context (of this study)

This is in agreement with social cognitive theory that views both internal and external factors as pivotal to learning. Environmental events, personal factors, and behaviours all operate together as interactive determinants or causes of each other in what Bandura (1997) calls the self-system (Harris & Sanborn, 2013; Pajares, 2000). This interlocking system shows that personal factors (beliefs, expectations, attitudes, and knowledge), the physical and social environment (resources, consequences of actions, other people and physical settings), and behaviour (individual actions, choices and verbal statements) all influence and are influenced by each other. As such, the

individuality of the variables in influencing SATSS cannot be overemphasized at the expense of their interdependency. The bi-directional arrows show that teacher factors influence audience factors, audience factors influences message factors whilst message factors also influence the audience factors and lastly, teacher factors and the message factors also influence each other. The factors are linked showing their interdependency in influencing SATSS. This interaction among teacher factors, audience factors and message factors brings about changed opinions in the learner, changed perception and changed behaviour which is collectively termed changed attitudes.

Analysis of the relationship between academic achievement and attitude exposed a positive relationship. This stipulates that, students with high academic achievement in science subjects have high attitude towards science subjects and those with low academic achievement have low attitude towards science subjects. Increasingly, the study had other findings though not listed in the objectives. Firstly, examination of students' attitudes toward science subjects on the basis of class, it was observed that student attitudes tended to decline while class level increased. Some studies on attitude and grade level have also produced similar results (George, 2006; Külçe, 2005; Weinburg 2000). The reasons behind this decline can be students decrease in self-efficacy, challenging science curriculum, ineffective teaching methods and techniques, teachers' inefficiencies in delivery of the curriculum, lack of teaching aids, students' stress and anxiety of the national examinations as most students perceive science subjects as difficult. These factors will gradually dwindle the SATSS with increase in the class level. Secondly, it should be explained that there was no statistical significant difference in students' attitude across the subjects as most of the students gave the same score for an item measuring same variable in biology, mathematics, and Physical science except Computer studies where majority of the students were undecided on the choice to score. However, when the students were asked to rank the subjects in order of their preference in decreasing order, the results were as shown in Figure 6.

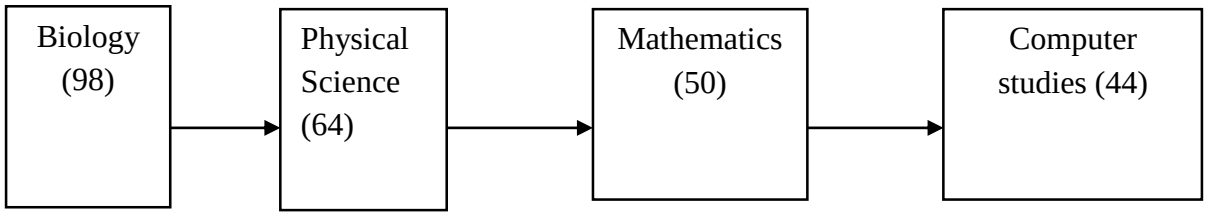

Figure 6: Subject preference rank order

This showed that biology is highly preferred seconded by physical science whereas mathematics came third on the list and computer studies had the least preference by many students perhaps because it is not offered to all students in many schools. In their justification of preference most students said "biology and physical science explain real life things and more of biology explain living things how they behave and adapt". This increases their interest in these subjects. When asked what hinders them from learning science subjects effectively, students mentioned the following problems: few equipment in the laboratories, other students failed to understand why they learn particular subject, teachers' failure to motivate the students and teachers' inadequacies in handling science subjects.

6.2 Recommendations

Following the results, the following recommendations were made to improve SATSS and the teaching and the learning process as a whole;

6.2.1 Recommendations to Teachers

- Must use constructivist approaches that stimulate interest in students to learn science subjects like problem solving, study circles, discussion, group work, field visits, experiments, peer teaching, and discovery learning.
- Must show great level of mastery of knowledge related to science subjects. Thus, thorough research and preparation before the lesson is greatly advised since teachers' mastery of content and ability to transfer it to learners affects the learning process. Hence learners' attitudes.
- Must be friendly and welcoming, so that the students feel free and encouraged to ask them challenging scientific and mathematical concepts
- Must be able to integrate all learning styles when teaching to meet the needs of all learners. Hence, increasing the learners' attitudes towards science subjects.
- Must be creative and give relevant real life examples to stimulate and increase the science learning value of the learners. Use appropriate visual materials (like life story, movies, games, cartoons, scientific models) should be used in schools
- Must give positive feedback. This is because people are motivated by feedback. This is recommendation to learners who are doing a good job and as a reflection of their capability. This leads to increased self-efficacy as learners are invigorated to work harder and even

accomplish more in science. Teachers must avoid negative comments as this kills students morale for the subject as well as the teacher himself.

6.2.2 Recommendations to students

- Must develop a culture of research. This is to read on topics of science and understand the real life examples and be able to apply in their everyday life. This increases the science learning value. Hence SATSS.
- Must learn to work in groups and discuss with friends. This gives a good platform for students to learn from each other and have their self-efficacy level increased. This is because Bandura's Social Learning theory posits that people learn from one another, via observation, imitation, modelling and vicarious reinforcements. This increases their performance in sciences as well.
- Must respect teachers at the expense of his/her inadequacies. This creates a mutual respectful relationship between the teacher and the students. Hence easy flow of lesson and the student is free to ask whatsoever is challenging.

6.2.3 Recommendations on areas for further research

- The influence of laboratory instruction on science achievement and attitudes toward science in secondary schools
- The impact of relevant material resources and qualified teachers on students' attitudes towards science subjects in secondary schools in Malawi.
- Investigate the teaching of science subjects in CDSSs and conventional secondary schools in Malawi.
- Students' attitudes towards science subjects for rural and urban secondary school learners in Malawi.

6.2.4 Recommendations to policy makers

- Professional development for teachers must be compulsory for all science teachers in CDSSs since teacher factors influences SATSS. This can equip the teachers with relevant active teaching and learning strategies of science subjects in CDSSs.
- Monitoring and evaluation of the implementation of the science curriculum should be consistent and on-going. This increases effectiveness and efficiency in the delivery of the curriculum since the way subjects are taught affects SATSS.

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APPENDICES

APPENDIX A- LETTER TO THE MINISTRY OF EDUCATION

Telephone: (265) 01 912 437/870 766
Fax: (265) 01 870 821

All correspondences should be addressed to:
The Education Division Manager

Reply please quote No: EDU/SWED/PF/484

SOUTH WEST EDUCATION DIVISION
PRIVATE BAG 386
CHICHIRI
BLANTYRE 3
MALAWI

16th November 2016

Mr. L. Msonthe

Chimwankhunda CDSS

P.O. Box 2575, Blantyre.

Dear Sir,

APPROVAL TO CONDUCT RESEARCH IN COMMUNITY DAY SECONDARY SCHOOLS.

Please refer to the above topic and to the letter dated 10th October 2016 in which you requested for permission to do research in Community Day Secondary Schools.

I am glad to inform you that **this office has granted approval** to your request to conduct research in the following schools; Chimwankhunda Community Day Secondary School, Joshua Community Day Secondary School, and Lirangwe Community Day Secondary School.

By copy of this letter, the Head teachers of these schools are informed and will do everything possible in their capacity to assist you whilst doing your research.

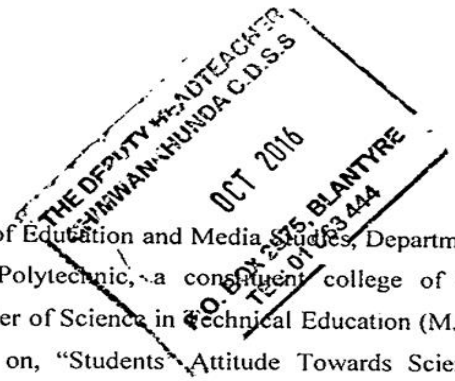
We wish you every best in your studies.

L. Minjale

For: **THE EDUCATION DIVISION MANAGER (SWED).**

Copy: *The Head teacher, Chimwankhunda Community Day Secondary School,*
The Head teacher, Joshua Community Day Secondary School,
The Head teacher, Lirangwe Community Day Secondary School.

APPENDIX B- INTRODUCTORY LETTER



INTRODUCTORY LETTER

Dear Respondent,

I am a post graduate student in the Faculty of Education and Media Studies, Department of Technical Education at the Malawi Polytechnic, a constituent college of the University of Malawi. I am pursuing a Master of Science in Technical Education (M.Sc. TVE), and currently conducting a study on, "Students' Attitude Towards Science Subjects (SATSS) in CDSSs." The study is a requirement for completion of my studies.

I would like different people from different places within Malawi to be sampled out, so as to provide relevant data for my study by answering the same questionnaire. As such, Chimwankhunda CDSS is chosen as one of the schools that have been sampled to give opinions on the SATSS.

You may also need to know that answers to our questionnaire will help to add an understanding to the existing literature on SATSS and provide guidelines to education officers and other stakeholders on what to incorporate when developing education programs involving CDSS students. Furthermore, it may provide recommended science subjects teaching strategies to be used by teachers in CDSSs. This study is relevant as it may reveal to the readers what should be taken into perspective when developing a curriculum and instructional materials for CDSSs students. This may have a direct impact on students' attitude that is proportional to the students' performance and learning process.

Some questions would like explanation of some personal details and if you feel like not to answer it, you may skip it. You have to know that your name will not appear on the questionnaire, neither will it appear in the study records. However, only respondent number will appear and fiction names will be used to maintain your privacy. Kindly note that all the responses will be held and treated with maximum security and confidence and it will only serve the job that it purports to (the study) and it will be mixed with other respondents' responses, hence making it more difficult to check each questionnaire by name.

In case you feel uncomfortable to take this questionnaire or uncomfortable to continue answering it please, you have the right.

If you wish more details or have any questions, please contact us through the following addresses:

+265 888 998 095/+265 995 298 095

or email me at msonthelevis@yahoo.com

Thank you very much for your cooperation. May the Good Lord bless you abundantly!!!!

Yours faithfully,

L. Msonthe.

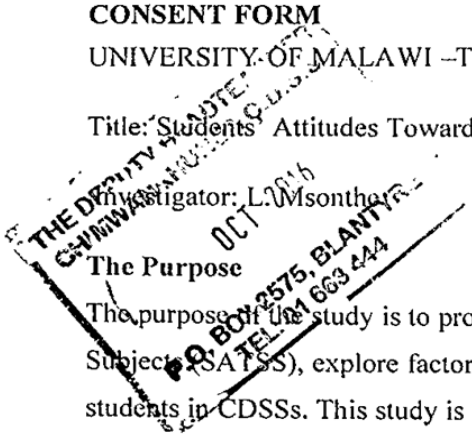
APPENDIX C-CONSENT FORM

CONSENT FORM

UNIVERSITY OF MALAWI –THE POLYTECHNIC

Title: Students' Attitudes Towards Science Subjects in Community Day Secondary Schools

Investigator: L. Msonthe



The Purpose

The purpose of the study is to provide a description of the Students' Attitude Towards Science Subjects (SATSS), explore factors influencing SATSS and relate SATSS to performance of students in CDSSs. This study is part of a requirement for completion of a Master's degree program in Technical and Vocational Education (MTVE) at The Polytechnic a constituent college of the University of Malawi.

Procedures and rights of the respondent

If you choose to participate, we will ask you to fill some questionnaire items regarding your attitude towards science subjects. Your participation is absolutely voluntary; as such your participation is out of free choice. No measures of force, coercion, or deceit will be employed.

Risks

There are no anticipated risks to participants in this study.

Anonymity and Confidentiality

The results in this study will be shared with the principals of the studied institutions and the Ministry of Education. Neither your name nor any personal identifiers will be associated with any information you supply

Compensation

There is no compensation for participating in this project

Freedom to Withdraw

Participants are free to withdraw from this study at any time without any penalty.

I voluntarily agree to participate in this study. I will complete the questionnaire without any form of coercion.

Participant's Permission

I have read and understood the Informed Consent Form for Participants and the conditions of this project. Any questions that I had about the project have been answered. I hereby acknowledge the above and give my voluntary consent for participation in this project. If I participate, I may withdraw at any time without penalty.

24/05/2016

Participant's Signature Date

25th May, 2016

Witness Signature Date

24/05/2016.

Researcher's Signature Date

Should I have questions about this research project I may contact: msonthelevis@yahoo.com or a call at +265 888 998 095/+265995 298 095.

APPENDIX D-LETTER FOR DATA COLLECTION TO MANEB

All correspondence to be addressed to the Principal

University of Malawi – The Polytechnic
Private Bag 303
Chichiri
Blantrye 3, Malawi
Tel: (+265) 1 870 411
Fax: (+265) 1 870 578
E-Mail. principal@poly.ac.mw

PRINCIPAL
Prof Grant Kululanga, PhD. Eng , MSc Eng ,BSc. Eng , MASCE

Our Ref.:
Your Ref:
Date: 23rd December 2015

The Chief Executive Officer
Malawi National Examination Board
PO Box 191
Zomba

Dear Sir

DATA COLLECTION REFERENCE FOR LIVISON MSONTHE

I write to seek permission to allow LIvison Msonthe a Master of Science in Technical and Vocational Educational education to collect data from your organisation.

The proposed area of study will be 'Students Attitudes Towards Science Subjects in Community Day Secondary Schools'.

The student would like to collect data in science subjects student pass rates in secondary schools in Malawi as per

- Community Day Secondary Schools
- Convectional schools
- Private Secondary Schools

Your assistance will be greatly appreciated as it will help in the enhancement of technological and literacy for the graduates.

UNIVERSITY OF MALAWI
THE POLYTECHNIC
23 DEC 2015

D.P. Mtemang'ombe (Mrs)
HEAD OF TECHNICAL EDUCATION DEPARTMENT

APPENDIX E - SATSS QUESTIONNAIRE

SATSS QUESTIONNAIRE

PART A - BACKGROUND

The questions in this section are about yourself. Follow instructions for each question and write your responses in the spaces provided.

1. What is your sex? (Tick √ in the appropriate box).

Male	
Female	

2. In which class are you?

Form 1	
Form 2	
Form 3	
Form 4	

PART B: SATSS ITEMS

In this part of the questionnaire you are asked how you feel about four science subjects; mathematics, biology, physical science and computer studies. Please **TICK THE APPROPRIATE BOX:** ***1, 2, 4, or 5 if*** you ***strongly agree, agree, disagree or strongly disagree*** with each of the statements. 3 is for *Undecided* if you do not fully agree nor disagree.

Serial No.	**Item**	**Strongly Agree**	**Agree**	**Undecided**	**Disagree**	**Strongly Disagree**
		1	2	3	4	5
1	Biology is very easy					
2	Mathematics is very easy					
3	Physical science is very easy					
4	Biology is very difficult					
5	Mathematics is very difficult					
6	I understand mathematics easily					
7	I understand biology easily					

8	I understand physical science easily					
9	It's hard to understand physical science					
10	It's hard to understand biology					
11	It's hard to understand mathematics					
12	Biology is good for the future of this country.					
13	Mathematics is good for the future of this country.					
14	Physical science is good for the future of this country.					
15	I would like to get a job that needs Physical science.					
16	I would like to get a job that needs Mathematics.					
17	I would like to get a job that needs Biology.					
18	I would like to know more about Mathematics					
19	I would like to know more about Biology					
20	I would like to know more about Physical science					
21	A girl can do well in Mathematics.					
22	A girl can do well in Biology.					
23	A girl can do well in Physical Science.					
24	Physical science makes most things work better.					
25	Biology makes most things work better.					
26	Mathematics makes most things work better.					
27	You have to be very bright to study Mathematics.					
28	You have to be very bright to study Biology					
29	You have to be very bright to study Physical science					
30	You have to be very bright to study Mathematics.					
31	I like to read biology related materials					
32	I like to solve mathematical problems					
33	I like to read physical science related materials					
34	mathematics is only for the intelligent					
35	Physical science is only for the intelligent					
36	Biology is only for the intelligent					
37	Mathematics lessons are important.					
38	Biology lessons are important.					
39	Physical science lessons are important.					
40	Mathematics lessons are important.					
41	Boys are good at biology					
42	Boys are good at mathematics					
43	Boys are good at physical science					
44	I am very good in mathematics					
45	I am very good in biology					
46	I am very good in physical science					

47	I am poor in mathematics					
48	I am poor in biology					
49	I am poor in physical science					
50	I pass mathematics every term					
51	I pass biology every term					
52	I pass physical science every term					
53	I pass computer studies every term					
54	I do not understand why we learn mathematics.					
55	I do not understand why we learn biology.					
56	I do not understand why we learn physical science					
57	I will definitely pass my JCE/MSCE Mathematics examinations.					
58	I will definitely pass my JCE/MSCE biology examinations.					
59	I will definitely pass my JCE/MSCE physical science examinations.					
60	I pass mathematics sometimes					
61	I pass biology sometimes					
62	I pass physical science sometimes					
63	I pass computer studies sometimes					
64	I normally fail term test in Mathematics.					
65	I normally fail term test in biology.					
66	I normally fail term test in physical science					
67	I cannot pass mathematics					
68	I cannot pass biology					
69	I cannot pass physical science					
70	I like my Mathematics teacher					
71	I like my physical science teacher					
72	I like my biology teacher					
73	I like the way we learn Mathematics					
74	I like the way we learn biology					
75	I like the way we learn physical science					
76	Our teacher explains Mathematical concepts very well					
77	Our teacher explains scientific concepts very well					
78	Our teacher explains physical science concepts very well					
79	Everyone feels loved in a Mathematics class					
80	Everyone feels loved in a physical science class					
81	Everyone feels loved in a biology class					
82	The Mathematics class has no noise disturbances					
83	The biology class has no noise disturbances					
84	The physical science class has no noise disturbances					

85	Students do not misbehave in a mathematics class					
86	Students do not misbehave in a biology class					
87	Students do not misbehave in a physical science class					
88	I learn mathematics easily through discussions					
89	I learn biology easily through discussions					
90	I learn physical science easily through discussions					
91	I learn mathematics easily through group work					
92	I learn biology easily through group work					
93	I learn mathematics easily through discovery learning					
94	I learn biology easily through discovery learning					
95	I learn physical science easily through discovery learning					
96	I learn mathematics easily through discovery learning					
97	Teacher dominance is not good for my Mathematics learning					
98	Teacher dominance is not good for my biology learning					
99	Teacher dominance is not good for my physical science learning					
100	Teacher dominance is not good for my computer studies learning					
101	I would like peer teaching in Mathematics.					
102	I would like peer teaching in biology					
103	I would like peer teaching in physical science					
104	Mathematics is simple when the teacher knows the concepts					
105	Biology is simple when the teacher knows the concepts					
106	Physical science is simple when the teacher knows the concepts					
107	I enjoy Mathematics when the teacher is creative					
108	I enjoy biology when the teacher is creative					
109	I enjoy physical science when the teacher is creative					
110	I enjoy computer studies when the teacher is creative					
111	I learn well when encouraged by teachers in math.					
112	I learn well when encouraged by teachers in biology.					
113	I learn well when encouraged by teachers in physical science.					
114	I learn well when encouraged by teachers in computer studies.					
115	friendly teachers teach mathematics well					
116	friendly teachers teach physical science well					
117	friendly teachers teach biology well					
118	Math is tough when taught by difficult teachers					
119	biology is tough when taught by difficult teachers					
120	physical science is tough when taught by difficult teachers					
121	Mathematics is boring.					
122	Physical science is boring.					

123	Biology is boring.					
124	Girls think mathematics is interesting.					
125	Girls think biology is interesting.					
126	Girls think physical science is interesting.					
127	Girls think computer studies is interesting.					
128	I learn well in a Physical Science laboratory					
129	I learn well in a Biology laboratory					
130	I failed mathematics because there were no teaching aids					
131	I failed physical science because there were no teaching aids					
132	I failed biology because there were no teaching aids					
133	I failed computer studies because there were no teaching aid					

PART C: SEMI STRUCTURED QUESTIONS

Please answer the following questions by filling in the spaces provided.

134. In general which science subject do you like most? Explain why.

_____
_____
_____
_____
_____
_____
_____

135. Which science subject do you like least? Explain why.

_____
_____
_____
_____
_____
_____
_____

136. May you please rank the following science subjects in decreasing order of preference

Mathematics, Physical science, Biology and Computer studies (START WITH ONE YOU LIKE MOST)

1. _____
2. _____
3. _____
4. _____

137. What hinders you from learning science subjects i.e. Mathematics, Biology and Physical science?

_____
_____
_____
_____
_____

Thanks for answering this Questionnaire

God Bless You.

APPENDIX F: TABLE 10-STRUCTURE MATRIX FOR SATM

	Component									
	1	2	3	4	5	6	7	8	9	10
Mathematics is very easy	.814									
I understand mathematics easily	.808									
I would like to know more about Mathematics		-.694								
I would like to get a job that needs Mathematics.	.407	-.627								
Mathematics is good for the future of this country.	.323	-.511					-.420			
I learn mathematics easily through discussions			.777							
I learn mathematics easily through group work			.755							
Girls think mathematics is interesting.			.507							
I like the way we learn Mathematics				-.703						
Our teacher explains Mathematical concepts very well	.342			-.683						
Mathematics makes most things work better.	.356	-.481		-.495						
Everyone feels loved in a Mathematics class	.364	.414	.303	-.442						
I pass mathematics every term					.778					

Students do not misbehave in a mathematics class		.346			.553					
I would like peer teaching in Mathematics.						.726				
Mathematics is simple when the teacher knows the concepts						.609				-.388
I enjoy Mathematics when the teacher is creative							-.790			
I like to solve mathematical problems							-.778			
friendly teachers teach mathematics well								.732		
Teacher dominance is not good for my Mathematics learning								.653		
I learn mathematics easily through discovery learning								.509		
mathematics is only for the intelligent									.754	
Boys are good at mathematics						.302		.465	.474	
A girl can do well in Mathematics.									-.466	
I like my Mathematics teacher										-.753
I will definitely pass my JCE/MSCE Mathematics examinations.										-.649
Mathematics lessons are important.									-.420	-.575
The Mathematics class has no noise disturbances		.303		-.399	.386					.413

Total initial Eigenvalues	3.199	2.642	1.973	1.607	1.497	1.384	1.309	1.186	1.14	1.049
Total % of variance	11.424	9.434	7.045	5.738	5.346	4.944	4.673	4.235	4.072	3.747

Extraction Method: Principal Component Analysis.

Rotation Method: Oblimin with Kaiser Normalization.

APPENDIX G: TABLE 11-SATP ROTATED COMPONENT MATRIX[A]

	Raw											Rescaled										
	Component											Component										
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5	6	7	8	9	10	11
Physical science makes most things work better.	.646											.661										
I would like to know more about Physical science	.632											.602										
I like to read physical science related materials	.702							.383				.590							.322			
Physical science lessons are important.	.506											.571										
Physical science is good for the future of this country.	.551											.569										
A girl can do well in Physical Science.	.605											.517										

I would like to get a job that needs Physical science.	.541			.453				-.384				.478			.401				-.339										
Students do not misbehave in a physical science class		1.084											.853																
Everyone feels loved in a physical science class		.615	.405										.525	.346															
The physical science class has no noise disturbances		.586							-.508	.385			.463							-.402	.304								
I learn physical science easily through discovery learning		.519							.346				.453							.302									
Our teacher explains physical science concepts very well		.431	.394										.390	.356															
I understand physical science easily			.927											.731															
Physical science is very easy			.771											.670															

I like my physical science teacher				.974											.795										
Physical science is simple when the teacher knows the concepts	.428			.467								.388			.423										
I am very good in physical science					1.059											.836									
I pass physical science every term				.563	.692										.430	.529									
I will definitely pass my JCE/MSCE physical science examinations.	.415				.570							.364				.500									
Boys are good at physical science						1.220											.889								
friendly teachers teach physical science well							1.043											.840							

Teacher dominance is not good for my physical science learning						.549	.636			-.625							.414	.480			-.471	
I learn physical science easily through discussions								1.086											.860			
I enjoy physical science when the teacher is creative																						
I learn well in a Physical Science laboratory									1.185											.882		
Girls think physical science is interesting.										1.048											.822	
I like the way we learn physical science											1.539											.958

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 20 iterations.

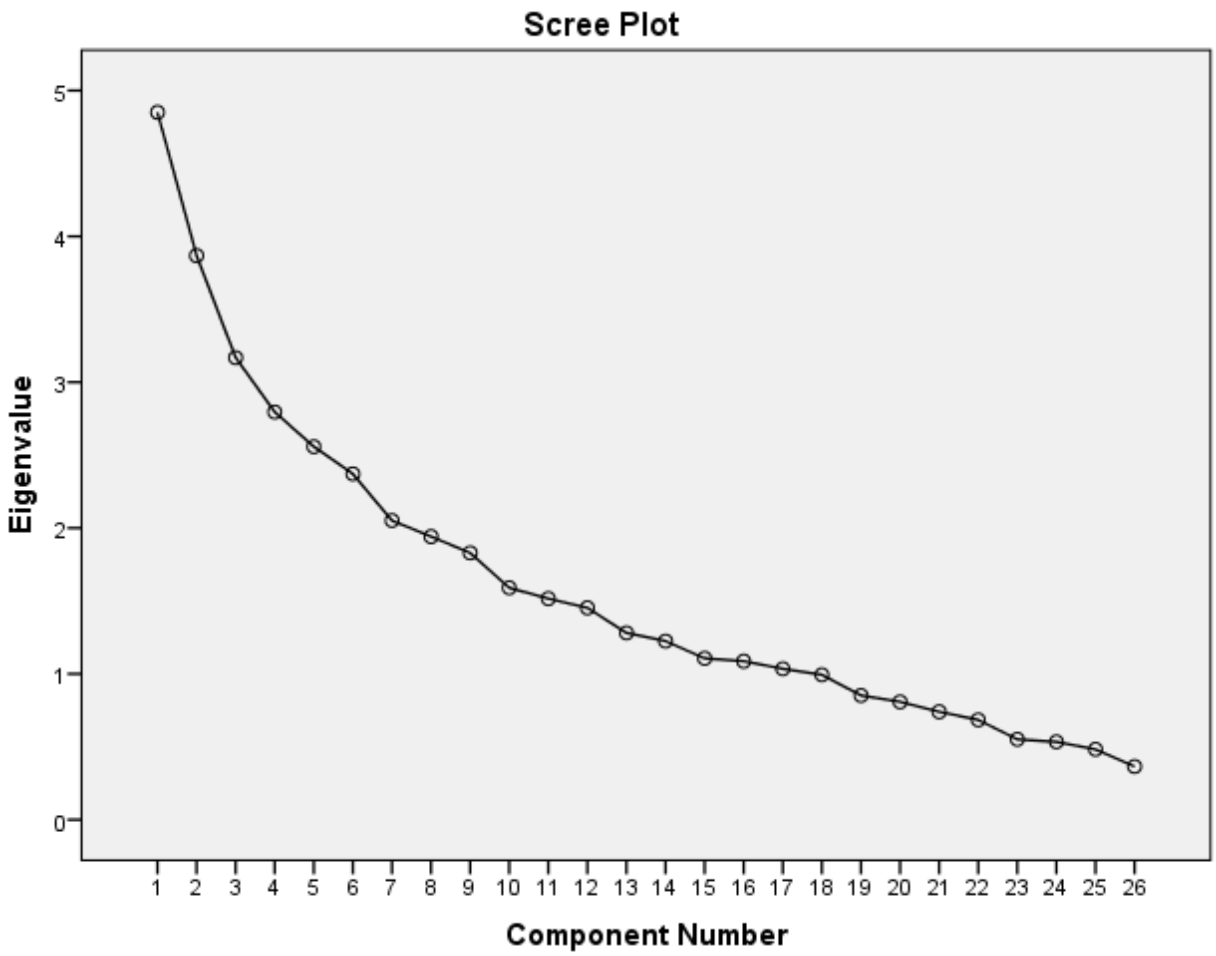
APPENDIX H: COMMUNALITIES

	Raw		Rescaled	
	Initial	Extraction	Initial	Extraction
Mathematics is very easy	1.164	.504	1.000	.433
I understand mathematics easily	1.528	.887	1.000	.581
Mathematics is good for the future of this country.	.701	.236	1.000	.337
I would like to get a job that needs Mathematics.	1.193	.649	1.000	.544
I would like to know more about Mathematics	1.158	.392	1.000	.339
A girl can do well in Mathematics.	3.186	3.146	1.000	.987
Mathematics makes most things work better.	1.062	.427	1.000	.402
I like to solve mathematical problems	1.184	.429	1.000	.362
Mathematics lessons are important.	1.779	1.172	1.000	.659
Boys are good at mathematics	2.001	1.684	1.000	.841
I am very good in mathematics	1.710	1.089	1.000	.637
I pass mathematics every term	2.007	1.500	1.000	.748
I will definitely pass my JCE/MSCE Mathematics examinations.	1.921	1.290	1.000	.672
I like my Mathematics teacher	1.900	1.223	1.000	.644
I like the way we learn Mathematics	1.528	.615	1.000	.402
Our teacher explains Mathematical concepts very well	1.892	1.354	1.000	.716
Everyone feels loved in a Mathematics class	1.691	.913	1.000	.540
The Mathematics class has no noise disturbances	1.813	1.215	1.000	.670
Students do not misbehave in a mathematics class	1.612	.876	1.000	.544

I learn mathematics easily through discussions	1.613	.766	1.000	.475
I learn mathematics easily through discovery learning	1.442	.406	1.000	.282
I would like peer teaching in Mathematics.	1.721	1.325	1.000	.770
Mathematics is simple when the teacher knows the concepts	1.293	.582	1.000	.450
I learn well when encouraged by teachers in math.	1.388	.760	1.000	.548
friendly teachers teach mathematics well	1.506	.950	1.000	.631
Girls think mathematics is interesting.	1.745	1.043	1.000	.598

Extraction Method: Principal Component Analysis.

APPENDIX I: SCREE PLOT FOR SATSS



APPENDIX J: SATB ROTATED COMPONENT MATRIX[A]

	Raw									Rescaled								
	Component									Component								
	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
A girl can do well in Biology.	.684									.654								
I understand biology easily	.652									.635								
I would like to know more about Biology	.632			.334						.605			.320					
Biology is very easy	.546									.590								
I would like to get a job that needs Biology.	.545	.328								.535	.322							
Biology is good for the future of this country.	.494									.505								
Our teacher explains biological concepts very well	.536				.371					.460				.318				
Biology lessons are important.		.673									.663							
I like my biology teacher		.698									.652							

I will definitely pass my JCE/MSCE biology examinations.		.772	.442								.631	.361						
Biology is simple when the teacher knows the concepts		.527									.507							
I pass biology every term			1.244									.899						
I am very good in biology			.735									.619						
Girls think biology is interesting.				-1.010									-.793					
Biology makes most things work better.				.457									.478					
I like to read biology related materials		.437		.546							.381		.475					
Boys are good at biology					1.211									.908				
Teacher dominance is not good for my biology learning						-1.199									-.883			

I enjoy biology when the teacher is creative																		
Students do not misbehave in a biology class							1.294									.938		
friendly teachers teach biology well								1.014									.816	
The biology class has no noise disturbances							.676	.697								.509	.525	
I learn biology easily through discussions									1.112									.906

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 11 iterations.

APPENDIX K-TOTAL VARIANCE EXPLAINED

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a]
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	4.508	16.097	16.097	4.508	16.097	16.097	4.165
2	3.751	13.281	29.378	3.751	13.281	29.378	3.899
3	3.357	11.989	41.367	3.357	11.989	41.367	3.675
4	3.104	11.084	52.451	3.104	11.084	52.451	3.645
5	1.309	4.673	57.124	1.309	4.673	57.124	1.954
6	1.186	4.235	61.359	1.186	4.235	61.359	1.720
7	1.140	4.072	65.431	1.140	4.072	65.431	1.458

Extraction Method: Principal Component Analysis.

a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.