Attitude and Conceptual Knowledge of Senior Secondary School Students towards Mathematics: A Study of Livingstone District

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Abstract: **- This research investigated attitudes and conceptual knowledge of students towards mathematics and perceptions teachers have about their students towards mathematics in the five schools in Livingstone district. It was not clear how student teachers perceived mathematics and their attitude towards it and what kind of cognitive-metacognitive skills and strategies they possess as they graduate from the colleges. This research employed a combination of both quantitative and qualitative methods. The study sample comprised 265 student teachers of mathematics from two colleges of education. Research instruments used in this study were: The 52-item Metacognitive Awareness Inventory (MAI) questionnaire was developed by Schraw and Dennison (1994) and the Questionnaire in the Teaching of Mathematics (QTM)") was developed by Paul Ernest (1996), and the semi-structured interview schedules were used in the focus group discussions. The MAI questionnaire had two factors; knowledge of cognition and regulation of cognition. The questionnaire for the students' perceptions and attitudes towards mathematics included statements about how they regard or perceive mathematics in their learning processes. The questionnaire also included attitude statements on the way student teachers felt when learning mathematics and how they react when asked to answer questions or solve problems in class. The statistical analysis applied predominantly in the data analysis to investigate and explore differences between groups of independent variables was analysis of variance (ANOVA). ANOVA allows one to compare the effects of each independent variable individually (Ho, 2006, p.57), which is beneficial in the context of study. To validate the findings produced from ANOVA test, the effect size measure Eta-squared (Levein & Hullet, 2002) were reported. The key findings indicated that student teachers had moderately high metacognitive awareness levels in both colleges. According to the results of the analysis, there was not a significant difference among the scores of metacognitive awareness of student teachers ($\boldsymbol{F = 0.522}$; $\boldsymbol{\rho = 0.491} > 0.05$) according to means. We accept the null hypothesis that the means in the two colleges of education do not vary since $\boldsymbol{\rho} > 0.05$. Results indicated that student teachers in both colleges of education had higher levels of their perceptions and attitudes towards mathematics. Further, results from the Focus Group Discussion (FGDs) indicated that student teachers perception of their performance is attributed to lecturers' methods of teaching and lecturers' attitudes towards them. Results from the focus group with all the years of study indicated that lecturers teach them procedures of solving problem without student teachers' participation. Hannula (2011), supports the idea that teachers' positive attitudes and good personal qualities bolster students' academic performance. In general the study concludes that student teachers in colleges of education have moderately high levels of metacognitive awareness and positive perceptions and attitudes towards mathematics. Therefore, this study recommends that teacher training programmes should include activities through the development and support of metacognitive awareness and affective factors that will be helpful in terms.**

Key words: **Meta -cognitive, Conceptual knowledge, cognitive-metacognitive**

I. INTRODUCTION

This chapter will deal with the importance of the study and the reasons for carrying out the study. Firstly it will look at the background of the study, then the statement of the problem

1.1 Background of the study

An attitude is a predisposition or a tendency to respond positively or negatively towards a certain idea, object, person or situation. Attitude influences an individual's choice of action, and responses to challenges, incentive and rewards called stimuli. The four major components of attitudes are (1) Affective: emotions or feeling. (2) Cognitive: belief or opinion held consciously. (3) Co native: inclination for action. (4) Evaluative: positive or negative response to stimuli (business dictionary). An attitude is "a mental and neural state of readiness organised through experience, exerting a directive or dynamic influence upon the individual's response to all objects and situations with which it is related" (Allport, in Kulm, 1980, p. 356). According to Leder (1992) attitudes are learnt, and predispose one towards action which may be either favorable or unfavorable with respect to a given object. Such a definition implies that attitudes are comprised of an emotional reaction to an object, behaviour towards an object, and beliefs about the object (Rajecki, 1982). Formation of attitudes towards academic subject matter is thought to develop through (a) the automisation of a repeated emotional reaction to the subject, and (b) the transference of an existing attitude to a new but related task. Additionally, formation of academic attitudes has been identified as a complex process involving socialisation, relationships with teachers, teacher attitudes and aspects of the subject matter itself.

The complexity of factors that can influence mathematics performance is demonstrated by Singh, Granville and Dika (1989) when they show that high achievement in mathematics is a function of many interrelated variables related to students, families and schools. Among student variables, attitudes are regarded by several researchers as an important factor to be taken into account when attempting to understand and explain variability in student performance in mathematics.

In Zambia for a long time now, in national examinations, learners have performed poorly in mathematics as indicated in the Ministry of Education (MoE, 1996) in its policy document *educating our future*. The performance of pupils in Zambia in mathematics has continued to be poor, with 6,600 candidates obtaining zero per cent in paper One in the 2012 Grade 12 final examinations. The Examinations Council of Zambia (ECZ) says another 6,843 candidates obtained zero per cent in paper two. The report also revealed poor performances at grade nine levels where more than 15 per cent of the 288,933 candidates scored zero per cent in paper two in addition to 0.24 per cent with the same marks in paper 1. "The scripts show that the candidates that obtained zero per cent did not master the concepts and skills tested in the syllabus for the two grade levels," it added. Since mathematics is a compulsory subject, there is a spillover and negative impact in that the poor results at grade nine were reflected at Grade 12. Some pupils who have failed to master mathematics have ended up cheating upon realising that the subject is a key in entering into college or universities. "Therefore, there is need to find a way forward so that the performance at both Grade nine and Grade 12 in mathematics is improved," the report stated (2012 ECZ Performance Review Report).

Mathematics remains a key driver for national development as it is used in various fields of the economy. This is the more reason why government has tried to encourage students to perform better in mathematics. Despite all the encouragements, performance has remain poor hence the reason for this research.

1.2 Statement of the problem

A research done by Mata et al (2012) on Portuguese students revealed those students' attitudes are positive in the lower grades and start to be negative as they progress in high school. Some reasons cited for negative attitudes in higher grades include pressure to perform well, disconnected concepts, hard tasks, over demanding tasks, uninteresting lessons coupled with less than positive attitudes on the part of the teachers. Barr Doyle et al (2003) point out that when we ask students to perform a procedure such as solving an equation, students can often follow an example and get a correct answer without understanding how or why the process works. Traditionally, the majority of assessments in mathematics learning have been based on students' ability to manipulate knowledge in a procedural format. Tests, examinations and quizzes aimed at students producing correct answers, highlight their ability to show how the mathematics processes work but do not shed light on the deeper meaning of why. With this evidence elaborated above, the researcher intends to investigate some of the causes of such failure rate through critical examination of learner attitude and their conceptual knowledge in mathematics.

1.3 Purpose of the study

To explore whether it is the attitude or conceptual knowledge or both that contribute towards good or poor performance of senior secondary school students in mathematics.

1.4 Objectives

1.4.1 To establish senior secondary school students' attitudes towards mathematics.

1.4.2 To assess conceptual knowledge senior secondary school students have in mathematics.

1.4.3 To investigate whether students' attitudes affects their conceptual knowledge of senior secondary school mathematics or whether students' conceptual knowledge affects their attitudes towards mathematics.

1.4.4 To describe how attitude could be used to improve conceptual knowledge or how conceptual knowledge could be used to improve attitude towards mathematics.

1.5 Research questions

1.5.1 What attitudes do senior secondary school students have in mathematics?

1.5.2 What conceptual knowledge do senior secondary school students have in mathematics?

1.5.3 How do students' attitudes affect their conceptual knowledge or how do their conceptual knowledge affect their attitudes towards mathematics?

1.5.4 How can attitude be used to improve conceptual knowledge or conceptual knowledge be used to improve attitude towards mathematics?

1.6 Significance of the study

This research will be significant for a number of reasons. The research will review the attitudes and conceptual knowledge the students have towards mathematics. It will also try to focus on how best to maintain the positive attitudes students have when they enter into school towards mathematics. The research will also try to focus on improving conceptual knowledge as opposed to procedural knowledge. Conceptual knowledge helps students have a deeper understanding of the concepts as it connects students to real life mathematics. The study will as well address the perceptions students have towards mathematics teachers and also the perceptions teachers have towards mathematics students. The results of the research will give impetus to the development of further research that seeks to characterize and understand different variables which may influence student performance. This will help to make possible strategies for future action in schools, families and communities in order to bring about an

improvement in the failure rate in mathematics. The educators will then find a way of sustaining the positive attitudes that mathematics students have in lower grades so as to bring about good performance through conceptual knowledge teaching and learning. Students of mathematics can easily see themselves in the future as conceptual knowledge connects students' mathematics to the world they live in. Students will not view mathematics as an uninteresting, more demanding and unrelated tasks.

1.7 Limitations and delimitations of the study

The study could not be done in the entire province due to limitations of resources as the researcher was unable to secure funds for the project. The research was also supposed to include grade 12 students who at the time of collection of data were busy writing their examinations while the grade 10s had not covered enough material to be able to answer the second part of the questionnaire which included grade 12 examination questions for 2012 Examination. The number of respondents was also affected as the teachers were busy with invigilation of grade 12 Exanimations.

1.8 Scope of the Study

The study focused on the attitudes and conceptual knowledge senior secondary school students had towards mathematics on the five schools of Livingstone district of southern province of Zambia. It also focused on the teachers of mathematics how they viewed the attitudes and conceptual knowledge their students had towards mathematics.

1.9 Organization of the Dissertation

The dissertation has six comprehensive chapters; chapter one, chapter two, chapter three, chapter four, chapter five and chapter six. Chapter one outlined the background to the research and stated the problem. It also outlined the research questions and objectives. Chapter two gives the theoretical framework followed by the review of related Literature which includes other research works that had been done on the same subject. Chapter three presents the research methodology. It shows the sampling techniques and methods used to collect data with a bias towards primary data from personal interviews and questionnaires. It also shows how and where the researcher collected secondary data for analysis. Chapter four presents the research findings. The researcher presents some selected variables from pupil and teacher questionnaires.

II. LITERATURE REVIEW

2.1 Introduction

This chapter dealt with the theoretical framework to guide the study and also the review of related literature.

2.2 Theoretical Framework

David Ausubel (1968) believed in the idea of meaningful learning as opposed to rote memorization. Through his belief of meaningful learning, Ausubel developed his theory of advance organizers. An advance organizer is information presented by an instructor that helps the student organize new incoming information. This is achieved by directing attention to what is important in the coming material, highlighting relationships, and providing a remainder about relevant prior knowledge. Advance organizers make it easier to learn new materials of a complex or otherwise difficult nature, provided the following two conditions are met which are: the student must process and understand the information presented in the organizer as this increases the effectiveness of the organizer itself and that the organizer must indicate the relations among the basic concepts and terms that will be used.Arslan (2010) indicates that conceptual knowledge is learning that involves understanding and interpreting concepts and the relations between concepts whereas procedural knowledge is learning that involves only memorizing operations with no understanding of underlying meanings. Conceptual knowledge will bring about meaningful learning which David Ausubel talked about. This will in turn develop positive attitudes towards mathematics as they will be able to deal with materials of a complex or otherwise difficult nature through the use of advance organizers. Mathematics students often believe that mathematics is a subject to be endured while at school and do not see it as a rich, enjoyable and worthwhile experience. Carr (1997), Lane (1999) and Le Seuer (1994) generally agree that disposition such as motivation, curiosity and perseverance can be recognized when students persist at different tasks, take risks and exhibit open mindedness. These dispositions are definitely evident when students are enjoying mathematics learning. Dispositions are highly valued in the eyes of educational theorists, so surely if teachers are aware of these positive learning dispositions, including attitude and incorporate them into their mathematics programme, the advantages for the students should speak for themselves. Dispositions according to Perkins, Jay and Tishman (1993) consists of triad of interacting elements, these being: inclination, which is how a learner feels towards a task, sensitivity towards an occasion or the learner's alertness towards a task, and lastly ability, this being the learner's ability to follow through and complete an actual task. Therefore attitude being a disposition, it is made up of these elements having an inclination element, a sensitivity element and an ability element. Using this framework, description can be developed in relation to attitudes towards mathematics. With inclination a student will be drawn or motivated towards a mathematics task, with sensitivity a student may feel that doing this task is worth their while, and with ability the student will persevere and see this task through. Students in lower grades thrive on mathematics and exhibit openly these dispositions which are: (i) well being – being involved, (ii) belonging – taking an interest, (iii) contribution – taking responsibility, (iv) communication -- expressing a point of view or feeling, and (v) exploration – persisting with difficulty. But as they progress through the year levels, this changes why? More tests tend to be given as a student progresses through school. Could there be a link between testing and the development of negative attitudes? Carr (1997) believes that while dispositions are different from knowledge

and skills, they are often a product of a knowledge/skills combination. Attitude is a favorable or unfavorable evaluative reaction toward something or someone exhibited in ones beliefs, feelings, or intended behavior. The Components of attitudes are: (a). *Cognitive* - our thoughts, beliefs, and ideas about something. When a human being is the object of an attitude, the cognitive component is frequently a stereotype, e.g. "welfare recipients are lazy" (b). *Affective* - feelings or emotions that something evokes. e.g. fear, sympathy, hate. May dislike welfare recipients. (c). *Cognitive, or behavioral* - tendency or disposition to act in certain ways toward something. Might want to keep welfare recipients out of our neighborhood. Emphasis is on the tendency to act, not the actual acting; what we intend and what we do may be quite different. Whitney and Arndt (1997) came up with five tips for getting all the students engaged in learning and these are: (i) connect what you are teaching to real life, (ii) use students' interests and fascinations, (iii) give students choices, (iv) present information in multiple formats and (v) teach students self-monitoring skills. The students will be attentive in that they will see themselves connected to what they learn in the classroom to what they see in their environment. When dealing with fascinating situations in problem solve their interest will be aroused and maintained. When the information is presented in multiple formats, it gives the students to have the freedom of choice when they come across a new situation. The students should be taught how to monitor themselves as this helps them see if they are improving or they are not. This approach will help in imparting the knowledge through learner centered approach.The research aimed at understanding how certain different but interrelated variables such as background, motivation and social support could lead to an explanation of students' attitudes towards mathematics and to an understanding of the defining characteristics of those attitudes in the school environment (Mata, et al., 2012)In Portugal proficiency in language, science and mathematics is seen as an essential precursor to success in modern society. Recent guidelines set by Ministry of Education in Portugal regarding mathematics and Portuguese language curricular tasks, evaluation and workload reflect this concern as these subjects are cross-curricular and are used in daily life (Mata, et al., 2012) Mata, et al (2012) has also revealed that comparative international evaluations revealed that Portuguese students did not perform as well as expected and that they underachieved in mathematics and language when compared to students from other countries in the OECD. In the Zambian context from the researcher's experience as an educator, learners seem to develop certain attitudes towards Mathematics due to their experiences in the subject, peer discussions, and the classroom environments. For example, when a student enrolls in the school, the student's will first inquire from the returning students on how simple or difficult mathematics is as they pursue it. They do not wait to experience the subject and be able to have their own feel of the subject. Often, poor performing students will discourage others, who in turn, develop negative perceptions that also affect their attitudes negatively. Goody koontz's assertions are supported by McLeod (2009) who also quoted Katz (1960) who outlined four functional areas of attitudes that serve an individual, which are; knowledge, self (ego- expressive), adaptive, and ego-defensive. By knowledge McLeod (2009), implied that attitude provides meaning for life, in this case learning. The knowledge function of attitudes allows learners to predict what is likely to happen when solving a problem and hence this enables the learner to a sense of control. The knowledge function helps learners to organize and structure their experiences. Knowing a learners attitude helps the teacher or instructor to predict his/her behavior. The self or ego-expressive function of attitudes enables an individual learner to communicate who he/she is to others. The ego-expressive makes a learner have a feeling of identity. For example, a student teacher will feel good to identify himself/herself as a student through a T-shirt slogan of the institution he/ attends. Harlen (1997: 39) emphasized the importance of Mathematics as he stated that, "Pupils' attitudes affect the willingness of individuals to take part in certain activities, and the way in which they respond to persons, objects, or situations." This shows that learners will only understand or participate fully in the learning process or ready to learn new concepts in Mathematics if they are willing and ready to learn.They further revealed that a positive attitude towards mathematics reflects a positive emotional disposition in relation to the subject and in a similar way a negative attitude towards mathematics relates to a negative emotional disposition. They continue to state that these emotional dispositions have an impact on an individual's behaviour as one is likely to achieve better in a subject that one enjoys, has confidence in or finds useful. They emphasis that for this reason positive attitudes towards mathematics are desirable since they may influence one's willingness to learn and also the benefits one can derive from mathematics instruction. They also state that negative attitudes are the result of repeated and frequent failures or problems when dealing with mathematical tasks, and that these negative attitudes may become relatively permanent. They say when children first go to school they usually have positive attitudes towards mathematics. However as they progress their attitudes become less positive and frequently become negative at high school. They continue to further state that there are a number of factors which can explain why attitudes towards mathematics become more negative with the school grade such as the pressure to perform well, over demanding tasks, uninteresting lessons and less than positive attitudes on the part of teacher. Sanchez, et al (2004) in their more recent studies point to a positive correlation between student attitudes towards mathematics and student academic achievement. It showed that students having positive attitudes achieved better than those with negative attitudes. In a wider research concerning mathematics study attitudes among the secondary school students of nine countries developed by Sanchez, et al (2004) showed that those with better academic performance have more positive attitudes regarding mathematics than those with poorer academic performance. In a study developed with USA

and Bielo Russian middle school students highlighted the importance of attitudes in predicting achievement when it showed that mathematics attitudes explained a variance of 25 percent to 32 percent in mathematics achievement with much of the explained variance independent of ability of students in mathematics (Lipnevich et al 2011).According to Wolfram, (2010) states that the problem with mathematics is that those learning it think it is disconnected, uninteresting and hard, those trying to employ them think they don't know enough while governments realize it is a big deal for our economies but don't know how to fix it and the teachers are also frustrated. He views mathematics to be more important to the world now than ever in history.

Different writers have tried to differentiate between conceptual knowledge and procedural knowledge such as the following; Conceptual knowledge is explicit or implicit understanding of the principles that govern a domain and of the interrelations between pieces of knowledge in a domain while procedural knowledge is action sequences for solving problems (Rittle-Johnson & Wagner 1999).Conceptual knowledge is ideas, relationships, connections or having a 'sense' of something while procedural knowledge is like a toolbox, it includes facts, skills, procedures algorithms or method (Barr. Doyle et al 2003).Conceptual knowledge is learning that involves understanding and interpreting concepts and the relations between concepts whereas procedural knowledge is learning that involves only memorizing operations with no understanding of underlying meanings (Arslan 2010).Conceptual knowledge is to know why something happens in a particular way but procedural knowledge is to know how something happens in particular way (Hiebert & Lefevre 1986).The debate over whether it is better to teach conceptual or procedural mathematics understanding first has been contested over the past Century. Significant research has been done in attempts to settle this debate and declare one superior over the other (Rittle-Johnson 1999, Gleman & Williams 1997, Halford 1993, and Arslan 2010). This research has greatly impacted teaching and learning approaches to mathematics. According to Dubeau, et al (2003) pointed out teachers main complaints about students' responses to mathematics and these included the following;They forget it from year-to-year. They can't transfer mathematics skills to other subject areas easily.

They can't problem-solve. They only feel confident with a ready-made recipe. They call it one of the 'hardest' subjects.

Star (2002) argues that instead of debating over superiority, education needs to consider the relationships that exist between these two approaches to mathematics understanding. In the perspective of Star, conceptual knowledge and procedural knowledge exist on a learning continuum and cannot be separated. The aim of the research should be to focus on how the relationships, connections and intersections between these two approaches impact and deepen student learning. Barr Doyle et al (2003) point out that when we ask students to perform a procedure such as solving an equation, students can often follow an example and get a correct answer without understanding how or why the process works. Traditionally, the majority of assessments in mathematics learning have been based on students' ability to manipulate knowledge in a procedural format. Tests, examinations and quizzes aimed at students producing correct answers, highlight their ability to show how the mathematics processes work but do not shed light on the deeper meaning of why.

In a study done by Star (2002) designed to highlight children's understanding of basic algebra, he found that there were three types of students which are; Student A could demonstrate one method of solving the problem, Student B could demonstrate 1-2 methods of solving the problem, Student C could see problem as complex with many different methods in which to arrive at the answer.

In Star's opinion student C demonstrates both a conceptual and procedural understanding of the problem. He sees mathematics understanding as infinite and complex. Wolfram, (2010) argues that mathematics outside of mathematics classroom involves the following four stages.

Stage 1: posing the right question

Stage 2: Real world mathematics formulation

Stage 3: computation

Stage 4: Mathematics formulation real world verification.

He points out that too often the majority of mathematics instructions concentrate on stage 3 (computation) and does not focus on teaching students how to develop mathematics thinking that relates to being able to pose relevant meaningful questions of ideas that exist outside the classroom.

III. METHODOLOGY

3.1 Introduction

The research was both quantitative and qualitative in nature and took the form of a cross-sectional survey. The primary data was sourced from the students and teachers of mathematics and secondary data from journals, Ministry of education officials, textbooks and other publications from the internet.

3.2 Target population

The study target the students in grades 11 in the five secondary schools in Livingstone district namely Linda secondary, St Marys' secondary, St Raphaels' secondary, David Livingstone secondary and Hillcrest National secondary school. It also comprised the teachers of mathematics in the five secondary schools.

3.3 Study sample

The study sample was drawn from the students in grades 11 in the five secondary schools in the district. The research comprised of 119 student respondents and 8 teacher respondents of mathematics. Participants were drawn from

each school and grade level using simple random sampling by use of class list and drawing of lottery.

3.4 Research instruments: the researcher used Attitude towards Mathematics Inventory (ATMI) questionnaires to collect data from pupil respondents and interviews schedules for teacher respondents.

3.5 Data collection: data was collected through Attitude towards Mathematics Inventory (ATMI) questionnaires and interviews schedules.

3.6 Data analysis: data analysis began during data collection by arranging the field notes in themes in relation to objectives. The researcher also use ANOVA test if attitudes had an effect on conceptual knowledge or if conceptual knowledge had an effect on attitude towards mathematics. Factor analysis was used to see which components had an effect on attitude towards mathematics.

IV. PRESENTATION OF RESEARCH FINDINGS

4.1 Introduction

The chapter deals with the research finding from the responses given by the respondents. There are responses from the students and also the responses from the teachers of mathematics. There are other findings from the Examinations council of Zambia also in this chapter. The other part included how students apply concepts learnt in mathematics

4.2 Questionnaires

This includes the number of responses on each of the items

Question	**SA**	**A**	**U**	**D**	**SD**
1. Mathematics is enjoyable and stimulating to me.	65	44	5	3	1
2. Mathematics is not important in everyday life.	4	2	4	17	93
3. In mathematics you can be creative and discover things by yourself.	40	62	6	9	3
4. I have never liked mathematics, and it is my most dreaded subject.	4	4	7	38	67
5. There is nothing creative about mathematics; it's just memorizing formulas and things.	4	7	11	47	51
6. Students who have understood the mathematics they have studied will be able to solve any assigned problem in five minutes or less.	32	55	18	5	8
7. I try to learn mathematics because it helps develop my mind and helps me think more clearly in general.	65	50	1	1	3
8. Using the web (or a computer) is a good way for me to learn mathematics.	4	38	22	38	18
9. Everything important about mathematics is already known by mathematicians.	9	25	20	46	19
10. Mathematics makes me feel uneasy and confused.	5	11	12	46	43
11. Mathematics is needed in order to keep the world running.	51	49	15	3	1
12. Mathematics is a solitary activity, done by individuals in isolation.	6	13	22	29	40
13. Mathematics is less important to people than art or literature.	5	3	9	35	65
14. Mathematics is important for my chosen profession.	81	30	3	2	3
15. Mathematics is needed in designing practically everything.	36	53	13	10	5
16. Communicating with other students helps me have a better attitude towards mathematics.	32	56	18	8	2
17. I am interested and willing to acquire further knowledge of mathematics.	95	21	0	1	1
18. Real mathematics problems can be solved by common sense instead of the mathematical rules you learn in school.	8	27	23	41	19
19. The skills I learn in mathematics will help me in other subjects.	55	54	6	2	1
20. Ordinary students cannot expect to understand mathematics, they expect simply to memorize it and apply what they have learned mechanically and without understanding.	13	23	16	32	34
21. I learn mathematics well from teachers.	31	58	14	11	5
22. Mathematics shouldn't have been compulsory in the secondary school.	6	5	3	26	79
23. Studying Mathematics really demands too much of me.	17	33	12	39	16
24.Success in Mathematics gives many opportunities in finding a job or place in a college.	91	20	3	1	2
25. Most Mathematics teachers make Mathematics difficult.	10	10	18	46	36

Do your pupils have a negative or positive attitude towards mathematics					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Positive Attitude	4	50.0	50.0	50.0
	Negative Attitude	4	50.0	50.0	100.0
	Total	8	100.0	100.0	

What are pupils interested in when dealing with a mathematics problem					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Procedure	1	12.5	12.5	12.5
	Concept	2	25.0	25.0	37.5
	Solution	5	62.5	62.5	100.0
	Total	8	100.0	100.0	

Secondary data from Examinations Council of Zambia for 2011 and 2012 and that for southern province

Number of pupils who entered for Mathematics

Subject	2011	2012	% increase
Mathematics	88,095	100,280	13.83

Number of pupils who entered for grade 12 Mathematics

Subject	2011	2012	% increase
Mathematics	88,095	100,280	13.83

Number of pupils who sat for grade 12 Mathematics

Subject	2011	2012	% increase
Mathematics	85,413	97,686	14.37

Number of pupils who were absent for grade 12 Mathematics

Subject	2011	2012	% decrease
Mathematics	2,681	2594	

Grade 12 (2012) Mathematics National Performance

					2012		2011	
Dist	Merit	Credit	Pass	Fail	Pass %	Quality %	Pass %	Quality %
7,768	6,988	14,823	15,353	52,754	46.0	30	45.83	31.75

Grade 12 (2012) Mathematics Provincial Performance (Southern Province)

					2012		2011	
Dist	Merit	Credit	Pass	Fail	Pass %	Quality %	Pass %	Quality %
718	603	1,127	1,118	5,280	40.31	27.67	36.69	24.33

Grade 9 (2012) Mathematics National Results

	ONE	TWO	THREE	FOUR	FAIL	ENTERED	SAT	ABSENT
Male	2,581	15,155	25,891	36,564	73,210	180,500	153,913	26,587
Female	1,848	12,133	20,757	30,986	71,291	163,132	137,472	25,660
Total	4,429	27,288	46,648	67,550	144,501	343,632	291,385	52,247

Grade 9 (2012) Mathematics Southern Province Results

	ONE	TWO	THREE	FOUR	FAIL	ENTERED	SAT	ABSENT
Male	198	872	1,942	3,758	12,007	21,987	18,817	3,170
Female	99	689	1,465	2,995	10,716	18,858	15,996	2,862
Total	297	1,561	3,407	6,753	22,723	40,845	34,813	6,032

Student productions from the 2012 grade 12 (P1& P2) selected questions that had already been taught at the time of collecting data in the secondary schools in Livingstone distri

V. DISCUSSION OF RESULTS AND FINDINGS

5.1 Introduction

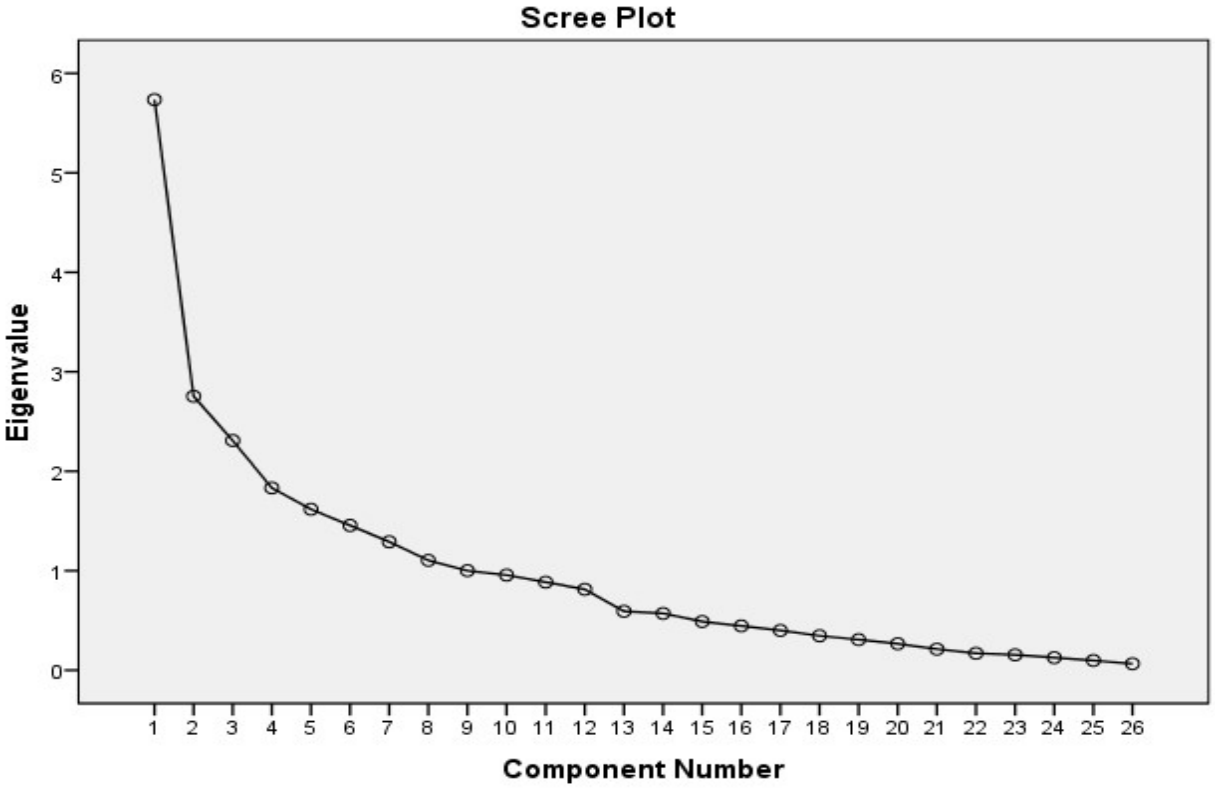
Communalities		
	Initial	Extraction
Mathematics is enjoyable and stimulating to me	1.000	.833
Mathematics not important in everyday life	1.000	.697
In mathematics you can be creative and discover things by yourself	1.000	.610
I have never liked mathematics and it is my most dreaded subject	1.000	.816
Nothing creative about mathematics just memorizing formulas and things	1.000	.643
Students understood solve any assigned problem in five minutes or less	1.000	.712
Mathematics helps develop my mind and think more clearly in general	1.000	.751
Using the web (computer) is good way to learn mathematics	1.000	.590
Everything important about mathematics is already known by mathematicians	1.000	.739
Mathematics makes me feel uneasy and confused	1.000	.743
Mathematics is needed in order to keep the world running	1.000	.613
Mathematics is a solitary activity done by individuals in isolation	1.000	.774
Mathematics is less important to people than art and literature	1.000	.737
Mathematics is important for my chosen profession	1.000	.817
Mathematics is needed in designing practically everything	1.000	.797
Communicating with other students helps better attitude towards mathematics	1.000	.754
I am Interested and willing to acquire further knowledge of mathematics	1.000	.720
Real mathematics problems solved by common sense instead of mathematical rules	1.000	.694
The Skills I learn in mathematics will help me in other subjects	1.000	.704
Ordinary students cannot expect to understand mathematics simply memorise apply	1.000	.719
I learn mathematics well from teachers	1.000	.811
Mathematics shouldn't have been compulsory in the secondary school	1.000	.729
Studying mathematics really demands too much of me	1.000	.723
Success in mathematics gives many opportunities in finding job or place in college	1.000	.586
Most mathematics teachers makes mathematics difficult	1.000	.627
Attitude affects conceptual knowledge or conceptual knowledge affects attitude	1.000	.773
Extraction Method: Principal Component Analysis.		

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	5.736	22.060	22.060	5.736	22.060	22.060	4.797
2	2.754	10.591	32.651	2.754	10.591	32.651	3.608
3	2.309	8.881	41.532	2.309	8.881	41.532	2.363
4	1.832	7.047	48.579	1.832	7.047	48.579	2.040
5	1.618	6.223	54.802	1.618	6.223	54.802	2.076
6	1.455	5.596	60.398	1.455	5.596	60.398	2.746
7	1.291	4.965	65.364	1.291	4.965	65.364	2.535
8	1.104	4.247	69.611	1.104	4.247	69.611	1.962
9	1.001	3.849	73.459	1.001	3.849	73.459	1.529
10	.956	3.678	77.137				
11	.885	3.405	80.543				
12	.813	3.128	83.671				
13	.592	2.278	85.949				
14	.571	2.196	88.145				
15	.490	1.884	90.029				
16	.445	1.713	91.742				
17	.400	1.537	93.279				
18	.346	1.330	94.609				
19	.308	1.183	95.792				
20	.266	1.024	96.817				
21	.212	.817	97.633				
22	.170	.655	98.288				
23	.155	.596	98.884				
24	.127	.488	99.372				
25	.098	.377	99.749				
26	.065	.251	100.000				

Extraction Method: Principal Component Analysis.

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



Analysis weighted by Mathematicsisenjoyableandstimulatingtome

Component Correlation Matrix									
Component	1	2	3	4	5	6	7	8	9
1	1.000	-.199	.160	.002	.194	-.485	.370	-.172	-.063
2	-.199	1.000	-.218	.126	.122	.225	-.162	.113	-.077
3	.160	-.218	1.000	-.101	.252	-.160	.208	.083	-.185
4	.002	.126	-.101	1.000	.025	.004	-.137	.181	.104
5	.194	.122	.252	.025	1.000	-.100	.182	-.020	-.197
6	-.485	.225	-.160	.004	-.100	1.000	-.284	-.152	.097
7	.370	-.162	.208	-.137	.182	-.284	1.000	-.325	-.037
8	-.172	.113	.083	.181	-.020	-.152	-.325	1.000	-.044
9	-.063	-.077	-.185	.104	-.197	.097	-.037	-.044	1.000

Extraction Method: Principal Component Analysis.
Rotation Method: Promax with Kaiser Normalization.

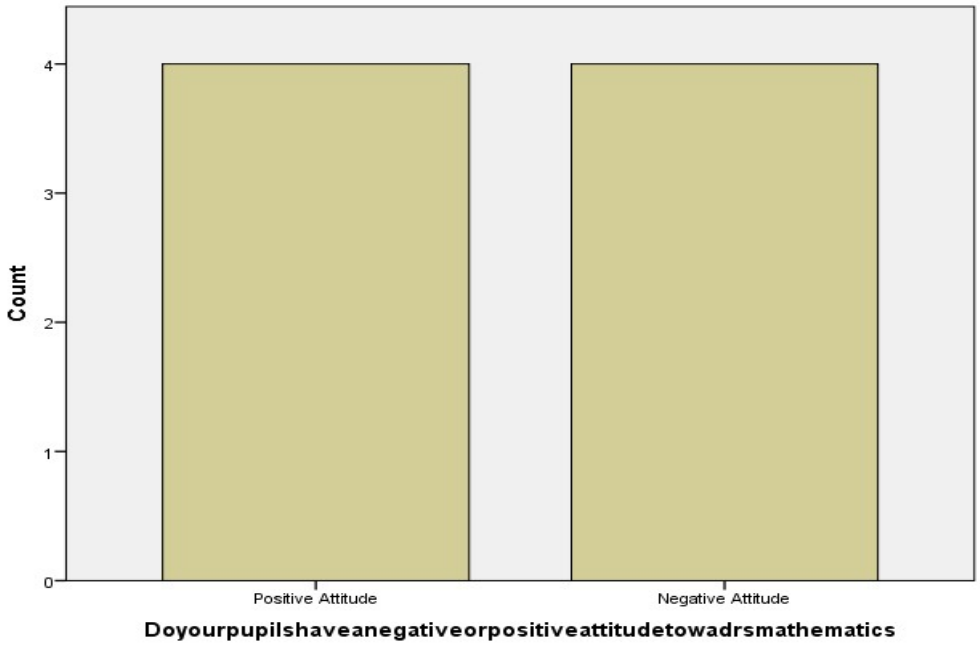
Has conceptual knowledge or procedural knowledge on an operation					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Conceptual Knowledge	20	16.7	16.7	16.0
	Neither Conceptual nor Procedural Knowledge	28	23.3	23.3	40.0
	Procedural Knowledge	72	60.0	60.0	100.0
	Total	120	100.0	100.0	

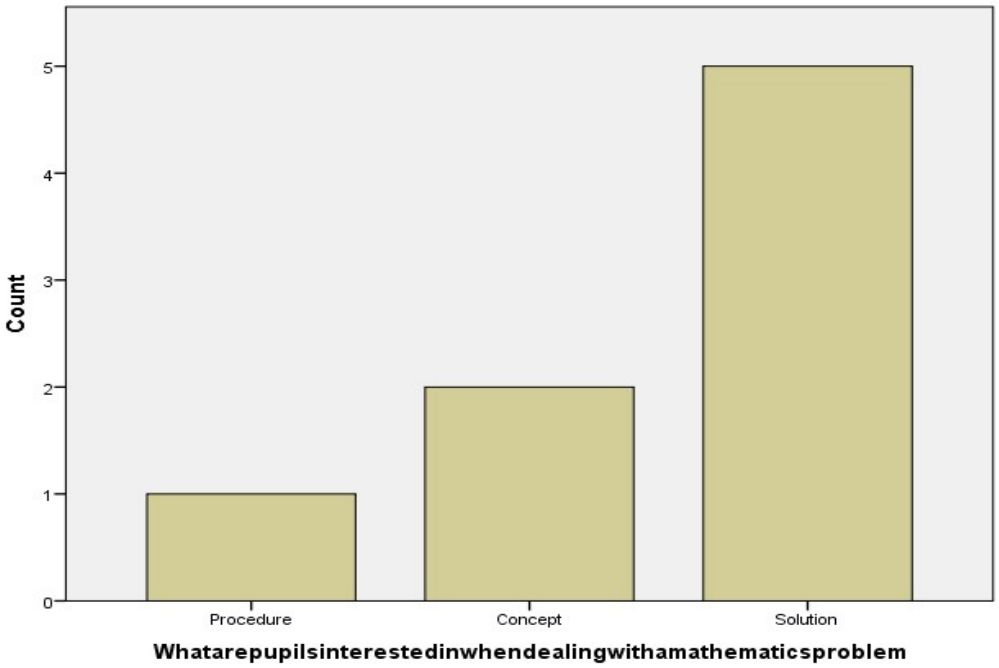
Attitude and conceptual knowledge					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	conceptual knowledge affects attitude	30	25.0	34.5	34.5
	attitude affects conceptual knowledge	57	47.5	65.5	100.0
	Total	87	72.5	100.0	
Missing	System	33	27.5		
Total		120	100.0		

ANOVA					
Attitude and conceptual knowledge					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.017	2	.009	.036	.964
Within Groups	19.518	83	.235		
Total	19.535	85			

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Has conceptual knowledge or procedural knowledge on an operation	120	1	3	1.65	.850
Valid N (listwise)	120				

ANOVA					
What are pupils interested in when dealing with mathematics problem					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.125	1	.125	.130	.730
Within Groups	5.750	6	.958		
Total	5.875	7			





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