American Interdisciplinary Journal of Business and Economics
ISSN: 2837-1909| Impact Factor : 4.6
Volume. 9, Number 1; January-March, 2022;
Published By: Scientific and Academic Development Institute (SADI)
8933 Willis Ave Los Angeles, California
https://sadipub.com/Journals/index.php/aijbe

MATHEMATICS TEACHERS' VIEWS ON TEACHING AND LEARNING CALCULUS IN SECONDARY SCHOOLS

Collins S.
The Copperbelt University, School of Graduate Studies

Abstract: This study aimed to investigate the perceptions and attitudes of mathematics teachers towards the teaching of calculus in secondary schools in the Mporokoso district of Zambia. A total of 16 mathematics teachers participated in the study, which employed a mixed-methods research design of structured interview questionnaires and data analysis using SPSS v20. The results indicated that teachers held positive attitudes towards the teaching of calculus, perceiving it as an essential foundation for other disciplines such as engineering. The study found that years of service in teaching and teacher qualifications influenced teachers' perceptions and attitudes towards teaching calculus. The study highlights the need to assess teachers' perceptions and attitudes towards teaching calculus, as they play a crucial role in determining the quality and effectiveness of mathematics education. Working on learners' perceptions and attitudes towards calculus can enhance their confidence and improve their understanding of the subject. The mastering of calculus is essential in learning, but many students consider it to be a difficult branch of mathematics. Assessing and addressing teachers' and learners' perceptions and attitudes towards calculus can lead to improved performance and outcomes in mathematics education.

Keywords: calculus; perception; attitude; teaching; secondary school; mathematics education; Zambia.

Introduction and Literature review

In relation to teaching and learning mathematics, teachers' perceptions and attitudes play an important role. According to Oktaviyanthi and Supriano (2015), learning mathematics is closely related to visualization and representation of mathematical objects and procedures; In relation to learning mathematics, teachers' perceptions and attitudes play an important role in teaching mathematics (Mills, 2007), and Calculus is part of mathematics. Calculus is a branch of mathematics that includes limits, derivatives, integration, and infinite series. Calculus which has general applications in science and engineering is used to help solve the complex problems that are not sufficiently solved by basic algebra techniques. Oktaviyanthi and Supriano (2015) contends that most of the weaknesses of students is that they are only able to perform simple calculations. Mathematics is made up of many branches that include Calculus. Calculus is a branch of mathematics that includes limits, derivatives, integration, and infinite series. Calculus has general applications in science and engineering and is used to help solve complex problems that are not sufficiently solved using basic algebraic techniques. Calculus is important in the curriculum of almost all disciplines, such as engineering, science, business, economics, computer science and information system. Its concepts are arranged in a systematic, logical, and hierarchical pattern transitioning from the simplest to the most complex. Therefore, the mastering of calculus is essential in learning. However, many learners consider calculus to be a difficult branch of mathematics in their learning process. Calculus as part of mathematics has an abstract concept that most learners are not able to conceptualise. Consequently, working on their perceptions and attitudes towards the

learning of calculus can greatly enhance their confidence and hence result in an improved understanding of the concepts surrounding calculus.

Gibson in 1966 and Gregory in 1970 propounded theories on perceptions called 'bottom-up' and 'top-down' theories. These theories posit that between sensations and our conscious perception of the real world there must be intermediate processes. For example, these processes would be 'inferential thinking'. This kind of thinking allows us to go beyond the evidence of the senses (these inferences are at an unconscious level). Gibson and Gregory believed that perception is more than direct registration of feelings, but that other events intervene between stimulation and experience. They further claim that perception is an activity of forming hypotheses and testing them. Signals received by the sensory receptors trigger neural events, and appropriate knowledge interacts with these inputs to enable us to make sense of where we stay or live or what we should and why we do it. Perception allows behaviour to be generally appropriate.

Perception and attitude deals with someone's cognitive, affective, and emotional abilities. This is in support with Ajzen (1993) who argues that perceptions and attitudes have a predictive validity in that they help us to explain social behaviour. It is argued that there is a relationship between perception and attitude and behaviour Ajzen (1993). This kind of correlation needs to be assessed among Mathematics teachers and learners regarding their views on Calculus. Gibson and Gregory further indicate that perceptions and attitudes develop because of salient beliefs formed about the attitude object. Based on this theory, Mathematics teachers' and learners' perceptions and attitudes could be considered as their disposition to react with a certain degree of favorableness or unfavorableness towards the teaching and learning of Calculus. Gibson and Gregory contend that perceptions and attitudes are hypothetical constructs, implying that they may not be accessible to direct observation but must be inferred from measurable reactions to the attitude object, in this which is Calculus.

This theory is fundamental to guide the proposed study, for instance, the cognitive component of Mathematics teachers could be viewed as those perceptions of and information about Calculus. The cognitive indicators of Mathematics teachers' and learners' perceptions and attitudes could therefore involve verbal expressions of beliefs, opinions and knowledge or non-verbal perceptual reactions towards the teaching and learning of Calculus in secondary schools of Mporokoso district. The effective indicators of teachers could include verbal expressions of feelings, physiological reactions, facial expressions, and non- verbal indicators of positive or negative sensations towards Calculus among teachers.

Studies report that perceptions and attitudes are part of the mindset that affect how a person thinks and acts (Tsanwani et al., 2014). These can influence a person's performance positively or negatively. For example, a positive perception and attitude towards Calculus could result in a positive performance. Conversely, perception and attitude could also influence how well a teacher plans and prepares his/her lessons in Calculus. In their study entitled 'student's attitude towards mathematics, Farooq and Shah (2008), argued that attitude and perception towards mathematics plays a crucial role in the teaching and learning processes of mathematics as it influences students' achievement in mathematics. They further stated that the teaching methodology, the support structure of the school, the family and students' perception and attitude towards mathematics affects the teaching and learning mathematics. It has been determined that teachers' attitudes highly affect students' interest in learning (Tsanwani et al., 2014). This is also supported by Nachiyunde et al. (2021) who posits that personality traits of the mathematics teachers are more powerful and influential than the course content or instructional strategies used in a classroom of mathematics. Breiteig & Grevholm (2005) also supports the preceding notion put forward by others that learning outcomes of students are strongly related to their beliefs and attitudes about mathematics.

The perceptions and attitudes of teachers, their motives for teaching Calculus and the feelings they have of themselves may influence how well they will eventually teach the subject in secondary schools. Mohammed and Ja'ashan (2015) posits that positive perceptions and attitudes are very critical when it comes to learning, and the factors related to attitudes include confidence, experience, satisfaction, usefulness, and motivation. These factors could be considered as a drive to push the teaching process in schools. A study on 'Outcomes

of Schooling: Mathematics Achievement and Attitudes Towards Mathematics Learning in Hong Kong' by Cheung (1990), showed highly positive perceptions and attitudes towards teaching of mathematics because of the many benefits that both teachers experienced.

Considering that perceptions and attitudes towards teaching can be related to motivation, Covington and Dray (2002) argue that decrease in attitudes towards mathematics can be associated with overall decrease in intrinsic motivation, competence-related beliefs, interest, and task values that occur during learning. The opposite is the same, when there is an increase in attitudes towards mathematics, generally, there is also an increase in learners' intrinsic motivation and competence-related beliefs. Teacher motivation are a very critical aspect of determining positive or negative attitude towards mathematics among teachers. A teacher with a positive attitude towards teaching mathematics could ensure that there is adequate preparation in terms of teaching strategy and other resources. A good teaching strategy requires full interest and support from administrators and learners. A teacher with a negative attitude tends not to appear interested or does not foster a supportive learning environment (Masaiti & Naluyele, 2011). In addition to that, teachers with negative attitudes may not be as approachable as teachers who are positively motivated. Learners could also find it difficult asking such a teacher question on the grey areas of the subject he/she teaches. This implies that teachers' attitude towards their students and teaching in general is very important for students' success. In the same vein, teachers need to be highly interested in the subjects and topics they teach.

Cheung (1990) argues that while many perception and attitude studies have generally focused on mathematics, little attention has been given to the specific topics like Calculus. Similarly, in a review article on attitudes towards mathematics, Covington and Dray (2002) concluded that perceptions and attitudes studies towards mathematics were very limited and hence the need to carry out an investigation of these perceptions and attitudes in teaching mathematics. Perceptions and attitudes towards mathematics become especially noticeable when studies that aim at evaluating and documenting them are implemented fully. Teachers' perception and attitude helps to determine how well teachers teach the subject. Therefore, the need to assess their perception and attitudes towards teaching Calculus should not be overemphasized.

To meet the needs of society or citizens, many countries in Africa reformed their educational curricula shortly after attaining political independence (MoE, 1996). For Zambia, in order to respond to developmental needs of the country and those of individual learners, the government, through the Ministry of Education (MoE) in 1996 developed a national policy on education called 'Educating Our Future'. For some time now this policy has become a backbone or guide for all educational strategies and programmes in the country (MoE, 1996). The countries, Zambia inclusive, believed that educational provision was the key that could nurture the holistic development of all individuals. The education policy resulted in the development of the Zambia Education Curriculum Framework (ZECF) in 2013.

This development affected the school subjects including mathematics. Ordinary level mathematics syllabus underwent changes so that it could suit the trend in the Zambian education (ECZ, 2016). The changes resulted in the introduction of Calculus in the O-level mathematics syllabus in secondary schools (Nachiyunde et al., 2021). According to ECZ (2016), Calculus was only introduced for the first time in the Zambian secondary school mathematics syllabus in 2013. Before 2013, at secondary school level Calculus was only offered to learners taking Additional Mathematics and such learners were not many because few schools were offering the subject at that time (MESVTEE, 2013). It is argued that Calculus was introduced at the Zambian secondary school level in order to create a bridge for further education especially in tertiary mathematics courses where there is demand for such (Nachiyunde et al., 2021).

The following Calculus concepts were incorporated in the O-level Mathematics syllabus: calculating equations of tangents and normals, differentiating functions from first principles, using the formular for differentiation, explaining integration, evaluating simple definite integrals, finding the area under the curve, and finding indefinite integrals. Other topics included are composite functions, inverse functions, computer

and calculator, arithmetic and geometric progressions, graphs of cubic functions, standard deviation in statistics and trigonometric equations.

With the integration of Calculus in the O-level Mathematics syllabus, teaching and learning Calculus in schools appears to be a difficult process. This may be attributed to the fact that understanding Calculus has posed a challenge for most Mathematics students. Since the incorporation of Calculus in O-level mathematics syllabus, the general observation by stakeholders in Zambia particularly in Mporokoso secondary schools is that learners are underperforming in this topic. For instance, the Examination Council of Zambia examiner's report for 2016 revealed that some candidates of Mporokoso district that took part in the O-level mathematics syllabus performed poorly in Calculus topics. At Mukanga Secondary school, Grade 12 performance in Mathematics in 2016 was at 41%; 2017 at 42%; 2018 at 38.4% and 2019 at 42.1%. The underperformance of the learners in mathematics with reference to Calculus topics is generally becoming a major source of concern in Zambia at large.

It is against this background that the study sought to assess teachers' perceptions and attitudes towards the teaching and learning of Calculus topics in secondary schools of Mporokoso district. Specifically, the study was guided by the following questions:

1. What are the perceptions and attitudes of mathematics teachers towards teaching of Calculus in secondary schools?
2. What are the factors that influence mathematics teachers' perceptions and attitudes in teaching Calculus

Addressing these questions is important to the study for answers will indicate whether teachers appreciate the inclusion of the topic in senior secondary school Mathematics. How teachers respond to the questions may be an indication of how the topic is being taught. Consequently, it may be an indication of whether the topic is taught positively or negatively. The way the topic is taught may affect effect learners' performance, positively or negatively. Therefore, the study was necessary so as to determine perceptions and attitudes held by teachers towards teaching of Calculus at this level of the education system.

Methodology

The following methods and procedures were adopted to conduct this study.

Research design

The study adopted both a descriptive and analytical research design. Consequently, two distinct data collection approaches were incooperated resulting in a mixed approach to data collection. The quantitative approach enabled the researchers to analyse yielded data and develop a statistical representation of the trend or connection regarding attitudes and perceptions of both teachers towards teaching of calculus. On the other hand, the qualitative approach, helped the study to learn from gathered data, details of participants of the study, such that conclusion was drawn by compiling, comparing and evaluating the informants' feedback and input leading to the answer of the "why" behind the phenomenon or behaviour.

Population and sample

The population of the study comprised all mathematics secondary school teachers of Mporokoso district. Since Mporokoso district has a population of six (6) secondary schools, and 25 mathematics teachers, the study population then comprised six (6) secondary schools, and 25 mathematics teachers from the six (6) mentioned schools. Mporokoso district was selected using purposive sampling because it has secondary schools that offer mathematics and the researchers were interested in teachers' perceptions and attitudes towards the mathematics topic of Calculus. Purposive sampling technique was employed because it has the advantage of selecting participants based on assumptions regarding the population of interest. This is supported by Odhiambo et al. (2010) who categorically state that purposive sampling is any sampling method where some elements of the population have no chance of selection (these are sometimes referred to as out of coverage).

Research Instruments

A structured interview data collection method was used and data collected was quantitative in nature. Structured interviews were employed to gather data from Mathematics teachers. These interview schedules guaranteed a high response rate and allowed control of the interview situation (Odhiambo et al., 2010). The researchers were able to gain full insight into the participant's beliefs or perceptions (opinions) regarding teaching Calculus.

Validation of research instruments

To ensure validity, research instruments were discussed by the researchers and also given to other research experts to reveal and sort out ambiguities. The meaning of every term in the interview schedule was defined to have the same meaning for all respondents. Reliability concerns were addressed or countered by ensuring that respondents gave consistent responses.

2.5 Data Analysis Procedures

Analysis of data was based on research questions, and was made possible by using a software package called SPSS version 20.0 (IBM) for generating descriptive statistical data tables, and correlation tables. An inferential statistical test to indicate relationship or correlation between perceptions and attitudes and performance was done. This enabled us to understand whether perceptions and attitudes of teachers predict performance.

Results and Findings

The analysis of results of the data set obtained are presented starting with those to do with perceptions and attitudes of mathematics teachers. Data were analyzed for trends using the SPSS version 20.

Mathematics teachers' perceptions and attitudes towards teaching Calculus

The perceptions and attitudes questionnaire were administered to teachers in order to assess teachers' perceptions and attitudes towards teaching of calculus. The results of analyzing the teacher' perceptions and attitude towards teaching calculus are shown in Table 3.1.

Table 3.1 Perceptions and attitudes of mathematics teachers towards teaching calculus (n=12)

Factor	Indicators	Frequency	Percentage
In your opinion what is calculus all about?	1. Rate of change 2. Concept combinations	10 2	83.3 16.7
Why do you think it is important for secondary schools to learn Calculus?	1. Preparation of higher education 2. It's a mathematical backbone 3. Others	2 9 1	16.7 75.0 8.3
Generally, how are the learners performing in Calculus at your school?	1. poor 2. Fair 3. Good 4. Very good	2 6 2 2	16.7 50.0 16.7 16.7
Why do you think learners perform like that in Calculus?	1. Lack of basic concepts 2. Good strategies implemented	9 3	75.0 25.0
What strategies do you often use when teaching Calculus?	1. Group work 2. Home work 3. Class discussion	6 2 4	50.0 16.7 33.3
Why do you prefer these strategies?	1. Explore better ways of solving 2. Enable learners understand calculus better 3. Learners participate fully	3 3 6	25.0 25.0 50.0
Which strategies would you adopt to teach integration or differentiation effectively?	1. Group work 2. Class discussion 3. Home works 4. Others	4 5 1 2	33.3 41.7 8.3 16.7
Why?	1. There is positive feedback from the learners 2. Full participation by the learners	6 6	50.0 50.0
What kind of difficulties do you face when teaching Calculus?	1. Learners fail to use their algebraic skills 2. Learners are slow to understand 3. Others	5 5 2	41.7 41.7 16.7
In your opinion what could be the source of such challenges?	1. Poor mathematical background 2. Lack of interest 3. Lack of practice	7 1 4	58.3 8.3 33.3
How can you overcome such challenges?	1. Encouraging more study groups 2. More home work 3. Emphasizing on the basics of calculus 4. Others	4 3 4 1	33.3 25.0 33.3 8.3
Do you think introducing calculus in schools was necessary?	1. Yes 2. No	11 1	91.7 8.3
Why do you think so?	1. Promotes critical thinking 2. Prepares learners for higher education 3. Others	7 3 2	58.3 25.0 16.7
In your understanding what do you think should be done to improve the teaching and learning of calculus?	1. Introducing calculus early in the first term of high school 2. Encouraging more diverse strategies for teaching calculus	6 6	50.0 50.0

Going by the results of the study, teachers perceive calculus to be a subject that mainly deals with rate of change with a minority (16.7%) of teacher respondents pointing out that it is about concept combinations. Additionally, **Table 3.1** shows that teachers consider the teaching of calculus to learners important since it is viewed as the mathematical backbone of other disciplines more especially engineering. In pursuing the undertaking, teacher respondents also report that the most ideal teaching strategy to use when teaching calculus is group work followed by class discussion while home work is deemed the least preferred teaching

strategy. Teacher respondents argue that the aforementioned teaching strategies are ideal since they enable learners to participate fully during lessons. With these said teaching strategies, learners are able to reciprocate and hence give positive feedback. However, it goes without not mentioning that while implementing the aforementioned teaching strategies, there existed some challenges such as learners failing to use their algebraic skills, coupled with the slow pace to comprehend concepts. Going forward, the teacher respondents indicate that emphasizing the basics of calculus to learners is the most viable way of overcoming the challenges, that is also in conformity with encouraging more study groups among the learners.

Table 3.2: Mathematics teachers' perceptions, attitudes, qualification and experience teaching Calculus (n=12)

Variable	N	1	2	3	4	5	6	7	8
1. Years in service	12	-							
2. Teacher Qualifications	12	0.244	-						
3. Year began teaching calculus	12	0.000	-0.378	-					
4. What calculus is all about	12	0.000	0.378	0.200	-				
5. Importance of calculus	12	0.081	-0.143	-0.076	0.076	-			
6. Strategies for teaching calculus	12	0.357	-0.157	-0.083	-0.166	-0.220	-		
7. Challenges faced while teaching calculus	12	0.166	-0.293	0.155	-0.155	0.176	0.193	-	
8. Ways of overcoming challenges	12	-0.487	-0.371	-0.151	-0.076	0.371	-0.157	0.176	-

There is a mixed set of views regarding teaching of calculus among teachers. Those with diploma qualifications feel that teaching of calculus is a challenge for learners especially those that struggle in other topics. On the other hand, teachers with degrees feel that teaching calculus is not a challenge; all that is needed is to use different teaching strategies depending on which learners are being taught at a particular moment. A large majority of teachers, however, perceive the introduction of calculus as well timed although more preparations could have been done in order to ensure that there is an enabling environment within schools the teacher to thrive in their teaching of calculus. Furthermore, the correlation results obtained from the study indicate a very week correlation between mathematics teachers' perceptions and attitudes and years of teaching. This means that as one increases in the years of service, the challenges faced reduces.

Table 3.3: Table Factors that influence mathematics teachers' perceptions and attitudes in teaching Calculus (n=12)

Statement	Percentage	Rank
In your opinion what is calculus all about?	83	2
Why do you think it is important for secondary schools to learn Calculus?	75	3
Generally, how are the learners performing in Calculus at your school?	50	6
Why do you think learners perform like that in Calculus?	75	4
What strategies do you often use when teaching Calculus?	50	7
Why do you prefer these strategies?	50	7
Which strategies would you adopt to teach integration or differentiation effectively?	41.7	9
Why?	50	8
What kind of difficulties do you face when teaching Calculus?	41.7	10
In your opinion what could be the source of such challenges?	58.3	5
How can you overcome such challenges?	33.3	11
Do you think introducing calculus in schools was necessary?	91.7	1
Why do you think so?	58.3	5
In your understanding what do you think should be done to improve the teaching and learning of calculus?	50	8

Data was analysed to determine factors influencing mathematics teachers' perceptions and attitudes towards teaching calculus. The results indicate that teachers' perceptions and attitudes towards teaching of calculus were mainly influenced by teachers' qualifications and the number of years of teaching i.e., their teaching experience. It was observed from the results that teachers who had degrees and a considerable number of years in service had positive perceptions and attitudes towards teaching of Calculus as opposed to those with diploma qualifications even though they had many years in teaching.

Discussion and Conclusion

Results from respondents' responses to the questionnaires indicated that most teachers value the importance of teaching calculus. This is because teachers in this study viewed Calculus as a foundation for many disciplines, especially engineering and natural sciences. Thus, in general respondents revealed perceiving the introduction and teaching of Calculus in secondary schools positively. This could be attributed to the many uses of Calculus. However, the study has established that teachers' perceptions and attitudes towards teaching of Calculus were different depending on the qualifications of respondents. Respondents with degrees in mathematics exhibited positive attitudes and enthusiasm towards the teaching of Calculus in secondary schools. On the other hand, their diploma holding colleagues exhibited doubt and discomfort towards the teaching of Calculus as observed from their responses.

Qualification of respondents, therefore, seemed to be one of the factors that influenced teachers' perceptions and attitudes towards teaching Calculus in secondary schools. Apart from teachers' qualifications, teachers' years of experience in teaching mathematics were identified as one of the factors determining perceptions and attitudes of teachers towards the teaching of Calculus in secondary schools. Teachers who had more years of teaching exhibited positive perceptions and attitudes towards the teaching of Calculus. Such results reveal the confidence with which such teachers approach their teaching. The result is not just for Calculus but can be generalized to other topics (Mills, 2007). This group of teachers has over the years observed what works in their teaching and what does not work. As such they are able to arrange learning experiences which support learning for their pupils. Also, the teachers' attitudes were influenced by availability of teaching materials for teaching Calculus. Teachers, in the study suggested that the presence of teaching materials especially textbooks on Calculus helped teachers develop positive attitudes towards the teaching of Calculus. It helped them have increased levels of confidence. This was true for all sets of teachers, whether degree holders or diploma holders. The importance of learning materials in a teaching and learning situation is echoed in other studies (e.g., Adalikwu & Iorkpilgh, 2012).

Therefore, the researchers conclude that of the many factors determining teachers' perceptions and attitudes towards teaching Calculus two stand out. The two factors are teachers' qualifications and their teaching experience. Of the two, a teacher's qualifications is the main influencing factor regarding teacher perceptions and attitudes towards teaching of Calculus. For this reason, the study asserts that those with degrees developed positive perceptions and attitudes towards teaching calculus, which in turn impacted the learners positively and resulted in improved learner achievement in Calculus and consequently in mathematics. The study by Yara (2009) is in agreement with this finding, that positive attitudes towards learning have positive effects on achievement. However, the fact that achievement in Calculus has not been as expected in schools under study, the conclusion may be that schools do not have sufficient numbers of degree holding teachers. This may be true but it is recognized that other factors affecting learners' achievement in mathematics might be at play. Factors, such as learners' mathematical background, teaching materials available, methods of teaching and others.

Based on study findings, the conclusion is that teachers are of the view that teaching Calculus in secondary schools is a welcome development. Therefore, teachers in general are said to have positive attitudes towards teaching Calculus. Specifically, it has been established that a number of teachers exhibited differing levels of perceptions and attitudes and this depended mainly on two factors: teachers' qualifications and teacher's years of teaching mathematics. Consequently, it is recommended that further studies be conducted in future to determine what other factors influence teaching of Calculus in secondary schools.

References

Adalikwu, S. A, & Iorkpilgh, I. T. (2013). The influence of instructional materials on academic performance of senior secondary school students in mathematics in Cross River State. Global Journal of Educational Research: 12(1), 39 -45.

Ajayi, V. O. (2017). Primary Sources of Data and Secondary Sources of Data, (September). https://doi.org/10.13140/RG.2.2.24292.68481

Booth, W.C., Booth, W.C., Colomb, G.G., Colomb, G.G., Williams, J.M. and Williams, J.M., (2003). The craft of research. University of Chicago press.

Examinations Council of Zambia. (2016). Examinations Performance Review Report 2016, Examinations Council of Zambia. Lusaka, ECZ

Examinations Council of Zambia. (2017). Examinations Performance Review Report 2016, Examinations Council of Zambia. Lusaka, ECZ

Examinations Council of Zambia. (2018). Examinations Performance Review Report 2015, Examinations Council of Zambia. Lusaka, ECZ

MESVTEE. (2013). Zambia Education Curriculum Framework, Ministry of Education. Lusaka, Curriculum Development Centre.

Mills, J. D. (2007). Teacher Perceptions and Attitudes about Teaching Statistics in P-12 Education. *Educational Research Quarterly*, 30(4), 15-33.

Ministry of Education (1996). Educating our future – national policy on education, MoE. Lusaka

Nachiyunde, K., Zulu, J., Nalube, P., Masaiti, G. (2021). Improving Problem Solving Skills in Calculus among the Grade 12 Learners? in Selected Public Secondary Schools in Lusaka District

Odhiambo, R., Mwita, P., Kihoro, J., Mwalili, S., Waititu, A., Orwa, G., Mung'atu, J. & Mugo, C. (2010). Basic Statics: With Practical Examples in SPSS. Lagos: Atlantic Associated, Publishers.

Oktaviyanthi, R., & Supriani, Y. (2015). Utilizing Microsoft Mathematics in Teaching and Learning Calculus. Indonesian Mathematical Society Journal on Mathematics Education, 6(1), 63-76.Using SPSS Program. 6th Edition, McGraw-Hill Education, London, UK.

Yara, P. O. (2009). Relationships between teachers' attitude and students' academic achievement in Mathematics in some selected senior secondary schools in South West, Nigeria. European Journal of Social Sciences, 11(3), 364–369