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Factors influencing effective teaching and learning of mathematics: A case of selected secondary schools in Lusaka District, Zambia

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Abstract

Effective teaching in mathematics is crucial for students to develop a deep understanding of the subject, foster problem-solving skills, and cultivate a positive attitude toward math. While mathematics can be challenging for many students, a well-crafted teaching approach can make a significant difference in their learning experience. Hence, this study was carried out in Lusaka district and it aimed at investigating factors influencing effective teaching and learning of mathematics in secondary schools of Lusaka district in Zambia. The study was based on three major objectives: (i) to identify factors leading to poor learner academic performance in mathematics in selected secondary schools in Lusaka district, (ii) to establish challenges associated with the teaching and learning of mathematics in selected secondary schools in Lusaka district, and (iii) to suggest measures to promote effective teaching and learning of mathematics in selected secondary schools in Lusaka district. The study employed both qualitative and quantitative methods and a descriptive survey design that sampled head teachers, teachers, and pupils. Data was obtained from the respondents by means of interviews and questionnaires. Data were analyzed by the use of software; Statistical Package for Social Sciences (version 26) and Microsoft Excel (version 16). Frequency tables, graphs, figures, and pie charts were also used to analyze the data. The study established that improving teacher deployment, procurement of textbooks and acquiring of personal study materials by pupils, proper time management among pupils on studies, consistency in class attendance, constructing math labs well equipped with textbooks and relevant instruments, and improving on monitoring and inspection to ensure consistency among teachers were among key factors that would influence/promote effective teaching and learning of mathematics in secondary schools. The study therefore called for greater attention from school administrators, parents, the government, and other relevant stakeholders to cooperate and find ways of addressing challenges that are associated with the teaching and learning of mathematics in a bid to improve learner academic performance in secondary schools.

Keywords: Effective; Factors; Influence; Learning; School and Teaching

1. Introduction

As was the case in the past, most people today still believe that mathematics is all about computation. However, computation for mathematicians is merely a tool for comprehending structures, relationships, and patterns of mathematical concepts, and therefore producing solutions for complex real-life problems. This perspective of mathematicians has gained more attention and importance with rapid advancements in information and communication technologies. It has become a necessity for people of all ages to reach, analyze, and apply mathematical knowledge effectively and efficiently to be successful citizens in this information age (Sparks & Sarah, 2011). In particular, students need to be well-equipped with higher-order mathematical knowledge. The quality of teaching and learning in mathematics is a major challenge and for educators. General concern about mathematics achievement has been evident for the last 20 years. The current debate among scholars is about what students should learn and how they

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should learn it in order to be successful in mathematics (Walkerdine, 1998). The discussion emphasizes new instructional design techniques to produce individuals who can understand and apply fundamental arithmetic concepts. A central and persisting issue is how to provide instructional environments, conditions, methods, and solutions that achieve learning goals for students with different skill and ability levels. Innovative instructional approaches and techniques should be developed to ensure that pupils become successful learners (MoE, 2018).

It is important for educators to adopt instructional design techniques to attain higher achievement rates in mathematics (Stuart, 2000). Considering pupils' needs and comprehension of higher-order mathematical knowledge, instructional design provides a systematic process and a framework for analytically planning, developing, and adapting mathematics instruction (Loucks, 1998). "Instructional design is an effective way to alleviate many pressing problems in education. Instructional design is a linking science; a body of knowledge that prescribes instructional actions to optimize desired instructional outcomes, such as achievement and effect" (Kitta, 2004). Instructional design alone cannot produce better learning and achievement. The instructional designer must know crucial factors that affect student learning and build a bridge between goals and pupils' performance. Identifying these factors will help to utilize limited resources including financial resources and time more effectively (Marchesi and Martin, 2002).

In an effort to understand the factors associated with mathematics achievement, researchers have focused on many factors (Mtitu, 2014). The impact of various demographic, social, economic, and educational factors on students' math achievement continues to be of great interest to educators and researchers. For instance, SEDP (2010) concluded that parents' socioeconomic status is correlated with a child's educational achievement. Another study by Suan (2014) showed that factors such as individual study, parents' role, and social environment had a significant influence on "further education" decisions and achievements of young students. In another study, Tshabalala & Ncube (2013) investigated cognitive motivational variables that influence high school students' decisions to enroll in advanced math courses. Their findings revealed that math ability perceptions affect students' valuing of math and their expectations for achievement. A growing body of research provides additional factors that could have an impact on students' achievement such as gender, family structure, parents' educational level, socio-economic status, parent and student attitudes toward school, and parental involvement (Ibid, 2000). Three factors or predictors in math achievement, are divided into sub-factors: demographic factors (gender, socio-economic status, parent's educational level), instructional factors (teacher competency, instructional strategies and techniques, curriculum, school context, and facilities), and individual factors such as self-directed learning, arithmetic ability, motivation.

1.1. Statement of the Problem

Poor academic performance in Mathematics has attracted a lot of attention among relevant stakeholders in Zambia. The study noted that there are a lot of speculations on this matter and this has provoked an ongoing debate in many countries around the world (SEDP, 2010). The study noted that the responsible authority, parents, educators and learners throughout the country are concerned about the poor academic performance in mathematics in most schools. Despite various efforts which have been put in place by the responsible authority which include offering good staff accommodation, a token of appreciation for those teachers who will have reached a certain percentage in terms of pass rate as well as monetary incentives, the performance in mathematics at ordinary level remains a source of concern. As of 2018, the pass rate of Mathematics stood at 58% which was far below the expected when compared to other subjects (MoE, 2019). Poor academic performance in Mathematics at the Ordinary Level has become a trend in schools. Therefore, the researchers saw a need to conduct a study to investigate factors influencing effective teaching and learning of mathematics in secondary schools with a view to addressing the poor academic performance of learners in the subject.

1.2. The Purpose of the Study

The purpose of this study was to investigate factors influencing effective teaching and learning of mathematics in selected secondary schools of Lusaka district in Zambia.

Research Objectives

The objectives of the study were to:

- Identify factors leading to poor learner academic performance in mathematics in selected secondary schools of Lusaka district, Zambia.
- Establish challenges associated with the teaching and learning of mathematics in selected secondary schools of Lusaka district, Zambia.

- Suggest measures to promote effective teaching and learning of mathematics in selected secondary schools in Lusaka district

1.3. Theoretical Framework

Since human beings attribute their success or failure to something, the study selected the Attribution Theory of Weiner as a theoretical framework guiding this study. According to Weiner (1979), people attribute their success or failure in terms of causes. In order to understand the causation of behavior, they search for explanations or causes. They attempt to maintain a positive self-image when they do well by attributing the success to their own effort or abilities but if they do poorly, they believe it is because of factors beyond their control. They seek information that helps them to make attributions about causes and effects, particularly in situations where the outcome is unexpected or negative. If the causation of an unpleasant behavior is successfully attributed to something else, the individual feels better. The attribution theory assumes that the reasons people give to explain their behavior govern their behavior and predictable ways from one situation to the other. If failure is attributed to lack of ability there will be a decrease in performance. Thus, the causes attributed to a particular behavior will influence subsequent emotional and cognitive behavior. The Attribution theory is important in explaining future motivations since there might be affective reactions to success or failure if for example a learner fails and attributes it to lack of preparation. In the future, such a learner will work hard, but if attributed to task difficulty he or she is likely going to be demotivated. Explanations, justifications, and excuses about oneself or others influence the motivation of an individual to perform a task. The following aspects explain success and failure; ability, effort, task difficulty, and luck. Human beings believe that certain dimensions influence a person's interpretation of success or failure. These are internal/ external, controllable/ uncontrollable, and stable/ unstable. Learned helplessness develops when a person believes that the events and outcomes in their lives are mostly uncontrollable. This will result in a lack of motivation and a reduction of self-esteem.

Significance of the Study

It is hoped that the findings of this study would be beneficial to teachers, pupils, the government, and the general public in various ways. The study might assist the teachers in secondary schools in Lusaka district to adopt the consistent use of appropriate teaching methods and instructional materials in the classrooms to make learning interesting and enhance better understanding by the pupils. Since the use of instructional materials in teaching has positive results in the sense that it enhances effective understanding in the learners, it will therefore enable the government to produce and or procure more instructional materials for all secondary schools in order to enhance productivity in education. Teachers may consider pupils' cultural backgrounds before actual classroom teaching to know if the pupils have the basic concepts in a particular unit of study in mathematics. The study findings would also help future researchers to come up with other studies on how school environments and teacher's backgrounds are connected to students' cultural backgrounds that affect performance in mathematics. Lastly, the findings of this study would contribute to the existing Mathematics education literature and provide information for further studies.

2. Material and methods

2.1. Study Design

Due to the nature of this study, a mixed-methods approach which combined both the qualitative and quantitative research paradigms was adopted. The use of two methodologies was found to enhance research findings by providing a well-rounded understanding of the phenomenon under study. The mixed methods approach allowed the study to not only ensure the validity of the findings but also collect rich information from different perspectives. This mixed methods approach was used because it enabled the study to collect both quantified and personal verbatim which was of good help in furthering understanding of responses from the intended respondents. The study was aimed at collecting information from the respondents on the factors influencing effective teaching and learning of mathematics in secondary schools.

2.2. Research Site

The research was conducted at some selected secondary schools in the Lusaka district, Zambia.

2.3. Population, Sample and Sampling Procedure

The population for the study comprised head teachers, teachers, and pupils from the selected secondary schools of Lusaka district. The target population was 1300. The sample size involved a total of 130 respondents which included five (5) head teachers, one from each selected school. Fifteen (15) teachers, three from each selected school. One

hundred-ten (110) pupils, twenty-two (22) from each selected school. The study employed both purposive and simple random sampling on different participants from the selected secondary schools.

2.4. Data Analysis

The data collected was compiled from the instruments and then analyzed quantitatively and qualitatively. Thematic analysis was used to analyze the qualitative data and be able to come up with the themes that guided the generation memos. Descriptive statistics was used to analyze quantitative data by using analysis of frequencies and percentiles and making presentations in the form of charts (comparative column graphs and pie-charts) and tables. The quantitative data was managed by using Statistical Package for Social Sciences (SPSS) data software to get the frequencies and percentages from the survey.

2.5. Ethical Issues

Permission from the District Education Board for Lusaka District (DEBS) was sought to carry out this study. An informed consent was sought before collecting information from the informants and guaranteed them with security of the information they provided. Furthermore, the main objective of gathering such information was made clear to the respondents. The researchers avoided pressuring respondents to take part in the research. Alternatively, permission consent, and assents were obtained from respondents involved in the research, and the research topic was strategically selected to ensure that there was no harm whatsoever to the research respondents. In this study, the researchers were fully conscious of the need to abide by the ethical rule of respecting the privacy of individuals taking part in the research. In the same way, all the respondents of the research were to remain unidentified to the public as all their valuable views, opinions and perceptions were only known by the researchers for use only in the research, and participant's identities will forever remain hidden.

3. Results and discussion

The following findings and discussions were presented according to set research objectives:

3.1. Factors Influencing Poor Pupil Academic Performance in Mathematics

Out of the total respondents, 15% pointed out socioeconomic status to be one of the factors in the sense that it influences access to quality educational resources and opportunities. They explained that cultural attitudes towards mathematics and education can affect a pupil's motivation and beliefs about their own capabilities. 15% of another set of respondents also noted that inadequate foundational knowledge and understanding of fundamental mathematical concepts can hinder a pupil's ability to grasp more advanced topics. The study found that difficulty in comprehending basic mathematical operations, such as addition, subtraction, multiplication, and division, can lead to struggles with more complex math problems. 25% of respondents the majority, narrated that for pupils whose primary language is not the language of instruction, language barriers can make it challenging to understand mathematical concepts and instructions. When pupils grapple with vocabulary or syntax they are unfamiliar with before being able to attempt the mathematical problem, can negatively impact their learning. This may not only have an effect on their ability to learn in class but can also invalidate assessment measures. 10% of respondents also said that a disruptive or unsupportive learning environment, both at school and at home, can impede a pupil's ability to focus on their studies. They explained that lack of access to necessary educational materials, like textbooks or technology, can hinder learning. A good learning environment enhances the quality of spupils' responses, help pupils be more engaged in mathematics learning through social interaction and more active in oral communication, improves their classroom predictions and discussions, and supports student-content interaction through sustaining error-analysis to be a learning. Moving on, 15% of respondents observed that ineffective study habits, such as cramming or procrastination, can prevent a pupil from adequately preparing for assessments. The study also found that poor time management skills can lead to a lack of practice and revision, which are essential for mathematical proficiency. The reason pupils are not doing well in mathematics is because of ineffective study habits. Most pupils do not solve or practice mathematical problems because they assume that mathematics consumes their time and the consequence is low achievement.

Last but not least, 20% of respondents mentioned that poor teaching methods or inadequate instruction can have a significant impact on a pupil's performance. Ineffective teaching may not cater to diverse learning styles or may lack clarity and engagement. It was also noted that overcrowded classrooms or insufficient resources can limit the teacher's ability to provide individualized attention to pupils. The findings also revealed poor teaching methods or inadequate instruction as one of the factors considered to have an adverse influence on poor pupil academic performance in mathematics in secondary schools. Indeed, various research studies have shown that poor teaching stands out as one of the reasons for poor academic performance in Mathematics. Stuart (2000) concurs with the above assertion and states that poor academic

performance in Mathematics is traceable to poor or ineffective teaching. Studies done in America also made similar observations when they showed that poor Mathematics achievement is attributed to classroom factors such as poor teaching methods. Research shows that the commonly used teaching methods are question and answer, exposition, guided discovery, and group work. A study done by Saad (2004) in Zimbabwe revealed that the lecture method is however occasionally used while hands-on activities and field trips are not commonly used. This also confirms Ali et al (2010) observations when they stated that the commonly used methods are question and answer, work from the textbook, and teacher demonstration. Ibid (2004) also made similar observations when he indicated that there is a highly positive relationship between the methods used and pupils' performance.

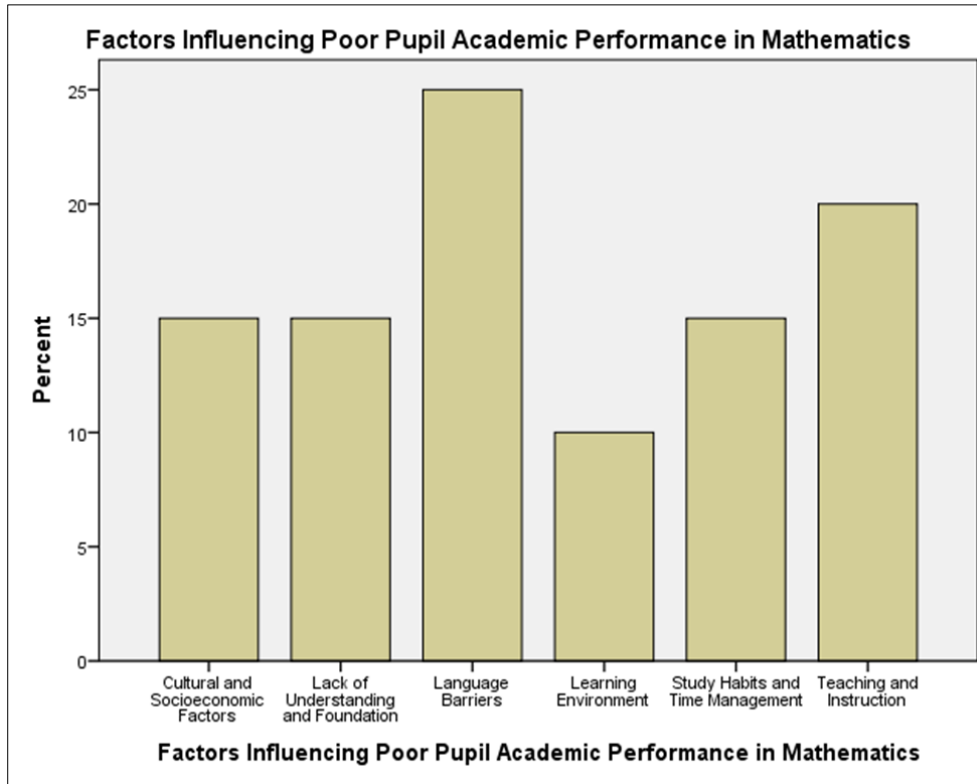


Figure 1 Factors Influencing Poor Pupil Academic Performance in Mathematics

3.2. Challenges Associated with the Teaching and Learning of Mathematics

3.2.1. Challenges Pupils face in Learning Mathematics

Table 1 Challenges Pupils face in Learning Mathematics

S/NO	Challenges	Percentage
1	Lack of study materials for pupils	15%
2	Lack of teaching experience and consistency in teaching by teachers	10%
3	Lack of money among pupils to afford sideline/ private tuition	20%
4	Inadequate number of mathematics teachers/ big pupil-teacher ratio.	15%
5	Lack of textbooks in schools.	10%
6	Mathematics teachers' pedagogical styles and rapport with pupils	30%
	Total	100%

Table 1 above presented findings on the challenges pupils face in learning mathematics in secondary schools. The findings established that mathematics teachers' pedagogical styles and rapport with pupils, lack of study materials for learners, lack of teacher consistency in teaching/ reporting for work, lack of money among pupils to afford sideline/ private tuitions, lack of textbooks, and inadequate number of teachers/ big pupil-teacher ratio were among the main challenges that learners were facing in learning mathematics in secondary schools.

3.2.2. Challenges Teachers Face in Teaching Mathematics in Secondary Schools

Table 2 Challenges Teachers Face in Teaching Mathematics in Secondary Schools

S/NO	Challenges	Percentage
1	Inadequate teaching experience.	35%
2	Big classes making it difficult to apply appropriate teaching methods.	20%
3	Shortage of teaching aids.	10%
4	Multiple classes making lesson planning ineffective.	15%
5	Inadequate well-equipped mathematics laboratories.	10%
6	Negative attitudes	10%
	Total	100%

Table 2 above presented findings on the challenges teachers face in teaching mathematics in secondary schools. The findings established that inadequate teaching experience, big classes that make it difficult to apply appropriate teaching methods, shortage of teaching aids, multiple classes that make lesson planning ineffective, and inadequate well-equipped mathematics laboratories were among the main challenges that teachers encounter in teaching mathematics in secondary schools. Figure 2 below indicates the findings of the study item that sought to explore levels of teaching experience among teachers of mathematics. It was evident from Figure 2 that there was insufficient experience of service delivery among teachers with 20% of the respondents attesting to having a teaching experience of below 1 year, while 60% had a teaching experience of between 2 and 5 years. Furthermore, the other 20% of the teachers had a teaching experience of 6 years and above. The findings made it clear that teachers had experience of teaching mathematics in secondary schools. Teaching experience is critical to one's success in service delivery. In support of the study findings, Georgiou (2002) revealed that teachers' teaching experience was significant to student's learning outcomes as measured by their performance. Thus, lack of relevant teaching experience may have a negative impact on the teacher's ability to deliver a lesson and ultimately lead to poor performance of pupils in Mathematics. Grouws (2001) noted that a significant number of teachers lack long teaching experience and have weaker practical instructional skills. Therefore, according to him, the longer a teacher takes in teaching 'O' Level classes the more equipped he or she becomes in preparing learners for public examinations. The study further revealed that there were big classes in most secondary schools, a situation that made it difficult for most teachers to apply appropriate teaching methods. According to Kitta (2004), 80% of teachers indicate mathematics as one of the subjects they find difficult to teach. Thus, according to Saad (2004), mathematics at the secondary level is not taught well because some Mathematics teachers lack pedagogic content knowledge and materials, especially in big classes. The Gallup Youth Survey (2014) reveals that mathematics is the subject that teenagers find to be difficult and this explains the poor academic performance.

Another prominent finding of the study was negative attitudes both among teachers and pupils towards mathematics. In agreement with the findings, Sparks & Sarah (2011) opined that teachers face the problem of the mentality that Mathematics is not for everyone. Mathematics is therefore thought to be one of the selected few. On the other hand, mathematics teachers also underscored that pupils often approach mathematics as a difficult subject. Researchers observe that the best cure for Mathematics anxiety is success and this should start with the teacher. Teachers' attitude to the pupils is very crucial as it rectifies the difficulties they are having in the subject. Mathematics teachers indicated that they should celebrate all efforts great or small in order to boost pupils' achievements. It has been noted that pupils who experience continuous failure in Mathematics expect to fail every time. Their lack of confidence compels them to rely on the assistance of others to complete tasks. Literature has it that math phobia has led the majority of pupils to believe that mathematics is a difficult subject. Furthermore, Ibid (2011) stressed that most teachers in the mathematics department hold that some pupils have memory problems and they also would like to attribute that result to negative attitude as well. Some of the challenges teachers face include a lack of mastery of the mathematical skills needed to find a solution to particular problems. For most learners, their skills take a long time to perfect. Another challenge is that of

the method of teaching. Mathematics needs to be taught in a way that is clear, informative, and interesting enough to attract learners' attention.

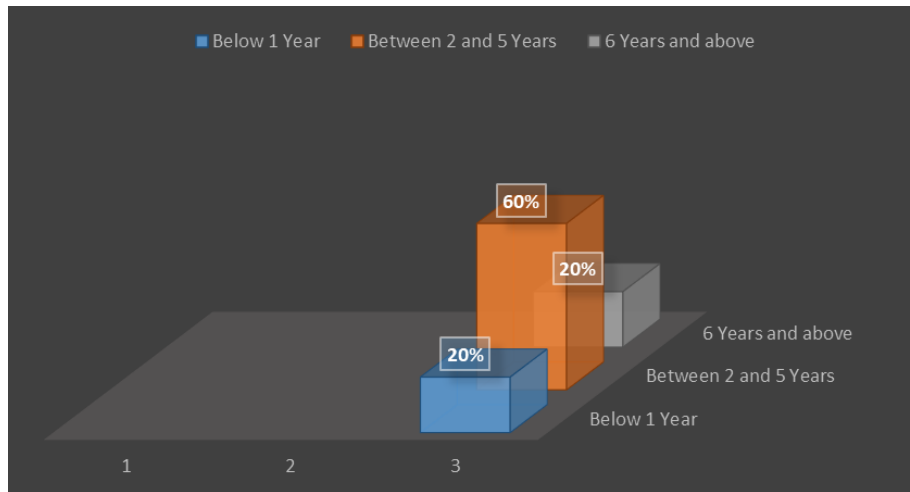


Figure 2 Teachers' Teaching Experience

3.3. Measures to Promote Effective Teaching and Learning of Mathematics in Secondary Schools

Table 3 Measures to Promote Effective Teaching and Learning of Mathematics

S/NO	Measures	Percentage
1	Building and equipping mathematics laboratories in schools.	10%
2	Providing incentives to teachers such as breakfast and allowances.	5%
3	Recruiting and deploying more teachers.	15%
4	Encouraging study leaves for in-service teachers.	10%
5	To provide quality teaching-learning aids.	15%
6	Procurement of textbooks and acquiring of personal study materials by pupils	20%
7	Proper time management among pupils with regard to studies and class attendance	15%
8	Improving on monitoring and inspection to ensure consistency among teachers	10%
	Total	100%

Table 3 above presented findings on measures to promote effective teaching and learning of mathematics in selected secondary schools. From the study findings, it was evident that building and equipping mathematics laboratories in schools, providing incentives to teachers such as breakfast and allowances, recruiting and deploying more teachers, encouraging study leaves for in-service teachers, and providing quality teaching-learning aids were among some measures suggested to promote effective teaching and learning of mathematics in secondary schools. Furthermore, it was also evident from the findings that improving on the procurement of textbooks and acquiring of personal study materials by pupils, proper time management among pupils with regards to studies and class attendance, and improving on monitoring and inspecting of schools to ensure consistency among teachers were also included among measures that respondents recommended to promote effective teaching and learning of mathematics. In agreement with the findings of the study, research by Karande & Kulkarni (2005) has shown that teachers should help learners develop positive attitudes toward mathematics and that teachers themselves to undergo a change of attitude towards teaching. This aids in the increase of interest in learning it. The teacher should make the subject interesting and exciting enough through the methods that will be used. There are quite a number of strategies that can be used in the teaching of mathematics. Student involvement is crucial in doing away with the problem of poor academic performance in mathematics. Students need to spend a great deal of time as well as effort in the learning of mathematics so as to be motivated to want to continue wanting to learn the subject. They should not be treated as passengers but as active participants. According to Iheanachor (2007), teacher competency is also crucial. Teachers should demonstrate competency in the pedagogic

content knowledge of all the chapters in the book. Also of importance is the constant and frequent feedback and remediation by the teachers. The provision of feedback and remediation on the learners necessarily improves performance in mathematics. Remediation aids in correcting deficiencies in pupils with the intention of putting them on the same level as other learners. Teachers who use interactive methods achieve active participation for their learners. Discovery methods, group work, and project work have proved to be effective methods in teaching and learning of mathematics.

4. Conclusion

Effective teaching in mathematics requires a multifaceted approach that encompasses clear objectives, active learning, real-life applications, and a supportive classroom environment. By implementing these strategies, teachers can inspire a love for mathematics, help pupils develop strong problem-solving skills, and prepare them for success in the real world. Ultimately, the goal is to empower students to become confident and capable mathematicians. The study therefore found that a crucial element of effective mathematics education is the development of a growth mindset, where pupils understand that their mathematical abilities can be improved through effort, practice, and perseverance. Teachers play a vital role in fostering this mindset by providing a supportive learning environment and constructive feedback. This approach allows pupils to overcome their fear of mathematics and become more confident problem solvers. The study concludes that differentiated instruction is another key aspect of effective mathematics teaching. Recognizing that pupils have diverse learning styles and abilities, teachers should tailor their instruction to meet individual needs. This may involve providing extra support for struggling students and offering more challenging materials for those who excel in math. By catering to the unique learning requirements of each student, educators can maximize the impact of their teaching.

Recommendations

The following are actions that should be taken on the basis of the findings of this study:

- The Ministry of Education should encourage Teacher Education Institutions to encourage student teachers the use pupil-centered methods in most of their teaching time to arouse interest and positive attitude in the learning of Mathematics.
- The Ministry of Education should supply adequate Mathematics textbooks to all secondary schools for effective teaching and learning of the subject.
- The Curriculum Development Centre (CDC) should develop Mathematics textbooks that will incorporate the practical application of mathematical concepts to arouse pupils' interest and positive attitude towards learning the subject.
- There is a need for the government to scale up teacher recruitment and deployment exercises, especially for mathematics teachers in secondary schools.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of ethical approval

If studies involve use of animal/human subject, authors must give appropriate statement of ethical approval. If not applicable then mention 'The present research work does not contain any studies performed on animals/humans subjects by any of the authors'.

Statement of informed consent



Informed consent was obtained from all individual participants included in the study.

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