Exploring Concrete Teaching Strategies Through Mathematics Laboratory Method to Enhance learner Achievements in Zambian Secondary Schools

Abstract

This study sought to investigate the effectiveness of the mathematics laboratory method in enhancing learner achievements in mathematics of Grade 12 pupils. The specific objectives in this were to; investigate the extent to which the Mathematics Laboratory Method enhances Grade 12 academic performance in Mathematics, and to establish the challenges teachers and learners encounter in teaching and learning Mathematics using the Mathematics Laboratory Method. The study employed a mixed method approach, a concurrent triangulation design was used, with a sample size of 120 pupils and 12 teachers from the 3 selected secondary schools. Simple random sampling was used on the pupils and purposive sampling teaching was used to select the teachers. The control group and the experimental group were subjected to a pre-test where an independent sample T-test was used to test the hypothesis. The mean pre- test scores were 52% and 54% for the experimental and control group respectively. Further, statistical analysis revealed that there was no statistically significant difference in the pre-test results between the two groups. On the other hand, results for the post test, which was administered after the control group was taught using the traditional method of teaching and experimental using the mathematics laboratory method showed a statistically significant difference. The mean score for the post-test rose to 63.97%% and 68.13% for the control and experimental group respectively. Pupils who were taught using the Mathematics Laboratory Method performed better than those who were taught using the Traditional Method of teaching. The study recommends the adoption of Mathematics Laboratory Method in Secondary Schools so as to enhance learner achievements in Mathematics.

1.0 Introduction

One of the objectives of education is to educate students who are capable of developing analytical, inventive, creative, and constructive thinking skills. order to realise that, Mathematics plays a critical role in producing a learner of that calibre. The quest to produce a learner that is critical, creative and analytical in thinking and able to relate thinking to real life situations lies in the way Mathematics is taught (Carmichael, 2017). According Cockcroft (1982) The Mathematics Laboratory method is often used today to refer to an approach to teaching and learning of Mathematics which provides an opportunity to the learners to abstract Mathematical ideas through their own experiences, that is to relate symbol to reality (Singh et al., 2018). It embraces the concept called "learning by doing" which is a very effective methodology in teaching and learning process as the skills and gained meticulously remains lastingly affixed in the minds of the learners , so innovative teaching Aids and projects of Mathematics Laboratory plays an important role in the conceptualisation of ideas (Dewan, 2016). The abstract nature of Mathematics can be reduced through demonstrations and practical methods in a special room called the Mathematics Laboratory.

As defined by Kunwar (2020) the Mathematics Laboratory is a unique environment or setting with appreciate and up-to-date equipment known as instructional materials formulated for teaching and learning of Mathematics and other scientific or research work, whereby a trained and professionally competent person (Mathematics teacher) eagerly inter-faces with learners (students) on specified set of instructions. It can also be defined as a place

where students can learn and explore various Mathematical constructs and verify different mathematical facts and theories using varieties of activities and materials. Alshafey and Aldosary (2021) defined a mathematics laboratory as "a place with hand tools and other equipment used by the learners to experiment, search for mathematical concepts and reveal mathematical relationships, and the place may be the same classroom or a private room, depending on the conditions of the laboratory work practiced by the student."

Matika (2015) state that Mathematics Education is a foundation and essential tool for scientific and economic advancement of an individual and a nation at large. Despite holding such a crucial role in human life, Mathematics Education suffers several setbacks due to the continued poor performance in National Examinations at all levels. The mean percentage marks for Mathematics have been 23.91, 26.34, 27.62, 25.46, 28.29 and 24.39 for the years 2021, 2020, 2019, 2018, 2017 and 2016 respectively. Many explanations have been ascribed to the causes of poor academic performance in Mathematics. Amongst the causes of poor academic performance in Mathematics which the researchers have noted are attitudes of the learners towards the subject, lack of teaching experiences, economic conditions, lack of appropriate teaching methods and low motivation of teachers and attitudes. Suffice to note that among the reasons leading to poor performance is the pedagogical aspect. The teaching of mathematics is a very complex undertaking and many factors determine the success of this process. The nature and quality of instructional material, presentation of content, the pedagogical skills of the teacher, the learning environment, and motivation of learners are all imperative and must be kept in view in any effort to ensure quality in teaching and learning of Mathematics. (Nyaumwe, 2011; Ugada et al., 2018)

Likewise, the Ministry of General Education embarked on STEM Education which advocates for a paradigm shift in the teaching of Mathematics from the ordinary traditional methods of teaching which is mostly lecture type and fails to equip students with skills and knowledge required for survival and job creation. The Traditional methods of teaching which mainly embrace deduction as opposed to induction are no longer adequate to meet the demands of modern mathematics Education and are responsible for high failure rate by the Grade 12 pupils (Alshafey & Aldosary, 2021).

Cicekci and Sadik (2019) recognised that the method of deduction was accountable for the slowness in learning and monotony in the class and taxed the brain too much. All new teaching should be initiated with inductive approach and should end in deductive approach. Inductive method is laborious and lengthy, but it leads to knowledge discovery. We proceed from concrete to abstract and from known to unknown. The significance of the Mathematics Laboratory Method in the development of Mathematical constructs cannot be overstressed as it has great potential to overcome the challenges experienced in learning Mathematics due to its modern approaches for teaching Mathematics, changing the role of the teacher from an active speaker to a facilitator and mentor of the teaching and learning process and this is what modern Education seeks achieve (Alshafey & Aldosary, 2021). The Mathematics Laboratory Method advocates for demonstration as a mode of instruction for teaching and learning of Mathematics. Mushin et al. (2013) proposed that demonstrations may evoke the "wow" experience. This consequently can upsurge their curiosity and boost their reasoning capabilities.

Ado and Nwosu (2016) conducted a study on the influence of Laboratory Method on Students' Mathematical Creativity in Yenagoa Local Government Area of Bayelsa State. This study examined the influence of laboratory method on students' mathematical innovation in

junior secondary schools in Yenagoa, Bayelsa State. The study was grounded by three research questions and three hypotheses. The Pretest- Postest non-randomise control group design was adopted for the study. A sample of 122 students from two intact classes selected randomly was used for the study. The instruments for data collection were the Mathematics Creativity Test (MCT) and the Students' Attitude towards Mathematics Questionnaire (SAMQ). The collected data was analysed using mean and standard deviation, as well as the Analysis of Covariance (ANCOVA) The findings revealed that the laboratory teaching style considerably improves students' mathematical inventiveness. Both male and female pupils benefited from the strategy in terms of mathematical innovation. Students' attitudes regarding mathematics had a substantial impact on mathematical innovation. It was suggested that mathematics teachers invest the use of the laboratory approach in teaching various ideas at the junior secondary school level, among other things. (Ado & Nwosu, 2016).

Nath and Binny (2018) conducted a study on the availability and Utilization of Laboratory Kits for Practical Teaching of Mathematical Skills in Chemistry. This study explored the availability and utilisation of laboratory kits for practical teaching of mathematics in chemistry in Ahoada West local government area of Rivers State. A descriptive research design was employed in carrying out this study. The population of the study was all public senior secondary I (SS1) chemistry students in Ahoada West education zone of Rivers State. A total of two hundred (200) chemistry students were used as a sample for the study which comprises one hundred and twenty (120) male, and eighty (80) female. The research was guided by four research questions. The data were analyzed using descriptive statistics such frequency distribution and percentages. A structured questionnaire was the instrument used for data collection, and the instrument was face validated by three experts. Reliability coefficient index of 0.76 was obtained using the test-retest method. The result suggested that the availability and utilization of laboratory kits in the sampled senior secondary schools were not adequate. Arising from the the result, it was recommended that the government at all levels of education should endeavour to make significant provision of laboratory kits for the practical teaching of mathematics in chemistry, besides chemistry teachers, should ensure that students are introduced to the use of the few available apparatus during practical classes to enhance their comprehension (Nath & Binny, 2018)

1.1 Statement of the Problem

Poor performance in Mathematics has attracted a lot of interventions such as homework policy, lesson study, remedial work, Continuing Professional Development and others. However, despite a number of interventions being put in place performance in Mathematics has continued to be extremely poor. In a presentation by the Examination Council of Zambia Mathematics Specialist at the (2019) ZAME Conference, the mean percentage mark at National level for 2016, 2017 and 2018 stood at 24.39, 28.29 and 25.46 respectively. The percentage of Candidates who got Grade one (distinction) stood at 6.24% whereas those who got Grade nine (fail) at 41.89%. Furthermore, Mathematics in general is increasingly becoming unpopular among the learners and detached from the real world despite being an interesting subject which can be learnt with a lot of enjoyment, pleasure and satisfaction because of its elegance and wide application to the real world. The failure rate could be attributed in the manner Mathematics is taught in most of the Secondary Schools in Zambia. The lack of mathematics laboratory and Mathematics teacher's non-use of laboratory technique in teaching mathematics is one of the major factors that contribute to poor achievement in mathematics by Secondary School students (Ogunkunle, 2014). Therefore,

this study is aimed at examining the effectiveness of using the Mathematics Laboratory Method on Grade 12 academic performance.

1.2 Objectives

i. To investigate the extent to which the mathematics laboratory method enhances Grade 12 academic performance in Mathematics

ii. To establish the challenges faced by Schools in establishing Mathematical laboratories.

1.3 Theoretical Framework

This Study is anchored on the theory of constructivism which advocates for "learners working out themselves". Constructivism theory is a theory that hypothesizes learners construct knowledge rather than just passively take in (Brandon & All, 2010). Thus, according to jean Piaget's theory of cognitive development which postulates that learning is accomplished best using a hands-on approach. Learners learn effectively by conducting practical experiments themselves in order to arrive at dependable Knowledge from the inferences established rather than being told what the concept is (Applefield et al., 2000). The theory posits that humans construct knowledge and meaning from their experiences. Constructivism is not a specific pedagogy(Schcolnik et al., 2006). Constructivism theory is well placed for this study as the Mathematics Laboratory method is based on the concept that learners are active participants for their own learning process as it prompts pupils to formulate their own questions, allows multiple interpretation and expressions of learning as well as advocating for group work and use of peers as resources.

1.4 Research Hypothesis

1.4.1 Hypothesis One

Null Hypothesis: There is no statistically significant difference between the pre- treatment test scores between the experimental group and control group.

Alternative Hypothesis: There is statistically significant difference between the pre- treatment test scores between the experimental group and control group.

1.4.2 Hypothesis Two

Null Hypothesis: There is no statistically significant difference between the post- treatment test scores between experimental group and control group.

Alternative Hypothesis: There is a statistically significant difference between the post-treatment test scores between the experimental group and control group.

2.0 Methodology

2.1 Research Design

This study evolved a concurrent triangulation design, this design involves a single study consisting qualitative and quantitative data collection which is done at the same time. The purpose of this type of investigation is to validate the findings generated by each method through evidence produced by the other (Creswell et al., 2004). The study targeted three

secondary schools within Lusaka district. These include David Kaunda secondary school, Kamwala Secondary School and Chilenje Secondary School. The schools were selected based on the performance of the pupils in mathematics in final examination. David Kaunda was in the category of schools that were recording excellent results in mathematics, while Kamwala was recording fairly good results and Chilenje was recording poor results.

2.2 Sample Size and Sampling Techniques

The study consisted a total sample size of 132, comprising 40 pupils from each of the 3 schools, (20 were in the experimental group and 20 in the control group). The qualitative sample comprised of 4 mathematics teachers from each school bringing the total to 12.

The study made use of probability sampling technique, specifically simple random sampling technique. Simple random sampling technique was employed on pupils. Thus, in order to select the pupils, the researcher obtained the lists of all names of the learners who are engaged in the learning process and serially name them. The same sequence of names was written on small pieces of paper, which were folded, and then subjected them to the draws of a hat. Only one piece of paper were picked at a time until the required sample is reached (n=40). The number on the piece of paper represented the names that were picked from the list as a sample.

2.3 Research Tools

Pre and Post Test Questions: In this study test questions were used on pupils of Mathematics to obtain qualitative data and the on the performance of the pupils. The sample size of pupils consisted of the control group and experimental group, 20 pupils were in the experimental group and 20 in the control group from each school.

Semi-Structured Interview schedule: Semi-structured interviews were used with teachers. The rationale behind the semi-structured interviews with the teachers was to have an in depth understanding, opinions, and views pertaining to the effectiveness of using the Mathematics Laboratory Method on Grade 12 academic Performance.

2.4 Data Analysis

Statistical Package for Social Sciences(SPSS) was used to analyse quantitative generate inferential statistics such as Independent Samples Test. While qualitative analysis was analysed through thematic analysis.

3.0 Results

3.1 Objective One: The Extent to which the mathematics' laboratory Method Enhances Grade 12 Academic Performance in Mathematics.

The pre-post test was conducted on both the control group and experimental group. The Independent Sample T-Test was used to statically test the results.

Pre- Test of the control group and the experimental group

To ensure that the experimental group and the control group were within the same level of performance. A pre-test was conducted on both groups and the results were tested using an independent sample T-Test.

The results show that out of 100% the mean test score of 60 students in the control group was 54.05% and the experimental group recoded 52.15%.

Table 1: Group Statistics

	Group Type	N	Mean	Std. Deviation	Std. Error Mean
Pre- Treatment Test Scores	Control group	60	54.0500	11.84136	1.52871
	Experimental group	60	52.1500	14.10953	1.82153

The significance of the variance of the means was tested by looking at the significance value of 0.426. Since $0.426 \geq 0.05$, we accept the null hypothesis and infer that there is no statistically significant difference between the pre- treatment test scores between the experimental group and control group

Table 2 : Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Pre-Treatment Test Scores	Equal variances assumed	2.016	.158	.799	118	.426	1.90000	2.37801	-2.80911	6.60911
	Equal variances not assumed			.799	114.553	.426	1.90000	2.37801	-2.81058	6.61058

Post -Treatment Test Scores

After the pre-test the experimental group was taught using mathematics laboratory while the control group was taught using the laboratory. The difference in the results were tested using the independent sample t-test.

Table 3 shows the post treatment mean score of 63.966 for the control group and post treatment mean score of 68.12 for the experimental group.

Table 3: post treatment mean score

Group Statistics

	Group Type	N	Mean	Std. Deviation	Std. Error Mean
Post-Treatment Test Scores	Control group	60	63.9667	11.96317	1.54444
	Experimental group	60	68.1167	10.72000	1.38395

The significance of the variance of the means was tested by looking at the significance value of 0.048. Since 0.048≤ 0.05, we accept the reject the null hypothesis and infer that there is a statistically significant difference between the post-treatment test scores between the experimental group and control group

Table 4: Independent Samples Test

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Post-Treatment Test Scores	Equal variances assumed	.355	.553	-2.001	118	.048	-4.15000	2.07379	-8.25667	-.04333
	Equal variances not assumed			-2.001	116.607	.048	-4.15000	2.07379	-8.25717	-.04283

3.2 Analysis of Variance of the Means Between the Control Groups and Experimental Group

Null Hypotheses: There is homogeneity of means between the post treatment test scores of the control group and experimental group.

Alternative Hypothesis: There is no homogeneity of means between the post treatment test scores of the control group and experimental group.

The analysis of variance of the post-treatment test score between the experimental group and control group shows the sig value of 0.048 which is ≤ 0.05. Hence, we reject the Null hypothesis and infer that there is no homogeneity of means between the post treatment test scores of the control group and experimental group.

On the other hand, the pre- treatment test score shows the significance value of .426 which ≥ 0.05. Hence, we accept the Null Hypotheses and infer that There is homogeneity of means between the pre-treatment test scores of the control group and experimental group.

Table 5: ANOVA Statistics

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
Post-Treatment Test Scores * Group Type	Between Groups	(Combined)	516.675	1	516.675	4.005	.048
	Within Groups		15224.117	118	129.018		
	Total		15740.792	119			
Pre- Treatment Test Scores * Group Type	Between Groups	(Combined)	108.300	1	108.300	.638	.426
	Within Groups		20018.500	118	169.648		
	Total		20126.800	119			

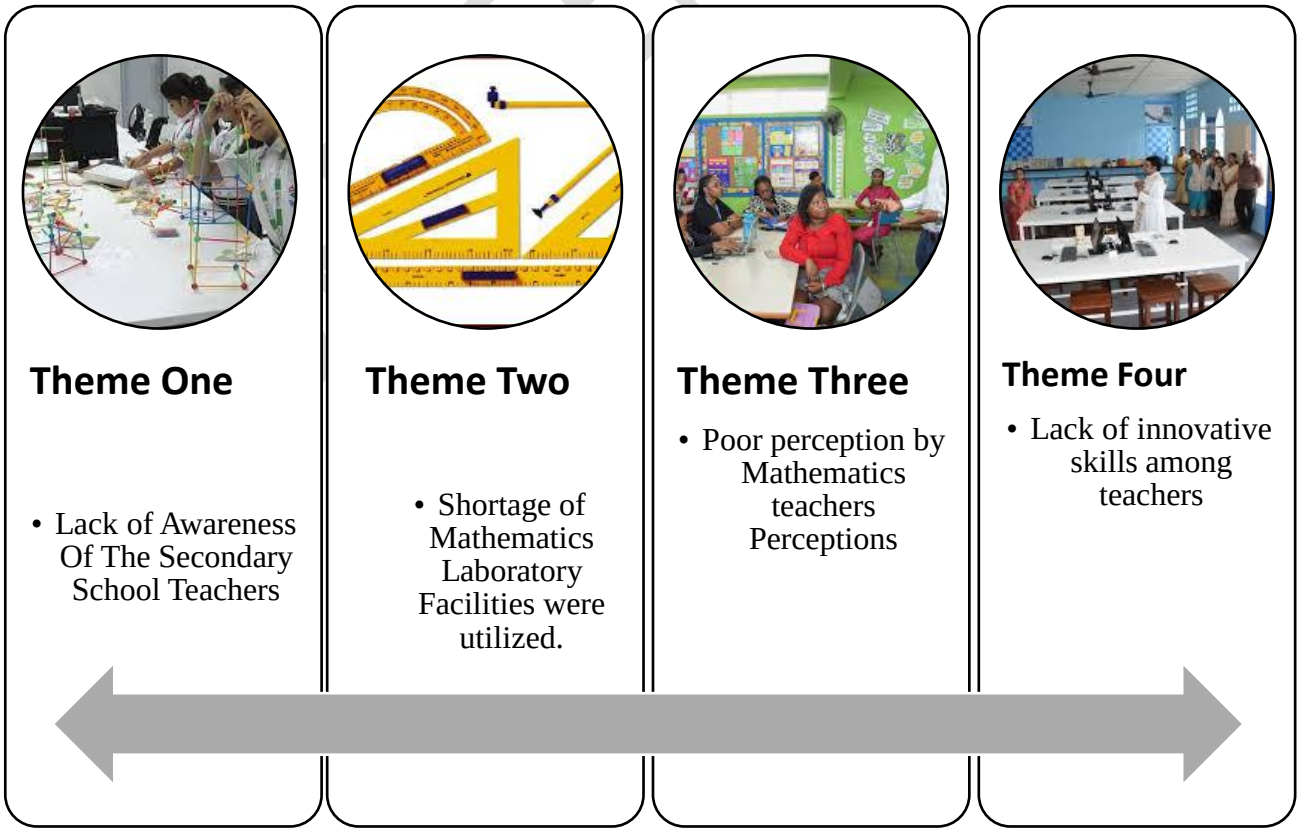
Comparison of the Performance of pupils in the Three schools

Table 6 shows that David Kaunda Secondary school recoded the best results in both the pre and post-test, followed by Chilenje Secondary and lastly Kamwala Secondary.
Table 6: Pre- Treatment Test Scores Post-Treatment Test Scores * School

Pre- Treatment Test Scores Post-Treatment Test Scores * School			
School		Pre- Treatment Test Scores	Post-Treatment Test Scores
Kamwala Secondary	Mean	48.1250	63.7000
	N	40	40
	Std. Deviation	13.80484	12.44104
David Kaunda Secondary	Mean	57.6750	67.9250
	N	40	40
	Std. Deviation	11.12721	11.38237
Chilenje Secondary	Mean	53.5000	66.5000
	N	40	40
	Std. Deviation	12.43651	10.47830
Total	Mean	53.1000	66.0417
	N	120	120
	Std. Deviation	13.00511	11.50111

3.3 Objective Two: Challenges Faced by Schools in Establishing Mathematical Laboratories.

During an interview with the teachers the following themes emerged as the key challenges faced by schools in establishing mathematics laboratories.
Figure 1: Key challenges faced by schools in establishing mathematics laboratories



Lack of Awareness of the Secondary School Teachers

Awareness of the Mathematics laboratory method is one important aspect to teaching and learning of mathematics as it places emphasis on "learning by doing" as a panacea to the generalization of mathematical concepts and ideas. Pertaining to lack of awareness by Secondary School one of the mathematics teachers stated in an interview:

> *"Most of the teachers lack awareness of the mathematics laboratory method and rarely use it. Very few teachers are aware of the mathematics laboratory method as such, they don't even use it. Typical of us teachers, we teach according to the prescribed textbooks and no room for other method that will enhance pupil understanding. The mathematics laboratory method is not so common in Zambia and I doubt if at All there is any school using the mathematics laboratory method. It is common among us teachers to be stuck with the same routine of executing our work and no room for innovative change despite producing poor results"*

Shortage of Mathematics Laboratory Facilities were utilized

In order for the Mathematics Laboratory method to be utilized effectively, availability of the mathematics Laboratory facilities is cardinal. The mathematics laboratory method seeks to heighten the incorporation of properly designed teaching aids in the teaching and learning of Mathematics for easy conceptualization process

> *"It is very difficult to find teaching aids for Mathematics in Schools, there are very few teachings and learning material for Mathematics found in Schools. Most schools do not have mathematical models for the teaching and learning Mathematics. In most cases Teachers do not value the usage of visual teaching aids for Mathematics"*

Poor perception by Mathematics teachers Perceptions

Perception by Mathematics teachers has a huge bearing on the success of a Mathematics lesson. A right attitude towards the usage of teaching aids as conduit for easy understanding of concepts is vital for a successful lesson

> "*Most teachers think it's impossible to teach Mathematics using the laboratory method, they see it as something impossible. Some teachers and pupils think that Mathematics is subject involving abstract solving and cannot be modelled into practical real-life experiences and they are stuck by textbook"*

Lack of innovative skills among teachers

The researcher also wanted to find out whether the teachers of Mathematics possess innovative skills. This is an essential element in ensuring that the Mathematics Laboratory Method is utilized in the absence proper Mathematical teaching aids

4.0 Discussion

4.1 The mathematics laboratory method enhances Grade 12 academic performance in Mathematics

The result showed that laboratory method has a significant effect on student performance and retention. After the treatment, the findings have shown that students in the experimental group had a higher post-test mean scores in transformation than the control group. This shows that there is significant difference between the two groups in terms of performance and retention scores. The study established that the Mathematics Laboratory Method accords the students with learning experience augmented with in depth examples from the surrounding

environment; students therefore had opportunities to be involved in concrete activities that promote the development of their performance and retention. As suggested by Radovan and Makovec (2015), students tend to be more successful in tasks when they turn to their cultural environment for clues. This finding is in agreement to the finding of Ugada et al. (2018) who argues that the teaching of mathematics with Mathematics Laboratory Method leads students to formation of constructs out of experience with concrete objects. Through the Mathematics Laboratory Method, the learning experience was related to the student's environment and this stimulated their interest and morale to engage in the relevant tasks resulted in developing their performance.

The Mathematics Laboratory Method has also contributed to its comparative efficacy in its activity-oriented nature. Activity oriented learning aids comprehension and retention of information as noted by Ajewole et al. (2021) that learners participate actively in lessons through laboratory experiments, and answering question and also the opportunities to explore, explain and elaborate their views hence, advance the deep comprehension of the subject by the student. The findings from this study therefore indicate that teaching transformation by the use of Mathematics Laboratory Method can enhance performance and retention of transformation among senior secondary school students.

4.2 Challenges of Establishing Mathematics Laboratory

The result of the study revealed that only the mathematics laboratory method was only used to a very low extent in the targeted schools. The average responses from David Kaunda secondary school showed that the facilities were available at a low extent. This result is in similarity with the findings of Abasi (2018) which showed that students were of the opinion that there are poorly available mathematics laboratory kits for teaching and learning of mathematics. Also, Okigbo and Osuafor (2008) who stated that there are inadequate material for teaching and learning of Science subjects in public secondary school in Nigeria

Secondary school teachers were found to be unaware of how to use the math lab to get the intended results, according to the study. Instructors agreed on the importance of the math laboratory and its necessity in the school, with teachers from schools where the laboratory was not available recommending that the laboratory be established so that it could be used and benefited from its components. These results are consistent with the study of Maschietto and Trouche (2010) who argue teachers' barriers are largely physical, i.e., a lack of equipment and geometrical tools that allow teachers to use them in laboratory activities. Maschietto and Trouche (2010) further a few mathematics laboratory facilities were used for educational reasons. The average response indicated that the facilities were underutilized. Further investigation revealed that students' views on the use of mathematics laboratory facilities for instructional objectives in secondary schools were gender agnostic.

Other obstacles revealed by the teacher interviews included a lack of materials and equipment to carry out practical approaches in mathematics. Simultaneously, it's likely that some of these goods and equipment are locked away in the school laboratory store without the teachers' knowledge. Even when they are aware that these materials are available, the conditions in which many teachers work do not inspire excitement for using the laboratory method of teaching mathematics.

The findings of the study exposed that the Mathematics Laboratories to the schools were not adequate to meet the growing demand for Mathematics practical. The findings of this study are in agreement with the findings of Milton and Ohira (2016) who stated that due to a shortage of laboratories, teaching mathematics in schools has been difficult. Teaching mathematics must focus on the development of an individual's analytical, critical observation, and problem-solving skills, as well as their creativity. The lack of apparatus in the Mathematics Laboratory, as well as their insufficiency, meant that scientific teaching was done in large part, albeit ineffectively (Maschietto & Trouche, 2010).

The study's findings revealed that the mathematics laboratory equipment was of poor quality. This was deduced from the respondents' assessment of quality of mathematics laboratories available in their schools. However, a sizable percentage of respondents did not see any difference between the negative and positive elements of these laboratories for them to used as the major tool for practical activities in science and mathematics. The findings are amplified by the MOE (2016) that's indicates that the National Science Centre started making Mathematics Laboratories and other low-cost teaching and learning aids and materials, as well as delivering in-service teacher training. The mathematics laboratories have been designed to allow students to move from one classroom to another with ease both inside and outside, but not on rough surfaces. This meant that, unlike conversional labs, the quality of the labs really wasn't durable. In the absence of built ones, the Laboratories were created as a way to introduce practicality. It was for this reason why they were not durable. Findings of the study are supported by Vos (2007) who indicates for efficient science and mathematics teaching or learning, the learning environment of the students must be considered, which should be tailored to the lesson by assembling the necessary equipment on time. He goes on to say that in order for learning to be effective, it must be consistent, not just with the Mathematics and Technology Curriculum, but also with the various components of mathematics taught in the classroom. The findings indicated that if the above-mentioned difficulties were addressed, the effectiveness of the mathematics labs may be improved. Due to malfunctioning wheels and a lack of apparatuses, the math labs were ineffective in providing the requisite mobility to the mathematics class when it was needed.

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5.0 Conclusion

On the first objective, the study found that students who were taught in a mathematics laboratory did better than those taught with the traditional method. According to the findings, the laboratory teaching technique provides students with a learning experience that is enhanced by in-depth examples from the environment, allowing them to participate in real activities that help them improve their performance and retention. This is true because having a mathematics laboratory in the classroom allows leaners to learn and internalize basic mathematical ideas, which has the overall benefit of improved student achievement.

On the second objective, according to the findings of the study, the unavailability of mathematics laboratory facilities and their use for instructional reasons are both poor. This means that secondary schools in the Lusaka district face the difficulty of a lack of mathematics facilities and inadequate pedagogical use of those that are available. Teachers with higher qualifications were also shown to be more proficient in teaching mathematics practicals in labs than teachers with lesser qualifications. Secondary school teachers were found to be ignorant of how to use the mathematics laboratory to get the intended results, according to the study. As the teachers of the school where the mathematics laboratories were

established, they agreed on the value of the mathematics laboratory and its usefulness in the school.

Ethical Approval and Consent:

Kombo and Tromp (2006) argue that ethical considerations should include things like obtaining full informed consent from any subject used in the study, explaining the research to the respondents ahead of time, ensuring that all subjects participate voluntarily, maintaining confidentiality at all times, and taking all reasonable measures to protect subjects physically and psychologically. Before administering the pre-tests, pupils were adequately informed on the study's aims and contents. The participants were also told what was expected of them and why they were obliged to participate. The consent form was then given to each consenting participant to complete. This was done to ensure that people took part voluntarily and without fear of being coerced. Furthermore, participants' responses were not interfered with or contested by the researcher during the research, and all respondents were treated equally. Anonymity and participant protection were preserved thanks to the ethical consideration process. The participants' anonymity was ensured by not requesting their names. Before each set of data collection, the respondents were additionally assured that the information would be used solely for academic purposes.

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