



By the Numbers: A Strategy in Teaching/Learning Mathematics.

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Abstract

This research study, titled By the Numbers: A Strategy in Teaching/Learning Mathematics, sought to investigate the efficacy of the “By the Numbers” instructional strategy in enhancing mathematics teaching and learning among primary school children. The study aimed to determine whether the “By the Numbers” strategy for teaching and learning mathematics would increase understanding of mathematical concepts, raise classroom engagement, and, subsequently, improve general academic achievement in mathematics among primary school pupils. A quantitative research method was used.

The sample consisted of primary school pupils and data was collected through classroom test, observations and other data-gathering tools used in the research to determine pupil’s mathematical performance prior and post implementation of “By the Numbers” strategy.

Data collected was analyzed using descriptive statistical procedures to determine any shift in the student achievement and engagement. Result from the study indicated that “By the Numbers” strategy helps pupils increase their understanding of mathematical concepts, have a greater confidence in solving mathematical problems, and actively engaged in their classroom math lessons. Consequently, it has the potential to be a valuable tool for effective mathematics teaching and learning practices in the primary school classroom. Recommendation from the study stated that teachers ought to include the “By the Numbers” instructional strategy in their everyday mathematics classes and provide professional development and training so as to help them implement this method with ease and success.

It also recommended that this particular topic can be further researched with larger samples, in diverse populations so as to be able to further affirm the results of the current study.

Keywords: Mathematics Education, Instructional Strategies, Primary Education, Mathematics achievement, Teaching and Learning.

Chapter One: Introduction and Background

1.0 Introduction

This chapter contains information regarding the area relevant to the study conducted, including problem statement, objective of the study and



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importance of the study. It outlines assumptions and limitations of the study, definition of terms used by the subject matter of the study and relevant questions required to be answered. It is anticipated that the hypotheses listed below are validated by the study thereby enabling initiation of the mental and practical change necessary to improve performance. Mathematics play a vital role in cognitive development of a child, and they form the basis of our everyday decision, reasoning, and problem-solving process.

In view of the vital role it plays, most primary school children find it difficult to grasp simple concepts and, in the process, it is viewed by pupils as being either hard or unappealing. This problem is posing a threat to the primary school children in the Central Corentyne area especially grade two, since the pupils find it difficult to comprehend simple topics which comprise numbers ordering, counting and geometrical reasoning. The study then proceeds by illustrating how rewarding learning is to enhance pupils' academic performance and develop children's way of viewing the topic.

1.1: Title of Study

By the Numbers: A Strategy in Teaching/Learning Mathematics.

1.2 Background of Study

Experiential learning is one of the newest trends in the teaching world. It is a hands-on, goal-oriented approach, the defining characteristic of which is that it is based on acquiring new skills and using them in real-life situations. As a more precise definition puts it, "that includes a method of learning that incorporates the hands-on execution of existing knowledge. "Although the name of the pedagogical technique, hands-on teaching, is self-explanatory, throughout training, children or pupils work with their hands to build models of real objects, carry out experiments, analyze different topics, and use experience to validate or disprove their hypotheses, rather than learning theoretical content.

In other words, students learn within the constraints of this system by finishing

assignments or finding solutions to problems. It not only draws the attention of pupils and makes learning more exciting, but it also aids in better assimilation of new knowledge, increased motivation, and increased productivity from employees. Finland has set itself apart as a world leader in STEM education, as many countries around the world struggle to keep up with the fast pace of technological change. It is a successful approach because of its multidisciplinary approach, its use of technology, and its experiential learning methods. Finnish STEM programs are unlike traditional educational settings in that they emphasize individual learning, creativity, and practical application, thus providing students with problem-solving skills that can be used in the real world. (Finland's STEM Education: A Model for International Excellence, 2025)

(Lectera, 2024)

This has proven that one of the most practical means to improve mathematics teaching in Jamaica is through firsthand investigation. These kinds of tasks allow pupils to engage in investigative exercises, raising learners' interest and deepening their understanding of mathematical concepts, and providing scope for differentiation as well as a good, likely assignment. Young children with very limited intellectual knowledge and problem-solving skills find it easier to use equipment such as the algebraic tile and problem-solving strategies. In Jamaican mathematics classrooms, every time these are used, the pupils reveal that they understand all about arithmetic, along with a good knowledge of 7 out of 17 math terms. These marks reflect the relevance of including firsthand learning in mathematics classes to bring about a higher performance in pupils and overcome all the tasks mathematics is involved with, at the primary level. (Cochrane, 2024).

Objective reasoning, research thinking, and problem-solving skills are greatly fostered by the study of mathematics. Mathematics is very relevant in the primary level curriculum and provides a basis on which many other subjects are

learned, such as science, technology, etc. Nevertheless, the relevance of learning mathematics continues to be a problem in primary level schools in Guyana, specifically the Central Corentyne area; ideas sap their spirit and make the work poor in presentation. Most teachers complained that pupils cannot understand the theory,

While the class teacher was brooding, arrangements were such that in mathematics, teaching emphasis was often placed on rote memorization and repetition, leaving limited scope for analysis and investigation. This teacher-centered process to classify skills instead of processes implies that pupils become docile learners who struggle to apply learned ideas to new contexts. Many pupils have difficulty with grasping the abstract thinking required to move seamlessly through subsequent stages of mathematics as indicated in the investigation.

With a focus on more current educational research, students can make things more concrete and comprehensible by actively experimenting with materials, researching concepts and conducting experiential study. Students will develop understanding and retention by visualizing the relationships among the numbers and processes by experimenting with manipulatives like counters, blocks, measurement activities and authentic applications. Besides accommodating the different learners in the classroom, manipulative methods have the potential to foster reasoning, collaboration, and changing attitudes in the children.

While few teachers in Guyana have begun to implement manipulative methods in their mathematics curriculum, the widespread, consistent implementation and evaluation of hands-on teaching strategies are limited, especially in the lower primary levels. Due to a lack of resources, training in manipulatives, or exposure to lead strategies, many of the schools in the Central Corentyne area continue to use the lecture/whole group instruction model.

Considering these examples, we need to find out whether the use of experiential learning activities

affects how children and their learning outcomes turn out in mathematics. Therefore, the objective of this study is to investigate how mathematics can be effectively taught to grade 2 pupils in four selected primary schools in Central Corentyne through hands-on learning activities. With the findings, we can find out whether this idea can serve as a practical measure for improving math performance, intellect, and interest level among primary students.

1.3 Statement of Problem

This study aims to investigate the effectiveness of hands-on learning activities in teaching mathematics to primary school pupils in the Central Corentyne Cluster. Mathematics pass rates in primary schools have been low/average pass rates; some pupils are having difficulties reasoning and comprehending basic concepts in the papers, many pupils are now seeing mathematics as a boring subject and not a fun area and lose focus quickly in the classroom while the teachers are teaching. These are some of the main issues that are encountered by the subject today. Therefore, because of these issues, research will be carried out to investigate the effectiveness of hands-on learning activities in mathematics in the primary schools to promote the use of hands-on learning during lessons to create a better attitude towards the subject, so that the pass rate will increase.

1.4 Purpose of the Study

This study aims to:

This study examines how experiential learning can be incorporated in primary mathematics and aims to improve young learners' conceptual understanding of mathematics concepts. This will involve Grade Two children from four selected schools in the Central Corentyne area. The ultimate purpose of this study will be to determine whether integrating experiential and activity-based learning in mathematics classes for young learners can effectively increase their conceptual understanding, enjoyment of mathematics, and performance by engaging them in hands-on, real-world activities. It will aim to deepen students'

understanding of concepts and foster positive attitudes. The effects of experiential learning on students' attitudes, skills in thinking critically and classroom engagement will also be evaluated. The study will further seek to determine the educational outcomes of using both the traditional teaching methodology and the student-centered learning methodology. Using a qualitative and quantitative approach for data collection, this study aims to highlight how these approaches can contribute to increased enjoyment, relevance and accessibility of mathematics for children. Recommendations will be made to educators, administrators, and curriculum developers for the effective incorporation of experiential teaching approaches in mathematics classes.

1.5 Research Questions

1. What impact do hands-on learning activities have on pupils' interest and behavior in learning mathematics at the primary level?
2. How effective are hands-on learning activities in enhancing performance and understanding of mathematics in primary schools?
3. How do teachers in the Central Corentyne Cluster currently use hands-on learning techniques in the delivery of mathematics?
4. What are some challenges teachers do face in incorporating hands-on learning in mathematics lessons?
5. To what extent do hands-on learning activities help pupils to reason, apply and comprehend mathematics concepts?

1.6 Significance of Research

The research was beneficial because it highlighted the need to incorporate hands-on experience into the teaching and learning of mathematics in primary schools. Involving active experience helps students better comprehend mathematical principles and makes the learning experience enjoyable and relevant to the learner.

Students engaged in activities that linked math concepts to the real world, thus improving their understanding and memorization of the crucial information. Apart from these, students were

provided with information to educators to make teaching strategies better so as to improve student experience and learning.

Teachers could use findings as a resource to provide help for educators as they refine their teaching techniques and methods. Curriculum developers, educational leaders also had this research to use to support the refinement of teaching techniques and provide teachers with essential tools to further develop professionally.

The research aimed to ultimately raise student success in mathematics, along with students' interest and confidence.

1.7 Assumption of the Study

This study is based on the following assumptions:

- They were enthusiastic, ready to participate in and learn mathematics through practical experience.
- The participating teachers of the study also were able to successfully employ experiential learning approaches, as was envisaged.
- Appropriate materials and resources were used for experiments/tasks conducted by pupils in Grade 2.
- Learners' understanding and achievement were based largely on the use of experiential learning methods.
- An appropriate amount of support was available in the educational context to help carry out the study.

1.8 Limitations of the Study

The following factors limit this study:

Four schools only were included in the study, in Central Corentyne so results may not be representative of all primary schools in Guyana.

Only Grade Two students were part of this study so the results may not be transferable to other grade levels.

The performance of the program may have been affected by the hardware and the resources available for hands-on activities.

Time might not have allowed for all or a great deal of lessons or activities within the school term.

Different levels of teaching skills, training and expertise may have caused differences in results among the different schools.

1.9 Operational Definition of Terms

Accomplishment

An accomplishment is an achievement, especially a notable one, resulting from skill, effort, or courage.

Getting to this agreement so quickly was a major accomplishment. (Achievement Definition and Significance | Collins English Dictionary, n.d.)

Effectiveness is a Latin-based word that means something like “the ability to produce an outcome”. Academic Achievement

Academic achievement is determined by grade point average, standardized test scores, educational aspirations, and achievements. These factors are a reflection of student achievement and attitudes toward education, such as motivation to attend and enjoyment of school. (Academic Achievement - a Summary | ScienceDirect Topics, 2012)

Experiential Method

An experiential learning method is a process-oriented method that centers around students' meaningful experiences in an activity (activity-based learning). It is a constructivist theory in that it maintains that through the experiences, senses, and feelings, one gains an increased knowledge through participative teaching methods where students are included in the learning process and have an opportunity to apply the knowledge they obtain in practical application. It is not passive like traditional teaching. (Singh,2024)

Improve To enhance or add to the value, beauty, quality, attractiveness, or desirability of.

Chapter Two: Review of Literature

2.0 Introduction

This chapter gives a comprehensive review of the literature that applies to the study being conducted; specifically, the effectiveness of the

use of experiential learning activities in teaching second-grade students Mathematics within the Central Corentyne area. The literature review highlights the use of various instructional practices, research, and theories that support the use of experiential learning activities for mathematics teaching, and it highlights their effect on the students' understanding of mathematics, the students' motivation, and the students' achievement. The literature review has been structured into themes that represent the variables of the study, namely, the theoretical basis of experiential learning, the importance of mathematics in the development of intellect, and the effect of hands-on teaching methods on students' motivation and academic performance. Furthermore, it also reviews studies conducted both locally and internationally, identifying the similarities, differences, and voids that the current study will aim to address. With references from the literature, this chapter aims to establish a theoretical ground for the study. It aims to bring forward how experiential learning, which is learner-centered, has the power to turn teaching of Mathematics into an inquisitive activity instead of a rote one, and how it fosters the ability to reason, to problem-solve and improve students' achievement in the long run.

2.1- The Theoretical Nature of the Importance of Hands-on Learning in Teaching Mathematics at the Grade 2 Level.

The concept of hands-on or experiential learning in the field of mathematics education is based on several theories in education that stress the active role of students in the construction of knowledge.

These theories stress the importance of giving learners relevant, practical experiences that relate abstract mathematical concepts to real-world understanding at the Grade Two level, when children are still developing their cognitive, social, and problem-solving abilities.

The basic theory of experiential learning is described in Kolb's book, *Experiential Learning* (1984). Kolb states that there are four stages in learning: active experimentation, abstract

conceptualization, reflective observation, and concrete experience.

In the area of mathematics this means that students will learn best when they are able to handle objects, see results, think about what they have done and use their knowledge in a variety of situations. Instead of just rote remembering formulas or strategies, this method helps students to build a more compassionate and modified understanding of mathematical concepts.

Similarly, the constructivist theory by Jean Piaget (1952) supports the idea that children develop their own understanding through their experiences. Piaget argued that young learners go through different developmental stages where the concrete operational stage is typical at the primary level. At this stage, children have better understanding when they see and manipulate objects, use manipulatives, and actively participate in. Therefore, empirical learning is consistent with the developmental readiness of children, allowing them to understand mathematical concepts such as number operations, dimension, and geometry through practical experiences.

Jerome Bruner's theory of discovery learning (1961) highlights the role of student engagement in math learning. Bruner (1966) claimed that learning the principles themselves develops firmer cognitive schemata that help retention and transfer of concepts over a long period. Hands-on math activities such as the measurement of room objects or classification of shapes are interesting and foster such a kind of discovery, with its resultant interest and creativity. Also, Vygotsky's Sociocultural theory (1978) focuses on the importance of social interaction and cooperation in the educational process. Vygotsky suggested that learning takes place in the Zone of Proximal Development (ZPD), which is the difference between what the learner can do with the help of adults or more capable peers and what the learner can do alone. Hands-on math learning activities create opportunities for cooperative, dialogical, and teamwork with other learners and teachers who scaffold their understanding and develop their learning processes.

At the Grade Two level, these theories are combined to teach educators that young children are learning most efficiently when they are being involved and challenged by learning, as it supports and develops learning from many angles. Learning opportunities such as the use of number cubes, measurement tools, shapes, or the construction of simple graphs give the children an opportunity to make connections with the symbols and operations of mathematics and reality. They have found that using math in this practical and experiential way enhances their knowledge and recall of mathematical concepts and makes them more excited to learn more, as the experience itself makes it fun.

In conclusion, to apply this concept of young children constructing their own knowledge, instead of simply being taught it, into the classroom, which has been introduced into the theoretical basics of experiential learning by implementing these theories; students' surveys, inquiry and mastery will be developed and encourage gifted analytical thinkers to begin at a young age.

2.2-The Impact of the Absence of Hands-on Learning in Mathematics on Pupils.

Lack of experience in learning mathematics has enormous impacts on students' cognitive development, motivation, and academic achievement. Lack of opportunities to learn math through practical, experimental means transforms math into abstract, difficult to understand, and unrelated to the real world. The absence of hands-on activities and experience-based learning has been identified across the national, state, and local levels, where traditional, teacher-centered teaching practices are utilized in classrooms, which prevents children from understanding concepts. At the national level, most educational systems tend to still be more focused on teaching procedures rather than using problem-based, inquiry-based learning. Students are having trouble grasping basic ideas of geometry, place value, and measurement through word problems and the teacher's explanation. Research has indicated that the lack of practical engagement

leads to low achievement rates and negative attitudes towards mathematics among young learners (Cochrane, 2024)

In the absence of instruments, authentic experience, and hands-on opportunities to explore or play, students find it difficult to make the connection between mathematical theory and practice, critical thinking, problem solving, and creativity – all of which are necessary for tertiary education-while modern workforce trainees are deprived of them through these non-participatory activities. Several Caribbean countries still experience similar problems with math education at the regional level. In countries like Jamaica, Trinidad and Tobago, and Barbados, standardized test results show that students often do poorly on basic numeracy and problem-solving tasks. Researchers attribute this phenomenon to a lack of integrated experiential learning at the classroom level; teachers use rigid, test-oriented strategies (Cochrane, 2024), and students often sit and listen rather than actively participate in the learning process. This lack of hands-on opportunity has fostered a perspective that mathematics is hard and unattractive, thus leading to low achievement. The experiences of countries that have integrated experiential learning have proven that learner-centered methodologies like Finland's approach to education have successfully enhanced student performance in mathematics. Finnish students learn mathematics through games, problem-solving activities, and a practical application method, rather than memorization alone. Through this interactive learning, Finnish students were able to develop an understanding and visualize mathematical concepts (STEM Education: A Model for International Excellence, 2025). Consequently, Finnish students are known for scoring highest in student satisfaction and mathematics on the international exams (PISA) (OECD, 2023). Therefore, the interactive approach to learning mathematics can truly change students' views towards the daunting subject and turn it into an activity for a lifetime.

Added to this is the increase in lack of resources, untrained instructors, and access to instructional materials. Without participation in these

experiential methods, many students lack a sense of space, numbers, logic, and problem-solving, which will benefit them as they move into future classroom environments. Also, when instructors just lecture, it is so hard to get students to really buy in or understand the subject matter. Mathematics is a subject where many students fall far behind both on classroom tests and national tests.

In conclusion, without hands-on learning in mathematics, students can never fully achieve cognitive and emotional engagement with the subject no matter where in the world they may be. Rote learning might be facilitated with traditional instruction, but it is no match for authentic comprehension or enthusiasm for mathematics. Based on the example of successful nations such as Finland, experiential learning is indeed able to produce confident, competent, and enthusiastic students. In this way, we can bring maths to the reach of all students in Guyana and the Caribbean by bridging the gap between theory and practice.

2.3 The Impact of Teachers' Pedagogical Knowledge on Hands-on learning activities in teaching Mathematics

Whether the activity is successful is largely dependent on the teacher. The teacher could be good due to teaching methodologies, theories, and classroom management skills, enabling students to experience activity. A teacher with pedagogical expertise can structure and guide lessons that will provide students opportunities to discover mathematical concepts through manipulation of concrete objects, observation of relationships, and problem solving. Teachers with a strong understanding of pedagogy can link students' everyday experiences to abstract mathematical concepts to understand why processes work instead of simply memorizing procedures. Use of concrete objects like counters or measuring tools helps in students' understanding of addition, subtraction, or measurement since they can see the concrete concepts, which can lead to more interest and a greater learning experience.

This goes with the theories of constructivism, which promotes hands-on learning and allows

students to construct their own mathematical understanding of relationships. Without adequate teaching skills, hands-on lessons can turn into nothing but playtime. A teacher's inability to facilitate exploration, ask guiding questions, or evaluate student thinking could impede learning objectives with hands-on activities. Shows that pedagogy-educated teachers would construct better, inclusive classrooms and students would show more interest, learning more. Therefore, teachers should be encouraged and given in-service education, which improves their knowledge of pedagogy, the teachers would be more confident to teach more active lessons, so make the math class more meaningful.

2.4 Reasons for pupils' negative attitude towards mathematics.

Most students end up feeling negatively about mathematics due to many factors including teaching methods, previous experiences and social attitudes toward the subject. Teaching styles are a cause as much attention is placed upon memorization rather than comprehension. Students perceive mathematics as boring and/or difficult when lessons focus on the rules and procedures rather than their relevance. According to McLeod (2025) children are most effective learners when teaching fits their cognitive level and allows them to construct knowledge through direct experience. Unfortunately, when instruction is not consistent with the students' mental abilities, especially in the concrete operational period where mathematics can be perceived as being abstract and confusing (Vygotsky 1978, 2019), social interaction and scaffolding play a major role in education. If students are not afforded opportunities to discuss mathematics, collaborate with others, or seek assistance within their zone of proximal development, they often come to fear mathematics and become anxious about the subject.

One other issue that contributes to negative mathematics attitudes includes environmental and affective factors, such as the fear of failure, attitudes of teachers, and parental pressure. According to Subramaniam (2025), humans learn

behavior and attitude by observing others. When teachers and/or parents display negative mathematics attitudes or exhibit math anxiety, students are likely to model their teacher's/parent's feelings toward mathematics, which, consequently, causes students to doubt their own ability to be successful. Constant experiences with failure, lack of feedback, and/or insufficient motivation cause students to have low self-efficacy regarding their mathematics abilities. If that weren't enough, negative emotions about mathematics are enhanced when teachers' classroom culture is more grades-oriented than learning-oriented. In order to overcome students' negative feelings towards mathematics, teachers should implement student-centered, constructivist approaches to build confidence and promote student exploration of the subject, connecting it to their own lives. By employing Piaget's and Vygotsky's constructivist theories and Bandura's social learning theory, teachers can help students shift their feelings toward mathematics from fear to curiosity and even pleasure.

2.5 The appropriate methodology in teaching mathematics at the grade 2 level

Teachers are to implement teaching strategies that are developmentally appropriate, taking into account Grade 2 students' preferred ways of learning when teaching mathematics. It is at this level of learning where concrete and physical manipulations are involved that the student would be at Piaget's functional pragmatic stage of cognitive development. Therefore, participation and the transition from the concrete to the abstract should be the two most useful teaching strategies. Teachers should begin by using concrete material such as counter chips, blocks, and beads, then transition into pictorial forms and eventually the concrete form. This strategy is best known as CPA (Concrete- Pictorial- Abstract) and helps the students to construct the mathematical ideas and concepts, not simply the process. Moreover, in discovery learning, teachers let children explore patterns and relationships by themselves but under the guidance of teachers will develop confidence inquiry and problem-solving skills as well as discovery activity. The use of co-operative and

student-centered teaching strategy where discussion reasoning and physical application occurs can be found in the social constructivism learning theory of Vygotsky (1978) that learning comes about through social interaction. Therefore, teachers should guide and foster interaction among children through paired activities or groupwork, through this they will be able to state their own idea, to construct and share it with others and build meaning together. Incorporating the use of game songs, stories and technologies will also help to make the learning process engaging. Through continuous monitoring on children's works such as observation inquiry and activities-based assessment teachers will be able to identify the child misconception.

Overall, effective mathematics instruction at Grade 2 should have a child being active-oriented and a construction-based approach to ensure that not only are students capable of completing mathematics operations but also understanding the underlying principles of why the operation is correct.

2.6 Summary

In this chapter, the study review was conducted by investigating previously conducted research on the effectiveness of experiential learning on second graders' learning of mathematics.

There was discussion of several influential learning theories that advocated experiential learning, like Vygotsky's Sociocultural Theory (1978), Bruner's Discovery Learning (1961), Piaget's Constructivist Theory (1952), and Kolb's Experiential Learning Theory (1984). Because all these theories argue that children learn best when they are allowed to be involved, to discover by themselves, and to work with others, complex mathematical knowledge was applied and taught using real-life situations.

The review also investigated the negative impact of not using experiential learning and discovered that when learning mathematics mainly takes place through teaching and rote learning, children lack conceptual understanding, interest, and mathematical abilities. A widely acknowledged

student-centered teaching approach of mathematics in Finland can illustrate the effectiveness of practical approaches in learning mathematics.

The chapter also points out the role of teachers' teaching skills in facilitating practical learning and creating meaningful learning opportunities.

Besides, there were analyses of factors contributing to students' negative attitudes toward mathematics, like anxiety, disinterest, and inappropriate teaching strategies.

Finally, the review showed that the CPA model, to learn by discovery and cooperative search strategies were effective methods for teaching mathematics to grade two pupils. In sum, it is evident from the literature that experiential learning can benefit students' conceptual understanding, attitudes toward learning mathematics, and overall math achievement at the early stage of their mathematical learning journey.

Chapter- Three Methodology

3.0 Introduction

This chapter presents the research design employed to assess the effectiveness of hands-on learning in teaching mathematics to Grade 2 pupils in four selected primary schools in the Center Corentyne area. The chapter examines key issues such as individual information, sample size, selection methodology, data collection instruments, research procedures and data processing methods. The methodology chosen is in keeping with the study's objective of assessing the impact of hands-on teaching methods on Grade 2 pupils' understanding of arithmetic, their attitudes, reasoning skills and overall achievement levels in mathematics. In addition, the method applied explains the purpose behind applying a mixed-method approach that would facilitate the collection of both qualitative and quantitative data, thereby enabling a well-rounded perspective on the effect of experiential learning in mathematics classrooms. All the procedures mentioned herein are aimed at achieving reliability, and the data collection instruments discussed aim to ensure reliability, accuracy, and

validity. All procedures were selected to help gather data that would reflect genuine and accurate results as observed by instructors and students from the identified primary schools. The ethics of the proposed study were also considered to ensure every individual is treated with dignity and all data collected remains confidential.

3.1 Methodology

The chosen methodology in this research was a mixed-methods approach, combining qualitative and quantitative methods. The purpose was to assess the impact of practical learning activities on improvements in mathematical knowledge among Grade 2 students in the four selected primary schools in the Central Corentyne area. The mixture of the method was chosen because the researcher found it gave an all-rounded view of how the use of practical in the classroom influences their attitude and behavior as well as their performance, enabling the statistical figures to be fleshed out by qualitative details and information. In support of the selected approach, theories used by researchers included, among others: Kolb's (1984) Experiential Learning Theory, which was applicable in describing students' learning style, that learning is acquired by experience, active experiment, and observation. The research explained the student learning on Kolb's cycle by using educational materials and problem-solving tasks for the grade 2 students, in which the children moved through the learning cycle. The research included the Constructivist Theory by Piaget (1952), which indicated that children in grade 2 are still on the concrete stage, so they learn by experience with learning materials. Piaget's learning constructivist principles were included in the formulation of the research because students in Grade 2 were primarily in the concrete stage; the concept of constructivism supports hands on-learning, because children learn through exploration. Vygotsky's (1978) sociocultural learning theory. This theory provided the basis for using interactive mathematics activities and learning, social learning through collaborative, guided activity or guided discovery was integral part of this research study.

In a quantitative approach, pre-tests and post-tests were used to measure the level of students' mathematical skills before and after the use of experiential methods, and data were collected that enabled researchers to evaluate whether hands-on exercises had a meaningful effect on students' levels of understanding, critical thinking skills, and use of math skills. In a qualitative approach, the study included teacher interviews, classroom observation, and student engagement checklists that provided researchers with insight into how students interacted with the materials, the learning process of teachers and students, and whether the planned learning activities assisted the students in the ways intended. The qualitative part of the study indicated that the way students interacted with their environment determined the direction of the learning and the general course of the students' development, which was consistent with the theories of constructivism. This was facilitated by the fact that this research study presented a framework not only of how actual teaching occurs, but also the ways in which the students were building mathematical understanding by embedding conceptual models within planned instruments for data collection. Overall, the research framework gave a reliable, valid, and thorough view for the assessment of experiential learning in the context of elementary mathematics teaching and learning.

3.2 Research Design

Thus, this study utilized mixed-method research in which qualitative and quantitative data were used simultaneously to explore the effectiveness of learning by doing in mathematics education. A structured questionnaire (which contained closed and open-ended questions) has been utilized as the main data collection instrument. Open-ended questions of the questionnaire have been designed to collect data regarding qualitative views and thoughts of the respondents while closed-ended questions have been planned for quantitative data collection. As described by Creswell (2014), mixed-method studies combine the trends and statistical analyses with narratives to develop more robust and valid findings. A survey design was a justified choice as Cohen, Manion, and

Morrison (2018) stated that a survey has the ability to collect accurate data from various participants about perceptions, attitudes, beliefs, and experiences. This choice of mixed method research in general and survey in particular has also been aligned with the Vygotsky's theory of social constructivism as the research investigated learning within the classroom which is perceived as the site of social learning and interaction between the teacher/facilitator and learners or peers within the context of the school and classroom environment. By collecting both quantitative data and qualitative narrations from teachers/educators it demonstrated that practical tasks could contribute towards improving students' learning process in real classroom context and at the end integrated these methods provide complete, valid, and comprehensive analysis of the topic in question.

3.3 Population

There were four main primary schools in Central Corentyne within which the population under study was found; 53 students and 3 teachers at Auchlyne Primary; 40 students and 2 teachers at Mc Gowan Primary; 24 students and 2 teachers at Alness Primary and 28 students and 2 teachers at Kildonan Primary. In all, the population comprised 145 students and 9 teachers. This population was chosen since it was assumed that students' learning is best explored within the social and instructional setting within which they find themselves. This would be consistent with Vygotsky's Social Constructivist Theory, which states that students learn from teachers, peers, and activities that entail instructions. Since the whole of the teaching staff and the number of students within each school were sampled, it would be more probable for the researcher to find differences between the classroom practices and the quantity of hands-on material available and support provided in each school. This sample would be a good mixture that would be diverse yet manageable for the researcher to identify how hands-on learning activities affected mathematical performance at these distinct schools.

3.4 Sample

The population for this study was composed of students and teachers at the four primary schools located within the Central Corentyne area. There were two categories of participants at this study: (a) students, (b) teachers as both entities comprised an essential component of learning.

All the grade two teachers were selected using purposive sampling, as they were involved in both teaching and learning of mathematics through practical activities. A sample of grade two students from each school was chosen using purposive sampling, because the group was responsible for the teaching and learning of mathematics through hands-on activities. Support for this approach to selection was obtained from Fraenkel and Wallen (2012, p. 99) who maintained that purposive sampling enables the researcher to purposefully select the best informants and most knowledgeable sources relevant to the study.

Seven teachers across the four schools and a sample of students from the four schools, whose learning could better illustrate the approach to learning being explored were used as the sample size for this study as supported by Vygotsky's Social Constructivist Theory which indicated that learning must be seen in the context of naturally occurring classroom and interpersonal settings, to facilitate effective analysis of this data collected to establish how students as well as teachers were involved in the learning process of grade two mathematics.

3.5 Instrumentation

The primary data collection tool for this research was a questionnaire designed to elicit both qualitative and quantitative data from the subjects. It had closed-ended questions that were used to gather numerical data concerning teachers' and students' attitudes toward hands-on activities; it had open-ended questions to gather descriptive information, opinions, and attitudes toward hands-on activities, implying that by this dual method, the researcher could evaluate the effects on performance outcomes along with attitudes,

difficulties, and pedagogical techniques related to hands-on math activities. The questionnaire approach was again justified by Cohen et al. (2018) because questionnaires are valid and effective ways to collect uniform information from large populations. Moreover, it supports Vygotsky's Theory of Social Constructivism (1978) with the idea that education can be seen as a mediated activity. Through use of hands-on materials, group projects, and realistic problem-solving tasks, teachers and students can share information based on their experience and deepen their understanding of the cognitive and social dimensions of learning through experience. This questionnaire was pilot tested at a comparable school to determine whether the questionnaire was clear, valid, and reliable before being administered to the actual research participants.

3.6 Validity

Some of the steps were put in place to validate the instruments; to be sure the instruments obtained the required information. This was confirmed by Fraenkel & Wallen (2012), who asserted that expert validation improves the instrument's suitability and appropriateness. The instruments were evaluated for content validity, where mathematicians and researchers in mathematics education assessed the survey instrument to make sure that all items of the survey were relevant to the study and that the items reflected the theory of experiential learning. The instrument was pilot tested with a small number of students and teachers who are members of a different school, but at the primary level and in the same conditions as the selected sample, to ensure clarity and comprehension of the items and that it is appropriate to be used to determine the outcome of the survey. Due to the results of the pilot study, some phrases and the arrangement of the questions were adjusted to make sure that all items of the survey can be easily read and comprehended by every respondent. It was also relevant to cite that Vygotsky's Social Constructivist Theory (1978) was the driving force in positioning the items in actual learning and social environments for the respondent to be tested. The assessment of instruments via expert

and pilot testing ensured that the instrument was fit for purpose for determining teachers' and students' perceptions, experiences and achievement in relation to hands-on learning activities in mathematics.

3.7 Reliability of the Instruments

The questionnaire's reliability was then assessed to ensure that similar samples of subjects under similar conditions would obtain similar and consistent measurements from the instrument. The questionnaire was pilot tested with a group of Grade Two pupils and their teachers who were not from the selected sample. Test-retest analysis on pilot testing, where the same questionnaire was administered twice to the same subjects with a two-week interval, followed by assessment using the two results, would determine the stability of the instrument over time. Finally, Cronbach's Alpha was computed on closed-ended items to measure the internal consistency of the items as a reliable measure of a common construct. Based on Fraenkel and Wallen's (2012) study on designing tests, Cronbach's Alpha coefficient above 0.70 signifies adequate reliability for instruments to be used in educational research. The reliability was strengthened by thoughtful construction, clarity in wording, and focus on the research question and the theoretical framework. Guaranteeing reliability of measurement assured that the measurement error in the data collected was minimal, therefore ensuring that interpretations of data were accurate about hands-on approach in learning mathematics.

3.8 Procedure of Data Collection

The procedure of collecting the data was a series of systematic steps to achieve validity, reliability, and completeness of the ethical investigation. Initially, permission was obtained from the authorities of the four selected primary schools in Central Corentyne, where the aim and objective of the study were explained, and their cooperation enlisted. When the permission was obtained, the sample size for the study, which comprised grade two children and teachers, was enlightened on the study and permission was requested to include them, so that the children would be part of the

study on their own free will. The questionnaire was administered to the teachers, who then filled out the question-and-answer sections, both the closed and open-ended types of questions, where the researcher collected quantitative data from them on instruction practice and qualitative data on their hands-on learning experience. The instructions to the teachers for answering the question-and-answer sections were also clearly spelled out, and the teachers were allowed enough time for proper consideration of the questions to ensure and confirm the validity and reliability of the data obtained.

The questionnaires were personally collected from the teachers by the researcher to ensure that all the questions were thoroughly and truthfully answered by them. The answers were analyzed in an organized manner with quantitative data classified and presented in tables to be used for quantitative statistics, whereas qualitative data were grouped in similar themes. This has been considered to support the theory of Social Constructivism by Vygotsky (1978), whereby learning and teaching methodologies should be assessed in relation to their authentic social context and their actual pedagogical application.

3.9 Proposed Data Analysis

Consequently, quantitative and qualitative data obtained from questionnaires were evaluated and analyzed to attain the research objectives. Statistical analyses were applied to the quantitative data produced by closed questions, which were systematically recorded, coded, and entered statistical software. Teacher perceptions toward managing teaching methods for learning mathematics were quantified through descriptive statistics in percentages, frequency, and mean scores. Through the use of descriptive statistics, the researcher identified patterns, trends, and levels of agreement among respondents. Qualitative information generated by open questions was then analyzed by classifying, coding, and ordering subject information into novel categories that represented teachers' perceptions toward teaching practices, challenges,

and observations with regard to its implementation and effectiveness using a thematic approach.

To support the understanding of educational phenomena, Ishtiaq (2019) suggested that the quantitative statistics derived from questionnaires should be complemented with qualitative research findings. Furthermore, the analysis of results takes into consideration the role of Vygotsky's Social Constructivist Theory (1978), in which the significance of a deeper understanding on social and interactional components of the learning environment were highlighted.

The intention of the present study was to acquire an in-depth understanding regarding the impact of implementing teaching practices with reference to students' engagement, achievement in learning mathematics and learning environment.

Chapter- Four: Data Analysis

4.0 Introduction

This chapter deals with the collection and analysis of questionnaire data. In the Central Corentyne Cluster, nine (9) teachers from the primary school level participated, and one hundred forty-five (145) pupils from the primary school level participated in this investigation. Since only nine teachers were involved in this study, the pupils were also part of this investigation to obtain a wider aspect of the situation. The reason why the whole population of pupils, that is, 145 pupils were used, was to eliminate the possibility of error and make the result more representative.

The results are illustrated in tables and graphs such as bar graphs, line graphs, and pie charts. Each table and each graph are explained in relation to the research questions so that readers can understand what the results entail. The questions that are discussed here include the views and experiences of the participants towards the implementation of hands-on activities to teach and learn Mathematics, including the advantages and disadvantages.

4.1 Presentation of data and results of analysis. Teachers Questionnaire

Table 1: Table 1 shows the gender of teachers within the Central Corentyne Cluster that was interviewed. This gives an overall description of the demographic profile of the interviewees.

Responses	No. of respondents
Males	2
Females	7

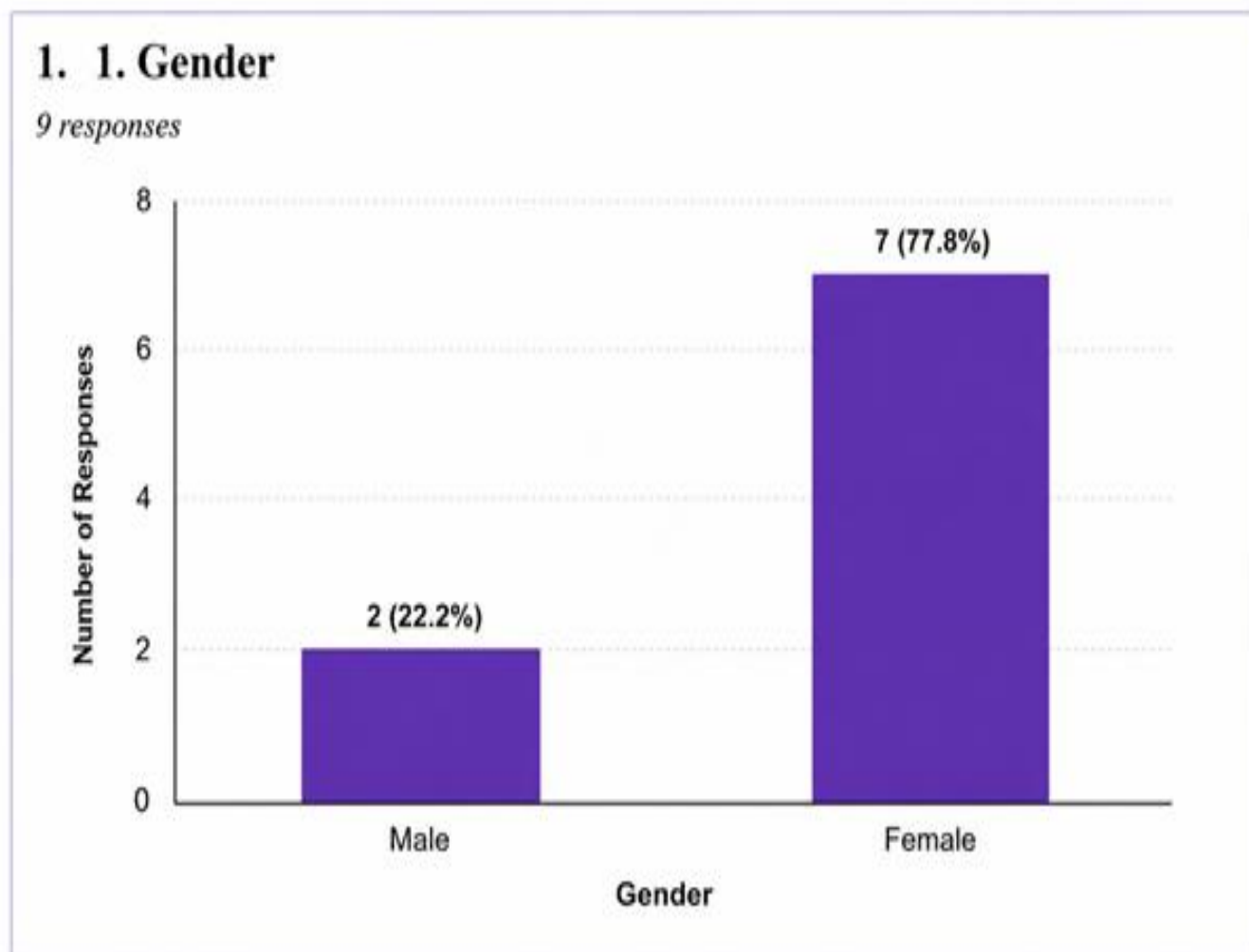
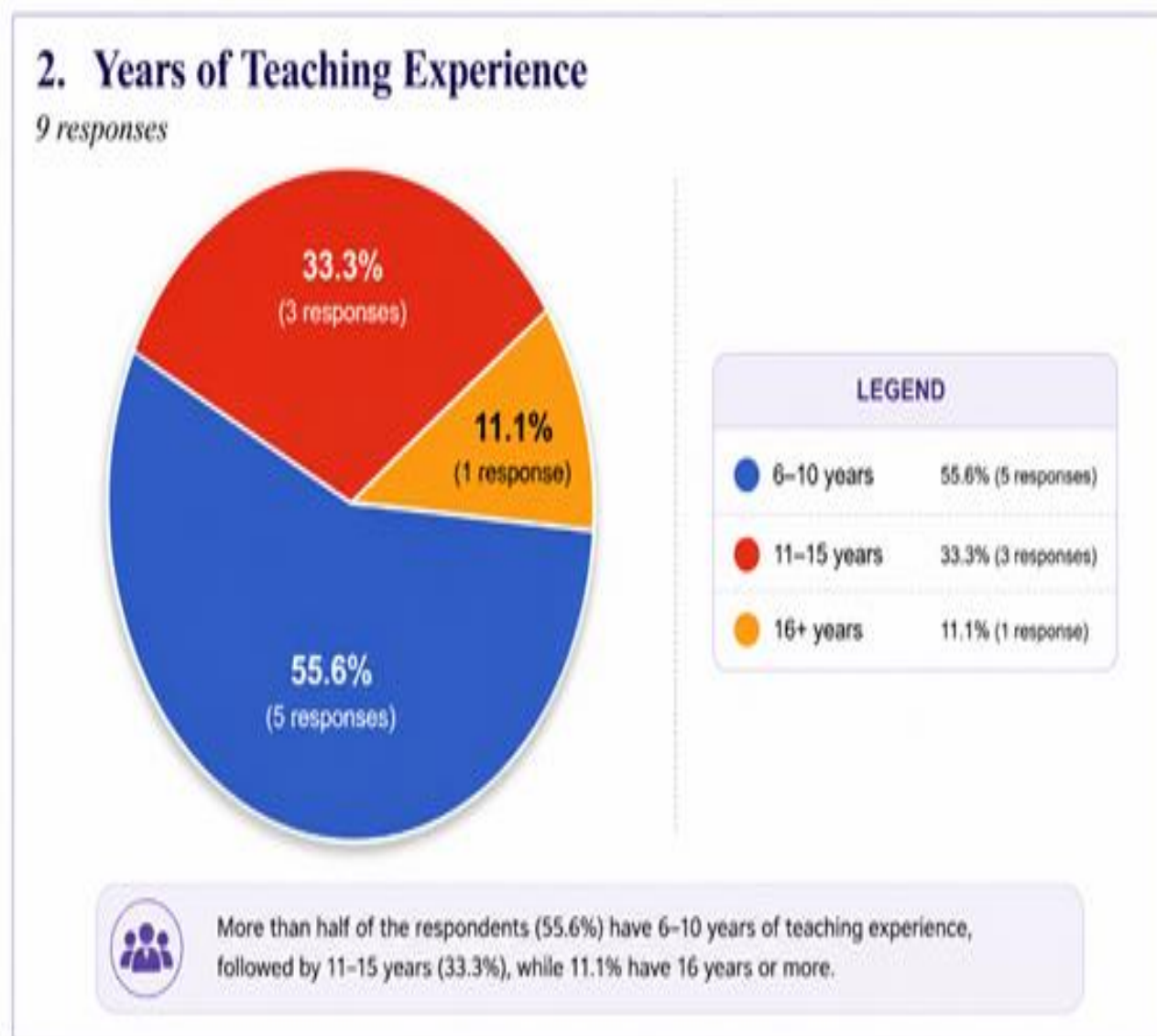


Figure 1 illustrates the gender distribution of teachers from the Central Corentyne Cluster who participated in the interview. It shows that 2 of the respondents were male (22.2%), while the majority, 7 respondents, were female (77.8%). This indicates that female teachers made up a larger proportion of the participants in this study. The visual representation helps to clearly compare the number of male and female respondents, making the data easy to understand.

As shown in **Table 2**, participants were sampled according to their years of teaching experience. Knowing this gives the reader an idea of how experienced the teacher sample is.

Responses	No. of respondents
6-10	5
11-15	3
16 +	1

Figure 2 indicates how many teachers are in each level of teaching experience. The large group of 5 teachers (55.6%) has 6-10 years of teaching experience. Following is 3 teachers (33.3%) with 11-15 years' experience. The small groups of only 1 teacher (11.1%) have 16+ years of experience. Most of the teachers fall into the mid-range of teaching experience.



The distribution of qualified the teachers in terms of professional qualifications is shown in **Table 3**. It shows how educated or academically teachers involved in the study are.

Responses	No. of respondents
Certificate	1
Diploma	1
Bachelor's degree in education	6
Other	1



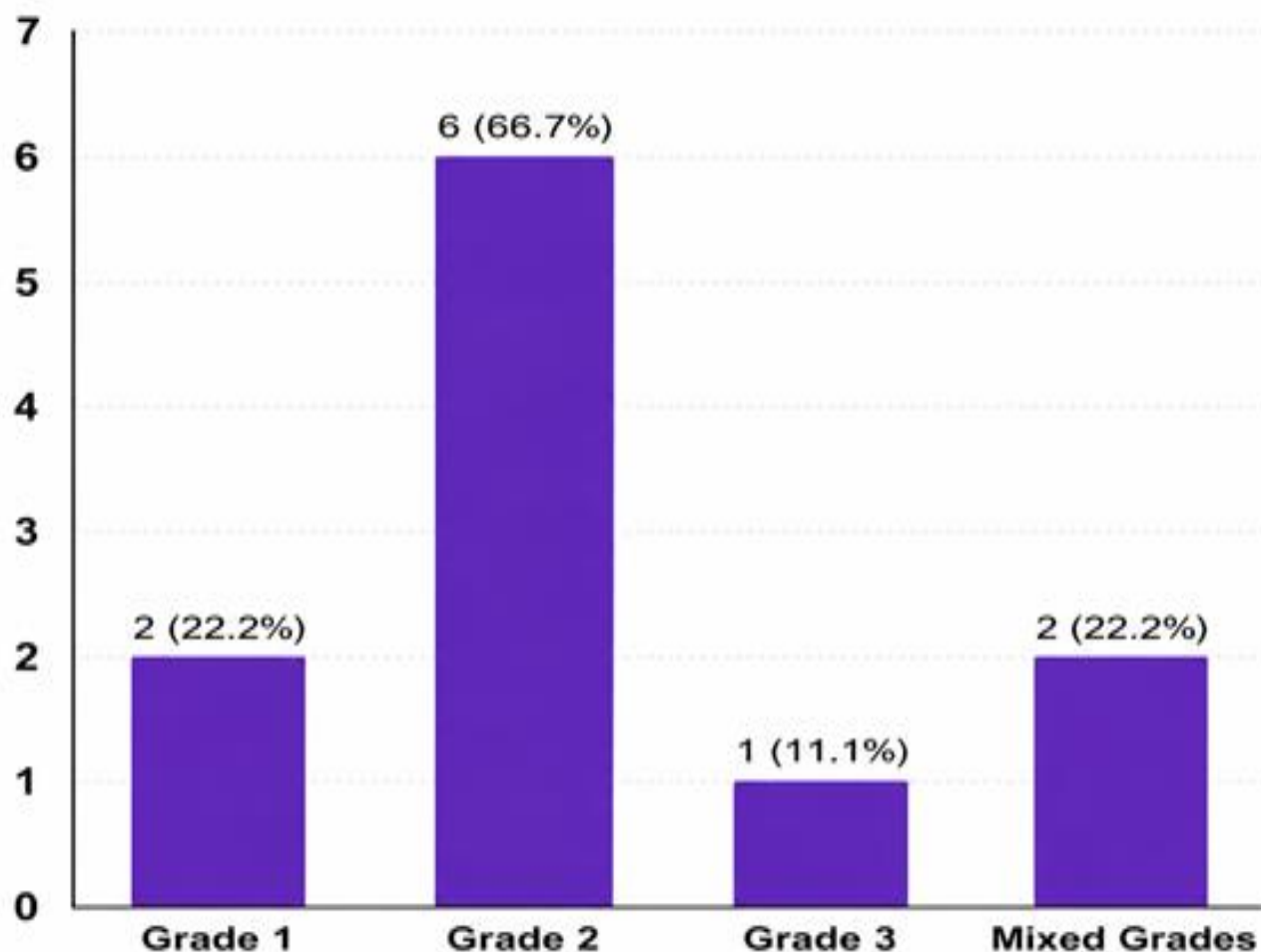
Figure 3 shows the qualifications of the teachers who responded to the questionnaires. 6 teachers (66.7%) have bachelor's degrees in education, and only one (11.1%) has a Certificate, 22.2% of teachers have a Diploma, and other qualifications. Most teachers have qualifications to degree level. This makes learning more effective in the Grade 2 classrooms, particularly in mathematics.

Table 4 provides a breakdown of which grade levels the teachers are teaching.

Responses	No. of respondents
Grade 1	2
Grade 2	6
Grade 3	1
Mixed grades	2

Grade Level Taught

9 responses



The figure above is a bar graph depicting the number of teachers according to the grades they teach. It appears that 6 (54.6%) teachers teach Grade 2, while 2 of them (18.2%) teach Grade 1, 1 teacher (9.1%) teaches Grade 3, and 2 teachers (18.2%) teach mixed grades. So, most of the respondents seem to teach Grade 2.

Table 5 shows the number of teachers that have attended training on the use of hands-on teaching of Mathematics. The number of teachers attending such training will be indicative of the level of training that participants have undergone and how this might reflect in their use of hands-on teaching approach.

Responses	No. of respondents
Yes	5
No	4

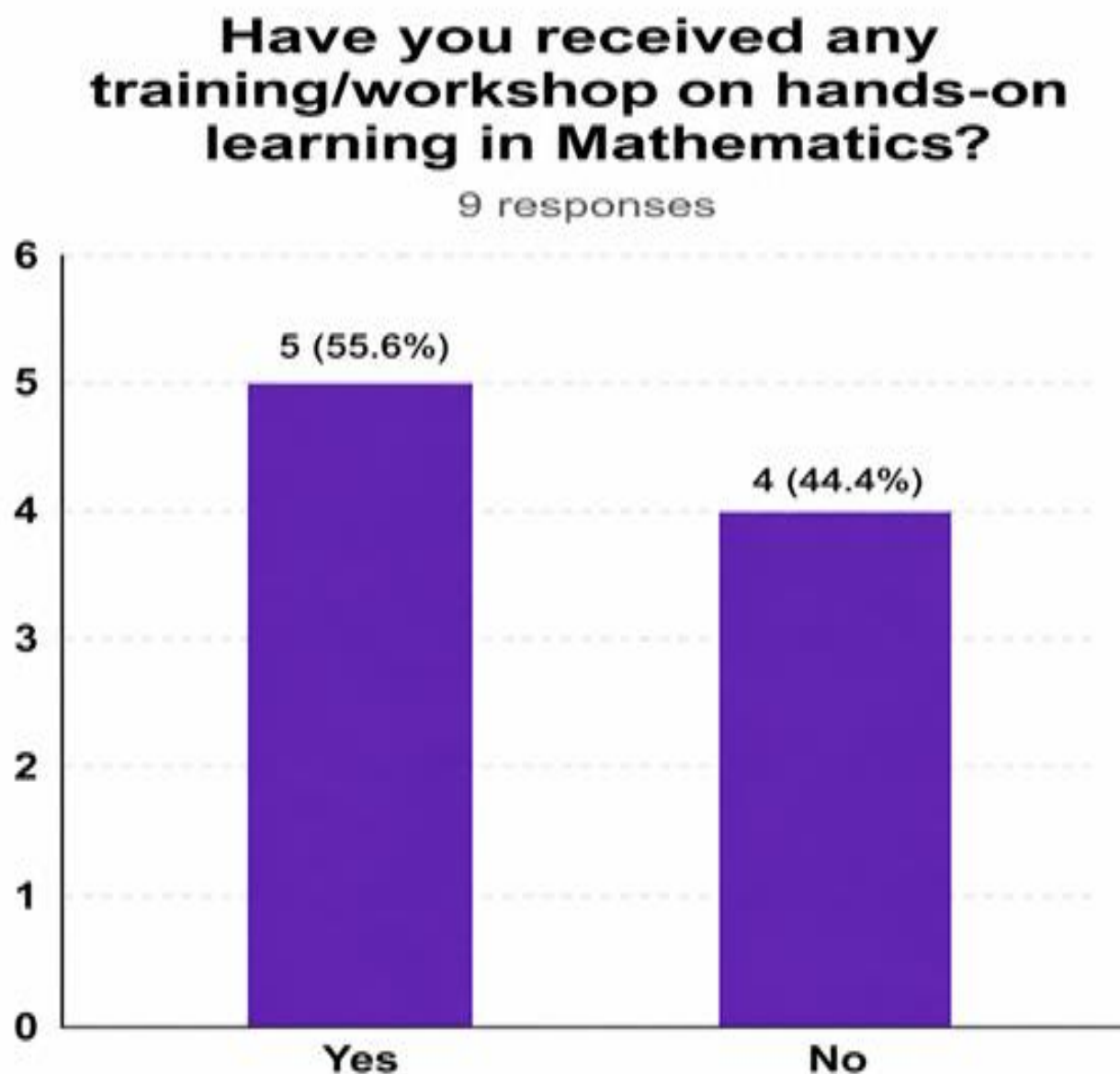


Figure 5: The bar graph shows how the respondents answered this question. We can see that 5 teachers (55.6%) answered "Yes", and 4 teachers (44.4%) answered "No". This means there were more teachers who had the answer as yes than no, so a slight variation between answers, and the bar graph is easy to compare with a little less difference between the two, and the responses were close to the same numbers.

Table 6 illustrates the teachers' reaction to the proposition that hands-on activities improve pupils' interest in Mathematics.

Responses	No. of respondents
Strongly Disagree	0
Disagree	0
Strongly Agree	7
Agree	2

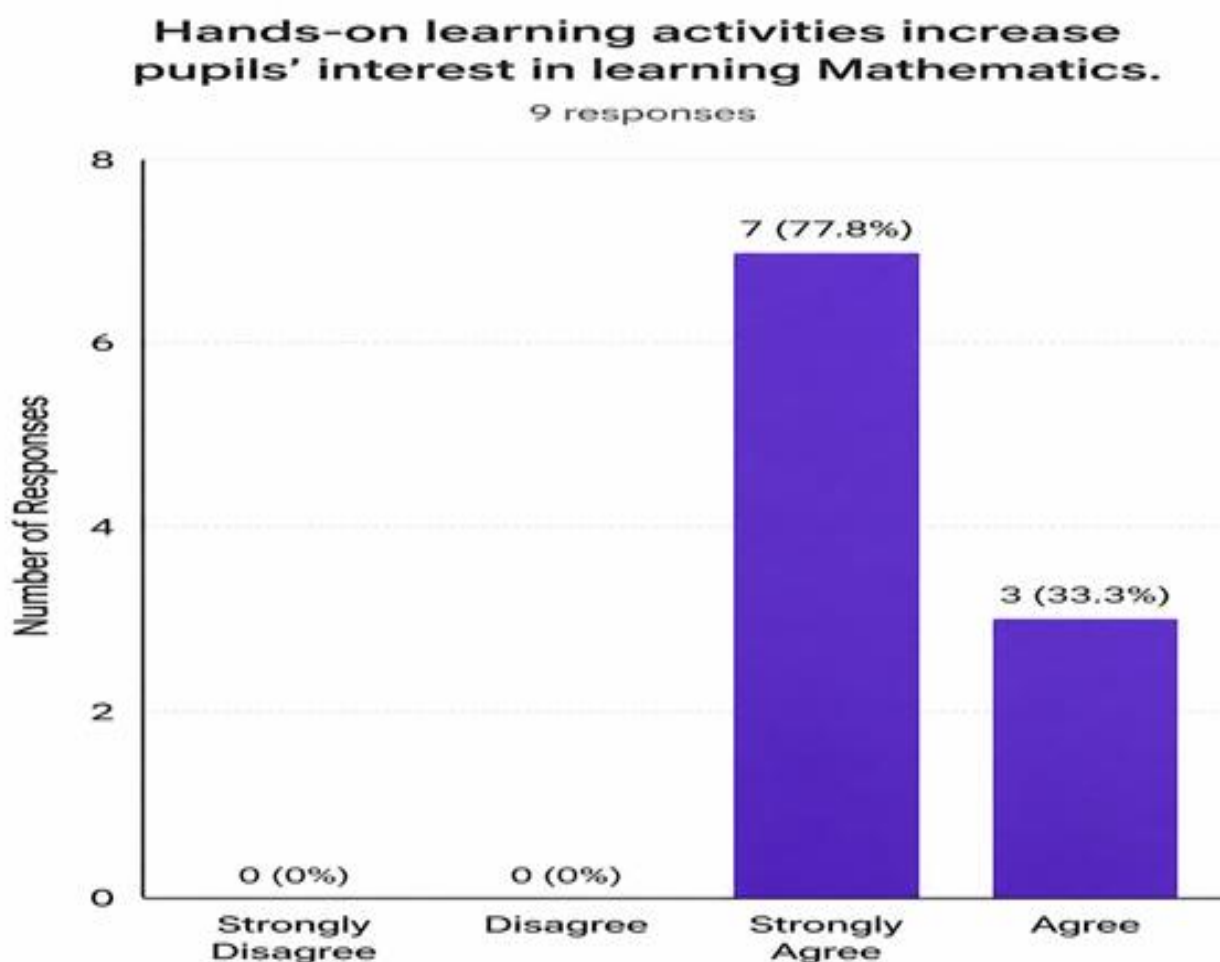


Figure 6 shows a bar graph of the teachers' responses to the statement that hands-on activities enhance pupils' interest in learning Mathematics. None of the respondents chose 'Disagree' or 'Strongly Disagree', whereas seven respondents (77.8%) chose 'Strongly Agree' and two (22.2%) chose 'Agree'. All the teachers agreed with the statement. Most teachers felt strongly that this was the case.

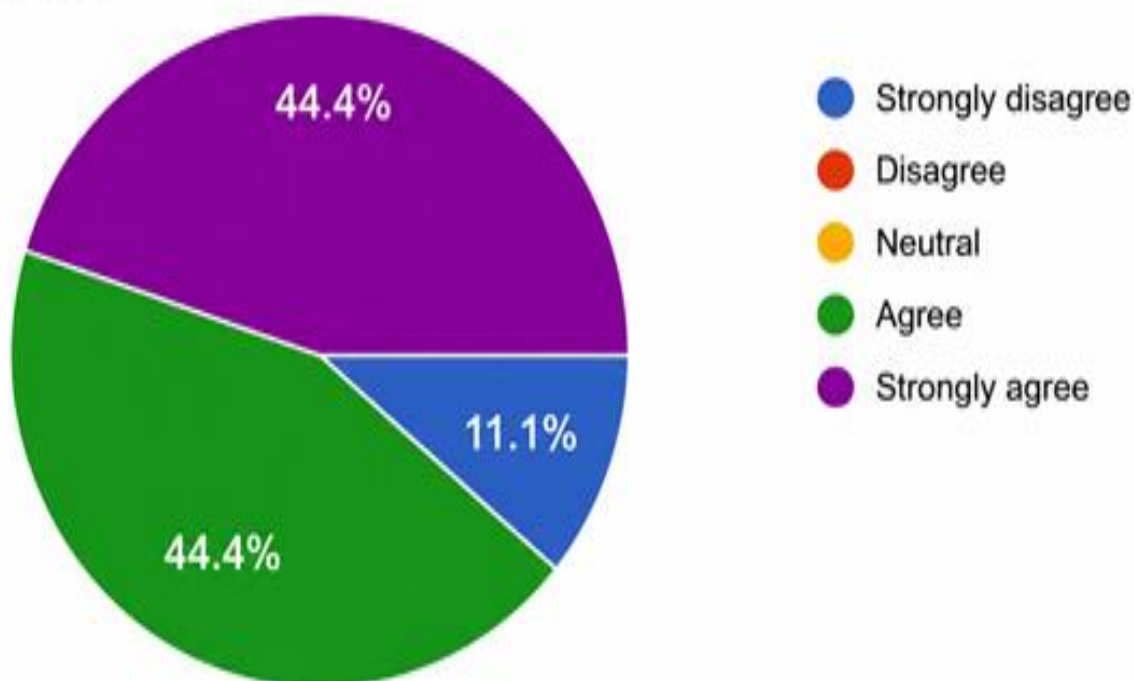
This demonstrates that teachers firmly believe in the use of hands-on activities to promote pupils' interest in Mathematics. The high proportion of teachers who answered 'Strongly Agree' suggests that they have observed student interest and participation increase with hands-on activities.

Table 7 shows the opinions held by teachers regarding the following statement: "Children exhibit better behavior and greater engagement when hands-on activities are used within mathematics lessons". This table serves as an indication of teachers' perceptions of the effect of hands-on activities on both classroom control and pupil engagement.

Responses	No. of respondents
Strongly Disagree	1
Disagree	0
Strongly Agree	4
Agree	4
Neutral	0

Pupils show better behaviour and participation when hands-on activities are used in Mathematics lessons.

9 responses



This pie chart in **Figure 7** represents the attitudes of the teachers toward whether they believed pupils behaved better and participated more during hands-on Mathematics lesson activities. This graph shows that 1 teacher (11.1%) has been asked 'Strongly Disagree', no teachers answered 'Disagree', 4 teachers (44.4%) answered, 'Strongly Agree', 4 teachers (44.4%) answered 'Agree', and 0 teachers answered 'Neutral'. From these results, the large percentage of teachers surveyed agreed that pupils behaved better and participated more, and the number who strongly agree is equal to the number who agree. One teacher however disagreed which represents the other part of the graph as a very small proportion of those surveyed did not feel this was the case. This suggests that most teachers feel that pupils' behavior and participation are better during hands-on activities. The fact that 4 teachers both strongly agree and agree shows there is a significant portion of those teachers surveyed who thought it was best and did think it benefited children.

Table 8 reports on teacher opinions regarding whether Mathematics lessons become more enjoyable for students through hands-on activities. This provides useful insight into how participants believed these strategies impact student enjoyment of mathematics lessons.

Responses	No. of respondents
Strongly Disagree	2
Disagree	0
Strongly Agree	5
Agree	2

Hands-on activities make Mathematics lessons more enjoyable for pupils.

9 responses

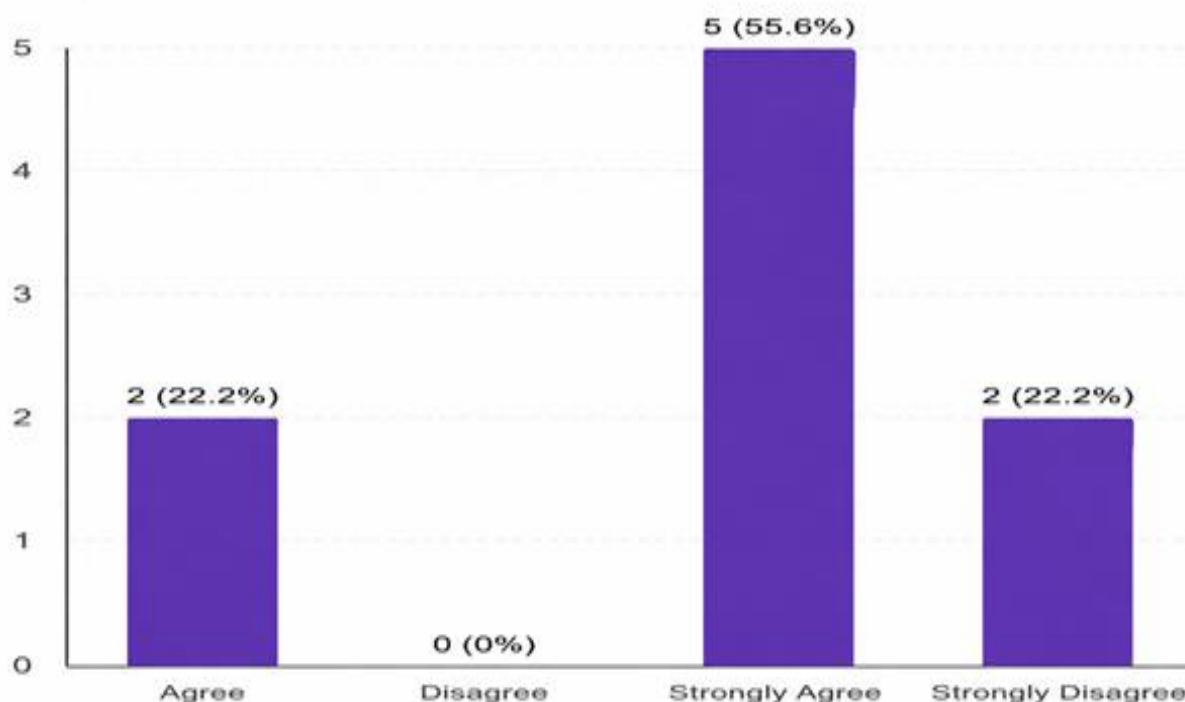


Figure 8 bar graph illustrates whether teachers feel that hands-on activities make Mathematics lessons fun for the pupils. It shows that two teachers (22.2%) 'Strongly Disagree' on the statement, and that 0 teachers (0%) 'Disagree' on the statement. However, 5 teachers (55.6%) agree with the statement on 'Strongly Agree,' and 2 teachers (22.2%) agree on 'Agree' on the statement. Most of the teachers agree and have strong feelings on whether this statement holds true; there are 2 teachers who feel otherwise about the statement, which is represented as 'Strongly Disagree'. These results indicate that teachers agree that hands-on activities help to make Mathematics lessons fun and engaging for the pupils. Many teachers strongly agree with the use of hands-on activities, and this is because it makes learning interesting and engaging. However, there are still 2 teachers who disagree; possibly they have other experience, or the classroom environment is not conducive to using such an activity. But overall, the bar graph shows that teachers feel it is a valuable method for pupils' enjoyment and engagement in mathematics.

Teachers' perceptions of the statement "Pupils learn the concepts of Mathematics best through hands-on activities" are revealed in **Table 9**. This demonstrates teachers' opinions on the efficacy of hands-on activities for learning concepts.

Responses	No. of respondents
Strongly Disagree	0
Disagree	0
Strongly Agree	6
Agree	2
Neutral	1

Pupils understand Mathematics concepts better when hands-on learning activities are used.

9 responses

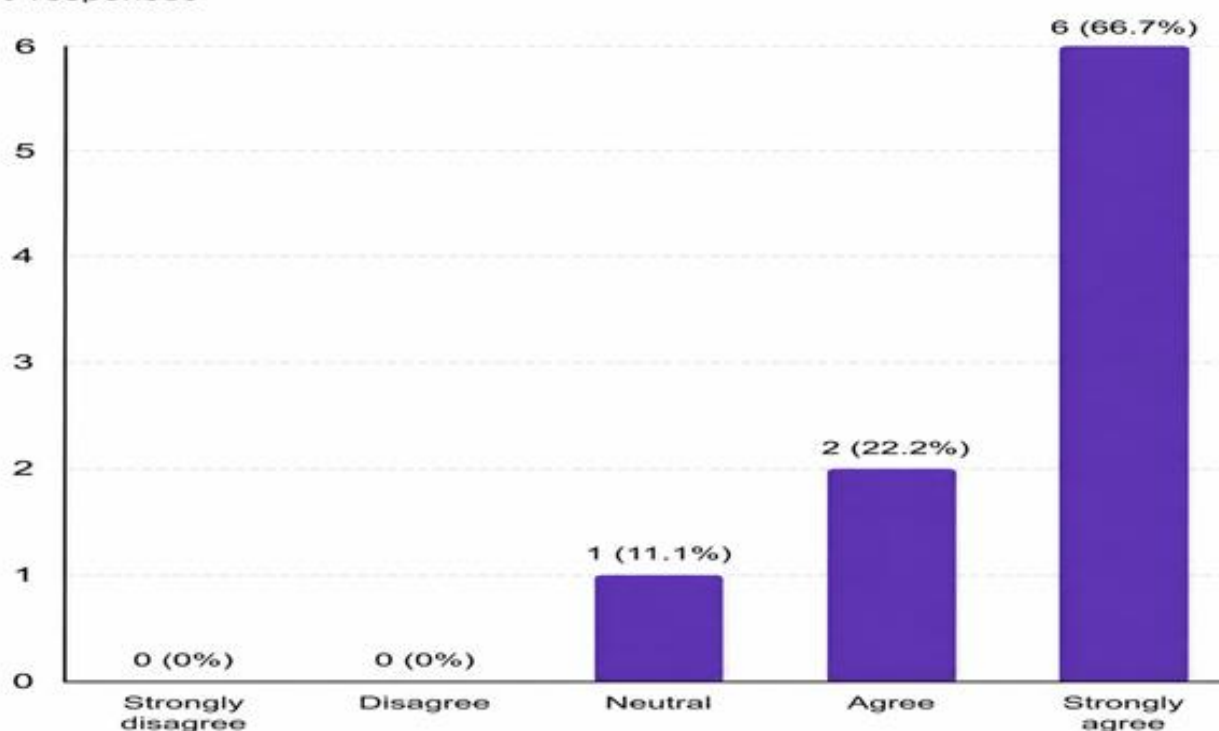


Figure 9 shows a bar graph of teachers' opinions of whether pupils grasp Mathematics concepts well with the aid of hands-on learning activities. None of the teachers that responded said "Strongly disagree" (0) or "Disagree" (0). "Strongly agree" had six responses (66.7%) and "Agree" had two (22.2%), with one "Neutral" response (11.1%). Therefore, the teachers that responded have generally positive feelings towards the statements, with most of the responses saying, "Strongly agree" with "agree" and "neutral" being in the minority.

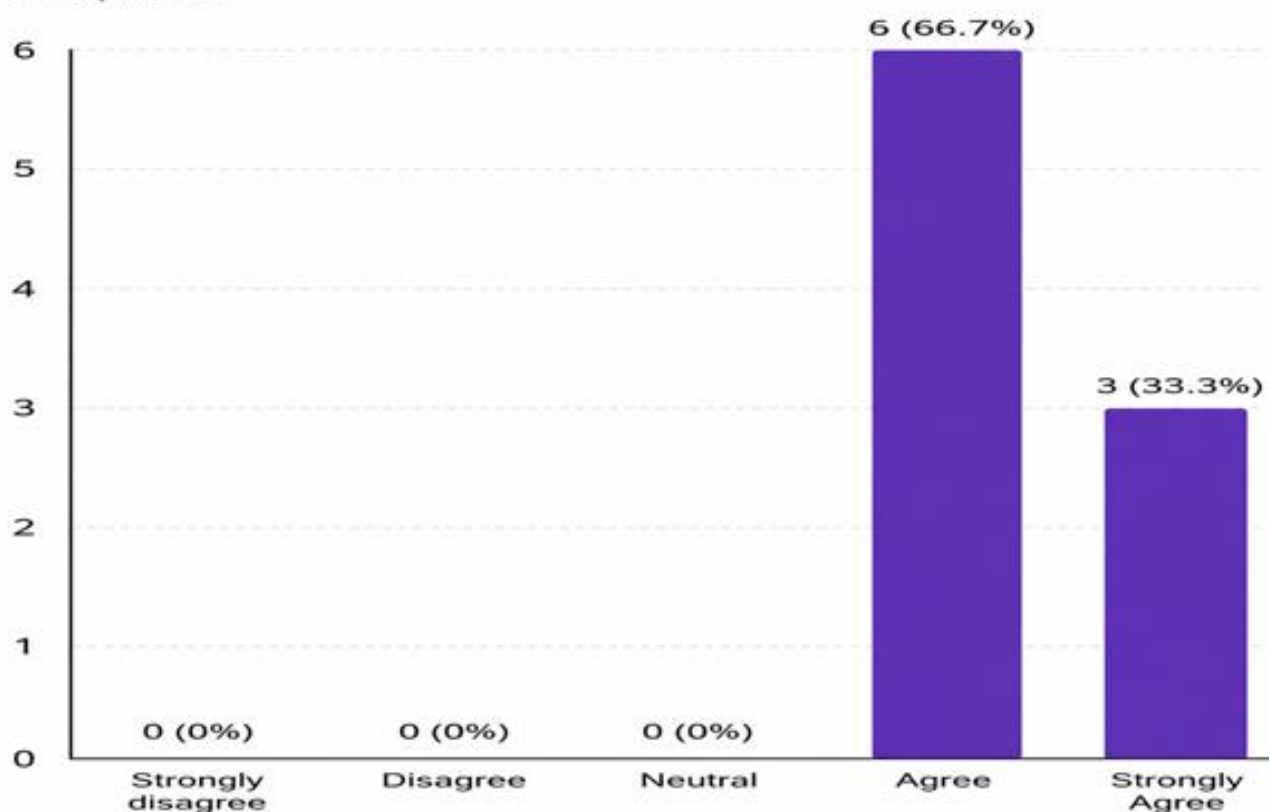
The implications of these results are that most teachers feel that hands-on learning is a successful method for helping pupils understand mathematical concepts. The many "Strongly agree" responses indicate teachers' confidence with the practical aspects of learning as effective. The "Agree" and "Neutral" responses perhaps shows that teachers feel it depends on the activity itself and the pupils' ability to take on the new ideas.

The perception of teachers about the statement: pupils can reason and explain their reasoning more effectively when there are manipulatives in the mathematics classroom is illustrated in **Table 10**. This shows teachers' perspectives on how a hands-on approach facilitates pupils to develop skills of reasoning and communication.

Responses	No. of respondents
Strongly Disagree	0
Disagree	0
Strongly Agree	6
Agree	3
Neutral	0

Hands-on learning activities help pupils to apply what they learn in Mathematics

9 responses



The bar graph above illustrates the teachers' perception of the effectiveness of using hands-on activities in applying Mathematics knowledge by the pupils. In this bar graph, it was noted that there was no response under "Strongly Disagree" (0%) or "Disagree" (0%), but there were three (33.3%) in the "Strongly Agree" and six (66.7%) in the "Agree" response, respectively. Neutral response was recorded as 0 (0%). All teachers agree on the application of mathematical knowledge learned by doing activities. These results showed that teachers strongly believe that hands-on activities were influential in enabling students to apply mathematics concepts. High percentages of strong agreement suggest teachers' high confidence in the effectiveness of hands-on activities for enabling students to apply mathematical concepts. Also, a high percentage of agreement implies the teacher also agrees with the statement. This bar graph indicates that hands-on activities were identified as an effective learning tool for the students.

In table 11, teachers' responses to the statement "Using hands on resources allows pupils to reason and communicate better" are provided. This can inform understanding of teacher perceptions of the role of hands-on resources in enabling pupils to develop the reasoning and communication skills within Mathematics.

Responses	No. of respondents
Strongly Disagree	1
Disagree	0
Strongly Agree	3
Agree	5
Neutral	0

Pupils are better able to reason and explain their thinking when hands-on materials are used.

9 responses

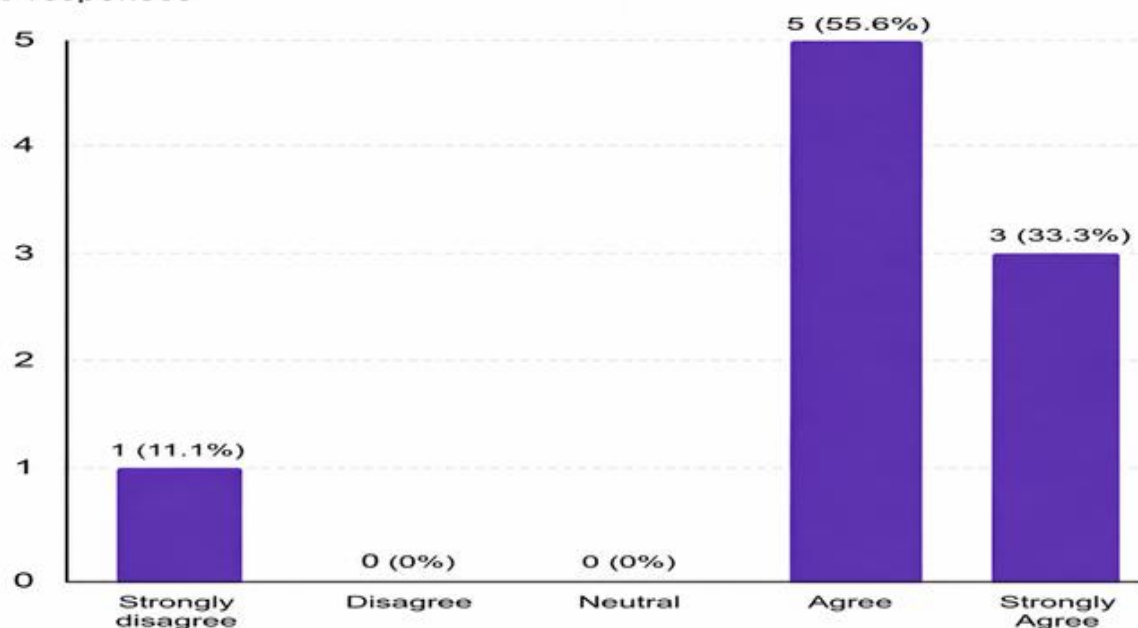


Figure 11 shows teachers' opinions on whether pupils' abilities to reason and explain were better using hands-on materials. The results shown are 1 (11.1%) for 'Strongly disagree', 0 (0%) for 'Disagree', 3 (33.3%) for 'Strongly agree', 5 (55.6%) for 'Agree', and 0 (0%) for 'Neutral'. The overall feel is that the responses are largely positive. This means that, for the most part, teachers agree that using hands-on materials aids pupils' reasoning and ability to communicate their answers.

These results could imply that hands-on activities generally appear to be beneficial when it comes to promoting pupils' higher-order thinking, their ability to reason and explain their solutions. The number of 'Agree' rather than 'Strongly agree' responses may mean that while teachers see the use of hands-on materials as being beneficial to a degree, some may feel that pupils' ability to explain may depend on a number of issues, such as the type of activity the pupils are doing, the different ability levels of pupils in the class or the level of support given by the teacher. There is only 1 'Strongly disagree' response indicating that hardly any teachers oppose the idea that pupils' abilities to reason and communicate are better when using hands-on materials.

Table 12 shows teacher's perceptions to the statement "Teachers always apply hands-on activities in teaching Mathematics". It describes the extent to which hands-on activities are utilized by teachers when teaching Mathematics.

Responses	No. of respondents
Strongly Disagree	1
Disagree	0
Strongly Agree	3
Agree	5
Neutral	0

I regularly use hands-on learning activities when teaching Mathematics.

9 responses

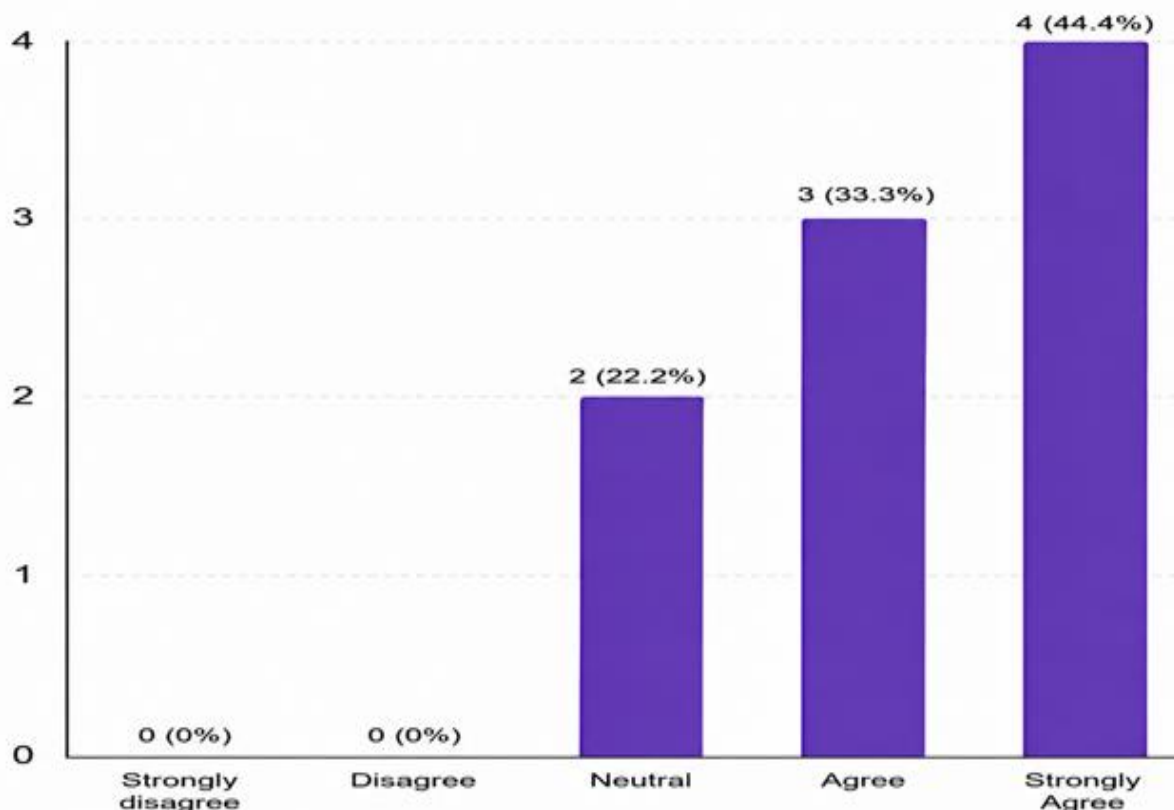


Figure 12 demonstrates teachers' responses regarding the use of hands-on activities when teaching Mathematics. With 1 teacher (11.1%) strongly disagreeing, 0 (0%) disagreeing, 3 (33.3%) strongly agreeing, 5 (55.6%) agreeing, and 0 (0%) neutral. This implies that most of the participants indicated using hands-on activities in the lessons that they teach for mathematics, with a slightly higher preference for agreeing to the statement. There were no neutral opinions recorded in this question. From this data, it could be inferred that the integration of hands-on learning activities into mathematics is being conducted by most of the teachers, although at varying levels. However, it could also be inferred that since the highest preference for responses is 'agree' rather than 'strongly agree', then perhaps whilst teachers do implement hands-on activities, this may not be consistent daily.

Table 13 discusses teacher perception of the assertion that 'I feel confident using physical manipulatives, blocks, counters, and number lines in my math class.' This tells us something about how confident and ready teachers feel when using hands-on instruction strategies in their classroom.

Responses	No. of respondents
Strongly Disagree	0
Disagree	0
Strongly Agree	5
Agree	3
Neutral	1

I feel confident using hands-on materials (counters, blocks, number lines, etc.) in my Mathematics lessons.

9 responses

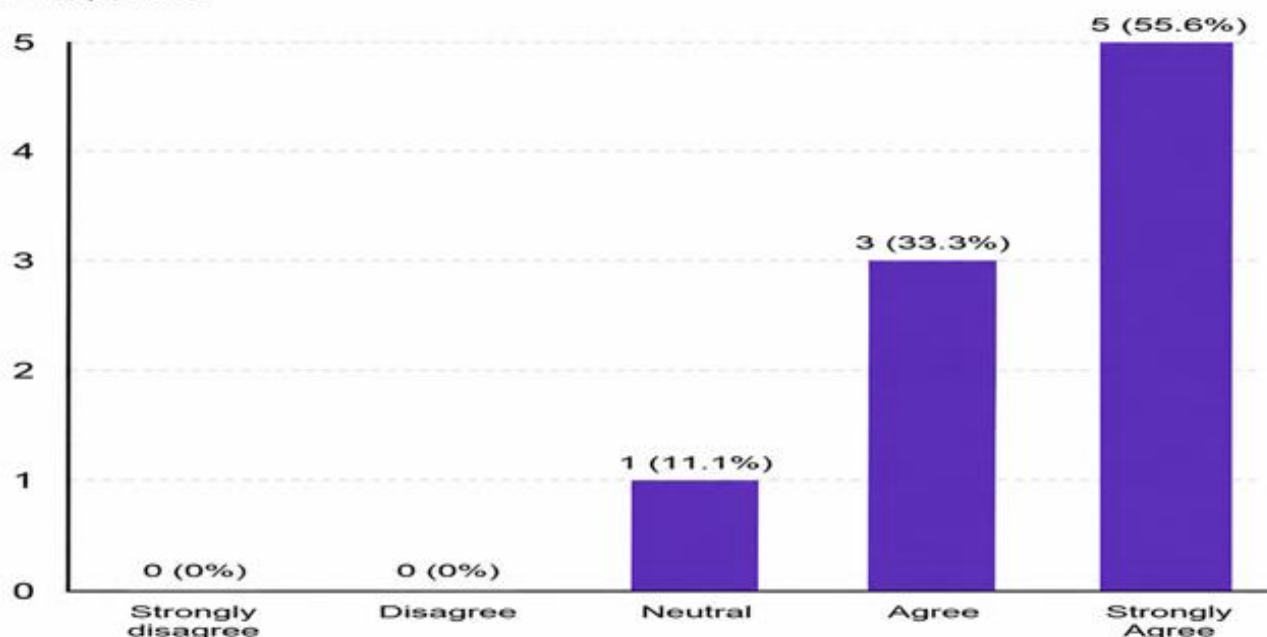


Table 13 gives a bar graph illustrating teacher opinion to "I feel confident using hands-on teaching resources such as counters, blocks and number lines when teaching Mathematics". The bar graphs for "Strongly Disagree" (0%) and "Disagree" (0%) contain no respondents, "Strongly Agree" shows 5 respondents (55.6%), "Agree" shows 3 respondents (33.3%), and "Neutral" shows 1 respondent (11.1%). From this information, most of the teachers stated they feel confident using hands-on resources, and most felt strongly confident about using them.

This information demonstrates that teachers seem to feel ready and prepared to use hands-on teaching resources in their Mathematics teaching. There seems to be a good level of confidence reported, and this could relate to having been taught to use and/or having experience using manipulatives for teaching children. There is only 1 teacher who feels "Neutral," and 3 teachers feel "Agree," but most have strongly agreed with the statement, and these small numbers may reflect those teachers require a certain amount of training or experience before they feel fully confident in using the resources.

Table 14 outlines the teachers' opinion on the statement "lack of learning resources and teaching materials make it hard to use hands-on activities in Mathematics lessons." This is used to find out how the teachers perceive the lack of resources as an obstacle to hands-on teaching.

Responses	No. of respondents
Strongly Disagree	0
Disagree	0
Strongly Agree	4
Agree	5
Neutral	0

Limited resources and materials make it difficult to use hands-on learning activities in Mathematics lessons.

9 responses

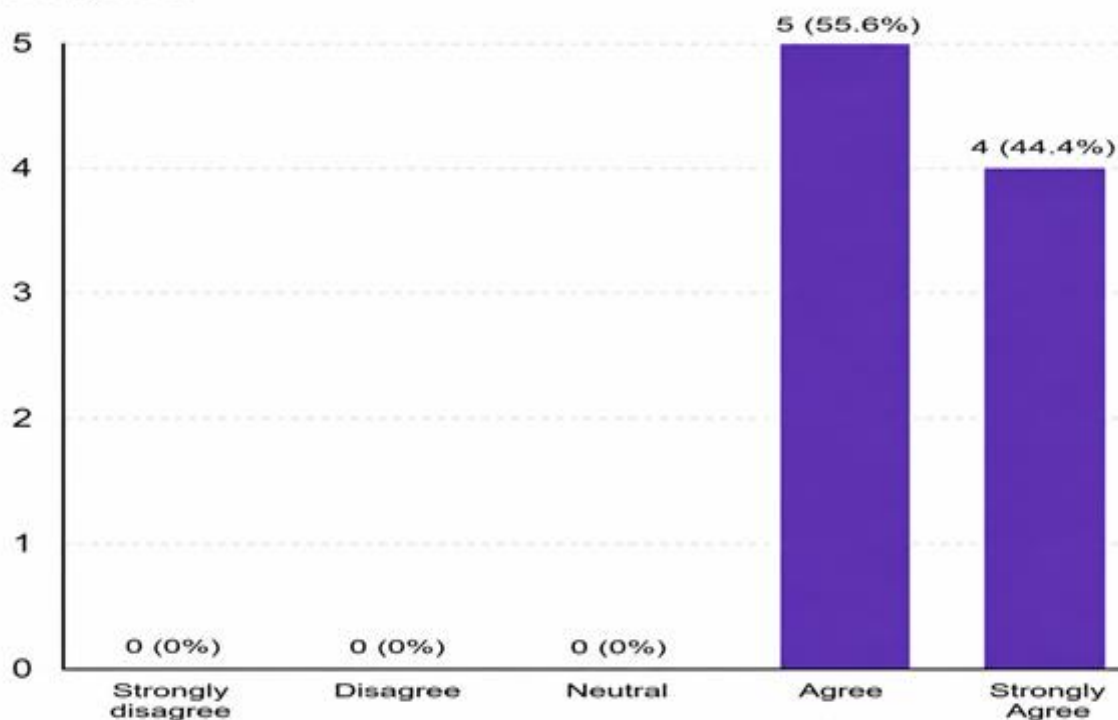


Figure 14 shows the views of teachers toward whether insufficient resources and materials restrict the use of hands-on activities in Mathematics lessons. All teachers said that they 'Strongly Agree' and 'Agree' with this statement, with 4 (44.4%) 'Strongly Agree' and 5 (55.6%) 'Agree'. No respondent chose to 'Strongly Disagree' or 'Disagree' and all chose a positive response. This proves that teachers see this as a barrier to the use of hands-on activities.

This would suggest that although teachers think that hands-on activities can be beneficial, their resources make it hard for them to be able to be using the hands-on activities within Mathematics. Most teachers agreed with the statement, so the main concerns were the lack of materials available for use. There were no negative responses in the survey at all for this part of the questionnaire which shows how much the teachers agree.

Table 15 shows the views of teachers regarding the statement that the time constraints and large classes make it difficult to incorporate hands-on activities into every Mathematics lesson. Through this, one may gauge teachers' perspectives on how the pressures of a classroom may restrict the implementation of hands-on learning.

Responses	No. of respondents
Strongly Disagree	0
Disagree	0
Strongly Agree	4
Agree	3
Neutral	2

Time constraints and large class sizes make it challenging to include hands-on activities in every Mathematics lesson.

9 responses

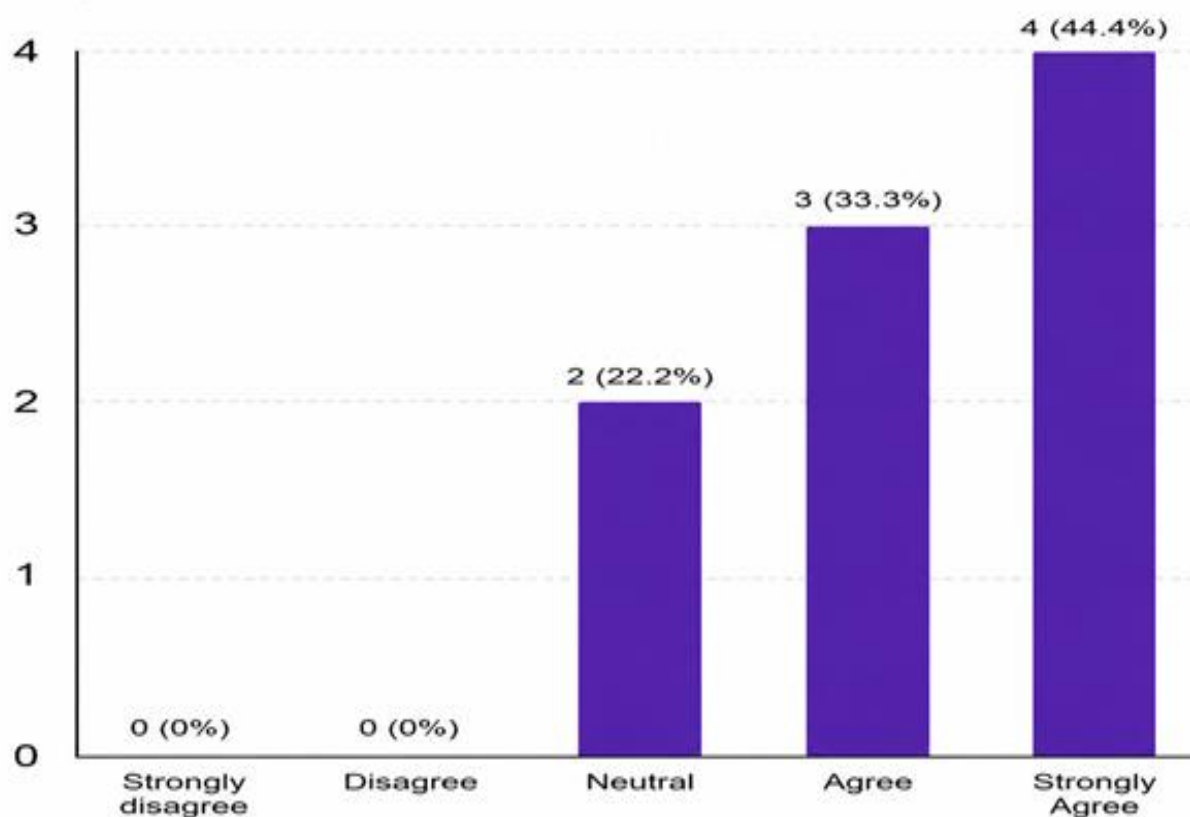


Figure 15 indicates teachers' opinions of the extent to which constraints, time, and class size influence the ability to integrate hands-on activities in each Mathematics class. Of the ten teachers surveyed, none chose to disagree (0%) or strongly disagree (0%); four chose strongly to agree (44.4%), three chose to agree (33.3%), and two chose neutral (22.2%). This shows that teachers are generally aware of time and class size as constraints; most teachers strongly agree or agree that time and class size constraints influence the regular integration of hands-on activities. The results of the bar graph may indicate that although teachers feel that hands-on learning should be incorporated, due to limitations in the classroom setting, it can only be used occasionally. The large number of respondents choosing strongly to agree shows that teachers very much agree that time and class size constraints make it difficult to adequately plan and implement hands-on lessons, but others agree or feel it is neutral, suggesting teachers have varying degrees of concern.

Pupils Interview.

Table 1 displays the number of boys and girls who participated in the interview.

Responses	No. of respondents
Boys	54
Girls	91

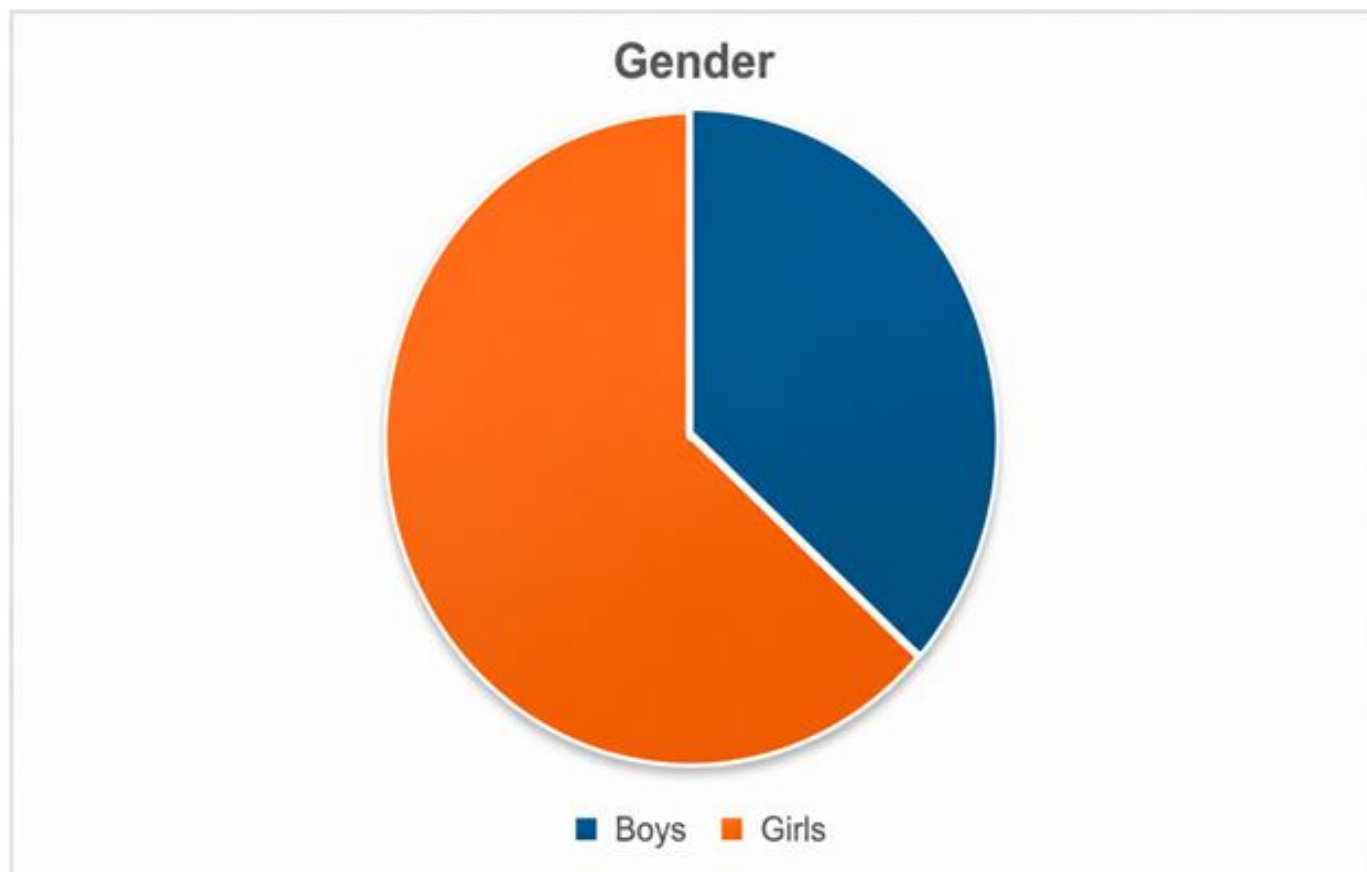


Figure 1: The pie chart explains the distribution of boys and girls being interviewed. The chart indicates that girls, who were 91 (63%) in number, outnumber the boys, which was 54 (37%).

Table 2 shows the number of learners in Grade 2 who like Mathematics.

Responses	No. of respondents
I like it.	21
No, I don't like it.	124

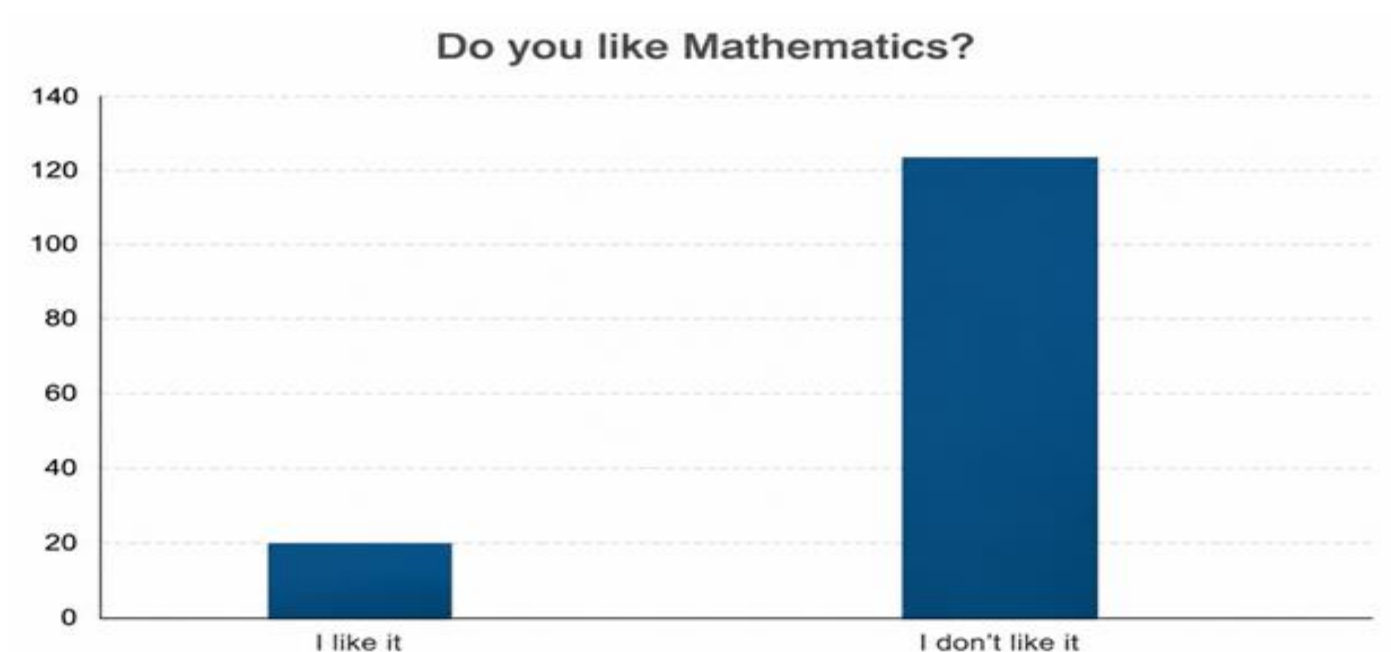


Figure 2: reflects the responses of Grade 2 pupils on whether they like Mathematics or not. The graph displays that out of the respondents, the number of Grade 2 learners who do not like Mathematics is significantly high, with 124 learners (85.5%), while only 21 Grade 2 pupils (14.5%) said they do like Mathematics.

Table 3 represents the number of children who like to use objects during mathematics class.

Responses	No. of respondents
Yes	136
No	9

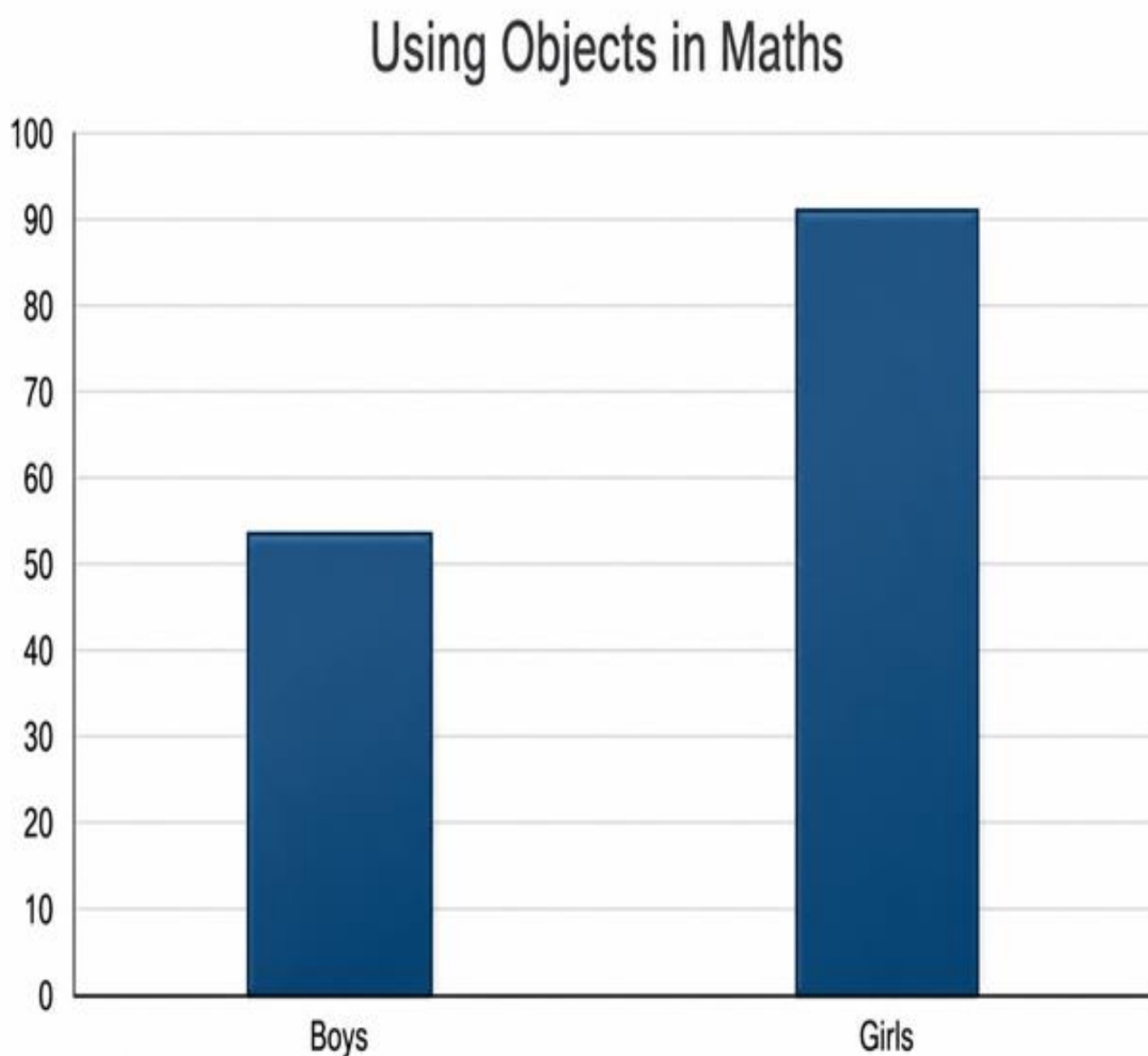


Figure 3 shows the children who enjoy using objects while they are learning Mathematics. We can see that most pupils said "Yes" and only 9 pupils said "No". The data shows us that most children would like to use concrete materials when learning Mathematics. From this graph, we could find that hands-on lesson activities are liked very much by the Grade 2 pupils.

Table 4 highlights the number of children who understand mathematics better when using objects.

Responses	No. of respondents
Yes	140
No	5

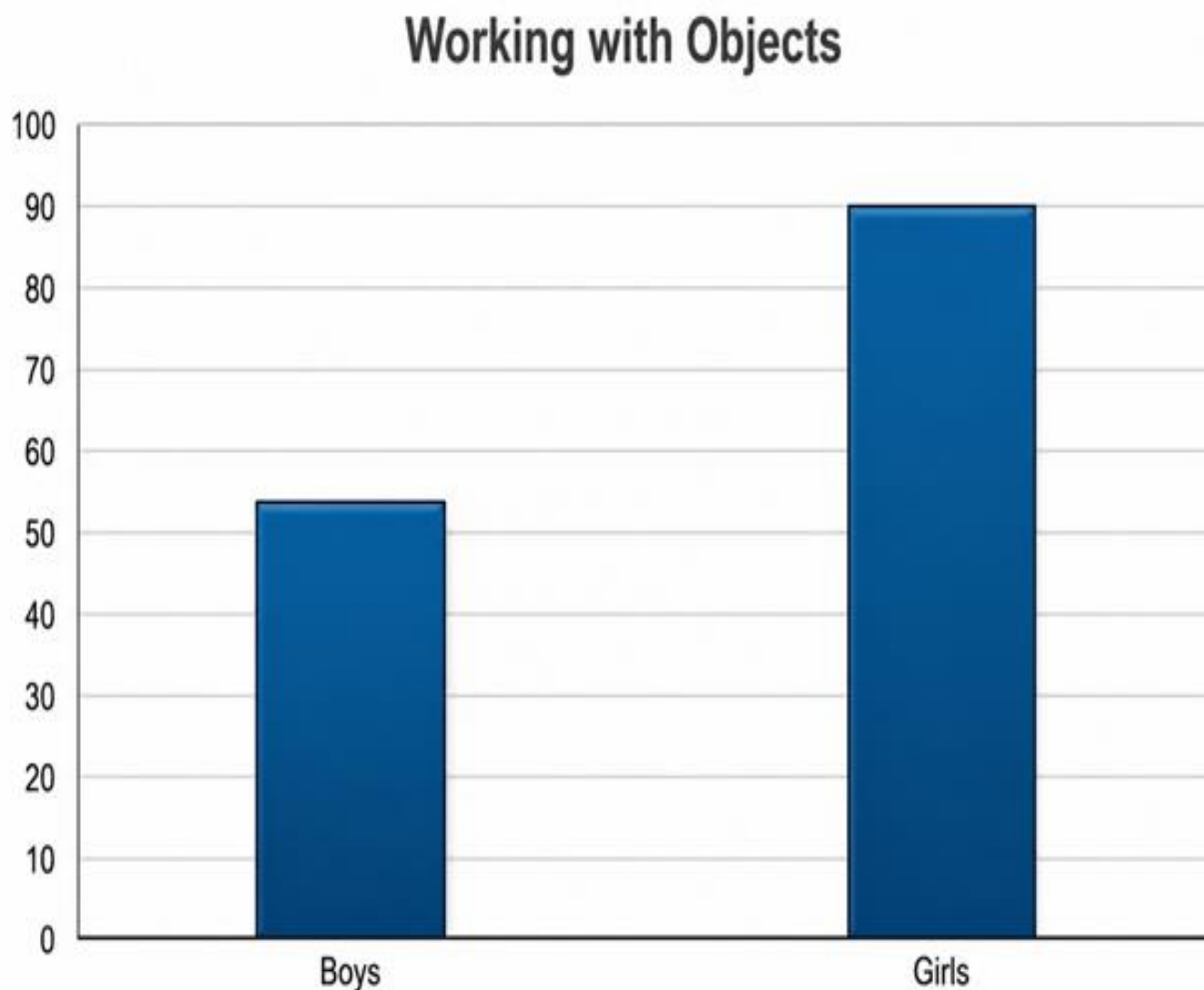
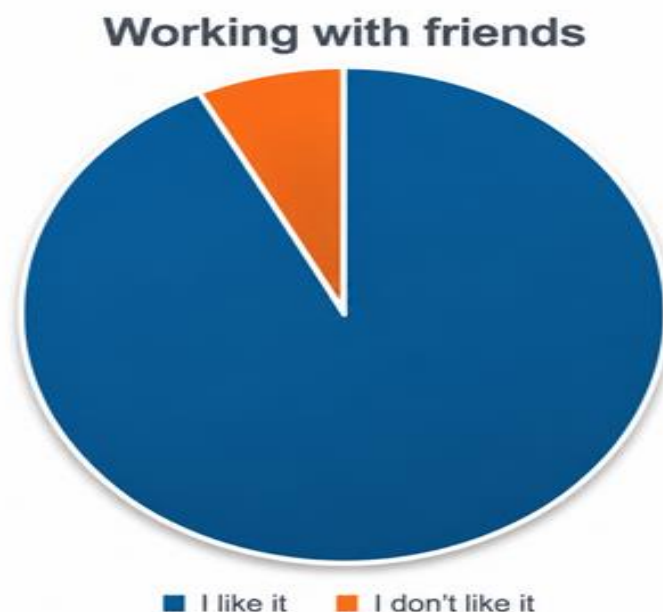


Figure 4 shows that more children understand Mathematics better when using objects in lessons. One hundred and forty learners (96.6%) chose "Yes" and only 5 learners (3.4%) chose "No". The results imply that most pupils can learn mathematics with the use of physical objects. The stark difference between the two answers clearly shows how effectively learning with objects makes understanding easier. These results show that objects used for mathematics can greatly enhance pupils' learning.

Table 5 shows how many students enjoy working with friends in mathematics class.

Responses	No. of respondents
I like it.	135
I don't like it.	10



The pie chart in **Figure 5** shows the number of pupils who like working in groups for the mathematics lesson. 135 pupils (93.2%) answered that they like it, and 10 pupils (6.8%) answered that they don't like it. Hence, the learning in groups is most favored by students. It is also suspected that when students work with others, they may feel more at ease and less pressure in the lesson.

Table 6 shows how many students pay attention in class when they are doing activities.

Responses	No. of respondents
Yes	103
No	42

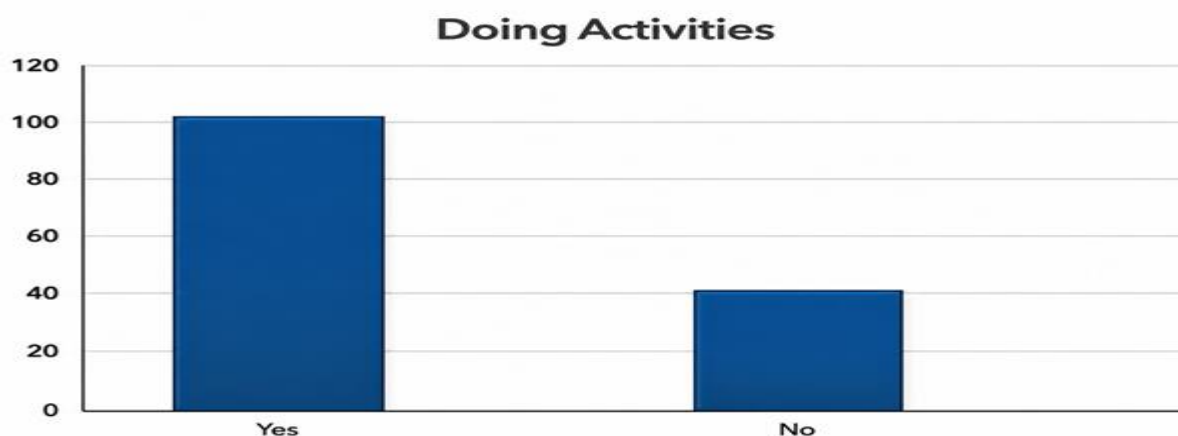


Figure 6 depicts the number of students who are focused when they are involved in activities. 103 of them (71.0%) replied with "Yes" and 42 of them (29.0%) replied with "No". Based on this, it can be observed that most students tend to focus on lessons when they are participating in activities. The differing number of responses obtained seems to indicate that having students learn through an activity would somehow increase their level of focus and involvement. This conclusion validates the use of concrete activities to grab the students' attention during the mathematics lessons.

Table 7 shows how many learners explain their answers when using objects.

Responses	No. of respondents
I like it.	58
I don't like it.	87

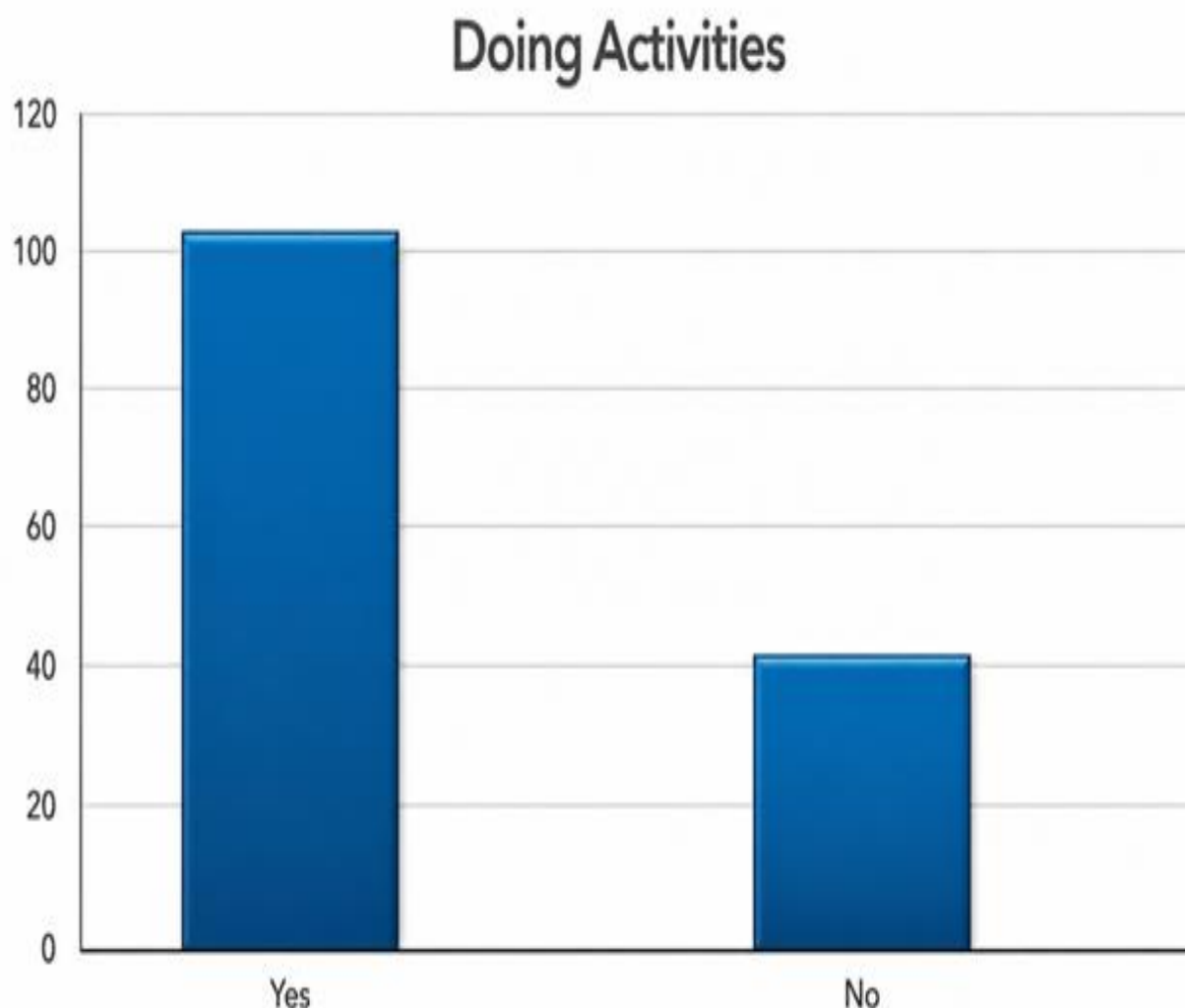


Figure 7 displays the number of pupils explaining their answer during the object lesson in Mathematics class. From the bar graph, 58 pupils (37%) answered yes, they like it, while 87 pupils (63%) answered no, they do not like it. It can then be observed that more pupils do not like to explain their answers during the object lesson. This shows that there may be difficulty for some pupils when answering the question about explaining their answer using objects. This result leads to another finding that pupils need more help and confidence in explaining mathematical concepts.

Table 8 represents the number of pupils who want their teacher to use more activities in mathematics.

Responses	No. of respondents
Yes	142
No	3

Using more hands-on activities in maths

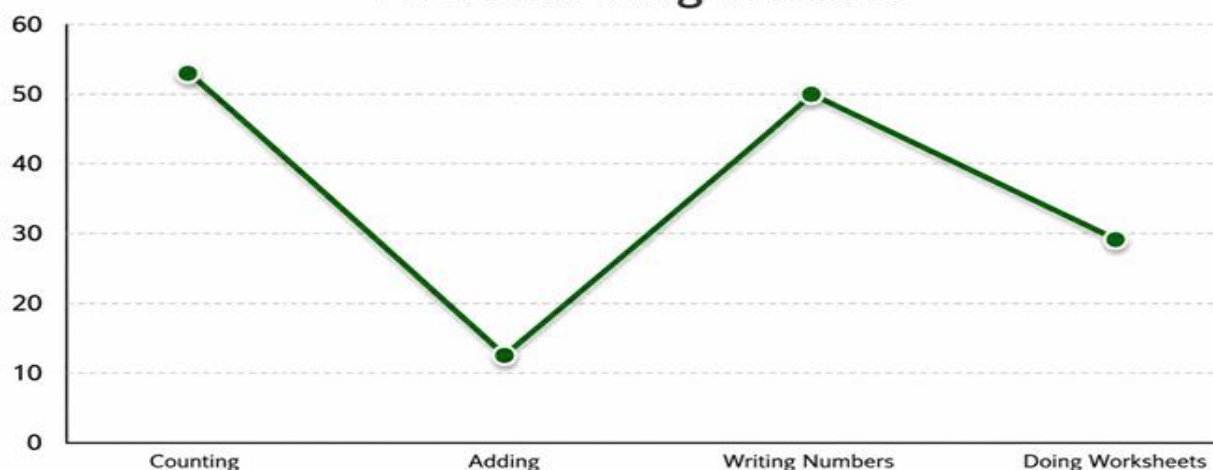


Figure 8 describes the number of students who preferred teachers to use activities more often in the mathematics class. The number of students who answered 'Yes' is 142 (98%), whereas the number of students who answered 'No' is 3 (2%). This demonstrates that a lot more students in the class preferred the teacher to use activities more often in Mathematics lessons. It indicates that the students are more excited to use activities during Mathematics class, so more activities are needed to gain attention from students.

Table 9 represents the responses of pupils listing some things they like most in mathematics.

Responses	No. of respondents
Counting	53
Adding	13
Writing numbers	50
Doing worksheets	29

Favourite thing in maths



The line graph represents the things that pupils enjoy the most in Mathematics, namely counting, addition, writing numbers, and worksheets. From the graph, it appears that counting is the most enjoyable, receiving 53 replies (37.9%), whereas writing numbers received the second most, with 50 replies (35.7%). Doing worksheets obtained the second-to-last position with 29 replies (20.7%), while addition received the least, with only 13 replies (9.3%). There is a definitive preference for more active, hands-on types of math and

less abstract forms. It shows, therefore, that learners will engage with greater effort when mathematics involves concrete tasks to which they can physically relate and in which they are actively involved.

Table 10 indicates the concrete materials students like using in mathematics class.

Responses	No. of respondents
Clock	11
Blocks	92
Number lines	27
Games	13
Charts	2

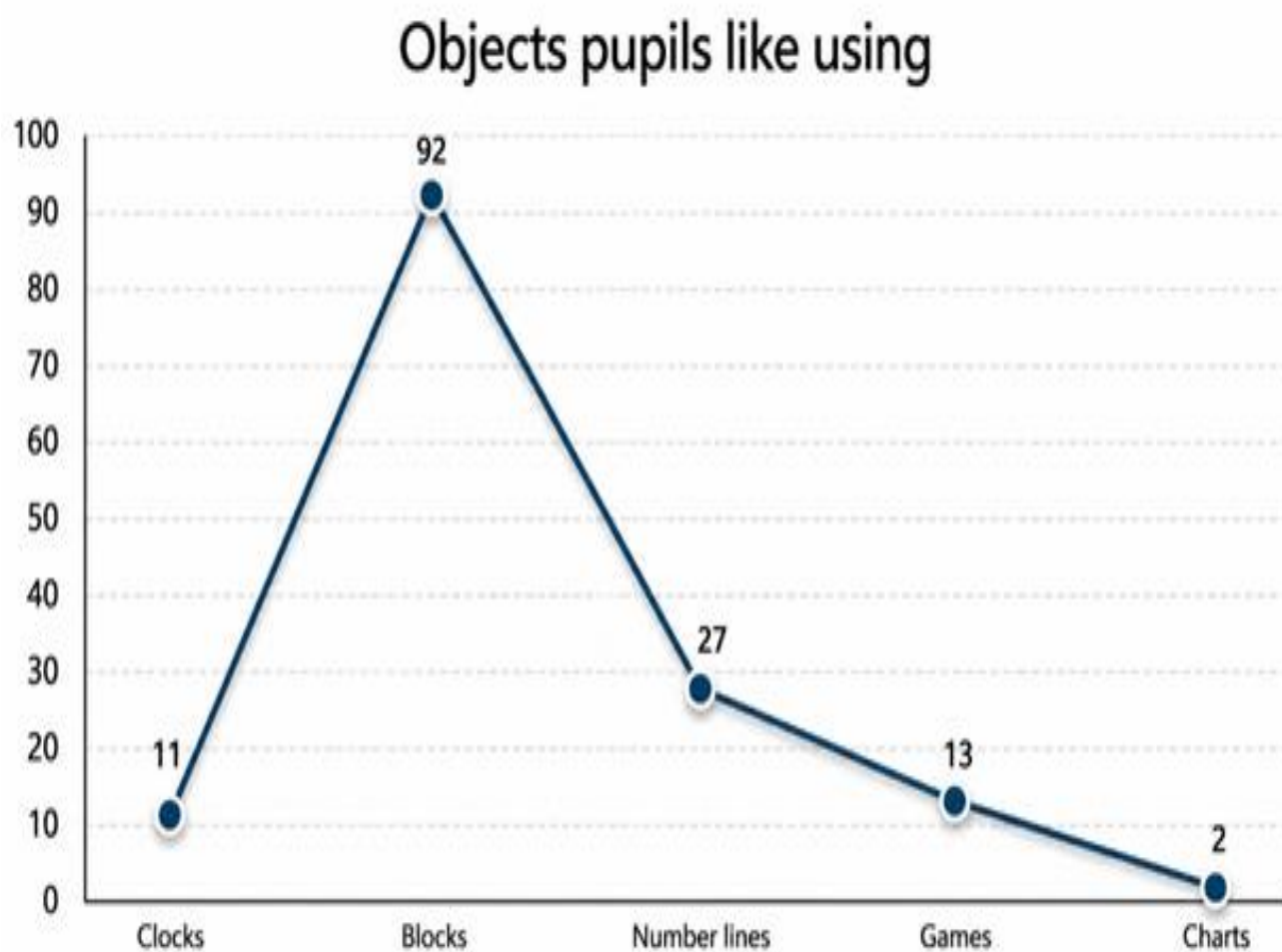


Figure 10 shows a concrete materials line graph, which reflects how the students prefer using which type of concrete materials in Math class, like clocks, blocks, number line, games, and charts. It showed that there were 92 students preferring the usage of block (65.7%), making it the highest in the graph. The number line showed 27 responses (19.3%) and was the next in the rank, whereas games and clock were the lowest with 13 (9.3%) and 11 (7.9%) responses, respectively. Charts were shown to be the lowest in the preference shown by the students, where they contained 2 responses (1.4%), and are the lowest in the graph.

Table 11 indicates pupils' views based on whether they like working with objects or writing.

Responses	No. of respondents
Working with objects	139
Writing	6

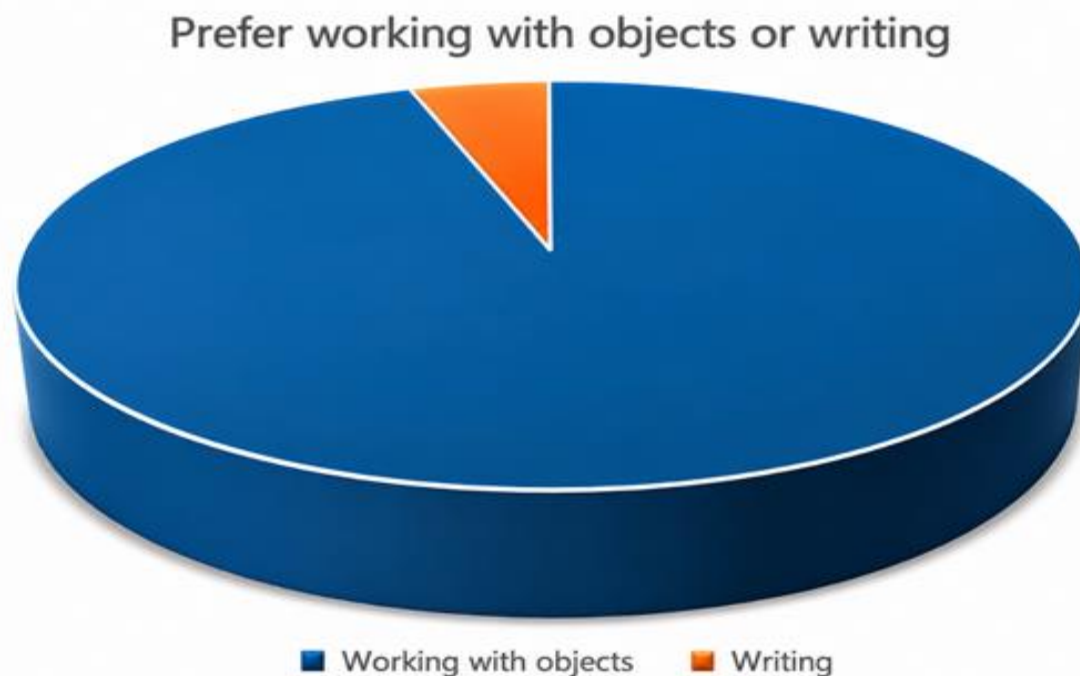


Figure 11 demonstrates pupils' ideas about whether they would rather work with objects or writing in Mathematics. The graph displays that there are 139 pupils (96%) who prefer to work with objects and only 6 pupils (4%) who would rather write. It is clear from this that there is a very high preference towards the practical activities involving objects rather than written work. The amount of disparity between the two results is evidence that most learners find object-based learning more involved.

Conclusion

It can be stated that information on teachers' and students' opinions on the implementation of hands-on materials in the mathematics curriculum at Central Corentyne Cluster was tabulated, represented and interpreted in the form of tables and graphs. A group of nine (9) teachers and 145 students were interviewed and their perceptions captured, making this a well-rounded study of both teachers' practices and learners' perceptions. The data as viewed through both teachers' and students' responses, showed an overwhelming support of hands-on activities in Mathematics. It was perceived that hands-on activities generate more interest among students, help in better

conceptualization, stimulate higher level of participation and enable effective application of mathematical concepts. Students themselves reported that they enjoyed using manipulative and found that math lessons based on activity is preferable and they understood math concepts better.

Despite the overall positive regard, the results clearly indicated various problems and constraints which might impede the effective use of hands-on activities in the classroom on a sustained basis. The main constraints encountered by the teachers, in order of priority, included unavailability of materials and tools, large class sizes and short duration of lesson. However, despite these

constraints, most teachers reported that they strive to employ hands-on materials and feel comfortable in utilizing them. Based on the study's findings it is justifiable to say that both teachers and students find hands-on approach conducive to the learning of mathematics, but enhanced provisions and conditions were essential to ensure wider and more sustained implementation.

Chapter 5 Summary

5.0 Introduction

This chapter discusses the summary of the study, the conclusions drawn from the research, and recommendations given based on the research done on teaching and learning Mathematics through hands-on activities in the Central Corentyne Cluster. Key findings that emerged from both the teachers and pupils were documented in this chapter in relation to teachers' and pupils' perspectives, experiences, and difficulties regarding hands-on materials used in Mathematics lessons. Interpretations of significant findings were provided based on the objectives and questions raised in this study. Practical recommendations were also provided with regard to the effective use of hands-on learning strategies in primary Mathematics classes.

5.1 Summary of main points

The study aimed to observe the extent of implementation of hands-on learning strategies in Mathematics teaching and learning within the Central Corentyne cluster. A total of 9 teachers and 145 pupils took part in this study, and data were collected by the administration of both questionnaires and interviews. Tables and graphs were utilized to display and interpret the response patterns among both teachers and students.

Generally, results of the study showed that both teachers and students felt that hands-on learning activities were beneficial in mathematics teaching and learning. Teachers generally believe that hands-on materials can boost pupils' interest, improve their understanding of mathematical concepts, and improve the overall classroom participation. Pupils also expressed that they

enjoyed learning with objects, that they were better able to understand mathematics using concrete materials, and that activity-based learning was better than written tasks.

Some factors found to limit the utilization of hands-on activities included the lack of teaching and learning resources, large class sizes, and limited time. Most teachers stated that they nevertheless tried to use hands-on materials, and they were confident that they could use them effectively.

5.2 Findings from the investigation

Summary of the Findings from Teachers and Pupils on the Teaching and Learning of Mathematics using Hands-on learning activities in the Central Corentyne Cluster.

From the responses of 9 teachers and 145 pupils on the implementation of hands-on activities in the teaching and learning of Mathematics in the Central Corentyne Cluster, several significant findings emerged:

It was revealed that there is a positive attitude towards the use of hands-on materials on the part of teachers and pupils. Teachers indicated that due to the availability of hands-on materials, pupils find learning Mathematics to be more enjoyable; pupils can understand Mathematics concepts with the help of hands-on materials; pupils' involvement and attention were higher when hands-on materials were utilized. These sentiments were also expressed by pupils; most of them stated that they love to play with objects, prefer learning Mathematics with objects, and find it easy to learn and understand mathematics when hands-on materials are employed.

The findings also found that the hands-on activities tend to improve pupils' behavior and participation. The findings showed that pupils were more attentive and participatory during activity-based lessons and that most pupils find that learning Mathematics through activity is better than writing.

However, a key barrier that hinders the successful use of the hands-on activities, as identified by teachers, was that there were no or very few

materials available; large class sizes and time constraints also caused teachers not to be able to utilize hands-on activities as often.

Most of the teachers stated that, even though most of them stated that there were no/very few materials available, they were making the effort to use materials as much as they could. Teachers further stated that they feel confident in using hands-on activities.

5.3 Conclusion

The study aimed to investigate the use of hands-on activities in teaching and learning Mathematics within the Central Corentyne Cluster. From the information obtained from both the teachers and pupils, it could be deduced that hands-on activities are instrumental in enhancing pupils' understanding, participation, and interest in Mathematics at the primary school level. It was observed that both teachers and pupils hold positive views about the utilization of manipulatives and activity-based learning approaches in the teaching of Mathematics.

Most of the teachers felt that hands-on activities contribute to enhanced understanding among pupils, increased participation in classroom activities, and a fun-filled and meaningful approach to teaching and learning Mathematics. From their views, it could be inferred that pupils have higher attention span, motivation, and are more actively engaged in their work with a hands-on approach through materials like blocks, counters, number lines, etc. Most of the teachers stated that they felt confident in using hands-on materials and claimed that they tried to implement them as frequently as possible in their lessons.

In the same way, pupils were receptive to hands-on methods. It was found that most pupils enjoy using manipulatives in Mathematics and learning concepts with objects makes learning and understanding easy. They have shown a high preference for active over passive written exercises, which indicates that activity-based lessons foster a more stimulating and learner-centered environment. Their willingness to collaborate during Mathematics activities was

highlighted and indicates that activity-based learning encourages interaction with friends and peers.

Although many benefits were observed with hands-on approach, several difficulties encountered by teachers limited its constant application in the mathematics classroom. Teachers revealed insufficient learning materials, shortage of equipment, large class size, and limited time as barriers that hinder the efficient use of hands-on teaching methods. These factors often make it impossible for teachers to set and deliver activity-based lessons regularly. Even though teachers seem to be willing and confident to apply manipulatives in their teaching, a shortage of help or lack of support has impeded their capabilities.

To summarize, this study was conclusive that hands-on activities is a productive and beneficial approach to improve the teaching and learning of Mathematics in the primary schools of Central Corentyne Cluster. The use of concrete materials and engaging activities has benefited the pupils' knowledge, involvement, and enjoyment of mathematics. Teachers need to be supported with sufficient materials, teacher development programmes, and a positive learning environment in their classrooms to enhance and ensure the implementation of hands-on activities in mathematics.

5.4 Implications

The study therefore has practical implications for primary Mathematics teachers, primary schools, mathematics curriculum designers, and primary mathematics education policy makers. The response from teachers and pupils confirms that 'hands-on activities should be considered as an integral part of mathematics instruction at the primary level' because the children are beneficiaries of learning concrete, hands-on material.

This research also has implications for primary school teachers. The study confirms the value of activity-based and learner-centered strategies in Mathematics classroom instruction. Teachers can,

for example, use more hands-on-based activity in the mathematics lessons because pupils are more enthusiastic, better conceptualized, as well as higher participation level when the study uses manipulatives and hands-on materials in learning. The study also indicates that teachers need to provide continued professional development and training in using hands-on learning to support their confidence and proficiency in the mathematics lesson.

This research will also be of great help to the school and education administrators. In order to support the school's needs for resources and teaching materials mentioned in the research, the school administrator should consider purchasing enough manipulatives, teaching tools, and materials. Administrators can also motivate teachers to cooperate by planning cooperatively. Teachers will be able to share ideas and devise inexpensive or homemade instructional materials for the mathematics curriculum.

The results of this study further suggest that educators and policymakers should concentrate on hands-on and interactive instructional approaches in the mathematics curriculum. The curriculum must also clearly advocate for the use of hands-on activities and provide teachers with instructions for their effective implementation in classrooms of diverse size and ability levels. School administrators should consider the implications for classroom sizes and instructional time dedicated to active, hands-on lessons.

Lastly, it indicates that practical activities have the potential to change the pupils' attitude to mathematics, and to alleviate the hatred or phobia of learning mathematics. By giving children an opportunity to be actively involved in mathematics learning, they are supposed to be more confident, more willing and enthusiastic to learn mathematics; thus, more interested in participating actively in mathematics class.

5.5 Recommendations

Given the results of the present investigation, several recommendations can be put forth to enhance teaching and learning of Mathematics

through hands-on activities in the Central Corentyne Cluster and other primary schools. These suggestions will be of assistance to teachers, administrators, curriculum developers, and policy makers in enhancing the teaching of Mathematics.

Teachers should be urged to make greater and consistent use of hands-on activities while teaching mathematics. Given the results of this study showing that students had a better understanding and are more interested when they are involved in lessons that utilize hands-on manipulatives, it would be imperative for teachers to involve concrete objects like blocks, counters, number lines, charts, clocks, flashcards, and games in daily Mathematics activities. Jean Piaget in his Cognitive Development Theory explained that children at the primary school level learn better from experience and involvement. It shows that children at the concrete operational level gain a better understanding through concrete manipulatives and hands-on tasks.

Secondly, the schools should take full advantage of the school grant provided by the government of Guyana to purchase and provide to the pupils and teachers effective Mathematics manipulatives and teaching aids. The teachers should work together with school heads to work out the most needed resources required in the mathematics subject and reserve some part of the school grant towards such resources. Among the items to purchase with the school grant are counting blocks, abaci, shapes, number lines, clocks, measurement tools, charts, dice, puzzles, and mathematical games, which are related to activity learning. Part of the grant can be used to set up a Mathematics corner or storage where such manipulatives can be stored in order and within the reach of the pupils and the teachers. The grant should be well accounted for.

Thirdly, teachers also need to be encouraged to make hands-on teaching materials using recycled locally available materials such as bottle tops, sticks, stones, cardboards, straws, and other recyclable materials, which can be made into effective manipulative teaching resources. The need for this recommendation is because some

schools might be on a limited financial background, thus finding it difficult to afford commercially purchased teaching resources. Nevertheless, through teachers' creativity and cooperation, the pupils could still enjoy having hands-on experience.

Fourthly, teacher professional development sessions and workshops should be carried out regularly in order to improve teachers' knowledge and skills of using hands-on teaching resources and manipulatives in their lessons. The results found that while teachers were more confident in the usage of manipulatives, some had some problems during implementation. Workshops should expose teachers to new activity-based strategies, classroom management strategies and a variety of ways of how manipulatives could be integrated in different topics in Mathematics. This recommendation supports Jerome Bruner's Constructivist Theory, which indicates that learners actively construct their knowledge through exploration and interaction with their surroundings. Thus, teachers require adequate skills and strategies to construct learning experiences that promote discovery and problem-solving.

It is also advised that schools and education authorities should try to eliminate overcrowded classrooms and poor classroom conditions. Due to large class sizes and a lack of classroom time, it was suggested that the opportunities for incorporating practical activities into the lessons were not very efficient. Smaller groups would provide the children with more opportunities to learn from the teacher and be more manageable and interactive.

Additionally, cooperative learning should be incorporated into mathematics activities. As many of the pupils seemed to enjoy learning as a group, it is advised that lessons should include opportunities for pupils to collaborate, share ideas, and work together, explaining their thinking and approaches to others. Lev Vygotsky's theory of Social Constructivism states that social interaction between children enhances their learning. It suggests that children learn better by working

cooperatively with guidance from their teachers and peers.

Lastly, emphasis must also be put on learner-centered and activity-oriented teaching and learning strategies by curriculum planners and policy makers, and this must be maintained and strengthened throughout the mathematics curriculum. Schools should also be provided more support by means of resource sharing, monitoring, and teacher training so that hands-on learning could become a common and sustained aspect of teaching and learning of Mathematics in primary education. Easy accessibility to manipulatives and promoting hands-on learning could also help pupils to build a positive view of Mathematics and to do well in Mathematics.

Reference

1. Achievement definition and meaning | Collins English Dictionary. (n.d.). [Www.collinsdictionary.com](https://www.collinsdictionary.com/dictionary/english/achievement).
<https://www.collinsdictionary.com/dictionary/english/achievement>
2. Academic Performance - an overview | ScienceDirect Topics. (2012). [Www.sciencedirect.com](https://www.sciencedirect.com/topics/psychology/academic-performance).
<https://www.sciencedirect.com/topics/psychology/academic-performance>
3. Bruner, J. S. (1961). *The Act of Discovery*. Harvard Educational Review, 31, 21-32. - References - Scientific Research Publishing. (n.d.). [Www.scirp.org](https://www.scirp.org/reference/references/papers?referenceid=1412275).
<https://www.scirp.org/reference/references/papers?referenceid=1412275>
4. Cochrane, D. (2024, October 7). *Examining the Math Problem in the Jamaican Education System – Leadership Reimagination* Enterprise. [Leadershipreimagination.com](https://leadershipreimagination.com/uncategorized/examining-the-math-problem-in-the-jamaican-education-system/).
<https://leadershipreimagination.com/uncategorized/examining-the-math-problem-in-the-jamaican-education-system/>
5. Cohen, L., Manion, L., & Morrison, K. (2018). *Research Methods in Education* (8th ed.). London Routledge. - References - Scientific Research Publishing. (n.d.).

- [Www.scirp.org](http://www.scirp.org).
<https://www.scirp.org/reference/referencespapers?referenceid=3026028>
6. Creswell, J. W. (2014). *Research Design: Qualitative, Quantitative and Mixed Methods Approaches* (4th ed.). Thousand Oaks, CA: Sage. [Www.academia.edu](http://www.academia.edu), 4(4).
https://www.academia.edu/57201640/Creswell_J_W_2014_Research_Design_Qualitative_Quantitative_and_Mixed_Metho
7. Definition of ENHANCE. (2019). Merriam-Webster.com.
<https://www.merriam-webster.com/dictionary/enhance>
8. Discovery Learning (Jerome Bruner – 1961). (2011, December 9). *Principles of Learning; Principles of Learning*. <https://principlesoflearning.wordpress.com/dissertation/chapter-3-literature-review-2/the-constructive-perspective/discovery-learning-jerome-bruner-1961/>
9. Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2012). *How to design and evaluate research in education* (8th ed.). New York: McGraw Hill. - References - Scientific Research Publishing. (n.d.). [Www.scirp.org](http://www.scirp.org).
<https://www.scirp.org/reference/Referencepapers?ReferenceID=1046940>
10. Hands-on Learning - definition, meaning, benefits and examples. (2024, March 5). *Lectera Glossary*.
<https://lectera.com/info/articles/hands-on-learning>
11. ishtiaq, muhammad. (2019). Creswell, J. W. (2014). *Research Design: Qualitative, Quantitative and Mixed Methods Approaches* (4th ed.). Thousand Oaks, CA: Sage. [Www.academia.edu](http://www.academia.edu), 4(4).
https://www.academia.edu/57201640/Creswell_J_W_2014_Research_Design_Qualitative_Quantitative_and_Mixed_Metho
12. JOHN DEWEY. (n.d.). *EXPERIENCE AND EDUCATION*. In Internet Archive.
<https://archive.org/details/ExperienceAndEducation/page/n7/mode/2up>
13. Kimura, M. (2025, January 27). *Finland's educational success: A global model to follow*. *Globalsociety.earth*.
<https://www.globalsociety.earth/post/finland-s-educational-success-a-global-model-to-follow>
14. Kolb, D. A. (1984). *Experiential Learning: Experience As The Source Of Learning And Development*. Research Gate; Prentice-Hall.
https://www.researchgate.net/publication/235701029_Experiential_Learning_Experience_As_The_Source_Of_Learning_And
15. Lectera. (2024, March 5). *Hands-on Learning - definition, meaning, benefits and examples*. *Lectera Glossary*.
<https://lectera.com/info/articles/hands-on-learning>
16. Lev S. Vygotsky-Mind in Society - The Development of Higher Psychological Processes-Harvard University Press (1978) | PDF | Psychology | Experiment. (n.d.). Scribd.
<https://www.scribd.com/document/358971710/Lev-S-Vygotsky-Mind-in-Society-the-Development-of-Higher-Psychological-Processes-Harvard-University-Press-1978-1>
17. McLeod, S. (2024) *Vygotsky's theory of Cognitive Development*. - References - Scientific Research Publishing. (2024). Scirp.org.
<https://www.scirp.org/reference/referencespapers?referenceid=3929726>
18. McLeod, S. (2025, June 4). *Piaget cognitive stages of development*. Simply Psychology.
<https://www.simplypsychology.org/piaget.html>
19. Most Powerful eLearning Course Authoring Tool | ELB Learning. (2024). Elblearning.com.
<https://products.elblearning.com/create-learning/lectera>
20. OECD. (2023). *PISA 2022 Results (Volume I)*. OECD.

- https://www.oecd.org/en/publications/pisa-2022-results-volume-i_53f23881-en.html
21. Piaget, J. (1952). *The Origins of Intelligence in Children*. New York, NY W.W. Norton & Co. - References - Scientific Research Publishing. (n.d.). [Www.scirp.org](http://www.scirp.org).
<https://www.scirp.org/reference/referencespapers?referenceid=1976633>
22. queen, syleen. (2023, April 22). *Research in education (Kahn, James V. Best, John W.)*. Academia.edu.
https://www.academia.edu/100602091/Research_in_education_Kahn_James_V_Best_John_W
23. Sahni, M. (2023). *EFFECTIVENESS OF EXPERIENTIAL LEARNING IN TEACHING MATHEMATICS TO PRIMARY SCHOOL STUDENTS*. 11(6), 2320–2882.
<https://ijcrt.org/papers/IJCRT2306766.pdf>
24. Singh, P. (2024, August 9). *What is Experiential Learning? Principles, Benefits, Examples*. Extramarks Blogs: Weaving Stories for Schools, Students, and Parents; Extramarks.
<https://www.extramarks.com/blogs/teachers/experiential-learning/>
25. Skemp, R. R. (2012). *The Psychology of Learning Mathematics*. Routledge.
<https://doi.org/10.4324/9780203396391>
26. STEM Education in Finland: A Model for Global Excellence. (2025). Techclass.com.
<https://www.techclass.com/resources/education-insights/stem-education-in-finland-a-model-for-global-excellence>
27. Subramaniam, D. M. (2025). *BANDURA 1977*. Scribd.
<https://www.scribd.com/document/696255556/BANDURA-1977>
28. The Benefits of Experiential Learning. (n.d.). Experiential Learning Depot.
<https://www.experientiallearningdepot.com/experiential-learning-blog/the-benefits-of-experiential-learning>
29. Understanding Effectiveness: Goals & Results Explained. (n.d.). [Www.awork.com](http://www.awork.com).
<https://www.awork.com/glossary/effectiveness>
30. Vygotsky 1978. (2019). Scribd.
<https://www.scribd.com/document/99780614/Vygotsky-1978>
31. Žakelj, A., Cotič, M., & Doz, D. (2024). *Evaluating the impact of active and experiential learning in mathematics: an experimental study on eighth-grade student outcomes*. Cogent Education, 11(1).
<https://doi.org/10.1080/2331186x.2024.2436698>
32. I acknowledge the use of Grammarly to assist with grammar, spelling, punctuation, and language editing during the preparation of this research. All ideas remain my work.
33. *Free AI Grammar Checker (no sign-up required)* - Quillbot AI. (2026). Quillbot.com; Quillbot.
<https://quillbot.com/grammar-check?msocid=03b5872ecce26c3716c394d0cd4d6d3c>