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The Effectiveness of Manipulating Real Objects in Enhancing Retention Among Grade 7 Students Struggling With Concepts of Angles

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Abstract:- Mathematics frequently involves abstract concepts and symbols, presenting a challenge for certain students who may need help to retain these concepts. This study aimed to determine the effectiveness of manipulating real objects in enhancing retention among grade 7 students struggling with concepts of angles during S.Y. 2023–2024 in a public institution in the city of Ozamiz. This study used a classroom-based action research design with 31 students as participants using purposive sampling. Research-made test questionnaires and interview guide questions were used to gather data. The data was interpreted using statistical tools, mean, standard deviation, and t-test, and analyzed using thematic analysis. Thus, the following were the study's key findings: the students' retention level of the concepts of angles before manipulating real objects did not meet expectations; the students' retention level of the concepts of angles after manipulating real objects was very satisfactory; there was a significant difference in the students' retention level of the concepts of angles before and after manipulating real objects; and other developments observed among the students after manipulating real objects involved increased student engagement, mastery of angles, and real-life application. Integrating manipulatives into mathematics instruction can significantly enhance students' retention of angle concepts. Teachers may incorporate the use of manipulatives and real objects in the teaching of angles to provide students with tangible and interactive experiences.

Keywords:- *Angles, Hands-On Activities, Manipulatives, Math, Real Objects, Retention.*

I. CONTEXT AND RATIONALE

Mathematics is a fundamental tool for understanding, analyzing, and solving various problems in various aspects of life. It frequently involves abstract concepts and symbols, presenting a challenge for certain students who may need help to retain these concepts. Currently, an institution in Ozamiz City is grappling with a significant hurdle in the realm of mathematics education. Students need help with the poor retention of mathematical concepts, a concern validated by math instructors through post-discussion assessments. The evidence was clear in the students' scores, with more than half proving difficulty retaining the discussion.

The Mathematics Assessment conducted as part of the Programme for International Student Assessment (PISA) has unveiled a concerning trend. Over half of Filipino students performed poorly, scoring below the lowest proficiency level. Notably, the Philippines ranks second lowest among the 79 participating countries in terms of mathematical literacy. This highlights a pressing need for targeted interventions and improvements in mathematics education at the national level. It is conclusive that concerted efforts should be undertaken to enhance academic performance among Filipino learners (Basco, 2020). However, despite the significance of mathematics and the concerted efforts made by teachers and government authorities to ensure high academic achievements in mathematics, there has been a consistent pattern of low achievement among secondary school students in this subject over the years (Adeshina & Eberechukwu, 2023).

Geometry is a fundamental subject in Mathematics since it refers to real-world experiences and various mathematical topics. However, some students continue to have trouble understanding this (Sudirman et al., 2023). Thus, various ideas in geometry must be understood in order to be used in the real world. Nevertheless, these ideas are frequently taught in classrooms without an examination of the learners' comprehension and analysis of actual ideas in their surroundings (Sarkar & Pillai, 2020).

It is conclusive that concerted efforts should be undertaken to enhance academic performance among Filipino learners. The capacity to store knowledge in the mind's short- or long-term memory is known as retention. Long-term memory is preferable. Helping students move concepts from short-term to long-term memory has become difficult for Math instructors (Valderrama & Oligo, 2021). The student's MLD (Mathematics Learning Disabilities) diagnosis criteria are low mathematics aptitude and poor working memory (Hobri et al., 2019). Due to the subject's complexity, students frequently struggle and lose interest in Mathematics (Gargrish et al., 2021). Indeed, many students perform below expectations in Mathematics, lose interest in the subject, and quit attempting to learn it (Yeh et al., 2019).

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The ongoing issue of poor student performance and retention in Mathematics is a significant concern for Mathematics educators and various educational stakeholders. The instructional strategies employed by teachers are a key factor contributing to this problem in mathematics education. Persistent low performance in Mathematics has the potential to prevent the achievement of educational objectives crucial for the scientific and technological development of the nation (Enikanolaye, 2021).

The capacity for mathematical connection involves the skill to establish links between mathematical concepts and their real-world applications. Unfortunately, the measurement of mathematical connection ability, indicated by three key aspects, frequently reflects low proficiency. Students commonly struggle with grasping the concepts they are studying, exhibit challenges in retention, fail to apply concepts, principles, and procedures, perceive mathematics as unrelated to other sciences, lack familiarity with utilizing mathematical concepts in daily life, and encounter difficulties in comprehending the contextual narrative (Kleden et al., 2021). Numerous learners encounter challenges when learning geometry in mathematics, prompting teachers to consistently explore the reasons behind these difficulties. The objective is to identify suitable pedagogic strategies that can effectively address and alleviate the challenges learners face in grasping geometry concepts (Naidoo & Kapofu, 2020).

Mathematics experts have identified several factors contributing to the persistent issue of poor achievement and retention among secondary school students in mathematics. These factors include math anxiety and negative attitudes toward mathematics among students (Sarfo et al., 2022). The severity of the mathematics teacher's approach during instruction, coupled with students' lack of diligence and discipline in approaching mathematical tasks, as well as teachers' unfavorable attitudes toward the subject, also play a role. Additionally, students' weak foundational understanding of mathematics, overcrowded math courses, a shortage of instructional materials, suboptimal teaching methods employed by teachers, and the use of worn-out mathematical resources further contribute to the problem (Egara et al., 2022).

Among the identified factors, educators' adoption of inappropriate teaching methods has been specifically highlighted as a significant contributor to learners' poor mathematics achievement (Mosimege & Egara, 2022). These inadequate teaching methods, which fail to enhance students' retention, are often associated with the continued reliance on traditional teaching approaches in mathematics instruction and learning (Nzeadibe et al., 2022).

Ensuring students' comprehension of math lessons is crucial for knowledge retention. However, Grade 7 students are experiencing challenges in understanding angle concepts, leading to poor retention. To address this gap, this study aims to assess the effectiveness of hands-on learning experiences in enhancing these students' understanding and memory of angle-related concepts. Using real objects for teaching angles is intended to fill this gap. Therefore, the effectiveness of manipulating real objects in enhancing retention among grade 7 students struggling with angles during the S.Y. 2023-2024 in one of the public schools in Ozamiz City is essential for addressing the issue of poor retention among students, particularly concerning mathematical topics, specifically the concepts of angles.

II. PROPOSED INTERVENTION

Manipulating real objects to teach angles on knowledge retention among Grade 7 students who face difficulties with angle concepts. This aims to assess the effectiveness of hands-on learning experiences in improving the understanding and memory of angle-related concepts among these students. The teaching strategy employed is an important factor influencing students' academic performance (Aliu & Raheem, 2023). Interacting with and manipulating deformable objects is a fundamental aspect of daily life for humans (Yin et al., 2021). So, in learning mathematics, students' engagement is evident through their attentiveness, genuine interest, and active participation. The abstract nature of mathematical concepts can pose challenges for students, particularly those who need help comprehending these abstract ideas. Difficulties grasping fundamental concepts can hinder students' progress to more advanced levels, diminishing their interest and engagement in mathematical learning activities. One approach to enhance students' interest in learning mathematics is incorporating manipulative materials during the mathematics learning process (Meke et al., 2019). Using tangible, real-modeled objects substantially enhanced learning outcomes (Marji et al., 2023).

Examining representations of physical objects is crucial, as it allows us to observe the transition in students' thinking and understand when such shifts occur (Kmetová & Nagyová Lehocká, 2021). Understanding the concepts of geometrical figures, shapes, and sizes is crucial for comprehending their features, relations, and proofs. In a geometry classroom, an effective teacher is expected to utilize objects associated with geometrical shapes to impart a genuine understanding of the figures, thereby enhancing the learning achievements of young learners. There is a difference in the learning outcomes when using manipulative materials in teaching geometry versus not using them. Students derived enjoyment and improved understanding when the class incorporated the manipulation of concrete objects. This valuable guideline for mathematics teachers encourages them to integrate the manipulation of various materials in geometry activities to promote a genuine understanding of geometry and enhance learning achievements (Gurung et al., 2022).

The intervention lies in introducing students to the concept of angles through practical, real-world engagement. Thus, the teacher begins by preparing examples of tangible objects that display various angles, such as a clock and bicycle wheels. Following a brief introductory discussion on the importance of angles in everyday life, students are encouraged to explore additional real objects and identify different types of angles present. Subsequently, students participate in individual or group tasks that require them to apply their knowledge of angles, ensuring a continuous

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connection to practical, real-life scenarios throughout the learning process. This approach aims to make the concept of angles more tangible and relevant to students' everyday experiences, enhancing comprehension and engagement.

III. ACTION RESEARCH QUESTIONS

This study aimed to determine the effectiveness of manipulating real objects in enhancing retention among grade 7 students struggling with concepts of angles. Specifically, this study sought answers to the following research questions:

- What is the student's retention level on the concepts of angles before manipulating real objects?
- What is the student's retention level on the concepts of angles after Manipulating real objects?
- Is there a significant difference in the student's retention level on the concepts of angles before and after manipulating real objects?
- What other developments are observed among the students after manipulating real objects?

IV. ACTION RESEARCH METHODS

A. Research Design

This study utilized a classroom-based action research design to assess the effectiveness of manipulating real objects in enhancing retention among grade 7 students struggling with angle concepts. This approach empowered teachers to examine their instructional methods and identify effective and ineffective strategies within their classrooms. Therefore, by establishing improvement goals and implementing action research, teachers could personalize their professional development, resulting in a more impactful approach to professional growth (Mertler, 2013).

B. Site

The study was conducted within a distinguished high school institution in the province of Misamis Occidental, specifically targeting Grade 7 students. This institution is a prominent secondary school in Ozamiz City and is crucial in providing secondary education to the local community. Drawing its student body primarily from the immediate barangay, the school serves as an educational hub for residents, shaping students' academic journey and influencing the region's overall educational landscape. Among the array of subjects it offers, Mathematics stands as a basis, shaping the academic development of its students.

C. Participants

The study included 31 Grade 7 students, chosen through purposive sampling. Inclusion criteria comprised: 1) enrollment as Grade 7 students for the academic year 2023-2024; 2) membership in sections taught by the researchers; and 3) voluntary consent for participation. Exclusion criteria encompassed: 1) students from sections not taught by the researchers; 2) students with exceptional academic performance; and 3) students with known behavioral or health-related issues that might affect their participation. Before administering the survey, the researchers confirmed that participants met these criteria.

D. Data Gathering Methods

This action research gathered quantitative and qualitative data. The retention in math among grade 7 students was assessed using a researcher-made instrument, such as test questions and interview questions.

➢ *Pre-Implementation Phase*

The researchers observed merging students' problems regarding their retention level in math. Then, sought permission from the school principal before initiating the study and then requested approval to gather data from the DepEd Schools Division of Ozamiz City. Once the permit was approved, the researchers informed the research instructor and the critic teacher, prepared a consent letter for the participants and explained the purpose of the study. Following this, a pre-test was administered to assess students' retention of the concepts of angles.

➢ *Implementation Phase*

The researchers taught lessons on angles by manipulating real objects for discussion. Following a month of implementing this strategy, a post-test was conducted to assess the extent of improvement in students' retention of angle concepts. In addition to the pre-test and post-test, observations and interviews were conducted to gather more comprehensive data. The researchers captured photos and took field notes throughout the entire implementation period.

➢ *Post-Implementation Phase*

The post-implementation phase involved drawing conclusions, making recommendations, revising, and finalizing the research study.

E. Data Analysis

With the use of Minitab statistical software and HyperRESEARCH software, the following statistical tools and thematic analysis were utilized:

- *Frequency and Percentage* were used to determine the students' retention level.
- *Mean and Standard Deviation* were used to determine the student's retention level on the concepts of angles before and after manipulating real objects.
- *T-test* was used to explore the significant difference in the performance of students before and after the manipulation of real objects.
- *Thematic analysis* was employed to analyze the qualitative data by thoroughly reading the data set and identifying patterns to uncover themes. Thus, HyperRESEARCH software was used to conduct qualitative analysis on observation and interview data, enabling researchers to code and analyze the data effectively (Gibbs, 2018).

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V. RESULTS AND DISCUSSIONS

Significant improvements in retention and understanding were achieved by incorporating the manipulation of real objects into the teaching of angles to Grade 7 students. This hands-on approach enhanced students' engagement with the material and sparked their interest and motivation to learn. Carefully analyzing the pre-test and post-test results provided valuable feedback to educators, enabling them to refine and enhance their instructional methods effectively. The following tables illustrate the impact of this teaching strategy on students' retention levels before and after the intervention.

A. *Student's Retention Level on the Concepts of Angles Before Manipulating Real Objects*

Table 1 presents the retention levels of Grade 7 students on the concepts of angles before manipulating real objects. The results show that all the students (100%) did not meet the retention expectations on this topic (M = 11.71; SD = 3.13).

The data indicates that prior to the intervention of manipulating real objects, the students struggled significantly with understanding and retaining the concepts of angles. It falls in the "Did not Meet the Expectations" category, underscores the severity of the struggle, and suggests some variability in students' retention levels, but overall, no student achieved a satisfactory score (M = 11.71; SD = 3.13).

Over the last 30 years, higher education institutions (HEIs) worldwide have struggled with the difficulties many students face upon entering higher education due to their weak pre-entry core mathematical skills (O'Sullivan & Crowley, 2021). Students often need more time to explore and learn with math manipulatives, hindering their ability to build a solid foundation and grasp mathematical concepts thoroughly (Lange, 2021). Some mathematical concepts or theories can be challenging to grasp in a classroom setting (Gargrish et al., 2021). Students who grapple with retention may encounter challenges recalling class lectures and navigating through mathematical problems that demand sequential steps (Cominghud, 2021).

The findings highlight a critical need for intervention strategies to enhance the understanding and retention of angle concepts among Grade 7 students. Educators and curriculum planners should consider incorporating hands-on learning activities, such as manipulating real objects, to improve students' grasp of geometric concepts. Additionally, professional development for teachers on effective instructional strategies for teaching geometry could be beneficial. Through manipulatives, students can address problems that contextualize mathematical operations or concepts within specific everyday situations (Kang et al., 2020). Indeed, memory retention is vital for academic success. To address related difficulties, students need to access math facts from long-term memory while remembering recent information and identifying the subsequent steps to take (Cominghud, 2021).

Table 1: ***Student's Retention Level on the Concepts of Angles Before Manipulating Real Objects***

Retention Level	Frequency	Percentage	M	SD
Did not Meet the Expectations	31	100.00	11.71	3.13

Note Scale: 26-30 (Outstanding); 23-25 (Very Satisfactory); 21-22 (Satisfactory); 18-20 (Fairly Satisfactory); 1-17 (Did not Meet the Expectations)

B. *Student's Retention Level on the Concepts of Angles After Manipulating Real Objects*

Table 2 presents the retention levels of Grade 7 students on the concepts of angles after manipulating real objects. The data reveal a significant improvement in retention levels compared to the initial assessment. The overall performance, encompassing all students (M = 23.16; SD = 4.80).

The findings from Table 2 indicate a marked "Very Satisfactory" improvement in students' retention of angle concepts following the manipulation of real objects (M = 23.16; SD = 4.80). This highlights the effectiveness of hands-on learning activities in enhancing conceptual understanding. The distribution of students across higher retention categories suggests that engaging with tangible materials facilitates better comprehension and memory retention. The substantial representation indicates that most students benefited from the practical approach, achieving scores that reflect a deeper grasp of the subject matter.

It is crucial to prioritize manipulating real objects to enhance spatial intelligence. This means actively engaging with physical objects in the environment, such as puzzles, models, or building blocks, to develop a deeper understanding of spatial relationships and concepts. Through hands-on interaction with tangible items, individuals can improve their spatial reasoning abilities and gain practical insights into how objects interact in physical space. This foundational experience with real-world objects lays the groundwork for further development of spatial intelligence, enabling individuals to understand better and solve complex real-world problems (Del Cerro Velázquez & Morales, 2021).

The implications of these findings are significant for educational practitioners and policymakers. Educators should integrate more experiential learning opportunities into their lesson plans. The demonstrated effectiveness of manipulating real objects in improving retention necessitates a reconsideration of current teaching methodologies. Incorporating hands-on activities into the curriculum can bridge the gap observed in traditional instructional approaches.

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Hence, integrating diverse forms of representation plays a vital role in teaching and acquiring mathematical knowledge, contributing significantly to the educational experience. Representation entails the utilization of symbols, characters, diagrams, objects, pictures, or graphs to aid in the teaching and understanding of mathematical concepts (Mainali, 2021).

Table 2: ***Student's Retention Level on the Concepts of Angles After Manipulating Real Objects***

Retention Level	Frequency	Percentage	M	SD
Outstanding	7	22.58	29.43	1.51
Very Satisfactory	11	35.48	24.01	0.94
Satisfactory	7	22.58	21.43	0.54
Fairly Satisfactory	3	9.68	19.33	0.58
Did not Meet the Expectations	3	9.68	13.00	1.73
Overall Performance	31	100.00	23.16	4.80

Note Scale: 26-30 (Outstanding); 23-25 (Very Satisfactory); 21-22 (Satisfactory); 18-20 (Fairly Satisfactory); 1-17 (Did not Meet the Expectations)

C. Significant Difference in the Student's Retention Level on the Concepts of Angles Before and After Manipulating Real Objects

Table 3 presents the analysis of the significant difference in students' retention levels on the concepts of angles before and after manipulating real objects. The data includes mean (M), standard deviation (S.D.),t-value, p-value, and the decision regarding the null hypothesis (Ho).

The results indicate a "highly significant" difference in students' retention levels before and after manipulating real objects. Specifically, the retention level before manipulating real objects (M = 11.71, SD = 3.13) compared to after manipulating real objects (M = 23.16, SD = 4.80) shows a substantial improvement (t = 20.11, p = 0.00). This p-value is less than 0.05, indicating a statistically significant difference.

The findings suggest that manipulating real objects positively impacts students' retention levels regarding the concepts of angles. The considerable increase in mean retention scores demonstrates that hands-on activities with real objects significantly enhance students' understanding and memory retention. In contrast, no non-significant variables are in the table, as all findings indicated significant differences ($p < 0.05$). Therefore, manipulatives are widely considered an effective practice, and within the concrete– representational–abstract instructional framework, an evidence-based practice used for students with a learning disability has been recommended (Peltier et al., 2020). Thus, mathematical manipulatives are tools employed in mathematics education. Students engage with these objects to investigate and understand mathematical concepts and processes. They utilize them in problem-solving tasks, relying on perceptual evidence like visual, tactile, or sensory cues (Bartolini & Martignone, 2020).

The implications of these findings are clear: Educators should incorporate more direct activities involving real objects to improve student comprehension and retention of mathematical concepts, such as angles. Students can achieve a deeper understanding and longer-lasting material retention by doing so. It is recommended that educators implement firsthand learning by regularly incorporating real object manipulation in lesson plans, particularly for abstract concepts like angles. Developing interactive modules and activities that allow students to engage physically with the material can further enhance learning outcomes. Additionally, attending or organizing professional development sessions focused on hands-on teaching strategies can be beneficial. School administrators must provide the necessary resources to ensure classrooms are equipped with manipulatives and real objects for hands-on learning. Supporting teachers through training programs emphasizing the importance and methods of hands-on learning will also contribute to better educational outcomes. Schools can significantly improve students' retention and understanding by integrating these strategies. Students had access to various manipulatives and could exercise voice and choice in selecting the tools that helped them make meaningful connections in math. Utilizing manipulatives in math classrooms enhances student learning by creating a more engaging and effective environment for understanding complex concepts (Rowly, 2020). Truly, Integrating manipulatives in math classes is advantageous for the learner (Lange, (2021).

Table 3: ***Significant Difference in the Student's Retention Level on the Concepts of Angles Before and After Manipulating Real Objects***

Variables	M	SD	t-value	p-value	Decision
Before Manipulating Real Objects	11.71	3.13	20.11	0.00	Reject Ho
After Manipulating Real Objects	23.16	4.80			

Ho: There is no significant difference in the student's retention level on the concepts of angles before and after manipulating real objects

*Note: Probability Value Scale: **p<0.01 (Highly Significant); *p<0.05 (Significant); p>0.05 (Not Significant)*

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D. Other Developments Observed Among the Students After Manipulating Real Objects

The researchers in this study focused on evaluating the effectiveness of incorporating real object manipulation to enhance retention among Grade 7 students struggling with angle concepts. Participants shared individual insights and emotions regarding their experiences with manipulating real objects. Through meticulous analysis, the researchers uncovered emergent themes that shed light on participants' sentiments. Three prominent themes emerged: increased student engagement, real-life application, and angle mastery. The findings highlight the significant impact of real object manipulation on students' retention of angle concepts.

➢ *Increased Student Engagement*

Manipulating real objects in discussions about angles adds a dynamic dimension to learning. Being able to physically interact with objects, like moving the hands of a clock to demonstrate angles, makes the learning experience more engaging and memorable. Furthermore, brainstorming and applying real-world objects to angle concepts fosters creativity and deepens understanding. So, this hands-on approach promotes active participation and enhances comprehension, making the topic of angles more accessible and enjoyable for students. These were mentioned by participants 1, 3, and 10:

"I find manipulating real objects very engaging because I can move the hands of a clock to demonstrate different kinds of angles." (P1)

"It was a fun discussion as I had to think of more real objects that would apply to the angles discussed, such as acute, obtuse, right, inscribed, and central angles." (P2)

"Manipulating real objects makes learning interesting." (P4)

"I like to volunteer in manipulating the real objects because I find it engaging, and the class was actively participating in the lesson about angles. (P10)

The education system needs to reassess its approach to teaching mathematics to enhance students' confidence in the subject. Incorporating manipulatives can help reduce students' anxiety by enriching their learning experience and boosting their engagement. Thus, using manipulatives increases students' engagement (Monte, 2021). Engagement in mathematics and positive attitudes towards the subject are crucial for effective learning. Implementing a classroom intervention grounded in reform mathematics principles—such as active participation, hands-on activities, real-world applications, and using manipulatives and technology—can enhance student engagement and was generated on attitudes. This approach involves students more deeply in their learning, making math more accessible and engaging.

The findings suggest a multifaceted approach to enhancing mathematics education, particularly regarding the teaching of angles. Direct manipulatives in angle discussions increase student engagement and foster a deeper understanding of mathematical concepts. By using manipulatives and technology, students gain a clearer understanding of complex concepts, while collaborative group work creates a supportive environment that boosts both engagement and positive perceptions of mathematics (Irvine, 2020). Encourage the incorporation of direct materials in math teaching to enhance student involvement in learning and problem-solving within mathematics (Roberts et al., 2020). Additionally, teachers frequently remark that incorporating manipulatives into mathematics instruction is enjoyable! Embedded within the notion of 'fun' are crucial concepts concerning the strategies and rationales guiding teachers' utilization of manipulatives in teaching mathematics (Moyer, 2001).

➢ *Mastery of Angles*

Manipulating real objects aids in remembering and understanding angles. By associating angle concepts with tangible examples, it becomes easier to recall them. Besides, visualizing objects about angles allows quick identification and measurement estimation without explicit calculation. This demonstrates the practical application of geometry in everyday observation and problem-solving, highlighting its relevance and utility in various contexts. The lines from participants 1, 3, and 6 confirmed this claim:

"I can easily remember the angles because of the examples with real objects." (P1)

"Real objects help me remember angles better." (P3)

"I only need to think of the object as an example, and I already know what kind of angle it is, as well as its measurement." (P6)

Mathematics has been fundamental to developing numerous modern scientific and technological fields. Across various academic domains, mathematics has been crucial for both learning and pushing the frontiers of existing knowledge. Investigating the impact of using mathematical manipulatives on students' academic performance is significant (Iqbal et al., 2020). Enhancing students' democratic attitudes and mathematical learning achievements through angle measurement materials supplemented by angle-clock props. The findings indicated that students exhibited a positive democratic attitude throughout the learning experience (Pangestu & Bintaro, 2020).

The implications drawn emphasized that incorporating manipulatives offers profound benefits for students' understanding and retention of geometric concepts, particularly angles. Providing tangible examples aids visualization and comprehension. Manipulating real objects as part of mathematical activities enhances students' comprehension of angles. Students gain a profound understanding of angle concepts by physically engaging with manipulatives. This hands-on approach allows them to visualize, measure, and manipulate angles directly, fostering a deeper and more intuitive grasp of geometric principles. Mathematical manipulatives are tools utilized in mathematics education, designed to be interacted with by students to delve

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into, grasp, or examine mathematical ideas or procedures. They enable problem-solving activities by utilizing perceptual evidence, such as visual, tactile, or other sensory cues (Bartolini & Martignone, 2020).

➢ *Real-life Application*

Exposure to real-life examples involving angles helps develop a keen awareness of geometric concepts in everyday objects. This familiarity allows students to easily identify various angles in their surroundings, ranging from the corners of furniture to the shapes of signs and doors. Moreover, applying angle concepts to practical scenarios, such as slicing a cake or pizza evenly, demonstrates the utility of geometry in everyday tasks and reinforces understanding through real-world application. Hence, the ability to recognize angles in familiar objects and apply angle principles to practical situations enhances geometric comprehension and highlights the relevance of geometry in daily life. Participants 4 and 7 supported this claim:

"Because of real-life examples involving angles, I tend to recognize the types of angles in things I see around me, such as tables, chairs, signboards, doors, and more." (P4)

"I can slice a cake equally by applying the concepts of angles and determine the angles of slices of pizza." (P7)

Examine and expound the interconnectedness among the practical utilization of mathematics in everyday scenarios, the application of mathematical principles in real-world contexts, the process of mathematical modeling, and the attainment of mathematical literacy (Mumcu, 2020). In angles, solving mathematical modeling problems entails translating real-world situations, typically described in the text, into mathematical models. This process hinges on understanding the given real-world context, a crucial step in effectively applying mathematical principles to practical scenarios involving angles (Krawitz et al., 2022).

Implementing this claim in an educational setting involves integrating real-life examples of angles into the curriculum. Teachers can encourage students to observe angles in their surroundings, such as the corners of desks, street signs' shape, or doors' tilt. By actively engaging with these examples, students develop a natural familiarity with geometric concepts, making identifying angles in various objects easier. Consequently, active learning strategies encompass various techniques such as interactive presentation styles, group work with discussion and feedback, volunteer presentations of solutions by groups, igniting students' interest in specific topics, involving students in mathematical explorations, experiments, and projects, and importantly, maintaining continuous motivation and engagement among students (Lugosi & Uribe, 2022).

VI. SUMMARY, FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

A. Summary

Mathematics is a fundamental tool for understanding, analyzing, and solving various problems in various aspects of life. It frequently involves abstract concepts and symbols, presenting a challenge for certain students who may need help to retain these concepts. This study aimed to determine the effectiveness of manipulating real objects in enhancing retention among grade 7 students struggling with concepts of angles during S.Y. 2022–2023 in a public institution in Ozamiz. This study used a mixed method research with 31 students as participants using purposive sampling. A research-made test questionnaires and interview guide questions were used to gather data. The data was interpreted and analyzed using statistical tools and qualitative analysis software. The study sought answers to the following research questions: 1) What is the student's retention level on the concepts of angles before manipulating real objects? 2) What is the student's retention level on the concepts of angles after manipulating real objects? 3) Is there a significant difference in the student's retention level on the concepts of angles before and after manipulating real objects? 4) What other developments are observed among the students after manipulating real objects?

B. Findings

The following were the study's key findings:

- The students' retention level on the concepts of angles before manipulating real objects did not meet expectations.
- The students' retention level on the concepts of angles after manipulating real objects was very satisfactory.
- There was a significant difference in the students' retention level on the concepts of angles before and after manipulating real objects.
- Other developments observed among the students after manipulating real objects involved increased student engagement, mastery of angles, and real-life application.

C. Conclusions

The study's findings led to the formulation of the following conclusions:

- Traditional instructional methods alone may not adequately facilitate students' retention of angle concepts.
- Integrating manipulatives into mathematics instruction can significantly enhance students' retention of angle concepts.
- The noticeable difference in students' retention levels regarding angle concepts before and after engaging with real objects highlights the impactful influence of hands-on learning methods.
- Incorporating real objects into educational practices can lead to a more engaging, comprehensible, and applicable learning experience for students.

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D. Recommendations

- Teachers may incorporate manipulatives and real objects in angles to give students tangible, interactive experiences. This approach can help students retain angle concepts by making abstract ideas more concrete.
- Teachers may assess the impact of manipulatives on student learning through formative assessments and reflections. Gathering feedback from students about their experiences with manipulatives can help refine and improve instructional strategies.
- School administrations may organize workshops and seminars where teachers can learn from experts in the field of hands-on learning and share best practices with colleagues.
- Students may approach hands-on activities with curiosity and a willingness to explore. Ask questions and seek to understand how the real objects relate to the concepts being studied.
- Further research could be undertaken to directly compare the effectiveness of traditional instructional methods with the integration of manipulatives and real objects in mathematics education.

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