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Math Strategies Used by Secondary Public School Teachers

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Abstract

Aim: This research aimed to investigate the most effective math strategies perceived by secondary public school teachers in Olutanga Island.

Methodology: The study utilized a mixed methods approach, a combination of quantitative and qualitative approaches. Twenty-six (26) participants were purposely selected for the research from four public schools in Olutanga Island. The study focused on the most effective math strategies perceived by the teachers and the challenges they faced.

Results: Cooperative learning was the most effective math strategy based on their perceptions, and the most frequent challenge was student apathy or disengagement when conducting math classes.

Conclusion: This implies that cooperative learning is the most effective math strategy used by the Olutanga Island teachers to enhance students' active engagement and participation, conceptual understanding, communication and social skills, problem-solving abilities, and positive and inclusive learning environment.

Keywords: Math Strategies, Teaching Strategies, Professional development, Challenges

INTRODUCTION

Mathematics is a fundamental subject that encourages logical thinking and develops problem-solving skills necessary for a variety of academic and professional pursuits (Delgado & Kassim, 2019; Flores, 2022; Muñoz & Sanchez, 2023; Regala, 2023). Most students have a negative attitude toward mathematics. Students tend to develop negative attitudes and concerns towards the subject because of the formulas and rules involved in a mathematics lesson (Altintas & Ilgun, 2017). Students' perception of mathematics was found to have a greater effect on their achievement (Kunwar, 2021; Flores, 2020; Salendab, 2021; Salendab, 2023; Sanchez & Sarmiento, 2020; Sanchez, et al., 2022).

Learning styles are the various ways in which people learn and process information (Escuadro, 2023). They can impact how learners understand, retain, and apply new knowledge (Escuadro, 2023; Amihan & Sanchez, 2023; Dizon & Sanchez, 2020; Flores, 2019a; Salendab & Akmad, 2023; Salendab & Cogo, 2022; Sanchez, 2022; Sanchez, 2020a). That is why understanding their learning styles can help improve the learning process and ultimately lead to better performance (Escuadro, 2023). Learning strategies are a significant predictor of student's academic achievement (Almoslamani, 2022; Carvajal & Sanchez, 2023; Flores, 2019b; Regala, 2022; Salendab & Dapitan, 2020; Sanchez, 2020b; Sanchez, 2023a). In the field of mathematics education, secondary school teachers play an important role in shaping students' understanding, engagement, and performance in this complex field (Salendab & Dapitan, 2021; Salendab & Laguda, 2023; Sanchez, Sanchez & Sanchez, 2023). The effectiveness of mathematics education is highly dependent on the strategies used by educators to convey mathematics concepts and facilitate student understanding. These strategies span a wide range of teaching techniques, teaching methods, and pedagogical approaches and can have a significant impact on a student's mathematics skills and overall attitudes toward the subject (Salendab & Dapitan, 2021b; Sanchez, 2020b).

This study aimed to investigate mathematics strategies employed by secondary public school teachers, with a focus on identifying effective approaches to promote improved student learning outcomes based on teacher



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perceptions. It also aimed to reveal the most successful and effective practices teachers use to promote their understanding and application of mathematics by examining different strategies used by teachers in secondary school settings.

The results of this study will contribute to the existing body of knowledge on effective mathematics instruction by providing valuable insight into the strategies used by secondary public school teachers. This research will inform educators and educational policymakers and serve as a resource for teacher professional development programs promoting the dissemination of good practices in mathematics education. This study aimed to bridge the gap between research and practice by focusing on mathematics strategies that have been successfully used by secondary public school teachers.

Research Questions

This study aimed to identify mathematics strategies employed by public secondary school teachers. Specifically, it sought to address the following key questions:

1. What are the prevailing math strategies implemented by secondary public school teachers of Olutanga Island in their classrooms?
2. How do these strategies vary when considering teacher demographics?
3. What are the challenges encountered in implementing math teaching strategies according to teachers' experiences and perspectives?

METHODS

Research Design

The research employed a mixed-methods research design to comprehensively investigate and analyze the most effective math strategies perceived by secondary public school teachers. This design combined quantitative data collection and analysis with qualitative method to provide a rich and comprehensive understanding of the research topic.

Population and Sampling

This study was conducted among the four secondary public schools in Olutanga Island from June 6, 2023, to June 15, 2023, with twenty-six (26) respondents. Purposive sampling was used, the participants were all teachers who taught math subjects in the identified four public schools in Olutanga Island.

Instrument

A survey questionnaire was used to collect quantitative data on the most effective math strategies perceived by secondary public school teachers from different public schools of Olutanga Island. The survey included questions related to instructional methods, assessment practices, and perceived effectiveness of the strategies. Semi-structured interviews were conducted with public secondary school teachers to gain detailed insight into their experience with specific math strategies. Interviews explored teachers' perspectives on the strengths, weaknesses, and effectiveness of the strategies they used. Instruments were validated by experts in the field.

Data Collection

Following the purpose of the study, data were collected from twenty-six participants, and the researcher read and analyzed the data gathered.

Treatment of Data

The survey data were analyzed using descriptive statistics, such as frequencies and percentages, to identify the prevalent most effective math strategies perceived by secondary public school teachers of Olutanga Island. Qualitative data were analyzed using thematic analysis. Identified emerging themes, and commonalities regarding the effectiveness of different math strategies employed, challenges encountered during math classes, and professional development or training attended related to math instruction.



Ethical Considerations

The researcher obtained consent from four identified public schools and twenty-six (26) participants that ensured the anonymity and confidentiality of the data collected. Ethical guidelines for research involving human subjects were also followed and the researcher adhered to Institutional Review Board protocols.

RESULTS and DISCUSSION

Table 1 presents the profile variables of a group of individuals, along with the corresponding categories, frequencies, and percentages. In terms of age, the participants were distributed as follows: 3 individuals (11.54%) were 50 years old and above, 8 individuals (30.77%) were between 40 and 49 years old, 4 individuals (15.38%) were between 30 and 39 years old, and 11 individuals (42.31%) were between 20 and 29 years old. Regarding sex, there were 4 male participants (15.38%) and 22 female participants (84.62%). The participants' permanent addresses were categorized as follows: 19 individuals (73.08%) resided within the island, while 7 individuals (26.92%) resided outside the island. In terms of educational attainment, 18 individuals (69.23%) held a Bachelor of Secondary Education (BSED) degree in Mathematics, while 8 individuals (30.77%) were not Bachelor of Secondary Education (BSED) Math graduates. The years of teaching experience were categorized as follows: 2 individuals (7.69%) had 30 years or more of teaching experience, 2 individuals (7.69%) had 20-29 years of experience, 5 individuals (19.23%) had 10-19 years of experience, and 17 individuals (65.39%) had 1-9 years of experience. These profile variables provide a demographic overview of the participants and serve as a basis for analyzing and understanding the characteristics of the group about the research or study being conducted.

TABLE 1

PROFILE VARIABLES	VARIABLES CATEGORY	FREQUENCY	PERCENTAG
AGE	50 YEARS OLD-ABOVE	3	11.54
	40 YEARS OLD-49 YEARS OLD	8	30.77
	30 YEARS OLD-39 YEARS OLD	4	15.38
	20 YEARS OLD-29 YEARS OLD	11	42.31
SEX	MALE	4	15.38
	FEMALE	22	84.62
PERMANENT ADDRESS	WITHIN THE ISLAND	19	73.08
	OUTSIDE THE ISLAND	7	26.92
EDUCATIONAL ATTAINMENT	BSED MATH GRADUATE	18	69.23
	NOT BSED MATH GRADUATE	8	30.77
YEARS IN TEACHING	30 YEARS-ABOVE	2	7.69
	20 YEARS-29 YEARS	2	7.69
	10 YEARS-19 YEARS	5	19.23
	1 YEAR-9 YEARS	17	65.39

SECTION 1: CURRENT MATH INSTRUCTIONAL PRACTICES

In this section, the respondents were asked the following questions.

A. Which grade level(s) do you teach?

Answer: Since the respondents were all secondary school mathematics teachers, they taught all grade levels from seven to twelve.

B. How many math classes do you currently teach?

Answer: Based on Table 2 the average math class these teachers teach 4 classes daily. This implies that these teachers were not only teaching math because the regular load in public school is six (6) classes daily.

C. What is the average class size in your math class?

Answer: Based on Table 2 the average class size they were teaching is 42 students. This implies these teachers were teaching below the ideal class size, which is 50, hence the smaller the number of students they were teaching the better.

D. How would you describe your teaching style in math classes?



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Answer: Based on the gathered data 15.38% of the respondents answered Lecture-based, 7.69% answered Inquiry-based, 15.38% answered Problem-solving oriented, and 61.54% answered the blended approach meaning the combination of different styles. Thus, the teaching style of secondary public school teachers of Olutanga Island is a combination of different styles. Teaching styles are significant environmental and social factors in satisfying the need for belongingness in the classroom, which consequently influences motivation and performance (Gillet, & et.al, 2010). In the classroom students are diverse, especially in their learning styles, thus teachers will employ also different learning styles that will suit students' needs.

TABLE 2: MEAN, RANGE OF SECTION 1-B AND 1-C

Descriptives	AGE	YEARS IN TEACHING	1-B	1-C
N	26	26	26	26
Missing	5	5	5	5
Mean	37.0	9.96	3.96	41.8
Std. error mean	2.21	1.87	0.306	1.58
Median	35.0	7.00	4.00	42.0
Mode	26.0	1.00	4.00	35.0 ^a
Standard deviation	11.3	9.56	1.56	8.06
Range	36	33	7	30
Minimum	24	1	1	24
Maximum	60	34	8	54
Kurtosis	-0.759	0.878	0.919	-0.705
Std. error kurtosis	0.887	0.887	0.887	0.887

^a More than one mode exists, only the first is reported

SECTION 2: MATH STRATEGIES (RANKING OF THE MOST EFFECTIVE MATH STRATEGIES)

Table 3 presents the most effective math strategy ranking based on the respondents' perceptions. For Olutanga National High School the most effective strategy was Conceptual Understanding. This implies that understanding the concept of the lesson is very important in the learning process but not easy especially grasping the why part of the lesson because you need the best tools in increasing conceptual understanding. For Mabuhay National High School, the most effective strategy was Using Concepts in Math Vocabulary. They believe a mathematical concept must be employed in mathematics classes because the more ways you can describe a mathematical concept the better you understand the meaning of the concept. For Talusan National High School the most effective strategy was Cooperative Learning. Students are more comfortable sharing their ideas with students. Working together will bring positive output and it will help not only the students who lead but also those who are struggling especially if it is monitored by the teacher. And lastly, for Mabuhay Agro-Industrial High School Strategic Questioning was the most effective strategy. Strategic questions will make simple math lessons into a deep learning experience. Asking questions on how they arrive at the solution will make them understand the lesson better. The table also shows that in the four public schools of Olutanga Island, the most effective math strategy perceived by secondary public school teachers was cooperative learning. Cooperative learning can positively impact all learners whether they are low achievers, high achievers, or have learning disabilities (Kent et al., 2015; Sangeeta & Sunita, 2019). This implies, with cooperative learning if employed by the teachers in teaching math lessons there would be a greater probability of achieving higher students' academic achievement whether they are enrolled in public or in private schools.

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TABLE 3: RANKING OF THE DIFFERENT STRATEGIES (BY SCHOOL)

STRATEGY	ONHS RANK	MNHS RANK	TNHS RANK	MATHS RANK	ALL RANK
EXPLICIT INSTRUCTION	3	8	7	5.5	6
CONCEPTUAL UNDERSTANDING	1	5	2	4	2
USING CONCEPTS IN MATH VOCABULARY	4	1	4	5.5	4
COOPERATIVE LEARNING	2	7	1	2	1
MEANINGFUL AND FREQUENT HOMEWORK	12	9	9	12	10
MATH GAMES	6	10.5	5	8	7.5
REFLECTION TIME	9	12	10	11	12
PROBLEM-SOLVING	7	2.5	6	3	5
TECHNOLOGY TO ENHANCE EFFECTIVE STRATEGIES FOR MATH	8	4	11	10	9
STRATEGIC QUESTIONING	5	2.5	3	1	3
REPETITION	10	6	8	7	7.5
MANIPULATION TOOLS	11	10.5	12	9	11

Table 4 shows the ranking of the most effective math strategy based on the age of the respondents. For those respondents aged 50 years old and above and 30 years old to 39 years old Conceptual Understanding was the most effective strategy. According to Mills (2018), conceptual understanding is a process, and when this process is utilized, students may better connect and organize knowledge aiding in the knowledge transfer that occurs between theory and practice. Hence understanding the concept first before applying different theorems is better than giving direct examples to the lesson. For those aged 40 years old to 49 years respondents, Cooperative Learning was the most effective, while for those respondents aged 20 years old to 29 years old, Problem-solving was the most effective strategy in teaching mathematics. Learning through a problem-solving strategy was more effective than the scientific approach to students' mathematical abilities in communication, creativity, problem-solving, and mathematical reasoning (Tambunan, 2019). The table shows that the most effective math strategies perceived by the respondents based on their ages varied since these respondents taught varied students with varied grade levels. Older teachers of age 41 years old and above are more effective in teaching and good in classroom management skills than younger teachers in high school (Zafer and Aslihan, 2012). This study has similar findings to Nyagah and Gathumbi (2017) in their cross-sectional survey in Kenya who found that older teachers were more likely to increase students' learning compared to their middle age and younger teachers. Thus, identifying which of those teaching strategies is the most effective is very important in connecting it to the ages of the teachers.

Table 4

STRATEGY	AGE			
	50 YEARS OLD-ABOVE	40 YEARS OLD-49 YEARS OLD	30 YEARS OLD-39 YEARS OLD	20 YEARS OLD-29 YEARS OLD
EXPLICIT INSTRUCTION	6.5	2	5	8
CONCEPTUAL UNDERSTANDING	1	3	1	5
USING CONCEPTS IN MATH VOCABULARY	5	4	6	4
COOPERATIVE LEARNING	2	1	3.5	2
MEANINGFUL AND FREQUENT HOMEWORK	12	10	8.5	9.5
MATH GAMES	6.5	6	10	7
REFLECTION TIME	11	11.5	11	12
PROBLEM-SOLVING	9	7	2	1
TECHNOLOGY TO ENHANCE EFFECTIVE STRATEGIES FOR MATH	3	8	8.5	9.5
STRATEGIC QUESTIONING	4	5	3.5	3
REPETITION	9	9	7	6
MANIPULATION TOOLS	9	11.5	12	11

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Table 5 shows the ranking of the most effective strategy based on the respondents' years of experience. Teachers with more years of teaching experience can manage well the classroom and have higher self-efficacies to engage students compared to those new in the field of teaching (Zafer and Aslihan, 2012; Putman, 2012). But separate studies conducted by Mahfooz ul Haq and Mumtaz Akhtar (2013) and Maolosi (2013) found that years of teaching experience can affect teacher effectiveness in engaging students and teaching strategies as they can become less motivated due to many years in the service and fatigue. This means knowing teachers' perceptions of the effectiveness of the different math strategies will give feedback on how teachers manage their math classes based on their ages. For those who were teaching 30 years and above the Conceptual Understanding was the most effective strategy. For teachers who were teaching for 20 years but not greater than 29 years both Explicit Instruction and Conceptual Understanding were the most effective strategies. They believed that explicit instruction is the foundation of any teaching strategy, thus it is still an effective teaching strategy. While for those teachers who are in 10 years of service but not greater than 19 years of service, Conceptual Understanding and Cooperative Learning were the most effective strategies, and lastly those who were in their 1 year but not greater than 9 years in service Problem Solving was their most effective strategy in teaching mathematics. The result shows that regardless of years of teaching experience the effectiveness of the strategy based on teachers' perceptions still varied.

TABLE 5: RANKING OF THE DIFFERENT STRATEGIES (RESPONDENTS' YEARS IN TEACHING)

STRATEGY	YEARS IN TEACHING			
	30 YEARS - ABOVE	20 YEARS- 29 YEARS	10 YEARS -19 YEARS	1 YEAR -9 YEARS
EXPLICIT INSTRUCTION	8.5	1.5	3	6
CONCEPTUAL UNDERSTANDING	1	1.5	1.5	5
USING CONCEPTS IN MATH VOCABULARY	5.5	3.5	5	4
COOPERATIVE LEARNING	3	3.5	1.5	2
MEANINGFUL AND FREQUENT HOMEWORK	12	9.5	8.5	10
MATH GAMES	4	7.5	8.5	8
REFLECTION TIME	10.5	7.5	11	12
PROBLEM-SOLVING	8.5	11.5	6	1
TECHNOLOGY TO ENHANCE EFFECTIVE STRATEGIES FOR MATH	2	11.5	10	9
STRATEGIC QUESTIONING	7	5	4	3
REPETITION	10.5	6	7	7
MANIPULATION TOOLS	5.5	9.5	12	11

Table 6 shows the ranking of the most effective strategy based on the respondents' sex, permanent address, and educational attainment. For those who were male respondents, the most effective math strategy was Using the Concepts in Math Vocabulary while for those females Cooperative Learning was their most effective strategy. Researchers found that male teachers typically lecture for most of each class session while female teachers are more likely to engage students with active and collaborative learning approaches, which are classified as learner-centered instructional practices. And When strategies were ranked based on the permanent address of the respondents, Cooperative Learning was the most effective strategy for those who resided in Olutanga Island. Cooperative Learning and Problem-Solving were the most effective strategies for those who resided outside the island. As for educational attainment, for those respondents who were BSED Math Graduates and not BSED Math Graduates the most effective math strategy was Cooperative Learning. Thus, regardless of the bachelor's degree earned by the respondents since most of the respondents are female then cooperative learning is the prevalent strategy perceived.



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TABLE 6: RANKING OF THE DIFFERENT STRATEGIES (RESPONDENTS' SEX, PERMANENT ADDRESS, AND EDUCATIONAL ATTAINMENT)

STRATEGY	SEX		PERMANENT ADDRESS		EDUCATIONAL ATTAINMENT	
	MALE	FEMALE	WITHIN THE ISLAND	OUTSIDE THE ISLAND	BSED MATH GRADUATE	NOT BSED MATH GRADUATE
EXPLICIT INSTRUCTION	2.5	6	5	4.5	6	4
CONCEPTUAL UNDERSTANDING	4.5	2	2	6	2	3
USING CONCEPTS IN MATH VOCABULARY	1	5	4	4.5	4	5
COOPERATIVE LEARNING	2.5	1	1	1.5	1	1
MEANINGFUL AND FREQUENT HOMEWORK	12	10	10	12	11	10
MATH GAMES	7	8	7	8	7	9
REFLECTION TIME	10.5	12	12	11	12	11
PROBLEM-SOLVING	6	4	6	1.5	5	6
TECHNOLOGY TO ENHANCE EFFECTIVE STRATEGIES FOR MATH	8	9	9	9	9	7
STRATEGIC QUESTIONING	4.5	3	3	3	3	2
REPETITION	10.5	7	8	7	8	8
MANIPULATION TOOLS	9	11	11	10	10	12

B. How do you assess students' understanding and progress in math? (Select all that apply)

Answer: Based on Table 7, the participants used different ways of assessing their students' understanding and performance, but both written tests, quizzes, and problem-solving tasks were the most used assessment by the respondents. This implies that these participants employed both assessment of learning or a grade-based assessment when giving written tests or quizzes and an assessment of learning or actively involving students in learning when given a problem-solving task. The measurement of student learning through assessment is important because it provides useful feedback to both instructors and students about the extent to which students are successfully meeting course learning objectives (Fisher, 2023). The assessment tool to be used depends on the learning objectives of the teacher, the goal is to meet the learning objectives discussed before the start of class.

TABLE 7

ASSESSMENT	FREQUENCY	PERCENTAGE
Written tests and quizzes	24	92.31
Oral presentations or discussions	23	88.46
Problem-solving tasks	24	92.31
Projects and assignments	22	84.62
Performance-based assessments	22	84.62

C. What challenges do you encounter when implementing math strategies in your classes? (Select that apply)

Answer: Based on Table 8 the participants faced different challenges when they implemented math strategies. The highest among the challenges identified with a percentage of 80.77% was student apathy or disengagement. It is evident if students are not motivated to cooperate and listen to class discussion there is a greater probability of not achieving the learning objectives. According to Benders (2011), students' apathy is the primary barrier to why students are not performing, and achievement attained, and it also increases the rates of diminishing education. Teachers' main role is to motivate students regardless of their backgrounds. It is difficult yet fulfilling.

TABLE 8

CHALLENGES	FREQUENCY	PERCENTAGE
Limited instructional time	16	61.54
Lack of resources or materials	19	73.08
Large class size	19	73.08
Student apathy or disengagement	21	80.77
Lack of teacher training or professional development	15	57.69



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D. Have you received any professional development or training related to math instruction? If yes, please provide the year attended.

Answer: Table 9 shows the professional development or training received by the participants. Based on the table 57.69% of the participants have not attended any professional development related to math instruction. This implies that the higher authority must make it a priority since teachers are the main actor in teaching and learning scenarios. Teachers can improve their time management and organization skills by pursuing professional development or training related to math instruction. In the end, this increases teacher productivity and frees up more time for them to concentrate on students' academic performance.

TABLE 9		FREQUENCY	PERCENTAGE
YES	YEARLY	3	11.54
	2020	5	19.23
	2016	1	3.85
	2015	2	7.69
NO		15	57.69

Summary, Conclusions, and Recommendations

Mathematics is one of the subject areas of education that plays an important role in molding and enhancing students' intellectual ability for success in the future. Thus, it is crucial to identify effective math strategies in secondary public schools in Olutanga Island to make students inspired in their studies since motivating them is the main role of the teachers in enhancing students' learning. This research aimed to address which among those identified math strategies is suitable to students residing in Olutanga Island implemented by secondary public schools despite the different challenges faced by the teachers. This study showed that cooperative learning was the most effective math strategy based on the teachers' perception. Also, the study showed the most frequent challenge faced by the teachers in Olutanga Island was student apathy or disengagement when having math classes. This study is highly recommended based on the data gathered on the conduct of professional development or training related to math instruction since most of the teachers have not attended any training related to math instruction.

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