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Research Paper

Common teaching strategies of mathematics teachers and learning achievement of high school students at Tacurong National High School

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ABSTRACT

Students' academic experiences are greatly influenced by effective teaching methods, especially in topics like mathematics. This study explores the opinions of math teachers about using different teaching pedagogies with high school pupils. Without an organized plan, information could be shared that isn't relevant to the interests of the students, which highlights the need of using a variety of techniques to create positive discipline and encourage student motivation. Twenty-two high school math instructors from a public school in New Isabela, Tacurong City, Sultan Kudarat, were chosen as respondents using a Purposive Sampling Technique. The study uses a validated questionnaire to measure teacher impressions and uses a quantitative comparative design. To evaluate the collected data, statistical methods such as mean, One-way-analysis of Variance, and Tukey-Kramer were used. The computed F-value of 3.238 indicates that the results show a significant difference in the learning achievement of High School pupils in Mathematics when exposed to diverse teaching styles. This emphasizes how crucial it is to modify teaching strategies to meet the various needs of students. The study provides insightful information about how different teaching methods can improve students' academic performance in mathematics, laying the groundwork for further research and possible advancements in teaching methods. Comprehending the viewpoints of educators about these tactics can facilitate the creation of focused interventions aimed at enhancing the educational experience for High School Mathematics pupils.

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1. INTRODUCTION

Mathematics is widely considered challenging, and students are not particularly interested in learning this subject. Because it is applied to numeracy skills, mathematics plays a significant role. It is the primary tool for helping students develops higher-order intellectual capabilities and logical reasoning. Mathematical concepts are crucial for developing basic numeracy skills, but it also serves as the language of science for various other scientific disciplines. Despite the stigma associated with studying math, talented people in this subject are frequently regarded as usual.

The use of teaching strategies in the classroom is essential. Without a plan, teachers would be randomly projecting information that does not relate to students' interests. Schemes encourage involvement, connection, and excitement in the delivery of the subject.

The most significant factor influencing student accomplishment in the educational system is teachers. Mathematical knowledge among students can be increased, and math performance can be enhanced by teachers who have mastered effective teaching strategies and methods (Core Learning, 2023). The teacher is responsible in the classroom and offers the framework for the children to learn. How a teacher presents a task or idea significantly impacts how the students respond to it.

A good teacher uses various methods and techniques to establish constructive discipline and inspire students. Teachers must identify the issues that students frequently encounter to lessen or eliminate problems, allowing for the achievement of mathematics competencies evident in students' increased performance.

Math performance issues can be attributed to teachers' failure to provide students with the required information, abilities, attitudes, and values. Brown (2022) cited that additional common teaching strategies might be used in high school classrooms, but their effectiveness is still unknown. There is a study vacuum in determining how different selected teaching strategies affect high school pupils' mathematics achievement.

The researchers believe that schools are still working to improve students' education. Limited research has been done to determine whether the integration of math games, reflection time, verbalizing math problems, puzzle pieces' math instruction, meaningful and frequent homework, cooperative learning strategies, using concepts in math vocabulary, conceptual understanding, and explicit instruction are beneficial in high school mathematics classrooms [1].

Further study is required to investigate how high school mathematics teachers perceive these common teaching strategies in the students' learning outcomes. Researchers were motivated to conduct a study based on the information to evaluate the common teaching strategies of mathematics teachers and the student's learning achievement at Tacurong National High School.

2. RELATED WORK

This chapter presents the different theories and literature of related studies. It includes citations from studies both outside the country and locally, giving ideas and direction or insight into this study. In particular, issues discussed include teaching strategies, conceptual understanding studies, cooperative learning studies, integration of math games studies, learning achievements, and learning competency.

Similarly, a study by Tarmizi and Bin Ahmad (2018) examined the effectiveness of cooperative learning in enhancing students' critical thinking skills in mathematics. The findings showed that cooperative learning students exhibited better necessary thinking skills than those taught traditional methods. In addition, a study by Chen explored the effects of cooperative learning on students' mathematical problem-solving abilities. The researchers found that cooperative learning students had higher problem-solving skills than those taught traditional methods. Along the way, Gail & Anthony (2013) define the Likert scale in medical education research and medical education; Likert-type scales were employed. The evaluation of trainee performance following an educational intervention, faculty evaluations of trainees, and end-of-rotation trainee feedback was commonly used. Furthermore, a study by [2] investigated the effects of cooperative learning on students' attitudes toward mathematics. The findings

showed that cooperative learning students had more positive attitudes toward mathematics than those taught using traditional methods. A study by [3] examined the effect of cooperative learning on students' motivation to learn mathematics. The results showed that students taught using cooperative learning were more motivated to learn mathematics than those taught using traditional methods.

According to a study of [4], students who had instruction that strongly emphasized conceptual understanding were more likely to use adaptable problem-solving techniques and exhibit higher levels of mathematical reasoning than those with an education only concerned with procedural fluency.

Limited research has been done to determine whether the integration of math games, reflection time, verbalizing math problems, puzzle pieces' math instruction, meaningful and frequent homework, cooperative learning strategies, using concepts in math vocabulary, conceptual understanding, and explicit instruction are beneficial in high school mathematics classrooms [1]. A Likert scale, which is a multidimensional measure, to gather the responses and views of the respondents. This psychometric scale is frequently used by researchers to learn how people feel about a particular scope of the study [5]. As articulated by [6]. Using their knowledge, researchers employ the non-probability "purposeful sampling" method to select particular subjects that aided the study's objectives. The entire test or survey questionnaire is also reasonable based on the Highly acceptable value of 0.80 for 5 validators [7]. Math games have been demonstrated to boost student engagement and motivation in mathematics. Students are more likely to be interested in and motivated to learn when participating in math games. Math games give students a fun and engaging learning experience that encourages them to participate actively in the subject, increasing their motivation and enthusiasm [8].

3. METHODOLOGY

This section outlines the research methodology used in the study to determine the extent to which specific teaching techniques are used by mathematics teachers and how well high school pupils are learning. The research design, respondents, locale, sampling techniques, data gathering instrument, data gathering procedure, and statistical treatment are all covered. Teaching strategies were used to systematically gather and analyze data to answer the research questions and fulfill the goals of the study.

3.1. Research Design

The research design employed in this study is a quantitative comparative research design using frequency distribution and ANOVA. An ANOVA was used to determine the extent of the relationship between these teaching strategies and the mean grades of students in different sections at Tacurong National High School. Frequency distribution was used to identify mathematics teachers' perceptions of their selected teaching strategies.

3.2. Locale of the Study

The study was conducted at Tacurong National High School (TNHS) in Tacurong City, Sultan Kudarat, Philippines. Figure 1 shows the detailed map referring to the locale of the study (Google Source, 2023).



Figure 1. Map Showing the Locale of the Study

3.3. Respondents of the Study

Tacurong National High School is a public secondary school in Tacurong City with the largest number of Mathematics Teachers. There were 23 who were currently teaching in the school year 2022-2023. Junior high school has 16 out of 16, and senior high has 6 out 7 in total high school Mathematics teachers responded from the tool distributed. Researchers opted to conduct the study in this institution that makes up the study to gather data.

Table 1. Sample Distribution of Respondents

Mathematics Teacher (Tnhs)	F	%
Junior High School (JHS)	16	70%
Senior High School (SHS)	6	26%
Total	n = 22	96%

3.4. Sampling Techniques

The study utilized a purposive sampling method to select the math teachers, as articulated by [6]. Using their knowledge, researchers employ the non-probability "purposeful sampling" method to select particular subjects that aided the study's objectives. The researchers must consider these people's unique qualities to assess their study question. In other words, the researchers choose the subjects "on purpose." The researchers opted to conclude with respondents in acquiring data. They ensured that the sample included math teachers with the appropriate education and expertise for teaching high school math at Tacurong National High School.

3.5. Data Gathering Instruments

The researchers developed a questionnaire as the primary tool to collect data from the teachers in this study. The researchers formulated the questionnaire based on the research questions and literature review. Below are the phases in the process of the tool analysis.

3.5.1. Phase 1: Identification of Common Teaching Strategies

The researched review and relevant literature on teaching strategies in Mathematics education have identified a set of teaching strategies commonly employed by Mathematics teachers. Then, the researcher collated the data answered and selected the most used teaching strategies in mathematics. These game-based learning strategies, conceptual understanding strategies, and cooperative learning strategies were used as the independent variable in the study.

3.5.2. Phase 2: Development of Researcher-Made Questionnaire

The researchers developed a questionnaire based on the identified teaching strategies. The questionnaire consisted of items that assess the perception of Mathematics teachers toward these teaching strategies. The items were formulated using a Likert scale format, with responses ranging from strongly agree to strongly disagree. Researchers utilize a Likert scale, which is a multidimensional measure, to gather the responses and views of the respondents. This psychometric scale is frequently used by researchers to learn how people feel about a particular scope of the study [5].

Table 2. Likert Scale

Numerical Scale	Qualitative Rating
5	Strongly Agree
4	Agree
3	Neutral
2	Disagree
1	Strongly Disagree

To describe the student's extent of learning achievement when exposed to the three common teaching strategies, the calculated mean grades collected from mathematics teachers were then described accordingly, as shown in Table 1 based on the DepEd Order No. 8. (2015) Policy Guidelines on Classroom Assessment for the K-12 Basic Education Program, as a basis with corresponding grading scale shown on Table 3.

Table 3. Extent of Learning Achievement

Descriptors	Grading Scales	Remarks
Outstanding	90-100	Passed
Very Satisfactory	85-89	Passed
Satisfactory	80-84	Passed
Fairly Satisfactory	75-79	Passed
Did not meet the expectation	74 and below	Failed

3.5.3. Phase 3: Validation and Pilot Testing of the Questionnaire

The tool underwent validation from the expert that it has made revisions and correctness in validating the survey questionnaire that should be connected to the SOPs as presented and was proved valid. Furthermore, after the questionnaire was validated, the researchers conducted a pilot test with a small group of Mathematics teachers to assess its clarity, comprehensibility, and appropriateness of items for measuring perception. Based on the feedback from the pilot testing, necessary revisions were made to the questionnaire.

3.6. Validity and Reliability of the Instrument

The instrument's validity was validated through a thorough analysis of pertinent literature on teaching techniques and working together with experts in the field of mathematics education. The latter were selected as they were knowledgeable in educational management. Results of content validation showed that indices for I-CVI in GLS = 1, CUS = 0.94, and CLS = 0.96 were all acceptable, while S-CVI/UA for GLS, CUS, and CLS is 0.1.

Thus, all items were considered valid. The entire test or survey questionnaire is also reasonable based on the Highly acceptable value of 0.80 for 5 validators [7]. The researchers also ran a pilot test with a small group of math teachers to evaluate the questionnaire's clarity, consistency, and relevance for assessing perception. The instrument's reliability was evaluated through a pilot testing of the questionnaire with a small group of Mathematics teachers. The researchers calculated Cronbach's Alpha coefficient to determine the internal consistency of the items. A coefficient of at least 0.70 is considered acceptable for research instruments.

Table 4. Cronbach's Alpha of Interpretation

A Cronbach's Alpha (α)	Descriptive Interpretation of the Internal Consistency
0.90 – 1.00	Excellent
0.70 – 0.89	Highly Acceptable
0.60 – 0.69	Acceptable
0.50 – 0.59	Poor
0.00 – 0.49	Unacceptable

The tool obtained a Cronbach's Alpha of 0.77 for the game-based learning strategy, 0.74 for conceptual understanding, and 0.79 for the cooperative learning strategy, which indicated that all items were highly acceptable and, therefore, reliable. Computation is shown in Appendix11.

3.7. Data Gathering Procedure

The data-gathering procedure for this study was conducted in several phases to ensure a

systematic and rigorous approach to data collection. The researchers obtain permission from the school authorities to complete the survey at Tacurong National High School from the pre-survey through the conduct of the final study. A letter of approval to conduct was sent formally to the school principal's office and approved by Teresita H. Escobia, Principal II. The Mathematics Coordinator permitted it, Patricia B. Nicor, MT I. The questionnaire was administered to the teachers during a designated time, and researchers retrieved it after they finished answering. Then, the mean grades of the students obtained were examined to the extent of the student's learning achievements. The mean grades were collected from different sections of high school students handled by the respondents at Tacurong National High School. After that, encoding, organizing, and interpreting the data gathered were performed and present

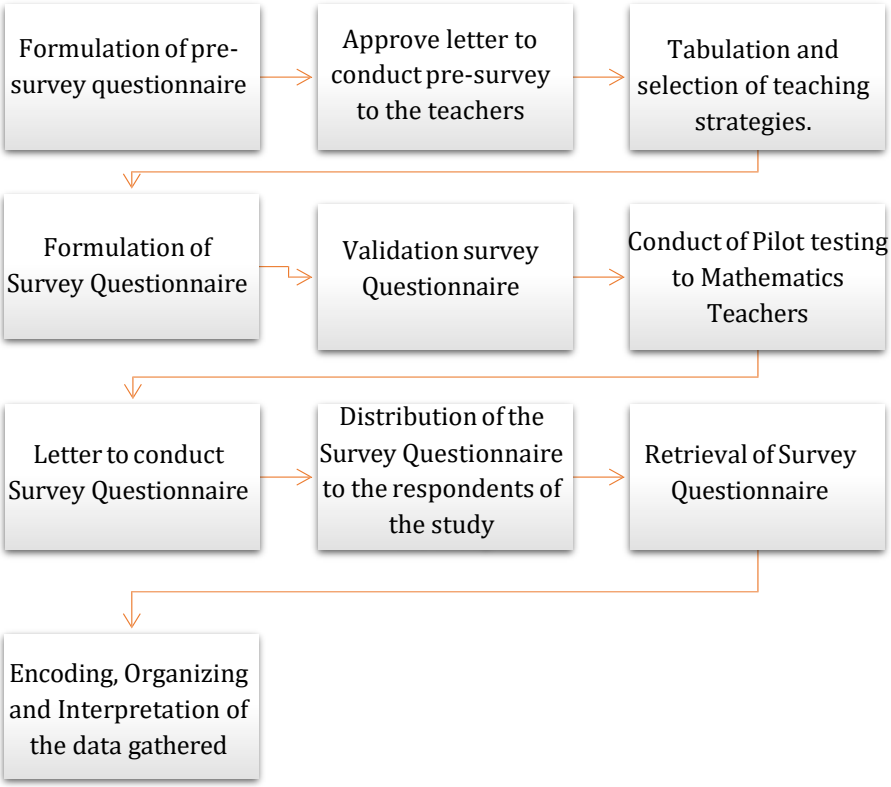

Figure 2. Flow Process in Data Gathering

3.8. Statistical Treatment

After data was gathered from the survey questionnaires, and checklist form was encoded using Microsoft Excel applications. Descriptive and inferential statistics were used in data analysis. The mean and standard deviation were applied to describe the game-based learning strategy employed by mathematics teachers. Likewise, the mean range and qualitative description, as shown, were used to interpret the results. The game-based learning strategy employed by math teachers was described using mean and standard deviation. The following mean range and qualitative description were used to interpret the results.

Table 5. Mean Range and Qualitative Description to Interpret the Results Toward Game-Based Learning Strategies

Range	Verbal Description	Interpretation
4.20 – 5.00	Very High	The Teachers are always using game-based learning strategies in the classroom.
3.40 - 4.19	Above Average	The Teachers are very often using game-based learning strategies employed inside the classroom.
2.60 – 3.39	Average	The Teachers are sometimes using game-based learning

		strategies in the classroom.
1.80 – 2.59	Below Average	The Teachers are rarely using game-based learning strategies in the classroom.
1.00 – 1.79	Very Low	The Teachers are never using game-based learning strategies in the classroom.

Similarly, the conceptual understanding strategy employed by math teachers was described using mean and standard deviation. The following mean range and qualitative description were used to interpret the results.

Table 6. Mean Range and Qualitative Description to Interpret the Results toward Conceptual Understanding Strategies

Range	Verbal Description	Interpretation
4.20 – 5.00	Very High	The Teachers are always using conceptual understanding strategies in the classroom.
3.40 - 4.19	Above Average	The Teachers are very often using conceptual understanding strategies employed inside the classroom.
2.60 – 3.39	Average	The Teachers are sometimes using conceptual understanding strategies employed inside the classroom.
1.80 – 2.59	Below Average	The Teachers are rarely using the conceptual understanding strategy employed inside the classroom.
1.00 – 1.79	Very Low	The Teachers are never using conceptual understanding strategy inside the classroom.

Similarly, the cooperative learning strategy was described using mean and standard deviation. The following mean range and qualitative description were used to interpret the results.

Table 7. Mean Range and Qualitative Description to Interpret the Results toward Cooperative Learning Strategies

Range	Verbal Description	Interpretation
4.20 – 5.00	Very High	The Teachers are always using cooperative learning strategies in the classroom.
3.40 - 4.19	Above Average	The Teachers are very often using cooperative learning strategies in the classroom.
2.60 – 3.39	Average	The Teacher sometimes uses a cooperative learning strategy in the classroom.
1.80 – 2.59	Below Average	The Teacher rarely uses cooperative learning strategy in the classroom.
1.00 – 1.79	Very Low	The Teacher never uses a cooperative learning strategy inside the classroom.

The mean grades of the students of the different sections were calculated and compared using Analysis of Variance (ANOVA) to determine if there were any significant differences in the learning achievement of students towards the common teaching strategies employed by the mathematics teachers. ANOVA is an appropriate statistical test for comparing the means of three or more groups. Post hoc tests, such as the Tukey-Kramer, were conducted because of the significant differences found in the ANOVA results. The statistical analysis was performed using software such as SPSS (Statistical Package for the Social Sciences) or other suitable statistical tools. The significance level for all statistical tests was set at $p < 0.05$ to determine the findings' significance level. The statistical analysis results were presented in tables and/or graphs to facilitate straightforward Interpretation and understanding.

4. RESULTS AND DISCUSSION

This section presents the findings and discussions of the study concerning the research questions stated in Chapter I. Analyses of the data are based on the statistical methods specified earlier in this paper. The collected data and their associated meaning are shown in the following tables.

4.1. Common Teaching Strategies

Teaching strategies are ways used by educators to increase comprehension and facilitate learning in students. Effective teaching strategies consider the subject matter, the requirements and skills of the students, and the learning objectives. Table 8, Table 9, Table 10, Table 11, Table 12, illustrate the findings of the study. In particular, the dominant teaching strategies employed by Mathematics teachers at Tacurong National High School are presented in Table 8.

Table 8. Common Teaching Strategies Employed by Math Teachers

Dominant Teaching Strategies	F	%
Conceptual Understanding Strategy	15	16. 30%
Game-based learning Strategy	14	15.22%
Cooperative Learning Strategy	13	14.13%
Using Concepts in Math Vocabulary	11	11.96%
Verbalized Math Problem	10	10.86%
Meaningful and frequent homework	9	9.78%
Explicit Instruction	8	8.69%
Puzzle piece's math instruction	6	6.52%
Reflection time	6	6.52%
Total	92	100%

It can be seen that 16.30% or 15 of high school teachers primarily employ a conceptual understanding learning strategy. Also, 15.22% of 14 predominantly utilize the game-based learning strategy. Very few, or 6.52%, used reflection time when teaching in the classroom. It implies that the high school Math teachers were generally perceived to be dominantly using conceptual understanding strategy as a medium of the strategy employed towards the designated classrooms.

4.2. The Perceptions of Mathematics Teachers towards Common Teaching Strategies

Various advantages, difficulties, and possibilities connected with using game-based teaching strategy (GLS), conceptual understanding strategy (CUS), and cooperative learning strategy (CLS) in mathematics instruction can be better understood by considering teacher perceptions. This investigation will help us better understand how teachers view specific teaching strategies and how they affect students' learning. Table 9 present summary of the teacher's perception of common teaching strategies employed in mathematics.

Table 9. Summary of Common Teaching Strategies Employed by Mathematics Teachers

Selected Teaching Strategies	Mean Rating	Sd	Qualitative Interpretation
Conceptual Understanding Strategy (CUS)	4.82	0.14	Very High
Game-based Learning Strategy (GLS)	4.53	0.10	Very High
Cooperative Learning Strategy (CLS)	4.64	0.11	Very High

As revealed, the mean scores of 4.82 and 4.64, respectively, mathematics teachers strongly agree on using CUS, CLS, and GLS in the classroom. It suggests sufficient proof that teachers are very particular in their methods to produce good student learning outcomes. According to a study of [4], students who had instruction that strongly emphasized conceptual understanding were more likely to use adaptable problem-

solving techniques and exhibit higher levels of mathematical reasoning than those with an education only concerned with procedural fluency.

4.3. The Extent of Learning Achievement of High School Student

An in-depth analysis of the extent of learning achievements among high school students concerning Game-Based Learning Systems (GLS), Computer-Utilized Simulations (CUS), and Collaborative Learning Strategies (CLS) depicts in Table 10.

Table 10. The Extent of Learning Achievement of High School Students

Common Teaching Strategies	Grades Mean	Sd	Description
Conceptual Understanding Strategy (CUS)	86.62	2.09	Very Satisfactory
Game-based Learning Strategy (GLS)	84.42	2.03	Satisfactory
Cooperative Learning Strategy (CLS)	83.98	1.63	Satisfactory
Total	85.00	1.91	Very Satisfactory

Table 10 reveals the extent of learning achievements among High School students toward GLS, CUS, and CLS. It suggests sufficient proof that teachers are very particular in CUS to produce good student learning outcomes, with grades mean 86.62 and 84.42, respectively. Supported from the study of Rittle-[9] revealed that students who developed a solid conceptual understanding of mathematical concepts tended to retain and transfer their knowledge to new situations over time than students focused primarily on procedural skills [10].

4.4. One-Way Analysis of Variance and Post-Hoc Test on Mean Grades

This section explores the exciting subject of analyzing the achievements of three teaching approaches used in mathematics instruction. Table 11, Table 12 present essential findings about the successful application of game-based learning, conceptual understanding, and cooperative learning procedures using the One-way Analysis of Variance (ANOVA) and posthoc test on mean grades.

Table 11. Result of the One-Way Analysis of Variance on Mean Grades of the Three Common Teaching Strategies in Mathematics

Common Teaching Strategies	Grades Mean	F-Ratio	F-Tab	Interpretation
Conceptual Understanding Strategy (CUS)	86.62	7.84	3.23	Significant
Game-based Learning Strategy (GLS)	84.42			
Cooperative Learning Strategy (CLS)	83.98			

As reflected in Table 11, the computed F-ratio of 7.84 is greater than the tabulated F-value of 3.23 at the $\alpha = 0.05$ level of significance, which further facilitates that there is a significant difference among the mean grades of the three teaching strategies. It implies further that the three common teaching strategies used by the teachers in delivering the lessons may likely affect the student's learning achievements. In this case, a mean separation can be used to determine which strategies are significantly different and which are comparable by using the Tukey-Kramer Test revealed in Table 12.

Table 12. Result of the Tukey-Kramer Test on Mean Grades of the Three Teachings Strategies

Common Teaching Strategies	Grades Mean
Conceptual Understanding Strategy (CUS)	86. 62[a]
Game-based Learning Strategy (GLS)	84.32[b]
Cooperative Learning Strategy (CLS)	83.98[c]

As indicated in Table 12, the CUS and GLS have a mean difference of 2.29, greater than the Tukey-Kramer value of 0.89 at $\alpha = 0.05$ significance level. The result reveals that a significant difference exists between the mean of CUS and the mean of GLS. It implies further that CUS are effective as compared to the

utilization of GLS as far as grades mean are concerned. However, the CUS and CLS have a mean difference of 2.64, greater than the Tukey-Kramer value of 1.79 at α = 0.05 significance level. The result indicates that there is a significant difference between the said strategies. It suggests sufficient proof that CUS are effective compared to CLS.

Finally, the GLS and CLS have a mean difference of 0.34, less than the Tukey-Kramer value of 1.82 at α = 0.05 significance level. The result shows that no significant difference exists between the mean of CUS and the mean of CLS. Indeed, conceptual understanding strategy is better compared to game-based learning Strategy and cooperative learning strategy. These findings highlight the importance of prioritizing conceptual understanding in mathematics education to support effective, meaningful and compelling learning experiences for students.

5. CONCLUSION

Based on the findings of the study, among the 9 identified teaching strategies in learning mathematics, teachers are generally aware of and receptive to conceptual understanding strategies as a form of teaching in mathematical education. Educators are now using this strategy more frequently to strengthen students' appreciation and application of mathematics. Meanwhile, researchers found significant differences in the three common teaching strategies, conceptual understanding, game-based learning, and cooperative learning strategy, which are noticeably different.

Each strategy has a particular advantage and influence. Furthermore, the Tukey-Kramer results support the researchers' findings that the conceptual understanding method substantially contributes to students' learning successes.

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Author Contributions Statement

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Lucino C. Sugabo Jr.	✓	✓	✓	✓		✓		✓	✓	✓	✓		✓	
Charmaine E. Niar	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓
Trisha Mae Siringan	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓		✓
Ernie C. Cerado Phd	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓

C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

Conflict of Interest Statement

The authors declare that there are no conflicts of interest regarding the publication of this paper.

Informed Consent

All participants were informed about the purpose of the study, and their voluntary consent was obtained prior to data collection.

Ethical Approval

Not Applicable.

Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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	**Charmaine E. Niar,** is affiliated with Sultan Kudarat State University, Philippines. She co-authored the 2024 study "Common Teaching Strategies of Mathematics Teachers and Learning Achievement of High School Students at Tacurong National High School", which was published in the Journal of Learning and Educational Policy. The investigation looked into what teaching approaches mathematics instructors used at a public secondary school, and how those methods are tied to student performance and also involvement.
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	**Ernie C. Cerado Phd,** is faculty member and researcher at Sultan Kudarat State University (SKSU) in Tacurong Philippines, where he also served as Vice President for Academic Affairs. He has a Doctor of Philosophy degree, and he has authored quite a few studies focused on Philippine education systems, especially on quality management practices among state universities and colleges in Region XII, school climate and teacher efficiency. He also looked at local government support for basic education. In addition, he co-authored instructional materials-like a textbook chapter on assessment in learning.