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ANGLE (ANALYZE, NOTE, GET, LOGIC, EVALUATE) APPROACH İN IMPROVING SOLVING SKILLS İN ANGLE OF ELEVATION AND DEPRESSION AMONG GRADE 9 STUDENTS

Judelyn L. Hernane[1], Sarah Mae A. Licomes[2], Rhea I. Rebusora[3],

[1] *Researcher, Institute of Teacher Education, Kapalong College of Agriculture, Sciences and Technology, Kapalong, Davao del Norte, Philippines*

[2]*Researcher, Institute of Teacher Education, Kapalong College of Agriculture, Sciences and Technology, Kapalong, Davao del Norte, Philippines*

[3]*Researcher, Institute of Teacher Education, Kapalong College of Agriculture, Sciences and Technology, Kapalong, Davao del Norte, Philippines*

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ABSTRACT

This study examined the effectiveness of the ANGLE Approach in improving Grade 9 students skills in solving problems related to angles of elevation and depression. Using a pre-experimental one-group pretest-posttest design, data were collected from 42 purposively selected students through both pre/post assessments and in-depth interviews. The ANGLE Approach consisted of structured lessons, a step-by-step process, and contextualized instruction aimed at developing a deeper understanding of trigonometric concepts. Results revealed a significant improvement from a mean pre-test score of 1.43% (poor) to a post-test score of 33.02% (needs improvement), confirmed by a paired t-test, $t(41) = 11.03$, $p < .001$. Qualitative findings supported these results, highlighting five themes: (1) encountering difficulties in solving trigonometry prior to the ANGLE Approach; (2) enhancing problem-solving skills through step-by-step methods and continuous practice; (3) enhancing conceptual understanding to improve accuracy and visualization in problem-solving; (4) enhancing learning through real-world application; and (5) believing that interactive activities enhance learning. Overall, the ANGLE Approach proved to be an effective intervention for improving both the performance and learning experiences of students tackling problems involving angles of elevation and depression.

KEYWORDS: *ANGLE Approach, intervention, problem-solving skills, step by step, Philippines*

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INTRODUCTION

Trigonometry is widely acknowledged as one of the most abstract and challenging areas of secondary mathematics, with students frequently struggling to transition from mere formula memorization to genuine conceptual understanding and problem-solving. A qualitative investigation of 35 tenth-grade students in East Kalimantan revealed that common errors, especially in comprehending trigonometric ratios and correctly formulating problem-solving algorithms stemmed from weak foundational knowledge and limited exposure to varied problem types (Alfitri et al.,2024). Studies employing Newman's Error Analysis, such as one conducted with vocational high school students in Yogyakarta, further underscore persistent comprehension and transformation errors, where students struggle not only to interpret problem information but also to accurately translate it into mathematical models (Fauzi et al., 2022). Extending this trend, research by Ani et al., (2024) examining trigonometric limit problems found that students dominant conceptual and procedural errors were rooted in a lack of understanding of limit concepts and calculation processes. These consistent findings across diverse educational contexts highlight an urgent need for instructional approaches that emphasize deep conceptual understanding and gradual skill-building in trigonometry.

Moreover, in the context of East Kalimantan, Kurniati et al. (2022) found that students often confuse the concepts of angle of elevation and angle of depression, which leads to frequent misinterpretation of problems and incorrect solutions. Similarly, Arhin and Hokor (2021) reported that students in Ghana face challenges in converting word problems into appropriate mathematical models, particularly when dealing with trigonometric applications such as angles of elevation and depression. These difficulties are largely attributed to limited conceptual understanding and the use of ineffective instructional strategies. In addition, Fauzi et al. (2022) employed Newman's Error Hierarchical Model in their study in Indonesia and discovered that students commonly made comprehension and transformation errors when solving trigonometric problems. Collectively, these findings highlight the urgent need for focused instructional interventions to address these specific learning difficulties in trigonometry.

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In the Philippines, particularly in Oriental Mindoro, problem-solving in trigonometry remains a significant challenge for many students, particularly in mathematical translation. A study conducted at a state university in Mindoro examined college students' abilities in this area, revealing that 11.76% performed poorly, scoring between 0–1, while the overall mean score of 5.18 was deemed satisfactory (Sosa et al., 2024). Similarly, at Saint Mary's University, Grade 10 students from public and private schools committed high levels of comprehension, transformation, and process skills errors when solving problems involving angles of elevation and depression, indicating major gaps in conceptual understanding (Sabanal & Guevara, 2025). Moreover, Guadiario and Salazar (2025) found that Grade 9 students in Iligan City struggled with trigonometry due to unfamiliarity with problem-solving procedures and negative perceptions of the subject, resulting in low performance. These findings highlight the need for targeted instructional materials and strategies that emphasize conceptual clarity and real-life applications to improve student understanding.

In the Division of Davao del Norte, particularly at Sawata National High School, many Grade 9 students face significant challenges in understanding the concepts of angle of elevation and depression, which marks their introduction to trigonometry. This difficulty rooted from their struggle to visualize and analyze problems that require the use of trigonometric ratios, which in turn affects their problem-solving abilities and leads to low performance in mathematics. Contributing factors include a lack of conceptual understanding, limited exposure to spatial reasoning, and insufficient practice in applying trigonometric principles. These findings highlight the urgent need for effective teaching strategies and targeted interventions to help students build a stronger grasp of key trigonometric concepts.

The purpose of this study is to determine the improvement of the students solving skills in angle of depression and elevation upon the implementation of ANGLE Approach to Grade 9 students. It highlights the pre-test to determine the students initial understanding in angle of elevation and depression. Also, the post-test determines the effectiveness of ANGLE Approach implementation. Then, the researchers determined the differences between the pre-test and post-test to know the impact of ANGLE Approach in grade 9 learners.

This study seeks to implement ANGLE Approach using a research made questionnaire to assess students solving skills in trigonometry. The researchers have identified a significant gap, noting the necessity of improving solving skills in solving angle of elevation and depression in Grade 9 students. These study emphasize the structured ANGLE Approach to enhance students problem-solving abilities, ensuring better comprehension and application of trigonometric concepts.

In addition, there were various studies that were being conducted which is somewhat similar to this study such as the study being conducted by Obeng et al., (2024) entitled 'Analysis of senior high school students errors in solving trigonometry' which focused on evaluating the errors made by senior high school students in solving trigonometry problems and found that most errors stemmed from transformation, processing skills, and comprehension, influenced by instructional methods, carelessness, and lack of practice.Another research study conducted by Gurat and Sagun (2017) entitled 'Effect of study group on grade 9 students achievement in solving trigonometric problems' which focused on the effects of study groups on Grade 9 students achievement in solving trigonometric problems and found that while both study groups and the existing method improved performance, the study group method proved to be more effective.These studies have offered valuable insights into improving students solving skills in trigonometry however, there remains a gap in the existing action research. This research works toward the gap by determining the effectiveness of ANGLE Approach in improving solving skills in permutation and combination of Grade 10 students at Sawata National High School. This action research contributes to the broader social need to address problems and issues regarding the solving skills of students.

Research Questions

The research questions below were formulated to investigate the effectiveness of ANGLE Approach as an intervention in improving solving skils in angle of elevation and depression among Grade 9 students. The research questions that guided this study were the following:

1. What is the level of solving skills in angle of elevation and depression of Grade 9 students before the implementation of the ANGLE Approach?
2. What is the level of solving skills in angle of elevation and depression of Grade 9 students after the implementation of the ANGLE Approach?
3. Is there a significant differences between the pretest and post-test scores of the students?
4. What insights can be drawn from the results regarding the effectiveness of the ANGLE Approach in enhancing the solving skills of Grade 9 students in angles of elevation and depression?

PROPOSED INTERVENTION PLAN

The ANGLE Approach is a systematic guide for solving Angle of Elevation and Depression. It breaks down the task into step-by-step process that allows more comprehensive problem solving. The ANGLE Approach is an acronym of the steps of the approach to follow. A for analyze the given problem, to visualize and create an illustration. N for noting the data or information given. G for getting the formula to be used in thw problem. L for logically solve the given problem using the derived data. And E for evualte the result, to recheck and finalize the answer.

10-item research made test was designed to assess the initial solving skills of Grade 9 students in understanding angle of elevation and depression. The purpose of the pre-test was to establish a baseline of students comprehension before any instructional intervention takes place. Last March 11, 2025, a pre-test was administered to the participants during their math time after having the letter of permission from the Schook Principal.

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On Day 2, the researcher introduced a systematic approach to the participants. A discussion happened on how to break down complex angle of elevation and depression problems into smaller, more manageable steps, promoting efficiency, accuracy, and consistency in their problem-solving process using the ANGLE Approach.

Between Day 3 to Day 16, the intervention was actively implemented through drills and boardwork by providing real-life context during their math subject time. Participants are advised to use the ANGLE Approach for every activity to see their development followed by assessment and feedback. Educators closely monitored student progress and adjusted as needed. This ensured students stay on track and maximize their learning.

On Day 16, last April 07, 2025, a post-test that is parallel to the pre-test was administered to assess students problem-solving skills in angle of elevation and depression using the ANGLE Approach. Afterwards, In-depth Interviews (IDI) from 10 students were conducted to inquire insight for the effectiveness of the ANGLE Approach intervention. By comparing the pre-test and post-test results, the effectiveness of the ANGLE Approach was evaluated. This provides insights into the impact of ANGLE intervention on students solving skills in angle of elevation and depression.

Table 1. Matrix of the Intervention

Week	Activities	Description	Purpose/Outcome
1	Pre-test and Introduction to ANGLE approach	Administered a 10-item pre-test on work-related angle of elevation and angle of depression problems; introduced the ANGLE approach: Analyze, Note, Get, Logic, Evaluate.	Assess baseline skills; familiarize students with the ANGLE systematic approach.
2	Teacher Explanation and Guided Practice	Teacher explained and broke down each step of the ANGLE approach, using simple examples to illustrate them; students participated by answering questions.	Help students understand and apply the strategy correctly.
3	Independent Problem Solving & Group Activities	Students solved problems on the board individually and participated in group work to practice teamwork and peer learning.	Reinforce application of ANGLE; foster collaboration.
4	Application of the ANGLE approach through drills and real-life problems	The ANGLE Approach is applied through a combination of structured practice drills and real-life problem contexts, both through board work and individual practice.	Strengthen problem-solving skills and strategy retention.
5	Post-test	Administered a 10-item post-test parallel to the pre-test to measure improvement.	Evaluate students' progress and effectiveness of the intervention.

METHODS

Research Design

This study employed mixed methods incorporating both quantitative and qualitative design. A quantitative research was employed through a one-group pretest-posttest design, a type of pre-experimental approach. It assessed changes resulting from an intervention or project by comparing values before (baseline) and after the intervention (end-line evaluation). Unlike experimental designs, pre-experimental designs lack a control group for comparison; instead, they focus on changes within a single group over time. The observed differences between baseline and end-line values are attributed to the project, suggesting its impact on the outcomes (Wamunyima & Nyirenda, 2023). Alongside, qualitative data were gathered to explore students' learning behaviors, reactions, and challenges throughout the intervention. Employing this combined approach strengthens the research's ability to capture not only what works but also why it works within the specific classroom context (Onwuegbuzie & Hitchcock, 2021).

In the context of the study, it adopted a mixed-methods research design, which is well-suited for action research aimed at evaluating the impact of a specific intervention on a targeted group. It employed a one-group pretest-posttest design to quantitatively measure changes in students problem solving skills before and after the implementation of the ANGLE Approach in solving problems involving angles of elevation and depression. Participants took both a pre-test and a post-test, allowing for comparison of their performance. At the same time, qualitative data, including classroom observations and student reflections were gathered to gain insight during the intervention. The integration of both quantitative and qualitative perspectives allowed for a more comprehensive evaluation of the ANGLE Approach, capturing not only improvements in test scores but also the deeper, more detailed aspects of student learning within the classroom environment.

Research Respondents

Purposive sampling is a non-random sampling method that allows researchers to focus on particular populations by selecting individuals, cases, or events that possess specific

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characteristics relevant to the study objectives. Also referred to as judgmental sampling, this technique relies on the researcher's informed judgment to choose participants who are most likely to provide meaningful and relevant insights. Unlike random sampling, where selection is left to chance, purposive sampling intentionally targets those best suited to contribute to the research (Nikolopoulou, 2023).

In this research study, Grade 9 students were chosen as participants since angles of elevation and depression are first introduced at this grade level as part of their exposure to trigonometry. One section of Grade 9 students from Sawata National High School, specifically Grade 9-Magsaysay, comprising 42 students has been choosen to be the participants of the study. This section was purposefully selected to focus on improving their problem-solving skills and understanding in solving angle of elevation and depression. The intervention focused on enhancing the problem-solving skills of Grade 9 students in angle of elevation and depression by implementing the ANGLE Approach. By the end of the study, students are expected to demonstrate improved proficiency in applying this systematic approach to solve the angle of elevation and depression problems.

Research Instrument

The researchers used 10-question research made test that assessed students understanding and solving skills in angle of elevation and depression. The test assessed students understanding and solving skills in angle of elevation and depression through 2 sections: five (5) angle of elevation and five(5) angle of depression. The test had 10 items, each worth 3 points, for a total of 30 points. The scores were distributed as follows: each correct response that properly utilized the ANGLE Approach = 3 points each, if the answer was correct but did not demonstrate the use of the ANGLE Approach = 2 points each, and an incorrect answer but applied 1 of the ANGLE Approach= 1 point each.

In assessing the scores of students, the researchers utilized a scoring scale adapted from Meidiastuti and Safitri (2021). This scale was used to evaluate the students total percentage scores in solving angle of elevation and depression:

Range of Percentage Score	Descriptive Level	Interpretation
90% – 100%	Outstanding	If the measures described in the solving skills in angle of elevation and depression of the students is outstanding.
72% – 89%	Highly Satisfactory	If the measures described in the solving skills in angle of elevation and depression of the students is highly satisfactory.
54% – 71%	Satisfactory	If the measures described in the solving skills in angle of elevation and depression of the students is satisfactory.
36% – 53%	Fairly Satisfactory	If the measures described in the solving skills in angle of elevation and depression of the students is fairly satisfactory.
18% – 35%	Needs Improvement	If the measures described in the solving skills in angle of elevation and depression of the students need improvement.
0% – 17%	Poor	If the measures described in the solving skills in angle of elevation and depression of the students did not meet expectation.

Procedure

The researchers utilized questionnaires before and after the implementation of intervention and innovation. The pre-test questionnaire measured the average of the students who are having difficulty in solving angle of elevation and depression problems before the implementation. The post-test questionnaire measured the knowledge of the students which is a parallel questionnaire to the pre-test.

The steps for data collection are as follows: First, the researchers obtained letter of permission to conduct the study by the program coordinator and director, research and development. Next is getting the approval from the school principals where the participants are enrolled. Then, a pre-test was administered to select the section to assess the students baseline challenges in solving angle of elevation and depression. Following this, the ANGLE Approach was introduced as the intervention and implemented over a four-week period. At the end of the study, a post-test was administered to the participants that is parallel to the pre-test to measure any improvements. The data from both the pre-test and post-test were analyzed and tabulated. After the tabulation, the researchers conducted interviews with the students to gather more data about their insights to provide an explanation of the effectiveness of the intervention. After the In-depth Interview (IDI), the researchers conducted a thematic analysis to create themes from the responses.

Statistical Treatment of Data

In analyzing the data, the researchers organized the students raw scores from both the pre-test and post-test. The following statistical tools were employed to compute and interpret the results between the two test:

Mean. This was used to assess the overall level of students problem-solving skills related to angles of elevation and depression among Grade 9 students.

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Standard Deviation. This was used to determine the consistency and variability in student performance in solving problems involving angles of elevation and depression.

Paired T-Test. This was used compare the scores from the pre-test and post-test in order to assess the effectiveness of the ANGLE Approach in enhancing students problem-solving abilities.

Cohen's d. This was used to measure effect size of the difference between the pre-test and post-test scores, providing insight into the impact of the ANGLE Approach as an intervention in improving students skills in solving problems involving angles of elevation and depression.

Data Analysis

In this study, data were collected through both pre-test and post-test assessments. The researchers computed the mean scores for each set and used a paired t-test to compare the pre-test and post-test means. Additionally, they examined the standard deviation to understand the degree of variability within the data. To further measure the practical significance of the observed difference, Cohen's d was calculated to determine the effect size of the intervention. This statistical analysis aimed to determine whether there was a significant difference between the two means and to evaluate if there was an improvement, which would suggest the effectiveness of the intervention.

Furthermore, the researchers employed **thematic analysis** to examine and interpret the qualitative data derived from the participants interview responses (Braun & Clarke, 2006). The process began with **data reduction**, where raw responses were translated, organized, and simplified by grouping similar ideas and expressions. These grouped responses then underwent data **coding**, wherein specific labels were assigned to recurring patterns and notable points within the data. The assigned codes were further organized into categories representing the shared **emerging themes**, each with a corresponding theme label. To confirm the trustworthiness of the results, the identified themes were examined and validated by individuals with expertise in qualitative data analysis.

Ethical Considerations

Adhering to ethical standards in research is essential as it ensures the integrity and validity of the study objectives, including the pursuit of knowledge, truth, and error prevention. It also promotes core values such as trust, accountability, mutual respect, and fairness in collaborative endeavors. To uphold ethical research practices, this study follows the principles outlined in the Belmont Report (2010), which emphasize respecting participants autonomy, promoting beneficence and non-maleficence, ensuring fairness and justice, obtaining informed consent, protecting confidentiality and data privacy, maintaining research integrity, and addressing any conflicts of interest.

RESULTS AND DISCUSSION

This chapter presents the findings and results of ANGLE Approach as a strategy for improving the solving skills parallel to the research objectives among Grade 9 students of Sawata National High School. Analyses and interpretations of data were done parallel to the research objectives.

Research Question No. 1: What is the level of solving skills in angle of elevation and depression of Grade 9 students before the implementation of the ANGLE Approach?

Presented in Table 2 are the results of the pretest, showing the performance levels of 42 students in the experimental group in solving angle of elevation and depression. The overall mean score was 1.43%, indicating poor performance by the students in the pretest. The highest score achieved was 3, while the lowest score was 0. The scores 0 were both obtained by 31 students each, making it the most frequent scores. The standard deviation is .86 , suggesting very low variability in the scores and indicating that most students clustered around the lowest possible performance level.

Table 2

Levels of solving skills in angle of elevation and depression in Pre-test

Pretest Scores	Frequency	Percentage
0	31	73.81%
1	7	16.67%
2	1	2.38%
3	3	7.14%
Total	**42**	**100.00%**
Mean Percentage Score		**1.43%**
Standard Deviation		**.86**
Description		**Poor**

Several studies involving 35 second-year students at Akontombra Senior High School in Ghana, reported poor pre-test results in trigonometric word problems, reflecting a lack of conceptual understanding and problem-solving skills. Arhin and Hokor (2021) also confirmed that students typically struggle with trigonometric problems support the finding of low student performance prior to intervention. Pan and Carpenter (2023) found that students exhibited very low pre-test scores before the implementation of the Self-Blend Approach (SBA), indicating limited initial proficiency. Similarly, Gyan et al. (2021), in their study

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before any instructional intervention, emphasizing the need for improved teaching strategies. Collectively, these studies highlight a consistent pattern of low baseline performance in mathematics, particularly in trigonometry, prior to the use of targeted teaching approaches.

Research Question No. 2: What is the level of solving skills in angle of elevation and depression of Grade 9 students after the implementation of the ANGLE Approach?

Presented in Table 3 are the results of the post test, showing the performance levels of 42 students in the experimental group in solving angle of elevation and depression. The overall mean score was 33.02, indicating needs improvement performance by the students in the post-test. The highest score achieved was 24, while the lowest score was 2. The scores 5 were both obtained by 6 students each, making it the most frequent scores. The Standard deviation is 6.21 indicating moderate variability among the students' scores and reflecting a wider distribution of performance levels after the intervention.

Table 3
Level of solving skills in angle of elevation and depression in Post Test

Pretest Scores	Frequency	Percentage
2	5	11.90%
4	1	2.38%
5	6	14.29%
6	4	9.52%
7	3	7.14%
8	3	7.14%
9	2	4.76%
10	2	4.76%
11	2	4.76%
13	4	9.52%
14	2	4.76%
17	2	4.76%
18	1	2.38%
20	1	2.38%
21	1	2.38%
22	1	2.38%
24	2	4.76%
Total	**42**	**100.00%**
Mean Percentage Score		**33.02%**
Standard Deviation		**6.21**
Description		**Needs Improvement**

Several studies support the notion that while instructional interventions lead to improved post-test scores, students overall performance in trigonometry often remains relatively low. Maphutha et al. (2022) found that Grade 11 students taught using an Activity-Based Approach improved from a mean pre-test score of 8.36 to a post-test mean of 22.29, indicating progress but still reflecting struggles with two-dimensional trigonometric problems. Similarly, Mailizar et al. (2025) reported that the use of micro-lecture videos enhanced students remedial learning outcomes, yet their post-test results remained low, highlighting the continued difficulty in mastering complex mathematical concepts. Moreover, Novero (2023) also observed this trend among Grade 9 students in Cebu, Philippines, where the use of an online LMS led to improved scores (Group 1: 17.44, Group 2: 15.36 out of 20), yet the performance still pointed to lingering challenges in understanding trigonometry. These studies align with the current findings, showing that although students make meaningful gains after interventions, their average performance often stays below expected proficiency levels.

Research Question No. 3: Is there a significant difference between the pre-test and post-test scores of the students?

Presented in the table 4 was the result of the significant difference between the pre-test and post-test scores of the grade 9 students, $t(41) = 11.03$, $p<.001$. Since the p-value is significantly lower than the alpha level of 0.05 ($\alpha = 0.05$), the null hypothesis is being rejected. The result indicates that there is a significant difference between pre-test and post-test results of the grade 9 students.

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In addition, the results indicate that the ANGLE Approach intervention can significantly improve students skills in solving problems related to angles of elevation and depression. The findings affirm the effectiveness of the ANGLE Approach in enhancing students' problem-solving abilities, as evidenced by their improved post-test performance. Moreover, the effect size, represented by Cohen's d= 1.70, is statistically classified as small, that may still be seen as not fully capturing the intervention's maximum potential. Although the data shows high variability, some students performed much higher or lower than others which leads to a smaller effect size, even if average performance improves. This implies that certain factors may have limited the overall impact of the intervention. Nevertheless, the results still demonstrate a significant relationship between the step-by-step instructional strategy and improved problem-solving skills among students in this mathematical concept.

Table 4

Significant Difference Between Pre-test and Post-test of the ANGLE Approach

Paired Sample T-test										
	Mean	***SD***	***Mean difference***	***df***	***SE difference***	***t-value***	***p-value***		***Effect Size***	***Decision α=0.05***
Pre-test	11.03	.86	31.6	41	2.86	11.03	< .001	Cohen's d	1.70	Significant
Post-test	33.02	6.21								

The effectiveness of step by step approach in teaching trigonometry is well supported by several studies. Fererde et al. (2024) conducted a quasi-experimental study involving 97 Grade 10 students in Ethiopia, where the experimental group received context-based mathematical modeling instruction. Their findings showed significant improvements in students conceptual understanding and problem-solving skills in trigonometry, particularly in solving problems related to angles of elevation and depression. Similarly, Ceremonia (2023) developed instructional videos that used a step-by-step methodology, incorporating puzzles and discussions to enhance engagement. This approach also led to improved understanding and application of trigonometric concepts. Supporting these findings, Da et al. (2024) integrated Realistic Mathematics Education with Game-Based Learning for Grade 9 students, which combined real-world contexts, interactive games, and a step-by-step process. Their study revealed improvements in problem-solving skills, motivation, and engagement. Collectively, these studies affirm that structured and step by step approach such as the ANGLE Approach are effective in enhancing students mastery of trigonometry.

Research Question No. 4: What insights can be drawn from the results regarding the effectiveness of the ANGLE Approach in enhancing the solving skills of Grade 9 students in angles of elevation and depression?

Table 5 presents the major themes that emerged from the in-depth interviews conducted to explore participants observations and experiences with the effectiveness of the ANGLE Approach in enhancing problem-solving skills in angles of elevation and depression. Participants provided insights based on their personal experiences, which led to the identification of five key themes. From the answers of the participants, fivemajor themes emerged: (1) Encountering Difficulties in Solving Trigonometry Prior to ANGLE Approach; (2) Enhancing Problem-Solving Skills through Step-by-Step Approach and Continuous Practice; (3) Enhancing Conceptual Understanding to Improve Accuracy and Visualization in Problem-Solving;(4) Enhancing Learning Through Real-World Application; and (5) Believing that Interactive Activities Enhances Learning.

Table 5. Themes and Supporting Statements on the insights of Grade 9 Students in Angle (Analyze, Note, Get, Logic, Evaluate) Approach in Improving Solving Skills in Angle of Elevation and Depression

Emerging Themes	Sample Statements
Encountering Difficulties in Solving Trigonometry	• "Before the ANGLE Approach, I struggled to visualize angles of elevation and depression, often mixing up height and distance in problems." (IDI-01) • "Difficulty visualizing and understanding problem." (IDI-03) • "The struggles and difficulties I really encountered in answering problems involving angles of elevation and depression were in analyzing the problem itself. It's not easy to solve and analyze, especially when the problem is very difficult." (IDI-06) • "The struggle I encountered before the ANGLE approach was analyzing the problems." (IDI-07) • "It was really confusing, ma'am, because sometimes I did not know what formula to use or how to solve the problem. I was not sure if I should divide or multiply." (IDI-08) • "Before learning the ANGLE approach, I struggled to visualize the relationship between the angle of elevation/depression and the sides of the right-angled triangle formed." (IDI-

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Prior to ANGLE Approach	09) • "Before learning about angles of elevation and depression using the ANGLE approach, I struggled to visualize the problem scenarios." (IDI-10)
Enhancing Problem-Solving Skills through Step-by-Step Approach and Continuous Practice	• "The ANGLE Approach helped by breaking down concepts into manageable parts, using visual aids and real-world applications, making it easier to set up problems correctly." (IDI-01) • "Angle approach helps me solve the given step by step and makes my procedure more accurate. Following the precise sequence of the approach could direct you to the right answer." (IDI02) • "The ANGLE approach is a big help in solving problems because it makes answering easier since you're already following the ANGLE steps, you just need to Analyze, Note the given information, Get the right formula, Logically solve the equation, and Evaluate and verify." (IDI-06) • "The ANGLE approach really helps make answering easier because it already has steps to follow." (IDI-07) • "Well, because of the systematic breakdown using the five steps in analyzing and noting the problem, it provided a clearer framework for solving. The step-by-step method helped reduce errors, and over time, I became more skilled at solving these types of problems." (IDI-10) • "For my opinion we need to... offer additional practice exercises and quizzes..." (IDI-03) • "Include additional activities that reinforce understanding of the concept and provide opportunities more for students to practice solving problems." (IDI-05) • "Also, providing more practice problems with varying levels of difficulty would further solidify their understanding and problem-solving skills." (IDI-09)
Enhancing Conceptual Understanding to Improve Accuracy and Visualization in Problem-Solving	• "Improved understanding of concepts through clear explanations and examples." (IDI-03) • "Through the ANGLE approach, it makes it easier to picture out a word problem because the ANGLE approach is a step in solving a word problem in angle of elevation and angle of depression and also it made me understand the concept of angles of elevation and depression easier. It helped me visualize problems and identify the correct angles." (IDI-05) • "It really helped a lot, because the problem became easier to understand. I already knew what formula to use, and I could solve it more easily—not totally easy—but much easier if you apply the ANGLE approach." (IDI-08) • "The approach significantly improved my solving skills by boosting my confidence and accuracy through systematic application of trigonometric ratios." (IDI-01) • "The ANGLE approach is very effective because it enhances both precision and confidence in solving these kinds of problems. I am not sure if I can consistently practice using this method, but I could develop better problem-solving habits that can be applied in other mathematical concepts as well." (IDI-04) • "The ANGLE approach was very effective. It was able to give emphasis on drawing accurate diagrams, which was particularly helpful in visualizing the problem and correctly identifying the sides of the triangle. After learning it, I made far fewer mistakes and could solve problems much more quickly and accurately. My ability to visualize and solve problems involving angles of elevation and depression improved dramatically." (IDI-09) • "It was very effective because my accuracy in solving problems related to angles of elevation and depression increased, thanks to your systematic approach. It really made everything much easier." (IDI-10)
Enhancing Learning Through Real-World Application	• "The best part was understanding real-world applications, which made the lessons more relatable and engaging." (IDI-01) • "Practical application of concepts to real-world problems and a step-by-step approach to solving problems." (IDI-03) • "Also, the best part of the ANGLE Approach is its focus on understanding the concept and visualizing the problems which are applicable to the real world." (IDI-05)
	• "To enhance the ANGLE Approach, I suggest incorporating more interactive activities,

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Believing that Interactive Activities Enhances Learning	using technology for visualizations." (IDI-01) • "Well, I think using fun things like games or challenges to make the learning exciting" (IDI-04) • "For me, ma'am, it would be nice if there were games or activities during the discussion so that students would enjoy and be more focused on the lesson, just based on my experience." (IDI-07)

In the study, it was revealed that Grade 9 students encountered significant difficulties in solving problems involving angles of elevation and depression prior to the implementation of the ANGLE Approach. These challenges included visualizing geometric relationships, selecting appropriate formulas, and analyzing complex word problems, which hindered their ability to apply trigonometric concepts effectively. This finding is supported by Orhani (2021), who highlighted students' struggles with graphical representations, real-life applications, and the conceptual understanding of angles and ratios. Similarly, Obeng et al. (2024) emphasized that misconceptions, ineffective teaching strategies, and insufficient practice contribute to common student errors, recommending more hands-on, inductive approaches to teaching trigonometry.

Furthermore, second theme was about enhancing problem-solving skills through step-by-step approach and continuous practice. Students shared that the ANGLE Approach helped them solve problems more effectively by following a structured method that involved analyzing the problem, noting given information, choosing the correct formula, solving it logically, and evaluating the result. This was further emphasized by Niamjapo (2024), who demonstrated that using Polya's problem-solving steps significantly improved students' academic performance and mathematical skills. Similarly, Permatasari et al. (2020) supported this by showing that students exposed to Problem-Based Learning (PBL) tools emphasizing systematic, step-by-step problem-solving demonstrated marked improvements in problem-solving performance and deeper mathematical understanding.

However, the students reported that the ANGLE Approach significantly enhanced their ability to understand and visualize mathematical concepts. They shared that the structured, step-by-step process helped them comprehend complex problems, accurately draw diagrams, and connect abstract trigonometric ideas to real-world applications. This was heightened by Chen (2024), who emphasized that Contextual Mathematical Modeling Instruction (CMMI) improves students' conceptual understanding and visualization in trigonometry. Similarly, Faturohman and Amelia (2020) highlighted that the use of proper teaching approaches significantly enhances students' ability to analyze, interpret, and solve mathematical problems effectively.

Additionally, the fourth theme that emerged was enhancing learning through real-world application. It revealed that understanding real-world applications made lessons more engaging and relatable. Students found that the ANGLE Approach, which emphasizes applying concepts to real-life situations, helped them visualize and grasp abstract ideas more effectively. This is supported by Wardana et al. (2021), who found that integrating real-world applications in mathematics enhances student interest and comprehension. Similarly, Maphutha et al. (2022) emphasized that using real-life scenarios in teaching trigonometry improves students' understanding, motivation, and retention, particularly in solving problems involving angles of elevation and depression.

Lastly, the fifth theme was about believing that interactive activities enhances learning. Students shared that interactive activities helped them become more active and participative in solving trigonometric problems using the ANGLE approach. The result of the study was supported by the study of Mclaren and Nguyen (2023), which demonstrated that interactive games lead to better learning outcomes than traditional methods by fostering active participation and enhancing critical thinking. Additionaly, a study by Godoy (2021) found that integrating augmented reality (AR) games into Precalculus instruction helped students engage with abstract trigonometric concepts, such as angles of elevation and depression, in a more visual and dynamic manner, thereby improving conceptual understanding and reducing math anxiety.

CONCLUSION

The pre-test results reveal that students had significant difficulty in solving problems involving angle of elevation and depression, as reflected by the extremely low overall mean score of 1.43% indicating poor performance prior to any intervention. The standard deviation of 0.86 further supports the result, showing minimal variability and suggesting that most students clustered around the lowest possible performance. These results clearly imply that students had very limited understanding of the topic before the implementation of any teaching intervention.

Following the implementation of the ANGLE Approach, the post-test results showed an overall mean score of 33.02%, which falls under the Needs Improvement performance level. The standard deviation of 6.21 reflects a wider range of scores, suggesting varied levels of understanding among the students. While the mean score significantly increased compared to the pre-test, the performance still remains within the Needs Improvementcategory. This suggests that despite the progress, factors such as limited mastery, uneven conceptual understanding, and insufficient practice may have contributed to the results. It is important to note that an increase in mean percentage does not always equate to satisfactory performance, especially when key competencies remain underdeveloped.

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Moreover, statistical analysis revealed a significant difference between the pre-test and post-test scores, $t(41) = 11.03$, $p < .001$, indicating the effectiveness of the ANGLE Approach in enhancing student performance. Despite the effect size , Cohen's $d = 1.70$ being statistically small likely due to high variability in individual student scores, the overall improvement supports the effectiveness of the approach in enhancing problem-solving abilities. This suggests that while the intervention was successful in raising average student performance, further refinement and support may be needed to maximize its benefits for all learners.

Complementing these findings, five major themes emerged that reflect participants' observations and experiences regarding the effectiveness of the ANGLE Approach: (1) encountering difficulties in solving trigonometry prior to ANGLE approach; (2) enhancing problem-solving skills through step-by-step approach and continuous practice; (3) enhancing conceptual understanding to ımprove accuracy and visualization in problem-solving; (4) enhancing learning through real-world application; and (5) believing that ınteractive activities enhances learning. These themes collectively highlight the positive impact of the ANGLE Approach on students' mathematical learning and problem-solving abilities.

In summary, both the quantitative and qualitative findings affirm that the ANGLE Approach is an effective strategy for improving students' understanding and problem-solving abilities in trigonometry, particularly in solving problems related to angles of elevation and depression. While the statistical data shows a significant increase in student performance, the qualitative insights provide deeper context, highlighting how structured, engaging, and real-world-based strategies contribute to better learning outcomes. Therefore, continued implementation and improvement of such learner-centered approaches are recommended to further support student success in mathematics.

RECOMMENDATION

This study has successfully demonstrated the ANGLE Approach's capacity to enhance Grade 9 students problem-solving skills in angles of elevation and depression, yielding statistically significant gains and positive student insights. However, its scope was limited to a single section at Sawata National High School over four weeks. Future research should therefore expand the sample to multiple schools or grade levels to improve generalizability and conduct longitudinal studies to assess whether improvements persist across an academic year. Comparative analyses with other structured strategies (e.g., Polya's problem-solving model, activity-based learning) will help identify the most effective approaches, while exploring educational technologies such as dynamic geometry software or mobile learning apps can further support students visualization and practice.

For classroom implementation, students are encouraged to engage actively with each step of the ANGLE Approach (Analyze, Note, Get, Logic, Evaluate) and collaborate in study groups for peer quizzing and clarification. Teachers, in turn, should pursue professional development on the ANGLE Approach and other systematic problem-solving models, integrate varied interactive activities, and use targeted formative assessments to monitor progress and provide immediate, constructive feedback on both procedural accuracy and conceptual understanding. These combined efforts will build on the promising outcomes of this research, ensuring that structured, student-centered methods continue to boost trigonometric competence and confidence.

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