The Effect of 7Es of Learning as an Approach in Improving Problem-Solving Skills of Students in Trigonometry

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DOI: 10.29322/IJSRP.16.04.2026.p17207
https://dx.doi.org/10.29322/IJSRP.16.04.2026.p17207

Paper Received Date: 16th February 2026
Paper Acceptance Date: 18th March 2026
Paper Publication Date: 12th April 2026

Abstract- The study was conducted to investigate the effect of 7Es of learning on students' problem-solving skills in Trigonometry of Alejandra L. Navarro National High School Grade 9 students for the school year 2018-2019. This study was conducted to test the significant difference in the problem-solving skills of Grade 9 students. A quasi-experimental type of research design was used to conduct the study on 70 Grade 9 students. A validated researcher-made 40 item test was used to measure the learning gained by both the control and experimental group. The data gathered were treated using the mean percentage score, t-test for independent samples, paired t-test, and Analysis of Covariance (ANCOVA). The control group was taught using the conventional method of instruction and the experimental group was taught using the 7Es of learning. Findings showed that there was a significant difference between the pretest and posttest scores of the students in the control group and experimental group. It was revealed further that the experimental group achieved more than the control group. This study will give curriculum developers new insight into emerging issues on students' performance and influence in a higher level of education and give benefits for students who have opportunities to pursue mathematics related courses in higher institute of learning.

Index Terms- 7Es of learning, conventional method of instruction, problem-solving skills, trigonometry

I. INTRODUCTION

Educators play an important role in developing students' creativity and innovation in facing real-world problems, as the education system in the Philippines is designed to produce individuals who love their country and are skilled enough to contribute to its progress. Guided by the vision of the Department of Education, teachers are expected to help achieve a learner-centered quality education system by providing excellent teaching that develops each learner's full potential and supports the nation's aspirations.

The traditional chalk and talk method has become less effective and often fails to sustain students' interest in learning. With the advancement of instructional technology, educators are encouraged to integrate digital tools to enhance experiential learning and improve engagement. Researchers emphasized that the practice of technology in teaching mathematics can transform a classroom from a boring place to an exciting learning environment and expose them in to a 21st century setting (Brooks, 2011). Integrating technologies in mathematics education developed students' motivation, higher order thinking, research skills, and communication among the peers (Cantürk-Günhan & Bukova-Güzel, 2010).

However, despite the importance of Mathematics, there seems to be growing reluctance of the student to go into subjects. This is in connection with the study conducted by Pranoto (2010) who stated that the process of teaching and learning achievement of Indonesian students' mathematics is low. Filipinos are generally not known for strong performance in Mathematics, as shown in the TIMSS 2003 results where the Philippines ranked low among participating countries in both elementary and secondary levels. This continued decline, along with poor performance in 2008 and lack of improvement in subsequent assessments, highlights the need for major reforms in the Philippine education system, which helped support the implementation of Republic Act 10533 or the Enhanced Basic Education Act of 2013 (International Association for the Evaluation of Educational Achievement [IEA], 2004).

In the local setting of the Division of Davao City, the National Achievement Test (NAT) results of Alejandra L. Navarro National High School for SY 2017–2018 showed low performance in Mathematics with a Mean Percentage Score of 39.05%, compared to

other subject areas. This result highlights the need to conduct a study aimed at supporting the school administration in developing an intervention program to improve students' problem-solving skills in Mathematics.

This study was anchored on the constructivist learning approach, which includes the stages Elicit, Engage, Explore, Explain, Elaborate, Evaluate, and Extend. It aims to contribute to the strategies used by Mathematics teachers in enhancing students' performance in Trigonometry, especially in developing their problem-solving skills amid the declining Math performance of secondary students. This study may provide additional insights on the use of the 7Es Learning Model as an effective approach in teaching Mathematics.

This study was conducted among Grade 9 students at Alejandra L. Navarro National High School, involving two classes where one group was taught using the 7Es of Learning and the other through a lecture-based approach. It is supported by Pritchard et al. (2008), who emphasized that students' mathematical learning depends on prior knowledge and instructional strategies, with learning progress being influenced by how instruction is delivered and applied.

The study aimed to determine the effect of the 7Es of learning as an approach in improving students' problem-solving skills in Trigonometry.

Specifically, the study sought to answer the following questions:

1. What is the level of performance in the pretest and posttest mean percentage scores of the control group in terms of:
   1.1 Lower order thinking skills; and
   1.2 Higher order thinking skills?
2. What is the level of performance in the pretest and posttest mean percentage scores of the experimental group in terms of:
   2.1 Lower order thinking skills; and
   2.2 Higher order thinking skills?
3. Is there a significant difference in the pretest scores between the Control Group and Experimental Group?
4. Is there a significant difference in the pretest and posttest scores of the Control Group?
5. Is there a significant difference in the pretest and posttest scores of the Experimental Group?
6. Is there a significant difference in the performance of the students during the posttest between control and experimental groups in terms of:
   6.1 Lower order thinking skills; and
   6.2 Higher order thinking skills?
7. Does 7Es of Learning significantly enhance students' problem-solving skills in Trigonometry after controlling the pretest?

Hypotheses

The following hypotheses were tested at 0.05 level of significance:

$H_0$1: There was no significant difference in the pretest scores between the control and experimental group.
$H_0$2: There was no significant difference in the pretest and posttest scores of the control group.
$H_0$3: There was no significant difference in the pretest and posttest scores of the experimental group.
$H_0$4: 7Es of learning did not improve students' problem-solving skills after controlling the pretest.

II. RESEARCH ELABORATIONS

The research method used in this research is quasi-experimental with the design of nonequivalent group pretest-posttest design. A quasi-experimental design involves the use of intervention, but not random assignment of participants to groups (Creswell, 2012). Furthermore, it is a design in which according to Ruseffendi (2010) consists of two groups: experimental group and control group. The students in the experimental group took the course about trigonometry from the researcher in an environment where the 7E's of learning model based on the constructivist approach was used. The students in the control group took the same course without intervention of the researcher, from their mathematics teacher in an environment where the activities of official mathematics curriculum were used. Further, the use of pretest and posttest to compare two different groups also conveys that this study is a quasi-experimental design (Capili & Anastasi, 2025).

The respondents of the study were randomly selected as experimental group and control group out of five sections of Grade 9 students at Alejandra L. Navarro National High School, where the researcher holds classes in Trigonometry. The number of respondents was dependent on how many students took completely the pretest and posttest. Group of students from Grade 9 Pahiyas and Sinulog were chosen in random order as the research respondents of the study to ensure that it would be fair to both groups. After the pre-test, 35 students were chosen as control group, and 35 students were chosen as experimental group.

For this study, a researcher-made 40-item test was used for the pretest and posttest, based on the Department of Education (DepEd) fourth quarter textbook and aligned with the course outline to assess students' problem-solving skills in Mathematics. The test

included items from textbooks, previous Grade 9 examinations, and other reliable sources, and was constructed following DepEd guidelines on test construction and validation, incorporating cognitive levels such as remembering, understanding, applying, analyzing, evaluating, and creating, with a distribution of easy, moderate, and difficult items.

The research instrument underwent a series of procedures, including expert validation, pilot testing, item analysis, and reliability testing, where 20 items were removed and the test achieved a Cronbach's Alpha of 0.735, indicating acceptable reliability. After revision, the final questionnaire was used in the study, while the experimental group was taught using lesson plans integrated with the 7Es of Learning under the constructivist approach, aligned with DepEd Mathematics IX competencies. The scoring and interpretation of results followed DepEd Memorandum No. 160, s. 2012.

The researcher first secured permission from Davao del Norte State College Graduate School, followed by a formal request to the Schools Division Superintendent (SDS) of the Division of Davao City. Upon approval, a letter was also submitted to the school principal to conduct the study in the identified school. Consent and assent forms were then distributed to parents and students before the implementation of the study.

After securing consent, the researcher administered the pretest to both the control and experimental groups on the first day of the study to determine their baseline knowledge and ensure comparability. The results were then checked, recorded, and used for initial analysis. Following the intervention, the posttest was administered. All collected data were tallied, processed, and analyzed using the Statistical Package for the Social Sciences (SPSS) version 20.0. The respondents were also informed that their test scores would not affect their academic grades.

III. RESULTS

The results of this study were discussed in consonance with the Department of Education mastery level which was based on the Mean Percentage Score (MPS) and its descriptive equivalent. The analysis of both pretest and posttest Mean Percentage Scores.

Table 1 shows the pretest and posttest mean percentage scores of the students in control group in terms of Lower Order Thinking Skills and Higher Order Thinking Skills. The overall pretest and posttest mean percentage scores of the students are 27.57 with a descriptive equivalent of *Low Mastery* and 39.07 with a descriptive equivalent of *Average Mastery*, respectively. This finding was supported by the idea of Chariton (2006) that lecture method was effective in teaching because it develops the ability of person in oral communication during actual presentations. Yet, the mastery level of the students based on Bloom's Taxonomy did not meet the DepEd requirement that students must achieve at least 75% mastery level.

Table 1: Pretest and Posttest Mean Percentage Scores of the Control Group

Taxonomy	Pretest MPS (%)	Descriptive Equivalent	Posttest MPS(%)	Descriptive Equivalent
Lower Order Thinking Skills	29.52	**Low**	40.10	**Average**
Higher Order Thinking Skills	21.71	**Low**	35.14	**Average**
OVERALL MPS	27.57	**Low**	39.07	**Average**

In Table 2, the pretest and posttest mean percentage scores of the students exposed in the 7Es of learning (experimental group) in terms of Lower order Thinking Skills and Higher Order Thinking Skills were presented. The overall mastery level of students exposed to 7E's of learning was from 27.64 with a descriptive equivalent of *Low Mastery* to 65.64 with a descriptive equivalent of *Moving Towards Mastery*. This finding is parallel to the study conducted by Weltman (2007) which stated that groups exposed to traditional strategy in teaching have lower achievement compared to the group with the active learning strategy. Balta and Sarac (2016) also stated that the usage of 7E learning increases students' academic and conceptual achievement more efficiently since the model gives students the chance to explore since constructivist theory requires the students to be active in the classroom and during the learning.

Table 2: Pretest and Posttest Mean Percentage Scores of the Experimental Group

Taxonomy	Pretest MPS (%)	Descriptive Equivalent	Posttest MPS	Descriptive Equivalent
Lower Order Thinking Skills	30.86	**Low**	66.76	**Moving Towards Mastery**
Higher Order Thinking Skills	18.00	**Low**	62.29	**Average**
OVERALL MPS	27.64	**Low**	65.64	**Moving Towards Mastery**

Results in table 3 reveal that there is no significant difference in the performance of the students in the control group, (*M* = 11.03, s = 2.88) and experimental group, (M = 11.06, s = 2.87), t (70) = 0.38, p = .97 > .05. It is further revealed that p = 0.97 and is greater than .05, the level of significance. Consequently, the first hypothesis stating that there is no significant difference in the pretest scores of the control and experimental group is therefore accepted. This means that there is no significant difference between students who were exposed to the conventional approach of instruction and 7Es of learning. Thus, both groups were equal in terms of class performance before the intervention was implemented. This finding is supported by Heiman (2011) when he claimed that if there is no significant difference between the means of the two groups then the difference is 0.000 or the means are equal.

Table 3: T-test Results Comparing the Pretest Scores between the Control Group and Experimental Group

Group	Mean	sd	t- value	p-value	Decision $\alpha = 0.05$	Remarks
Control Group	11.03	2.88	0.38	0.97	Not Rejected	Not Significant
Experimental Group	11.06	2.87				

Results in table 4 show that there was a significant difference between the pretest and the posttest scores of the students in the control group t(35) = 7.151, p = .000 < .05. Hence, the hypothesis that there is no significant difference between the pretest and posttest scores of the students in the control group is not accepted. This indicates that employing conventional method of instruction in the control group may have improved the students' performance. As Chariton (2006) pointed out, lecture is effective in teaching. Also, Hake (1998) found on his study that the lecture strategy can improve students' performance in mathematics.

Table 4: T-test Results on the Significant Difference in the Pretest and Posttest scores of the Control Group

Test	Mean	Sd	t-value	p-value	Decision $\alpha = 0.05$	Remarks
Pretest	11.03	2.88	7.151	.000	Rejected	Significant
Posttest	15.63	3.33				

Results in table 5 show that there was a significant difference between the pretest and posttest scores of the students in the experimental group t (35) =16.325, p= .000 < .05. Hence, the hypothesis that there is no significant difference between the pretest and posttest scores of the students in the experimental group is rejected. This indicates that employing 7Es of learning may have improved the performance of the students. Moreover, the results also imply that both methods have been found effective in enhancing performance of the students; however, 7Es of Learning was seen more effective than the conventional method of teaching. Researchers recommend that mathematics teaching is effective when students actively participate in learning process, so mathematics teachers should not use explanatory teaching approaches but should use reconnaissance, manual activities and interactive group works so as to encourage students to learn better (Runisah et al., 2017).

Table 5: T-test Results on the significant difference in the pretest and posttest scores of the Experimental Group

Test	Mean	sd	t-value	p-value	Decision $\alpha = 0.05$	Remarks
Pretest	11.06	2.87	16.325	.000	Rejected	Significant
Posttest	26.26	4.72				

Table 6 results show that 7Es of Learning has significant effect on the performance of the students in terms of lower order thinking skills after controlling the covariate which is the pretest. F (1,67) = 89.054, p = .000 < .05. Results also reveal that in Lower Order Thinking Skills, the students exposed in 7Es of Learning performed better compared to students who were exposed in conventional approach of instruction. This finding coincides with the results of study conducted by Al Shahri (2013) which divulged that 7Es of learning can improve students' achievement, can develop creative thinking skills and can enhance mathematical thinking skills in both sides of the brain when used during mathematics instructions than traditional method (Saleem, 2012).

Table 6: Summary of Analysis of Covariance (ANCOVA) Test Results in Students' Performance between Control Group and Experimental Group in terms of Lower Order Thinking Skills

Source	SS	DF	MS	F	p-vaue	Remarks
Group	1102.171	1	1102.171	89.054	.000	Significant
Pretest	2.726	1	2.726	.220		
Error	829.217	67	12.376			

Results in Table 7 show that there is a significant difference in the performance of the students between the control group and experimental group in terms of Higher Order Thinking Skills after controlling for the effect of the covariate, which is the pretest, F (1,67) = 42.708, p = .000 < .05. Results also reveal that in Higher Order Thinking Skills students exposed to 7Es of Learning performed significantly better compared to the students exposed to conventional method of instruction. US National Council for Mathematics Teachers (2000) emphasized the fact that mathematics teachers need to encourage and motivate their students to develop their mathematical knowledge through investigation, exploration and examining the hypothesis, approximation, solving problems, researching, and discussing ideas. Thus, educational literature emphasizes the effectiveness of using the 7Es Learning model in improving the mathematics teacher's performance in teaching mathematical concepts (Khashan, 2016).

Table 7: Summary of Analysis of Covariance (ANCOVA) Test Results in Students' Performance between Control Group and Experimental in terms of Higher Order Thinking Skills

Source	SS	DF	MS	F	p-value	Remarks
Group	128.833	1	128.833	42.708	.000	Significant
Pretest	.800	1	.800	.265		
Error	202.114	67	3.017			

Table 8 results show that there is significant difference in the overall performance of the students between the control group and experimental group after controlling pretest, which is the covariate, F (1, 67) = 118.008, p= .000<.05. The findings show that 7Es of learning improved the problem-solving skills of the students. Thus, the hypothesis indicating that 7Es of learning does not improve the problem- solving skills of the students is rejected. This confirmed the claim of Saleh et al. (2018) in his study that students' achievement of mathematical problem-solving under 7Es of learning are higher than students obtained conventional teaching.

Table 8: Summary of Analysis of Covariance (ANCOVA) on Test Results in Overall Students' Performance between Control Group of and Experimental Group

Source	SS	DF	MS	F	p-value	Decision $\alpha = 0.05$	Remarks
Group	1975.224	1	1975.224	118.008	.000	Rejected	Significant
Pretest	13.403	1	13.403	.801			
Error	1121.454	67	16.738				

Table 9 shows the adjusted mean scores of the original Posttest group means. Another ANCOVA was used to compare the overall performance on the students who were exposed to Conventional Approach of Instruction and 7E's of Learning while controlling the pretest. It also shows that the adjusted mean of the control group is 15.631 while the adjusted mean of the experimental group is 26.255. Moreover, this study utilized an SPSS computer program to conduct the independent samples t-tests to compare the pretest scores of students who were exposed to the conventional method of instruction and students with 7Es of learning. The control group was students who received conventional approach of instruction and the experimental group was students who received 7Es of learning as an approach in learning trigonometry. The comparison was performed to examine six research questions and three corresponding null hypotheses. The results of the comparison rejected each null hypothesis and showed that students who were exposed in the 7Es of learning had higher average score on the test than students who received conventional method of instruction. Generally, the study revealed that 7Es of learning is effective for both Lower Order Thinking Skills (LOTS) and Higher Order Thinking Skills (HOTS).

Table 9: The Adjusted Group Means

Estimates

Dependent Variable: Posttest

Group	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Control	15.631[a]	.692	14.250	17.011
Experimental	26.255[a]	.692	24.875	27.635

a. Covariates appearing in the model are evaluated at the following values: pretest = 11.0429.

IV. CONCLUSION

Based on the findings derived from the study, the following conclusions were drawn:

Students in the control group show Low Mastery in both cognitive domains of the lower order thinking skills and higher order thinking skills before the experiment. Low Mastery level of performance indicates lack of skills in lesson comprehension, application, analysis and evaluation. Moreover, students in the control are found wanting in cognitive skills for the topics in Trigonometry 9 at the

start of the experiment and before instructions. However, after the conventional method was employed, the control group has improved to the average level in both lower order thinking skills and higher order thinking skills

Students in the experimental group show Low Mastery level of performance in both lower order thinking skills and higher order thinking skills before the experiment. This implies students in the experimental group show low performance level in the measurement of skills for knowledge, comprehension, application, analysis, synthesis, and evaluation of the topics in Grade 9 Mathematics particularly in the fourth quarter. Conversely, after the experiment, the experimental group shows Moving Towards Mastery level of performance in Lower Order Thinking Skills, and Average Mastery level in Higher Order Thinking Skills.

The students in both groups have the same level of performance before the conduct of the experiment. Students in the control group are of equal performance to students in the experimental group. This implies students in the experimental group and control groups has low mastery level in the measurement of skills for knowledge, comprehension, application, analysis, synthesis, and evaluation of the lessons. Thus, the hypothesis stating that there is no significant difference in the pretest scores of the control and experimental group was not rejected.

Students in the control group showed improvement in their performance when exposed to the conventional approach of instruction. Therefore, the hypothesis which states that there is no significant difference in the pretest and posttest scores of the students in the control group was rejected; this indicates that employing conventional approach of instruction may have improved the performance of the students.

Students in the experimental group showed improvement in their performance when exposed to 7Es of learning. Hence the hypothesis that there is no significant difference between the pretest and posttest of the students in the experimental group was not accepted. This indicates that employing 7Es of learning in the experimental group may have improved the performance of the students.

Students in the control group and experimental group showed improvement in their performance when exposed to the conventional approach of instruction and 7Es of learning in terms of lower order thinking skills and higher order thinking skills. This indicates that both methods were effective and have improved the problem-solving skills of students in Trigonometry. However, the control group who were the recipient of the conventional method of instruction has less mean score compared to the experimental group who were treated with 7Es of learning.

7Es of learning has significant effect on the problem-solving skills of the students after controlling for the covariate which is the pretest. The approach has improved both the lower order thinking skills and higher order thinking skills of the students in the experimental group compared to the control group.

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