IGNATIAN
INTERNATIONAL JOURNAL FOR MULTIDISCIPLINARY RESEARCH
www.icceph.com
ISSN 2984-9942

PROBING STUDENTS' PROBLEM-SOLVING SKILLS USING STRUCTURED ACTIVE LEARNING STRATEGY (SALS)

Jeneth M. Sausal, Denis A. Tan

Science Education Department, Central Mindanao University, University Town, Musuan, Bukidnon, Philippines

https://doi.org/10.5281/zenodo.20383690

ABSTRACT

The Structured Active Learning Strategy (SALS) is a teaching approach that engages students in thinking, problem-solving, and meaningful learning through the combined use of the 7Es and George Polya's problem-solving framework. This study employed a mixed-methods sequential explanatory design to examine the effectiveness of the SALS in enhancing Grade 10 students' problem-solving skills in Mathematics at Lumbo Integrated School. Participants were divided into an experimental group, exposed to the SALS, and a control group taught using a traditional 7Es lesson plan. Instruction focused on the third quarter topics for the school year 2024-2025 of Grade 10 mathematics competencies related to permutations and combinations. Quantitative data were gathered using the adopted Problem-Solving Questionnaires. At the same time, qualitative insights were obtained through semi-structured interviews with six students from the SALS group. Statistical analysis revealed that students exposed to SALS significantly improved their problem-solving skills from low to moderate levels and maintained these gains over time, while students in the non-SALS group showed minimal improvement and poor retention. Statistical analyses also confirmed significant differences between the two groups in problem-solving skills, highlighting the immediate and lasting impact of SALS. Overall, the findings suggest that SALS fosters conceptual understanding and systematic problem-solving, making it an effective strategy for enhancing cognitive outcomes in mathematics learning.

Keywords: *Structured Active Learning, SALS, 7Es Model, Polya's Problem-Solving, Problem-Solving Skills, Mathematics Education*

INTRODUCTION

Mathematics education plays a vital role in developing learners' critical thinking, analytical reasoning, and decision-making skills needed to address real-world challenges. Among the competencies emphasized in mathematics instruction, problem-solving skills is essential in helping students become independent and confident learners. According to George Pólya, mathematical problem-solving involves understanding the problem, devising a plan, carrying out the plan, and looking back, highlighting the importance of systematic and reflective thinking.

Despite the importance of these competencies, many students continue to struggle in mathematics, particularly in solving non-routine and higher-order problems. Studies revealed that learners experience difficulties in interpreting mathematical situations, selecting appropriate strategies, and applying concepts to real-life situations (Rahmmatiya & Miatun, 2020). Similarly, Novitasari and Masriyah (2020) found that weak analytical and reasoning skills contribute to poor mathematical problem-solving performance. These concerns are reflected in the Programme for International Student Assessment results, where Filipino learners performed below proficiency expectations in mathematics. The Philippines ranked among the lowest-performing countries in the 2022 assessment, indicating persistent concerns regarding students' mathematical understanding and problem-solving abilities.

To address the concerns, active learning approaches have gained attention in mathematics education. Active learning encourages collaboration, inquiry, discussion, and reflection, allowing students to participate actively in the learning process. Freeman et al. (2014) found that active learning improves student achievement and engagement compared to traditional instruction. Similarly, Lugosi and Uribe (2018) emphasized that collaborative and inquiry-based strategies enhance conceptual understanding and critical thinking. Structured Active Learning Strategy (SALS), in particular, combines guided inquiry, collaboration, and structured scaffolding to create an engaging learning environment. By integrating the 7Es learning cycle with Pólya's problem-solving framework, SALS promotes active participation and systematic problem-solving.

Although several studies have explored active learning strategies, inquiry-based instruction, and mathematical problem-solving independently, limited research has examined the combined application of SALS, the 7Es model, and Pólya's framework in enhancing students' problem-solving skills in mathematics. Existing studies often focus only on academic achievement or conceptual understanding, with fewer investigations addressing how integrated instructional approaches influence learners' higher-order thinking and problem-solving processes simultaneously. Furthermore, there remains a scarcity of localized and contextualized studies, particularly in secondary mathematics education, that evaluate the effectiveness of such combined strategies in real classroom settings. Addressing this research gap is important because it may provide empirical evidence on how structured active learning environments can strengthen students' ability to solve mathematical problems effectively while promoting deeper understanding, active participation, and learner confidence. The findings may also guide mathematics teachers, curriculum developers, and educational institutions in designing more responsive and evidence-based instructional practices that support 21st-century learning competencies.

Research Questions

Hence, the present study aimed to determine the effect of the Structured Active Learning Strategy (SALS) on Grade 10 students' problem-solving skills in Mathematics. Specifically, it sought to answer the following questions:

1. What is the level of students' problem-solving skills as exposed to Structured Active Learning Strategy (SALS) and those exposed to non-Structured Active Learning Strategy (non-SALS) in terms of:
   a. understanding the problem;
   b. devising a plan;
   c. carrying out the plan; and
   d. looking back?
2. Is there a significant difference between the levels of students' problem-solving skills as exposed to Structured Active Learning Strategy (SALS) and those exposed to non-Structured Active Learning Strategy (non-SALS), with pretest as covariate, in terms of:
   a. posttest; and
   b. retention test?
3. What are the elements of the Structured Active Learning Strategy (SALS) that affect students' problem-solving ?
4. How do these elements of the Structured Active Learning Strategy (SALS) affect students' problem-solving skills?

METHODOLOGY

The study assessed the students' problem-solving skills using Structured Active Learning Strategy at Lumbo Integrated School Junior High School for SY 2024-2025. A sequential explanatory mixed-method research design was employed in the study. The quantitative phase utilized a quasi-experimental pretest-posttest control group design, while the qualitative phase employed semi-structured interviews to further explain the quantitative findings.

The respondents of the study consisted of eighty-four (84) Grade 10 students from two heterogeneously intact classes. One class served as the experimental group exposed to SALS, while the other class served as the control group which was exposed to non-SALS instruction. Simple random sampling through tossing of coin was employed to determine which section would serve as the control group or experimental group.

Two research instruments were utilized in the study, namely the Problem-Solving Skills Questionnaire and Problem-Solving Interview Guide. The problem-solving questionnaire was adapted from Polestico (2023) and consisted of sixteen (16) items aligned with Polya's four stages of problem-solving. To ensure the validity and appropriateness of the instruments, they underwent expert validation by three specialists in mathematics education.

The researchers secured permission from the school administration and informed consent from the parents and students prior to the conduct of the study. Pretests were administered to both groups before the intervention. The experimental group was exposed to SALS integrating the 7E instructional cycle and George Polya's Problem-Solving framework while the control group was taught using strategy aligned with k to 12 curriculum. The intervention lasted for eight weeks covering the third quarter topics of Mathematics 10 in the Curriculum Guide under K to 12 Curriculum. Posttest was administered after the intervention and the retention test was conducted two weeks after the posttest. Finally, the semi-structured interview was conducted. The researchers identified six (6) participants through purposive sampling from the experimental group, representing two (2) of each performance group: upper, middle and lower based on their posttest scores. The selection ensured a diverse range of perspectives on the impact of SALS on problem-solving skills.

Finally, after all the test and interview were conducted, the researchers analyzed the gathered data using both quantitative and qualitative approaches. The researchers used descriptive statistics such as mean, standard deviation frequency and percentage to determine the level of students' problem-solving skills. The following rating scale was used to better understand the data:

Percent Equivalent	Descriptive Rating	Qualitative Interpretation
90-100	Outstanding	Very High Problem-Solving Skills (VHPSS)
80-89	Very Satisfactory	High Problem-Solving Skills (HPSS)
70-79	Satisfactory	Moderate Problem-Solving Skills (MPSS)
60-69	Fairly Satisfactory	Low Problem-Solving Skills (LPSS)
Below 59	Did Not Meet Expectations	Very Low Problem-Solving Skills (VLPSS)

To identify significant differences between the experimental and control groups while controlling the pretest scores as covariates, Analysis of Covariance (ANCOVA) was employed. Furthermore, qualitative data obtained from the interviews were analyzed using Creswell's thematic analysis framework, which involved coding, categorization, theme generation, and interpretation of responses.

RESULTS AND DISCUSSION

The data obtained from the study were analyzed, interpreted and presented in this chapter. Tables and other figures were used to provide a straightforward data analysis. The presentation was in the order of the objectives of the study.

Level of Students' Problem Solving Skills before and after SALS

This section shows the level of the students' problem solving skills in structured active learning strategy and non-structured active learning strategy on the pre-test, posttest and retention test. The analysis focuses on four key dimensions: understanding the problem, devising a plan, carrying out the plan and looking back. It shows the frequency distribution, range of percentage, and qualitative interpretation of the collected data.

Table 1. Level of students' problem solving skills in terms of understanding the problem

Range	GROUP												QI
	SALS n=42						non-SALS n=42						
	Pretest		Posttest		Retention Test		Pretest		Posttest		Retention test		
	f	%	f	%	f	%	f	%	f	%	f	%	
90%-100%	0	0%	21	50%	19	45%	0	0%	20	48%	5	12%	VH
80%-89%	0	0%	6	14%	6	14%	0	0%	9	21%	7	17%	H
70%-79%	0	0%	9	21%	10	24%	2	9%	6	14%	13	31%	M
60%-69%	0	0%	3	7%	4	9.5%	4	10%	3	7%	3	7%	L
59% and below	42	100%	3	7%	3	7%	36	86%	2	5%	14	33%	VL
Mean	3.98		10.12		9.90		3.74		9.90		7.5		
MPS	33.16%		84.33%		82.50%		31.16%		82.50%		62.5%		

Table 1 shows the pretest results that both groups demonstrated very low problem-solving skills, with all students in the SALS group (100%) and most students in the non-SALS group (86%) classified under "Did Not Meet Expectations." This was reflected in their low Mean Percentage Scores (MPS) of 33.16% for SALS and 31.16% for non-SALS, indicating that students initially had difficulty comprehending mathematical problems. Although the non-SALS group had slightly better pretest performance, both groups started with weak foundational understanding prior to the intervention.

After the intervention, both groups showed improvement in understanding the problem, but the SALS group demonstrated stronger and more sustained performance. In the posttest, 50% of SALS students achieved the Outstanding level with an MPS of 84.33%, while the non-SALS group also improved, with 48% reaching Outstanding and an MPS of 82.50%. However, the retention test results revealed a clear advantage for SALS, as the group maintained a high MPS of 82.50% and 45% of students remained in the highest category. In contrast, the non-SALS group's retention MPS declined to 62.5%, with 33% of students falling back into the Very Low category. The mean scores further supported these findings, with SALS obtaining means of 3.98, 10.12, and 9.90 across the pretest, posttest, and retention test, respectively, compared to 3.74, 9.90, and 7.50 for non-SALS.

Overall, the findings indicate that the Structured Active Learning Strategy (SALS) was more effective than the non-SALS in improving students' understanding of mathematical problems and sustaining learning gains over time. While both groups improved from the pretest to the posttest, the SALS group consistently achieved higher posttest and retention performance, suggesting stronger conceptual understanding and better long-term recall. The findings conformed to the study of Redoble (2020), which states that students may easily comprehend the problem and recognize the provided information depending on their prior knowledge. In addition, this outcomes aligns with recent studies of Santos-Trigo (2024) that problem-solving learning environments that encourage active participation and structured reasoning lead to more meaningful mathematical understanding. Similarly, Leonardo II et al. (2025) found that problem-based and active learning strategies significantly improve students' mathematical performance and retention. In addition, Serrano (2025) reported that active, student-centered strategies foster higher-order thinking skills, including comprehension and problem analysis.

Table 2. Level of students' problem solving skills in terms of devising a plan

Range	GROUP												QI
	SALS n=42						non-SALS n=42						
	Pretest		Posttest		Retention Test		Pretest		Posttest		Retention test		
	f	%	f	%	f	%	f	%	f	%	f	%	
90%-100%	0	0%	30	71%	23	55%	0	0%	22	52.4%	11	26%	VH
80%-89%	0	0%	7	17%	13	31%	0	0%	6	14%	18	43%	H
70%-79%	0	0%	1	2%	1	2%	0	0%	3	7%	4	10%	M
60%-69%	0	0%	2	5%	3	7%	1	2%	5	12%	5	12%	L
59% and below	42	100%	2	5%	2	5%	41	98%	6	14%	4	10%	VL
Mean	0.60		6.81		6.55		0.52		5.79		5.57		
MPS	7.5%		85.12%		81.87%		6.5%		72.37%		69.62%		

Table 2 displays that both the SALS and non-SALS groups initially demonstrated very low mathematical problem-solving skills in terms of devising a plan. During the pretest, all students in the SALS group (100%) and nearly all students in the non-SALS group (98%) were categorized under Did Not Meet Expectations, with Mean Percentage Scores (7.5% and 6.5%, respectively). These findings suggest that students from both groups struggled significantly in identifying appropriate strategies and organizing the steps necessary to solve mathematical problems.

After the intervention, a marked improvement was observed, particularly among students exposed to the SALS. In the posttest, a substantial proportion of SALS students (71%) reached the Outstanding level, with an MPS of 85.12%, and this high level of performance was largely maintained in the retention test (81.87%), where 55% remained in the highest category. In comparison, the non-SALS group also showed improvement, with 52.4% achieving Outstanding in the posttest and an MPS of 72.37%; however, their performance slightly declined in the retention test (MPS = 69.62%). The results demonstrate that SALS students, with a mean of 6.81 in the posttest and 6.55 in the retention test, consistently outperformed non-SALS students, with means of 5.79 and 5.57, respectively, in terms of devising a plan.

The results imply that the Structured Active Learning Strategy (SALS) plays a meaningful role in strengthening students' ability to devise effective plans when solving problems. The more substantial gains observed in the posttest indicate that continuous engagement in SALS helps students internalize systematic approaches to planning solutions, while the superior performance in the retention test highlights long-term retention of problem-solving skills. This implies that SALS enhances students' ability to devise effective plans in problem solving, as supported by Schoenfeld (2016), Hmelo-Silver et.al (2015) who emphasized that structured and active learning strategies improve strategic planning, metacognitive control, and sustained problem-solving behaviors over time. Similarly, Tan and Limjap (2018) found that students' mathematical problem-solving success is strongly associated with the use of metacognitive processes such as identifying strategies, organizing information, and planning solution procedures before executing solutions. Their emergent model emphasized that effective problem solving involves "planning solution strategies by identifying, conjecturing, and selecting strategies," which parallels the objectives of SALS in enhancing students' ability to devise plans in solving mathematical tasks.

Table 3. Level of students' problem solving skills in terms of carrying out the plan

Range	GROUP												QI
	SALS n=42						non-SALS n=42						
	Pretest		Posttest		Retention Test		Pretest		Posttest		Retention test		
	f	%	F	%	f	%	f	%	f	%	f	%	
90%-100%	0	0%	23	54%	17	41%	0	0%	13	31%	10	24%	VH
80%-89%	0	0%	7	17%	12	29%	0	0%	8	19%	8	19%	H
70%-79%	0	0%	3	7%	2	5%	0	0%	4	10%	5	12%	M
60%-69%	0	0%	1	2%	2	5%	0	0%	4	10%	4	10%	L
59% and below	42	100%	8	19%	9	21%	42	100%	13	31%	15	36%	VL
Mean	0.43		12.50		11.79		0.36		11.10		10.67		
MPS	7.5%		78.12%		73.68%		6.5%		69.37%		66.68%		

The data in Table 3 reveal that both the Structured Active Learning Strategy (SALS) and non-SALS groups initially exhibited very low levels of mathematical problem-solving skills in terms of carrying out the plan. During the pretest, all students in both groups (100%) were classified under Did Not Meet Expectations, with very low Mean Percentage Scores of 7.5% for the SALS group and 6.5% for the non-SALS group. This indicates that students encountered significant difficulty in executing solution procedures, applying mathematical operations accurately, and following through with planned strategies.

Following the intervention, both groups demonstrated considerable improvement; however, the SALS group showed more pronounced and sustained gains. In the posttest, more than half of the SALS students (54%) reached the Outstanding level, with an MPS of 78.12%, and 41% remained in the highest category in the retention test (73.68%). In contrast, the non-SALS group also improved, with 31% achieving Outstanding on the posttest and an MPS of 69.37%, but their retention performance declined further to an MPS of 66.68%, with 36% reverting to the "Very Low" category. The results demonstrate that the SALS group, with a mean of 12.50 in the posttest and 11.79 in the retention test, outperformed the non-SALS group, with a mean of 11.10 and 10.67, in terms of carrying out a plan.

The findings highlight how crucial it is for teachers to build students' foundational mathematics skills, as this strengthens their overall problem-solving skills. This aligns with the study by Balairos (2020), which found that weak pretest performance often stems from shaky basic knowledge of key concepts. This implies that Structured Active Learning Strategy made an impact on students' problem-solving skills compared to their pretest. Students showed real gains in problem-solving compared to their starting point—they could put their plans into action effectively and even apply what they'd learned to everyday situations. A solid plan gives structure, but students need to test each step carefully and realistically; if one strategy flops, they should scrap it and try the next, as Dema and Phuntsho (2019) suggest. This echoes Ortiz (2016), cited in Niño (2021), who describes how students develop a plan early on, execute it, and verify every phase. Nambatac (2011, as cited in Niño, 2021), also notes that many learners struggle with mathematical aptitude, especially when they can't connect concepts to language, leading to half-formed understanding and difficulty sharing their knowledge.

Table 4. Level of student's problem solving skills in terms of looking back

Range	GROUP												QI
	SALS n=42						non-SALS n=42						
	Pretest		Posttest		Retention Test		Pretest		Posttest		Retention test		
	f	%	f	%	f	%	f	%	f	%	f	%	
90%-100%	0	0%	6	14%	3	7%	0	0%	0	0%	0	0%	VH
80%-89%	0	0%	6	14%	5	12%	0	0%	1	2%	0	0%	H
70%-79%	0	0%	18	43%	17	41%	0	0%	14	33%	5	12%	M
60%-69%	0	0%	4	10%	9	21%	0	0%	12	29%	18	43%	L
59% and below	42	100%	8	19%	8	19%	42	100%	15	36%	19	45%	VL
Mean	0.09		1.95		1.67		0.0		1.02		0.67		
MPS	1.10%		48.75%		41.75%		0%		25.50%		16.75%		

The results in Table 4 indicate that both the Structured Active Learning Strategy (SALS) and non-SALS groups initially demonstrated extremely low levels of mathematical problem-solving skills in terms of looking back. During the pretest, all students in both groups (100%) were categorized under Did Not Meet Expectations, with very low Mean Percentage Scores of 1.10% for the SALS group and 0% for the non-SALS group. This suggests that students had minimal to no practice in evaluating their solutions, checking for errors, or reflecting on the reasonableness of their answers, highlighting that the "looking back" phase—often considered a higher-order metacognitive skill—was largely undeveloped among the learners prior to the intervention.

Following the implementation of the intervention, the SALS group showed noticeable improvement in this aspect of problem-solving. In the posttest, 43% of students reached the Satisfactory level, with some progressing to Very Satisfactory and Outstanding levels (14% each), resulting in an MPS of 48.75%. Although there was a slight decline in the retention test (MPS = 41.75%), 41% remained in the Satisfactory category, indicating that the SALS was able to cultivate students' ability to review and reflect on their solutions and support deeper mathematical understanding and metacognitive awareness.

In contrast, the non-SALS group exhibited only slight improvement in the posttest (MPS = 25.50%) and declined further in the retention test (MPS = 16.75%), with 45% remaining in the Very Low level and no students reaching the highest performance levels. These findings suggest that without structured and guided learning experiences, students may struggle to develop and sustain reflective problem-solving practices. The pretest results were completely expected, as the class hadn't yet probed into those specific topics, aligning with Orendain's (2020) study that learners tend to perform poorly on pretests without a solid foundation in math fundamentals, and further supported by Ardines (2021) that students' problem-solving skills in terms of looking back are very poor. In addition, Falsis (2019) found that students' abilities in the "looking back" aspect of problem-solving stayed very weak even after an intervention was introduced. Tanquilan (2023) provides further support, reporting similarly dismal results in students' looking back skills. In this study, both the experimental and control groups showed ongoing major weaknesses in the looking back area.

Table 5. Comparison of students' problem solving skills on the post test

GROUP	N	MEAN	SD
SALS	42	31.38	7.191
non-SALS	42	27.81	8.116
TOTAL	84	29.60	7.830

SOURCE	SS	df	MS	F-Value	Sig.	Partial Eta Squared (η^2)
Group	198.413	1	198.413	5.833	.018*	0.67
Pre-test (Covariate)	2065.002	1	2065.002	60.705	. 001	0.428
Error	2755.379	81	34.017			
Total	78662.000	84				

*Note: * - highly significant at 0.05 level*

Table 5 presents the students' posttest problem-solving skills after being treated with SALS. Students who were exposed to SALS had a mean percentage of 31.38 (SD = 7.191), compared with 27.81 (SD = 8.116) for those exposed to non-SALS. A significant difference was observed between the two groups at the 0.05 level (F = 5.833, p = 0.018), highlighting that exposure to the Structured Active Learning Strategy (SALS) led to significantly higher posttest problem-solving performance among students compared to those taught using the non-SALS, indicating the effectiveness of SALS in enhancing problem-solving skills.

The significant improvement in posttest problem-solving performance among students exposed to the Structured Active Learning Strategy (SALS) is strongly supported by existing research emphasizing the role of active engagement in learning. For instance, Freeman et al. (2015) demonstrated that students taught through active learning strategies consistently outperformed those in traditional lecture-based settings, particularly in problem-solving and conceptual understanding. Similarly, Prince and Felder (2017) found that structured student-centered strategies promote deeper cognitive processing, which directly enhances learners' ability to analyze and solve complex problems. In the same vein, Hmelo-Silver et al. (2015) reported that learning environments that actively involve students in reasoning and inquiry significantly improve problem-solving outcomes. Moreover, these findings are further supported by Bayarcal and Tan (2023) who found that students exposed to the Open-Ended Approach performed significantly better in mathematics and demonstrated stronger problem-solving skills than those taught through conventional methods. Their study highlighted that allowing students to explore different solution strategies encourages deeper understanding and critical thinking. Similarly, Cambaya and Tan (2022) revealed that contextualized instruction improved students' engagement and problem-solving performance because learners became more actively involved in the learning process and were able to relate mathematical concepts to real-life situations. These studies support the present findings by showing that structured and active learning approaches, such as SALS, help students participate more meaningfully in class, develop confidence in solving problems, and achieve better performance in mathematics.

Table 6. Comparison of students' problem solving skills on the retention test

GROUP	N	MEAN	SD
SALS	42	29.90	7.407
non-SALS	42	24.40	7.140
TOTAL	84	27.15	7.742

SOURCE	SS	df	MS	F-Value	Sig.	Partial Eta Squared (η^2)
Group	531.505	1	531.505	17.048	.001**	0.174
Pre-test (Covariate)	1814.414	1	1814.414	58.198	. 001**	0.418
Error	2525.324	81	31.177			
Total	66915.000	84				

*Note: ** - highly significant at 0.01 level*

Table 6 presents the students' problem-solving skills retention test results after being treated with SALS. Students who were exposed to SALS had a mean percentage of 29.90 (SD = 7.407), compared with 24.40 (SD = 7.140) for those exposed to non-SALS. A significant difference was observed between the two groups at the 0.01 level (F = 17.048, p = 0.001**). The Structured Active Learning Strategy (SALS) improves significantly superior long-term retention of problem-solving skills in mathematics, as shown by a significantly higher mean percentage score, underscoring its potential to equip students with enduring cognitive competencies essential for academic success.

The overall results aligns with a growing body of research emphasizing the enduring impact of structured active learning on student achievement and cognitive development. Freeman et al. (2020) reported that active learning implementations reliably enhance retention across varied disciplines and age groups. Similarly, González et al. (2020) highlighted that learners exposed to structured, inquiry-oriented instruction exhibit not only immediate performance gains but also more resilient competencies over time. More recently, López-Perez et al. (2019) highlighted that well-designed cooperative and structured activities contribute to sustained academic competencies, including problem-solving, months after instruction has ended.

Elements the SALS that affects students' problem-solving skills

This section presents the qualitative data analysis of the dataset gathered from the students' responses to the Structured Active Learning Strategy on Students' Problem-Solving Skills.

Theme 1: Structured Problem-Solving and Conceptual Understanding

Structured Problem-Solving and Conceptual Understanding refer to an instructional strategy that deliberately guides learners through organized stages of thinking while emphasizing deep comprehension of underlying concepts rather than rote procedures. Many students refer to following a step-by-step procedure or breaking down word problems into smaller parts, which means they follow guided questions to answer word problems.

"kuan maam gisabot nako ang problem. Gi follow ra nako ang guide parehas atong pag solve nato sa uban problem.Una kay gi identify nako unsa ang given, dayon unsay problem. Ako dayon gi identify kong permutation ba or combination siya. Gi solve dayon nko gamit ang formula."
(I tried to understand the problem. I followed the guide just like how we solved the problems before. First, I identified what the given is and what is asked. Then I identify if it's a permutation or a combination. Then, I solved it using the formula)

Participant-1

"Gi parehas nako ug solve kong unsa ka magsolve ma'am ug kong gina unsa pag solve sa una. Kato galing i-identify ang given mag formula dayon."
(I solved it the way you solve it, ma'am, and how it's solved before. The one where you identify the given, then use the formula.)

Participant-2

The students' responses clearly reflect the theme of Structured Problem-Solving and Conceptual Understanding, as they consistently described solving word problems through a guided, step-by-step process. Their emphasis on identifying the given information, determining what is asked, and classifying the problem before applying a formula indicates that their problem-solving skills were shaped by an organized cognitive structure rather than by random trial and error.

These findings are supported by recent studies highlighting the effectiveness of structured and concept-focused problem-solving strategies. Hattie (2017) emphasized that explicit teaching of problem-solving steps enhances students' ability to organize their thinking and improves learning outcomes, particularly in mathematics. Similarly, Polya-inspired instructional models examined by Sari and Putri (2021) revealed that students exposed to guided problem-solving stages demonstrated stronger conceptual understanding and higher achievement in solving word problems than those taught through traditional methods. Together, these studies affirm that structured guidance combined with conceptual emphasis fosters deeper understanding and more effective problem-solving skills among learners.

Theme 2: Collaborative Learning and Peer Support

Collaborative and Peer Support refers to a learning environment in which students actively engage with one another to construct understanding, clarify misconceptions, and develop confidence through shared problem-solving experiences. Within this theme, learning is not viewed as an individual and isolated process but as a socially mediated activity where knowledge is strengthened through interaction, dialogue, and mutual assistance. Such collaboration fostered a supportive atmosphere that encouraged questioning, explanation, and collective sense-making. The following responses support this:

"Naa ma'am, sa una galibog gyud ko kong unsaon. Pero pagdiscuss nimo ma'am kay nakasabot nako. Naa paman gihapo'y gamay nga dili masabtan ma'am pero gapatabang ko sa akong classmates." (There is ma'am, before, I am really confused on how to do it. But when you discussed it, ma'am, I understood how it is done. There are still a few things that I don't understand, but I asked for help from my classmates)

-Participant 3

"Yes ma'am. Sa una apil ko maglibog sa akong solution kay wala man ko kasabot. Pero maminaw ko sa akong classmates nga ga explain. Makasabot na dayon ko ma'am. Karon kabalo nako mag-solve. Awaton ra nako tong parehas sa activity pag-solve."
(Yes, ma'am. Before, I was also confused about my solution because I didn't understand it. But I listened to my classmates' explanation. Then, I understood, ma'am. Now I know how to solve. I just copied how it is solved in the activity.)

-Participant 5

The participants' responses clearly illustrate how peer support influenced their problem-solving strategies. For instance, Participant 3 explicitly shared that their understanding of the solution was reinforced by a classmate, who taught them how to solve the problem during activities, highlighting the role of peer explanation in learning. Similarly, Participant 5 emphasized that listening to classmates' explanations helped them overcome confusion and eventually understand how to solve the problems correctly. These responses demonstrate that peer interactions served as an accessible and effective source of clarification, especially for learners who initially struggled with the concepts.

The Structured Active Learning Strategy, specifically within the 7Es instructional model, aligned with George Pólya's Problem-Solving Framework, encourages students to actively construct knowledge through structured phases of inquiry and reflection. Collaborative and peer support is most enhanced during the Explore and Explain phases, where students work together to interpret problems. In the Explore phase, learners collectively examine problem statements and share initial ideas, while in the Explain phase, they clarify their solutions and reasoning with one another. Through these structured interactions, learners refine their understanding and internalize problem-solving strategies more effectively than through solitary engagement.

These findings are consistent with research highlighting the value of peer-assisted learning. According to Gillies (2016), peer interaction facilitates deeper comprehension and critical thinking in mathematics. Johnson and Johnson (2017) emphasized that cooperative learning structures enhance student achievement and interpersonal skills. More recently, Fernández-Río et al. (2023) demonstrated that peer-supported instructional strategies improve motivation and academic performance across disciplines.

Effect of SALS on students' problem-solving skills and self-efficacy

This section presents both the quantitative results and qualitative interpretations of the effects of the (SALS) on students' problem-solving skills and self-efficcacy.

Table 12. Effect of SALS on students' problem-solving skills

	Quantitative Results		Qualitative Results	
	SALS	non-SALS	Elements	Impact
Posttest	Mean is 69.64	Mean is 64.81	Theme 1: Structured Problem-Solving and Conceptual Understanding	Enhanced conceptual grasp
Retention Test	Mean is 29.90	Mean is 24.40		
	ANCOVA			
Posttest	F value is 5.833 p-value is 0.018 ($p<0.05$)	The partial eta squared (η^2) is 0.67	Theme 2: Collaborative Learning and Peer Support	Improved Collaborative problem-solving
Retention Test	F value is 17.048 p-value is 0.001 ($p<0.05$)	The partial eta squared (η^2) is 0.174		

The quantitative results showed that students exposed to the Structured Active Learning Strategy (SALS) outperformed those taught using non-SALS in both the posttest and retention test. The SALS group achieved higher mean scores in the posttest (69.64) and retention test (29.90) compared to the non-SALS group, indicating stronger learning gains and better long-term retention of concepts. ANCOVA results confirmed that these differences were statistically significant, demonstrating that SALS had a substantial and lasting effect on students' problem-solving performance. Qualitative findings further revealed that SALS enhanced students' conceptual understanding and improved collaborative problem-solving through structured guidance and peer interaction. Students reported that identifying givens, determining the type of problem, and following guided procedures helped them solve problems more effectively and confidently.

"kuan maam gisabot nako ang problem. Gi follow ra nako ang guide parehas atong pag solve nato sa uban problem.Una kay gi identify nako unsa ang given, dayon unsay problem. Ako dayon gi identify kong permutation ba or combination siya. Gi solve dayon nko gamit ang formula."
(I tried to understand the problem. I followed the guide just like how we solved the problems before. First, I identified what the given is and what is asked. Then I identify if it's a permutation or a combination. Then, I solved it using the formula)

-Participant 1

Kay mao akong nasabtan ma'am sa atong previous lesson kong unsaon pag solve. Mao sad gitudlo sa ako ni Rux. Nagpatudlo man gud ko sa iya ma'am anang mag activity ta ma'am.
(Because that's what I understood from our previous lesson on how to solve it. That's what Rux also taught me. I asked Rux to teach me, ma'am, when we are having an activity.)

-Participant 3

-

These findings are supported by Hattie (2017), who emphasized that structured teaching strategies with clear learning progressions significantly enhance students' conceptual understanding and academic performance. Johnson and Johnson (2017) reported that collaborative learning environments improve problem-solving skills and retention through peer interaction and shared responsibility. More recently, Sun et al. (2023) found that guided and active learning strategies in mathematics lead to higher achievement and sustained understanding.

Conclusions and Recommendations

The findings conclude that the Structured Active Learning Strategy (SALS) is an effective instructional approach for improving students' problem-solving skills in mathematics. Before the intervention, both groups had low problem-solving skills. After the implementation of SALS, the experimental group showed significant improvement, achieving Moderate Problem-Solving Skills, while the control group remained at lower levels. The retention test also revealed that students exposed to SALS maintained their learning and problem-solving abilities over time, indicating that SALS supports both immediate achievement and long-term retention in mathematics.

Furthermore, statistical analyses confirmed significant differences between the SALS and non-SALS groups in problem-solving skills, demonstrating the effectiveness of the intervention. Through structured guidance, collaborative learning, and step-by-step activities aligned with the 7Es instructional model and Pólya's framework, students developed stronger conceptual understanding problem-solving skills.

The findings suggest that the Structured Active Learning Strategy (SALS) should be integrated into regular mathematics instruction to help students better understand and solve complex problems through clear, step-by-step processes. Teachers are encouraged to use activities that not only build problem-solving skills but also strengthen students' confidence, motivation, and belief in their own abilities. With proper implementation, SALS can create a more engaging and supportive learning environment that promotes both immediate learning gains and long-term retention. School leaders are also encouraged to support teachers through training and professional development to ensure effective use of the strategy across classrooms. Lastly, future studies may further explore which parts of SALS are most effective and how it can be applied in other subjects to enhance both academic performance and student growth.

Compliance with Ethical Standards

The researcher followed the complete standards in conducting the study. The study aims to improve the students' problem-solving skills in mathematics. In conducting research, the respondents' welfare and respect are given top priorities and to ensure the confidentiality of this research, the sample group as well as the institutions in which the study was undertaken had their privacy protection. Thus, the researchers kept in absolute confidence the names of the participants and institutions. Adhering to the protocol, particularly in managing sample and data, the respondents had free will to participate without any form of consequences. The researcher encouraged but did not oblige anyone to take part in the study.

Acknowledgments

The author sincerely thanks all individuals and institutions who supported this research. Special appreciation is given to Dr. Denis A. Tan for her guidance, along with Dr. Jenyliza T. Ucang and Dr. Cherly C. Cordova for their valuable insights, as well as the College of Education and Central Mindanao University for their support. Gratitude is also extended to family and friends for their constant love and encouragement. Above all, heartfelt thanks are offered to Almighty God for His wisdom, grace, and guidance throughout the journey.

REFERENCES

Ardines, M. P. (2021). Problem Solving Ability and Self-Regulated Learning Strategy on Students' Performance in Mathematics in Modular Distance Learning: A Path Analysis. Central Mindanao University. Unpublished Masters' Thesis.

Balairos, J. (2020). Foundational knowledge gaps and students' performance in mathematics: Evidence from pretest assessment. International Journal of Educational Studies, 7(2), 45–56.

Bayarcal, G. C., & Tan, D. A. (2023). Students' achievement and problem-solving skills in mathematics through open-ended approach. American Journal of Educational Research, 11(4), 183–190. https://doi.org/10.12691/education-11-4-2

Cambaya, E. J. D., & Tan, D. A. (2022). Enhancing students' problem-solving skills and engagement in mathematics learning through contextualized instruction. Science International (Lahore), 34(2), 101–109

Dema, Y. & Phuntsho, U. (2019). Examining the Effects of Using Polya's Problem- solving Model on Mathematical Academic Achievement and Analyzing Ability of the Fourth

Grade Students. Asian Journal of Education and Social Studies. doi:10.9734/AJESS/2019/v5i230142.

Falsis, A. (2019). Students' Mathematical Problem-Solving Ability, Attitude, and Achievement in a Differentiated Instruction. Central Mindanao University. Unpublished Masters' Thesis.

Fernández-Río, J., Cecchini, J. A., Méndez-Giménez, A., Méndez-Alonso, D., & Prieto, J. A. (2023). Impact of cooperative learning on academic achievement, motivation, and social relationships: A systematic review. Educational Psychology Review, 35(2), 1–30. https://doi.org/10.1007/s10648-022-09702-3

Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2015). Active learning increases student performance in science, engineering, and mathematics. Proceedings of the National Academy of Sciences, 111(23), 8410–8415. https://doi.org/10.1073/pnas.1319030111

Freeman, S., Haak, D., & Wenderoth, M. P. (2020). Strengthening active learning by establishing what works and why. Journal of Cell Biology, 219(7), e202001108.

Gillies, R. M. (2016). Cooperative learning: Review of research and practice. Australian Journal of Teacher Education, 41(3), 39–54. https://doi.org/10.14221/ajte.2016v41n3.3

González, A., Rodríguez, Y., Faílde, J. M., & Carrera, M. V. (2020). Anxiety in the statistics class: Structural relations with engagement and academic performance. Educational Psychology, 40(5), 1–20. https://doi.org/10.1080/01443410.2019.1695804

Hattie, J. (2017). Visible learning for mathematics, grades K-12: What works best to optimize student learning.

Hmelo-Silver, C. E., Manlove, S., & Jordan, R. (2015). Supporting students' collaborative learning in problem-based learning. Interdisciplinary Journal of Problem-Based Learning, 9(1), 1–17. https://doi.org/10.7771/1541-5015.1529

Hmelo-Silver, C. E., DeSimone, C., & Zajac, R. (2015). Supporting collaborative learning and problem solving in problem-based learning. In C. E. Hmelo-Silver, C. A. Chinn, C. K. K. Chan, & A. O'Donnell (Eds.), The international handbook of collaborative learning (pp. 69–84). Routledge.

Johnson, D. W., & Johnson, R. T. (2017). Cooperative learning and social interdependence theory. Theory and Research in Education, 15(1), 1–17. https://doi.org/10.1177/1477878517699250

Leonardo II, J. O., & Ortega-Dela Cruz, R. A. (2025). Effects of active learning strategies on students' mathematical performance and retention. Journal of Mathematics Education Research, 18(2), 45–62.

López-Pérez, M. V., Pérez-López, M. C., & Rodríguez-Almendros, M. L. (2019). Effectiveness of cooperative and structured learning activities in sustaining long-term academic competencies. Journal of Educational Research, 112(4), 389–402.

Lugosi, E., & Uribe, G. (2018). Active learning strategies with positive effects on students' achievements in undergraduate mathematics education. International Journal of Mathematical Education in Science and Technology, 49(5), 675-688.

Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematics. Proceedings of the National Academy of Sciences, 111(23), 8410–8415. https://doi.org/10.1073/pnas.1319030111

Niño, E.J. (2021). Problem-Solving Skills, Learning Engagement, and Motivation on Students' Performance in Mathematics. Central Mindanao University. Unpublished Masters' Thesis.

Novitasari, N. T., & Masriyah, M. (2020). Identification of students' analytical and reasoning skills in mathematical problem-solving. Proceedings of the 7th Mathematics, Science, and Computer Science Education International Seminar (MSCEIS 2019). EAI. https://doi.org/10.4108/eai.12-10-2019.2296534

Orendain, L. (2020). Mathematical Problem Solving Skills and Academic Self- Concept of Students Through Diagnostic Teaching Approach. Central Mindanao University. Unpublished Masters' Thesis.

Polestico, J. (2023). Development and validation of a problem-solving skills questionnaire aligned with Pólya's problem-solving framework (Master's thesis, Central Mindanao University).

Prince, M., & Felder, R. M. (2017). Active learning: An introduction. Journal of Engineering Education, 93(3), 223–231. https://doi.org/10.1002/j.2168-9830.2004.tb00809.x

Redoble, S. (2020). Students' Problem Solving Skills and Motivation Through Mathematical Modelling Approach. Central Mindanao University. Unpublished Masters' Thesis.

Rahmmatiya, R., & Miatun, A. (2020). Students' difficulties in mathematical problem-solving and their implications for mathematics learning. Journal of Physics: Conference Series, 1460(1), 012010. https://doi.org/10.1088/1742-6596/1460/1/012010

Santos-Trigo, M. (2024). Problem-solving in mathematics education: Designing learning environments for conceptual understanding. Mathematics Teaching and Learning Journal, 16(1), 10–28.

Sari, D. K., & Putri, R. I. (2021). The effect of Polya-inspired guided problem-solving instruction on conceptual understanding and achievement in mathematics. Journal of Mathematics Education Research, 10(2), 45–60.

Schoenfeld, A. H. (2016). Learning to think mathematically: Problem solving, metacognition, and sense making in mathematics. Journal of Education, 196(2), 1–38. https://doi.org/10.1177/002205741619600202

Serrano, F. D. C. (2025). Student-centered learning approaches and the development of higher-order thinking skills in mathematics. International Journal of Educational Studies, 12(3), 77–91.

Sun, J., Li, X., & Zhang, H. (2023). Effectiveness of structured collaborative problem-solving on mathematics achievement and motivation. Journal of Educational Research and Practice, 13(2), 145–162. https://doi.org/10.5590/JERP.2023.13.2.10

Tan, D. A., & Limjap, A. A. (2018). Filipino students' use of metacognitive skills in mathematical problem solving: An emergent model. International Journal of Development Research, 8(5), 20430–20439.

Tanquilan, M. A. (2023). Students' difficulties in the "looking back" phase of mathematical problem-solving. International Journal of Learning and Instruction, 15(3), 101–112.

APA Citation:

Sausal, J. M., & Tan, D. A. (2026). PROBING STUDENTS' PROBLEM-SOLVING SKILLS USING STRUCTURED ACTIVE LEARNING STRATEGY (SALS). Ignatian International Journal for Multidisciplinary Research, 4(5), 2281–2297. https://doi.org/10.5281/zenodo.20383690

Corresponding author: *abc360.jenethsausal@gmail.com*