INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY: APPLIED BUSINESS AND EDUCATION RESEARCH
2025, Vol. 6, No. 6, 3150 – 3162
http://dx.doi.org/10.11594/ijmaber.06.06.36

Research Article

Integration of Place-Based Education for Fostering the Problem-Solving Skills of Grade 9 Students

Nympa M. Moyano[1]*, Rose R. Andrade[2]

[1]Department of Education, Ulango Integrated School, 4232, Philippines
[2]Laguna State Polytechnic University, San Pablo City Campus, 4000, Philippines

Article history:
Submission 26 March 2025
Revised 31 May 2025
Accepted 23 June 2025

**Corresponding author:*
E-mail:
nympa.masongsong@deped.gov.ph

ABSTRACT

Enhancing problem-solving skills is one of the primary goals of Mathematics education, however, it is still the least mastered competency among secondary learners. The primary goal of the study was to explore Place-Based Education as an innovative pedagogical approach in improving the problem-solving skills of Grade 9 students in one national high school in the Philippines. The study utilized a pre-experimental research design integrating PBE into mathematics classes. The researcher created a survey questionnaire to assess students' level of perceptions on the integration of PBE in terms of local context, learner-centered, design-thinking, inquiry-based, community as classroom, and interdisciplinary. A researcher-made test was used to assess the pretest and posttest assessment of students' problem-solving skills in terms of understanding the problem, planning problem-solving, problem-solving, and re-examining and conclusion. Based on the findings, students highly believed that PBE utilizes the community as a classroom, interdisciplinary, and inquiry-based. Moreover, students believed that it focuses on local context, learner-centered, and design thinking teaching approach. Furthermore, there is a significant difference in the students' problem-solving skills before and after the experiment, thus, integration of Place-Based Education was associated with improvements in students' problem-solving skills. The study recommends that teachers adopt the integration of PBE in the teaching-learning process in other disciplines to test other higher-order thinking skills.

Keywords: *Place-Based Education (PBE), Problem-Solving Skills*

Introduction

Concerns regarding the effectiveness of the K–12 curriculum's implementation have been brought to light in recent years. This includes an overloaded curriculum, excessive workloads for both teachers and learners, and high

How to cite:
Moyano, N. M. & Andrade, R. R. (2025). Integration of Place-Based Education for Fostering the Problem-Solving Skills of Grade 9 Students. *International Journal of Multidisciplinary: Applied Business and Education Research*. *6*(6), 3150 – 3162. doi: 10.11594/ijmaber.06.06.36

demands for education within a constrained time frame, all of which have hindered the mastery of fundamental reading and mathematical skills, particularly the students' problem-solving skills, as evident by a weak performance of Filipino learners in various assessments such as the Programme for International Student Assessment (PISA; OECD, 2023).

Students' reading, mathematics, and science knowledge, as well as their application, are assessed by PISA. It provides the most accurate and comprehensive worldwide assessment of student learning outcomes. The quality and equity of learning outcomes achieved globally are shown by PISA findings, which also give educators and decision-makers insight into the approaches and strategies employed in other countries (OECD, 2023).

According to PISA, Filipino students ranked third to the last in science and sixth from the bottom in mathematics in 2022. Around two-thirds of the problems in PISA's mathematics problem-solving scenarios require students to apply and reason. The findings indicated that Filipino students had poor problem-solving skills based on their low scores. The results showed that Filipino students were five to six years behind their 15-year-old counterparts from most participating countries in reading, science, and mathematics. The Philippines' performance in the three subjects of the most recent PISA has remained consistently poor. In addition, Senator Romulo emphasized the importance of instituting "much-needed reforms" and stressed age-appropriate "reading, reading comprehension, and mathematical skills." Chief of staff and undersecretary of education, Atty. Michael Poa, claimed that the pandemic was a factor in the nation's stagnant performance.

Even though enhancing problem-solving skills is one of the primary goals of mathematics education under the K–12 curriculum, it is still the least mastered competency among secondary learners. In the City Schools Division, mathematics garnered the lowest mean percentage among the learning areas, which only obtained a Mean Percentage Score (MPS) of 50%–70%. Various action researches conducted by teachers revealed that the reason behind the lowest MPS in mathematics in the Division is due to a lack of students' comprehension of mathematical concepts, particularly in understanding and solving mathematical problems (SGOD, 2021–2024).

Consequently, in one national high school in the Philippines, based on tracking of students' performance in mathematics, the Grade 9 level has the lowest Mean Percentage Score (MPS) from consolidated data for three consecutive school years. Competencies related to solving mathematical problems garnered below the 75% mastery level.

However, even with the continuous effort of the City Schools Division Office in conducting training/seminars among mathematics teachers and the school in implementing catch-up and remedial classes, peer tutoring, buddy learning systems, Independent Cooperative Learning (ICL), and re-teaching of mathematical concepts, students were still unable to attain a passing rate in the Mean Percentage Score (MPS).

It is in this thrust that the researcher aims to develop students' problem-solving skills through the adaptation and integration of Place-Based Education (PBE) and Polya's Problem-Solving Method as strategic and problem-solving pedagogical approaches in teaching the subject.

By integrating PBE into the problem-solving process, teachers can help students develop the skills necessary to handle challenges in the real world (Akbas & Çakmak, 2019). Students' problem-solving abilities can be enhanced by posing engaging real-world situations to them, allowing them to gather information about the problems, and then asking them to come up with solutions. When they find a subject interesting, students typically want to learn it.

Place-Based Education (PBE) emphasizes the connection between the learning process and the actual locations of teachers and students. It considers the meanings and experiences of place in education that extend beyond the classroom, and the community will serve as another platform for the teaching-learning process (Yemini, Engel, & Ben Simon, 2023). Community-as-classroom design principles broaden the conventional idea of school and enable learning to occur anywhere and at any time (Vander Ark, Liebtag, & McClennen, 2020). It is a distinct feature of PBE that the teaching-learning process will take place not just within the four corners of the classroom but extend into community premises, wherein community members work together in sharing responsibilities for students' learning and in solving community-related problems.

Students' motivation to become responsible members of the community has been the primary focus of learning experiences. Real-world linkages that take place in place-based education help to create educational experiences that produce socially responsible citizens.

Moreover, PBE is a teaching and learning strategy that is based on the local environment (Akbas & Çakmak, 2019). It focuses on providing students with worthwhile work experiences and incorporating local problems and expertise into the curriculum (Smith, 2017). By bringing students' attention to environmental and community problems, analyzing these problems (understanding the problem), asking them to identify their causes (planning problem-solving), having them come up with solutions (problem-solving), and finally arriving at the desired result (re-examining and conclusions) (Polya, 1957; Prapti, Susanto, & Sumardi, 2023), teachers can help students become more responsible members of the community while also enhancing their problem-solving abilities.

Place-based education, in its broadest definition, refers to educational approaches that prioritize the "local" in the learning process. In addition to the primary goal of basic education, many modern PBE initiatives aim to give young students a more valuable educational experience. Furthermore, other learning areas such as language, arts, social studies, and science have already adopted this approach, and many related researches have confirmed its effectiveness in improving students' social and scientific skills, environmental awareness, and good citizenship. This time, the researcher is motivated to adopt this learning approach, which has six learning principles, namely: local context, learner-centered, inquiry-based, design-thinking, community as classroom, and interdisciplinary (Prapti et al., 2023), to test also its impact in teaching mathematics and in improving students' problem-solving skills in particular.

Methods

Below is the **APA in-text citation conversion** for the provided paragraph. Specifically, citations [9], [10], [7], and [8] are replaced with full APA-style in-text citations, based on your previously provided references:

This study employed a pre-experimental research design, also called a one-group pretest-posttest design. Since one set of respondents serves as both the treatment and control group in this design, it is possible to compare the respondents' performance before and after the intervention (Hakimah, 2023). There is no control group in this instance to compare with the experimental group (Asenahabi, 2019).

By directly comparing students' performance before and after the intervention, the selected research methodology was used to provide a thorough analysis of the effect of Place-Based Education on their problem-solving skills. The researcher can determine if the PBE integration has improved students' problem-solving abilities through this within-group comparison. Any individual differences among the participants that can have an impact on the results are reduced by using the same group for both the treatment and control, guaranteeing a more accurate evaluation of how well the PBE integration improves problem-solving abilities. In general, using a pre-experimental one-group pretest-posttest provides insightful information about how well PBE works as a teaching strategy to improve students' problem-solving abilities.

The respondents of the study covered sixty (60) Grade 9 students only from two heterogeneous sections in one of the national high schools in the Philippines. Since there was a small number of students, the entire population served as the experimental group, and no sampling technique was utilized.

The survey questionnaire, researcher-made pre-test and post-test assessments, and lesson plans were the research instruments employed in this study. The researcher provided two lesson plans implemented in the class. A self-made questionnaire was utilized, which was composed of statements that determined the perception of the respondents on the integration of Place-Based Education in terms of local context, learner-centered, inquiry-based, design thinking, community as a classroom, and interdisciplinary approach using a 4-point Likert scale. The researcher-made pretest and posttest assessments were composed of 5 problems on quadratic equations and 5 problems on solving problems involving quadratic inequalities, with a total of 10 items. The researcher prepared two lesson plans with PBE integration and focused on the improvement of students' problem-solving skills based on Polya's theory (Polya, 1957; Prapti, Susanto, & Sumardi, 2023).

The researcher sought expert validation for the research instruments. The survey questionnaires used in this study underwent rigorous validation procedures to ensure the relevance and representativeness of the items in relation to the study's objectives. A panel of experts in the field evaluated each item for clarity, relevance, and alignment with the research constructs. Based on their ratings, the Content Validity Index (CVI) was computed and yielded a value of 0.92. This high CVI indicates excellent content validity, suggesting that the items effectively capture the intended dimensions of the study and are appropriate for use in data collection. Pilot testing resulted in good reliability with Cronbach Alpha coefficients for local context (0.814), inquiry-based (0.807), community as classroom (0.828), and interdisciplinary (0.808) and excellent reliability for learner-centered (0.902) and design thinking (0.901).

To ensure that the pretest and posttest effectively measured students' problem-solving skills, the instruments were reviewed by a panel of experts in mathematics education. The resulting Content Validity Index (CVI) was 0.95, indicating strong agreement among the validators on the relevance and clarity of the test items. This high CVI suggests that the assessments were well-aligned with the learning objectives and cognitive skills targeted in the study.

To determine the reliability of the test results, a parallel-form reliability method was employed. Two equivalent forms of the test, containing the same number of items and measuring the same constructs, were administered to the same group of respondents at different times. The consistency of the scores between the two forms was analyzed using the Pearson Product-Moment Correlation Coefficient, which yielded an **r** value of 0.87, indicating a high level of reliability. Although minor variations in scores were observed, students who performed well on the first form generally performed well on the second, and those who scored low on the first form also tended to score low on the second. This consistency suggests that the test demonstrates strong reliability and stability across equivalent forms, making it a dependable tool for data collection.

The test items were administered to students using Polya's problem-solving framework. Each of the four steps—understanding the problem, planning problem solving, problem solving, and looking back or re-examining and conclusion—was assessed using a rubric with corresponding scores: 4 points for the highest level of performance and 1 point for the lowest, depending on the quality and completeness of student responses.

To earn a top score of 4 in the "Understanding the Problem" phase, students were required to demonstrate a clear grasp of the problem and accurately identify all key elements that influence the choice of strategy. In the "Planning Problem Solving" stage, students were expected to select one or more appropriate strategies, coordinate multiple steps into a coherent approach, and articulate the decision-making process, including any necessary reversals or reconfigurations of steps. For the "Problem Solving" phase, students needed to execute their plan using logical and accurate steps, resulting in at least one correct or viable solution. Finally, in the "Re-examining and Conclusion" phase, students were assessed on their ability to apply relevant background knowledge, evaluate the appropriateness of their solution, and reflect meaningfully on the problem-solving process—offering insights and identifying possible improvements.

Students' responses were scored using the rubric, and their total scores served as the basis for categorizing problem-solving performance into four levels: Unsatisfactory, Needs

Improvement, Good, and Excellent. To ensure consistency in scoring, an inter-rater reliability test was conducted. The Pearson Product-Moment Correlation Coefficient was computed, yielding an **r** value of 0.813. This indicates a strong level of agreement between raters and confirms that the rubric provided consistent and dependable results under similar conditions. The high reliability coefficient affirms the instrument's effectiveness in assessing students' problem-solving skills across Polya's four-step model.

The researcher strictly adhered to established research guidelines and protocols to uphold the validity, trustworthiness, and integrity of the study. A clearly defined instructional plan and timeline were followed in each lesson, grounded in the prepared lesson plans that integrated Place-Based Education (PBE) principles and Polya's problem-solving steps. These plans were validated and approved by the school principal to ensure the intervention was implemented as intended.

To maintain consistency, student attendance was closely monitored to ensure that all participants from the two heterogeneous sections received the same intervention. Student engagement was assessed through reflective feedback, where learners shared their insights and experiences regarding the intervention. The fidelity of implementation was further evaluated through principal-led walkthrough observations, during which technical suggestions were provided to improve instructional delivery.

The impact of the intervention was measured by tracking student progress through pre-test and post-test scores, which were assessed using a researcher-developed rubric. Finally, the study also identified the distinct characteristics of the intervention by comparing it to other teaching strategies. A key feature that emerged was the emphasis on using the community as a classroom—a hallmark of place-based learning.

Pre-test, post-test assessment, and questionnaires were retrieved by the researcher. Responses to the pre-test, post-test, and questionnaire were tallied and tabulated, and appropriate statistics were applied. Mean and Standard Deviation were applied to find out the learners' perceptions on the integration of place-based education in terms of local context, learner-centered, inquiry-based, design thinking, community as classroom, and interdisciplinary approach. Frequency and Percentage Distribution were employed to determine the level of problem-solving skills of the experimental group before and after the integration of Place-Based Education (PBE), and Paired T-test was used to determine the significant difference between the pretest and post-test scores of the respondents in problem-solving skills assessment. To check the normality and appropriateness of the t-test employed, Shapiro-Wilk Test was used, and with a *p*-value of greater than 0.05, it demonstrates that the data are normally distributed.

Results and Discussions

Table 1. Perception of the Integration of Place-Based Education

PBE Principles	Over-all Mean	Verbal Interpretation
1. Local Context	3.41	Agree
2. Learner-Centered	3.45	Agree
3. Inquiry-Based	3.50	Strongly Agree
4. Design Thinking	3.48	Agree
5. Community as Classroom	3.53	Strongly Agree
6. Interdisciplinary	3.51	Strongly Agree

Legend: *3.50-4.00 = Strongly Agree, 2.50-3.49 = Agree, 1.50-2.49 = Disagree, 1.00-1.49 = Strongly Disagree*

Table 1 shows the perception of the students towards the integration of Place-Based Education as to local context, learner-centered, inquiry-based, design thinking, community as a classroom, and interdisciplinary approaches in improving students' problem-solving skills.

The students' perception of Place-Based Education (PBE) in terms of the local context obtained an overall mean of 3.41, which falls under the numerical range of 2.50–3.49, verbally interpreted as *agree*. This indicates that localizing the lessons by adapting the community's beliefs, culture, traditions, and problems familiar to students motivates them to learn, and this is evident in the integration of PBE. Using local situations or contexts in the learning process can improve students' knowledge, which stimulates their interest and motivation (Chunphoon & Sawangmek, 2023).

This was evident during the lesson proper when the students were given localized mathematical problems by the teacher. The teacher highlighted in the math problems some important events in their barangay, distinct places, local establishments, industries, community stakeholders, and objects found within the school premises that they are familiar with. When mathematical problems are presented in familiar contexts, students may find it easier to recognize, understand, and solve them (Susanta, Koto, & Susanto, 2022).

In terms of the learner-centered principle, students agreed that Place-Based Education promotes and focuses on a learner-centered teaching approach, as evidenced by an overall mean of 3.45, which also falls under the range of 2.50–3.49. This means that the lessons were focused on student learning, where learners were motivated to participate in the learning process, as it considered their individual needs and learning styles. This approach shifts the emphasis from teacher instruction to student active participation during the integration of PBE. This was evident during the lesson proper as students were given equal opportunities to solve problems provided by the teacher and to share what they had learned and how they acquired that knowledge during the teaching-learning process—symbolized by raising a flaglet. When students are given the chance to solve problems independently with teacher support, it fosters a nonjudgmental atmosphere and provides engaging learning activities (Khongyoo, Toopsuwan, & Phaksunchai, 2024). Learners who actively participate in class discussions and remain attentive stay more engaged throughout the learning process (Deslauriers, Schelew, & Wieman, 2011).

In terms of inquiry-based learning, students strongly agreed that integrating PBE in class utilized an inquiry-based teaching approach where students are more engaged in problem-solving and experiential learning by exploring and asking higher-order relevant questions. This is evident with an overall mean of 3.50, which falls under the range of 3.50–4.00. This is seen during the "Math Isip-Isip" part of the lesson, where the teacher allowed students to participate in answering guide questions, think of appropriate strategies or methods for solving the problems presented, and ask further questions to clarify mathematical concepts based on their understanding. Students are more likely to be motivated and interested in the subject matter when they are actively participating in class discussions and solving problems (Khan, 2022).

Moreover, asking questions can boost students' involvement in the classroom and encourage critical thinking. An inquiry-based teaching approach supports students in exploring, observing, and questioning the results of their investigations and the implications of those findings for their learning, rather than simply remembering facts or following a predetermined set of instructions (Thompson & Mus, 2018).

In terms of design thinking, students agreed that integrating PBE allows them to creatively think of possible representations, layouts, or blueprints on mathematical concepts, with an overall mean of 3.48, which falls under the range of 2.50–3.49. This is evident during group activity where students think creatively about how they will strategize finding the solution to the problem through constructing graphic representations of the given community problems showing possible dimensions. They were guided by Polya's problem-solving method on how to make a mathematical model (Prapti, Susanto, & Sumardi, 2023). After students constructed their mathematical representations and layouts, they were asked to present them in class. Models, simulations, and prototypes may be made and used in the problem-solving process, as well as sketches and drawings (Lor, 2017). In order to lessen cognitive burden, these techniques are helpful as external representations of thought. These offer substitute avenues for experiential education and frequently form the foundation for the development of implicit knowledge.

In terms of "community as a classroom," students strongly agreed that through Place-Based Education, learning can happen not just in the four corners of the classroom but can expand outside the school premises or even in the community, with an overall mean of 3.53, which falls under the range of 3.50–4.00. This was highly observed when the students were brought into the community vicinity, particularly in the barangay hall and gymnasium—where the lessons were delivered and students were engaged in outdoor learning activities. The "community as a classroom" design principle permits learning to take place anywhere and at any time, and it broadens the conventional meaning of education (Holland, 2019). This method involves students in outdoor learning and connects the learning to the community. "Community as a classroom" is a distinct feature of PBE; breaking down barriers between the community and the classroom is its main objective (Motumi, 2021).

In terms of interdisciplinary, students strongly agree that by integrating Place-Based Education, an interdisciplinary approach in the teaching-learning process was highly implemented as the teacher integrated various learning area contents and skills in teaching Mathematics as confirmed by the overall mean of 3.51 which falls under the range of 3.50-4.00.

This is apparent as the subject teacher invited other teachers specialized in the subjects being integrated into Mathematics to share their knowledge with students—particularly a TLE teacher who discussed compost pit making and the utilization of *Gulayan sa Paaralan*, a Science teacher who delivered a lesson about proper waste disposal of biodegradable materials, and a MAPEH teacher who shared his expertise about the elements of art in measuring and constructing rectangular plots. This is aligned with the overall goals of the Philippine Professional Standards for Teachers (PPST), which encourage more dynamic and interrelated learning areas or disciplines. Through such collaboration, students' critical thinking, problem-solving, and creative skills—all of which are vital in today's world—are emphasized (Department of Education [DepEd], 2017).

Table 2. Pretest and Post-test Results in Understanding the Problem

Mean Interval	Understanding the Problem			
	Pretest		Post-test	
	F	%	F	%
3.50-4.00	13	21.7	46	76.7
2.50-3.49	33	55.0	14	23.3
1.50-2.49	14	23.3	-	-
1.00-1.49	-	-	-	-
Total	60	100.0	60	100.0

Legend: *3.50-4.00 = Excellent, 2.50-3.49 = Good, 1.50-2.49 = Needs Improvement, 1.00-1.49 = Unsatisfactory*

Table 2 shows that from 33 students (55.0%) who demonstrated *good* performance during the pretest, the number improved to 46 students (76.7%) who performed at an *excellent* level in understanding mathematical problems after the administration of the post-test. This understanding included determining the goal of the problem, identifying what is being asked and given, and restating the problem in their own words. This means that most of the students demonstrated high proficiency in identifying the given information and the goal of the problem. It can be inferred that the improvement in students' level of understanding stemmed from their exposure to real-life local and community issues, and from their active participation in solving identified problems—an effect that was clearly observed when students were brought into the community vicinity. Research supports that students better understand environmental problems and improve their problem-solving skills when they have the opportunity to apply what they have learned to real-world issues in their own communities (Baek, Saito-Stehberger, Jacob, Nam, & Warschauer, 2023).

Table 3. Pretest and Post-test Results in Planning Problem-Solving

Mean Interval	Planning Problem-Solving			
	Pretest		Post-test	
	F	%	F	%
3.50-4.00	3	5.0	36	60.0
2.50-3.49	27	45.0	22	36.7
1.50-2.49	28	46.7	2	3.3
1.00-1.49	2	3.3	-	-
Total	60	100.0	60	100.0

Legend: *3.50-4.00 = Excellent, 2.50-3.49 = Good, 1.50-2.49 = Needs Improvement, 1.00-1.49 = Unsatisfactory*

Table 3 shows that out of 28 students (46.7%) who needed improvement during the pretest, the number improved to 36 students (60.0%) who demonstrated an *excellent* level of performance in connecting data to a possible strategy, approach, or method for solving the problem. This includes evaluating one or more strategies, integrating multiple processes into a strategy, identifying or categorizing the problem's structure, inverting a process to create a plan, and effectively explaining their decision-making process after the administration of the post-test. This was evident during the activity and evaluation parts of the lesson, where students were given opportunities to explore different methods, strategies, or formulas based on the identified data as part of the *planning problem-solving* phase. To determine the most effective strategy, approach, and method for problem-solving, students must connect the data to similar problems, as different types of problems require different approaches—not all problems can be solved using the same method or strategy (Akhsanul, 2014).

Table 4. Pretest and Post-test Results in Problem-Solving

Mean Interval	Problem-Solving			
	Pretest		Post-test	
	F	%	F	%
3.50-4.00	-	-	13	21.7
2.50-3.49	1	1.7	40	66.7
1.50-2.49	34	56.7	7	11.7
1.00-1.49	25	41.7	-	-
Total	60	100.0	60	100.0

Legend: *3.50-4.00 = Excellent, 2.50-3.49 = Good, 1.50-2.49 = Needs Improvement, 1.00-1.49 = Unsatisfactory*

Table 4 shows from 34 students (56.7%) who needed to improve their level of performance during the pretest, it improved to 40 students (66.7%) who demonstrated a good level of performance in applying or implementing the devised strategy based on the suggested plan to solve mathematical problems after the administration of the post-test. This implies that many of the students now frequently recognize the need for multiple paths and strategies to carry out the plan to solve mathematical problems.

This is noticeable during the actual solving of local community problems, wherein the students tried multiple strategies or methods to solve the identified problems based on the suggested or devised plan. Integrating Place-Based Education (PBE) into teaching methodologies not only improves students' comprehension of the subject matter but also equips them with practical problem-solving techniques, thereby enhancing their problem-solving abilities (Kuhn, 2023).

Table 5. Pretest and Post-test Result in Re-examining and Conclusion

Mean Interval	Re-examining and Conclusion			
	Pretest		Post-test	
	F	%	F	%
3.50-4.00	-	-	-	-
2.50-3.49	-	-	34	56.7
1.50-2.49	-	-	24	40.0
1.00-1.49	60	100.0	2	3.3
Total	60	100.0	60	100.0

Legend: *3.50-4.00 = Excellent, 2.50-3.49 = Good, 1.50-2.49 = Needs Improvement, 1.00-1.49 = Unsatisfactory*

Table 5 shows from 60 students (100%) who showed unsatisfactory performance during the pretest, it improved to a good level of performance, as 34 students (56.7%) showed their abilities in rechecking their answers or solutions to determine if the strategy or method being implemented is effective or not. If not, students are trying another problem-solving strategy until they come up with the correct answers or solutions. This implies that students became proficient, as evident in the post-test results.

This is observable during the actual problem-solving of the students on local community problems, wherein they rechecked and verified their solutions and answers before they performed the actual measurements of compost pits and rectangular vegetable plots. Students involved in PBE are better equipped to identify, analyze, and verify community and solutions. They concluded that PBE leads students to engage in community service projects, where they apply their learning to verify and address real-world issues, ultimately contributing to community transformation (Merill, 2015).

Table 6. Test of Difference in the Problem-Solving Skills

Problem-Solving Skills	Pretest		Posttest		t	df	Sig. (2-tailed)
	Mean	SD	Mean	SD			
Understanding the Problem	2.94	0.59	3.69	0.38	-10.550	59	.000
Planning Problem-Solving	2.41	0.61	3.47	0.46	-13.912	59	.000
Problem-Solving	1.60	0.40	3.07	0.43	-23.304	59	.000
Re-examining and Conclusion	1.00	0.00	2.47	0.53	-21.347	59	.000

Table 6 indicates that there is a significant difference in students' problem-solving skills in terms of understanding the problem, planning problem-solving, problem-solving, and re-examining and conclusion before and after the integration of Place-Based Education with a p <0.001.

This is evident in Table 2, as per the understanding of the problem, before the integration of PBE, students only identified what was being asked and all the given showing prior knowledge and background however, after PBE was integrated, students did not just identify all the given but also established the main goal of the problem including the unknown, the condition, its sufficiency, redundancy, and contradictory, they restated the problem in their own words, and determined many specific factors that influence the approach to a situation before solving, showing improvements in their critical thinking skills.

Moreover, as reflected in Table 3 under *planning to problem-solve*, pretest results revealed that before PBE was integrated, students demonstrated limited problem-solving strategies, methods, or approaches. They were only able to solve simple problems and failed to connect the given problems to similar situations. However, after the integration of PBE, students were able to link the given problems to other similar issues, identify multiple appropriate problem-solving strategies, coordinate several processes into a coherent approach, recognize or classify the structure of the problem, invert processes to form appropriate plans, and effectively demonstrate their decision-making abilities. Additionally, students were also able to solve more complex problems.

Furthermore, as seen in Table 4 under *problem-solving*, students initially could only solve simple equations following clearly established steps based on their devised plans. They struggled with more complex real-world problems and rarely recognized the need for multiple paths and strategies. After PBE was integrated, students' metacognitive skills developed, enabling them to proficiently recognize, select, and implement multiple problem-solving strategies, especially when addressing complex real-world problems rather than only simplified ones.

Likewise, Table 5 on *re-examining and conclusion* revealed that prior to the integration of PBE, no student demonstrated the ability to recheck and verify their answers. They seldom used contextual or background knowledge when approaching a problem and did not engage in evaluating or synthesizing results. However, after PBE was implemented, students were able to revisit and validate their answers, demonstrating their reasoning skills from multiple perspectives. This process led to more thoughtful reflection and strategic adjustments.

These significant findings indicate that students demonstrated positive changes in their problem-solving skills after the integration of PBE. Students found the experience engaging and meaningful, especially when they were brought into the community, which became an extension of their classroom. Through lectures and guidance from community members, exposure to real-life problems, and participation in generating solutions, students developed stronger problem-solving abilities. As students engaged more deeply with place-based education, their skills in relating theoretical knowledge to real-world scenarios improved markedly (Kuhn, 2023).

Place-Based Education (PBE) also helps students develop a comprehensive understanding of mathematical concepts, techniques, steps, or methodologies (Smolinsky, 2023). As pointed out in the *Mathematics Curriculum Guide for Grade 9*, students should be able to perform the steps in solving mathematical problems—such as identifying and comprehending the issue, modeling it using various representations, planning a solution, carrying it out, and then determining whether the solution was successful—to further improve their problem-solving skills.

Furthermore, PBE has demonstrated significant improvements in students' problem-solving and social skills, suggesting that it fosters not only critical thinking but also collaborative abilities. The integration of PBE implies that students' abilities in defining problems, analyzing dynamics, developing strategies, and planning and implementing possible solutions have significantly improved (Akbas & Çakmak, 2019). PBE, with its strong emphasis on experiential learning, contributes to higher academic achievement, fosters a greater appreciation for the natural environment, enhances students' problem-solving abilities in community-related contexts, and increases their commitment to becoming actively engaged and contributing members of society (Hata, Kondo, Allen, Singer, & Furihata, 2021).

Conclusions

Based on the significant findings of the study, the following conclusions were drawn:

1 Students positively perceived the integration of Place-Based Education (PBE) in their mathematics classes. Specifically, they agreed that the approach reflected local context, learner-centeredness, and design thinking. They strongly agreed that PBE was inquiry-based, interdisciplinary, and treated the community as a classroom—core elements that align with the principles of meaningful, real-world learning.

2 Prior to the integration of PBE, students' problem-solving skills varied across different domains: they demonstrated a good level in understanding the problem, needed improvement in planning and executing problem-solving strategies, and were at an unsatisfactory level in re-examining and drawing conclusions. Following the intervention, students showed marked improvement, reaching an excellent level in both understanding and planning, and a good level in solving and re-evaluating problems.

3 A statistically significant difference was found in students' problem-solving skills before and after the implementation of PBE. This suggests that the integration of PBE was associated with improvements in students' ability to approach and solve mathematical problems effectively.

However, while the findings are promising, the conclusions must be considered in light of the study's methodological limitations. The use of a one-group pretest-posttest design limits the ability to draw causal inferences, as there was no control or comparison group to account for other possible influences on the observed gains.

Given these limitations, it is recommended that future researchers adopt more rigorous experimental or quasi-experimental designs, such as randomized control trials or matched-group comparisons, to validate and extend the findings. Expanding the sample to include students from diverse schools and grade levels would also enhance the generalizability of the results. Through these methodological improvements, future studies can provide stronger evidence on the effectiveness of PBE in developing students' problem-solving skills in mathematics and beyond.

Acknowledgment

The completion of this study would not have been possible without the involvement and help of numerous individuals. Their efforts are greatly appreciated and recognized. However, the researcher would like to convey her heartfelt gratitude and indebtedness to her family, friends, colleagues, student respondents, LSPU administrators, researcher's adviser, statistician, subject specialist and technical editor.

References

- OECD. (2023). *PISA 2022 results (Volume I)*. Programme for International Student Assessment. Legislative Research Service on Second Regular Session, 19th Congress.
- SGOD. (2021–2024). *School Monitoring and Evaluation Assessment, S.Y. 2021–2024*.
- Akbas, Y., & Çakmak, S. (2019). The effect of place-based education integrated project studies on students' problem-solving and social skills. *Asian Journal of Education and Training, 5*(1), 183–192. https://doi.org/10.20448/journal.522.2019.51.183.192
- Yemini, M., Engel, L., & Ben Simon, A. (2023). Place-based education–a systematic review of literature. *Educational Review*, 1–21. https://doi.org/10.1080/00131911.2023.2172816
- Vander Ark, T., Liebtag, E., & McClennen, N. (2020). *The power of place: Authentic*

learning through place-based education. ASCD.

- Smith, G. A. (2017). Place-based education. In *Oxford Research Encyclopedia of Education*. https://doi.org/10.1093/acrefore/9780190264093.013.95
- Polya, G. (1957). *How to solve it: A new aspect of mathematical method* (2nd ed.). Princeton University Press.
- Prapti, H. N., Susanto, E., & Sumardi, H. (2023). Students' mathematical problem-solving ability in Bengkulu Tabot context based on Polya steps. *International Journal of Contemporary Studies in Education (IJ-CSE), 2*(1).
- Hakimah, N. (2023). Assessing the impact of project-based learning on students' writing skills: A pre-experimental study. *Acitya: Journal of Teaching and Education, 5*(2), 434–448. https://doi.org/10.30650/ajte.v5i2.3906
- Asenahabi, B. M. (2019). Basics of research design: A guide to selecting appropriate research design. *International Journal of Contemporary Applied Researches, 6*(5), 76–89.
- Chunphoon, W., & Sawangmek, S. (2023). Place-based education for promoting environmental literacy in human and natural resources and environmental sustainability for grade 12 students. *Journal of Education and Innovation, 25*(1), 267–280.
- Susanta, A., Koto, I., & Susanto, E. (2022). Teachers' ability in writing mathematical literacy module based on local context. *Education Quarterly Reviews, 5*(3). https://doi.org/10.31014/aior.1993.05.03.507
- Khongyoo, D., Toopsuwan, C., & Phaksunchai, M. (2024). A study of students' mathematical problem-solving skill and satisfaction through mathematics camp activity using SSCS model and BAR model on ratio, proportion, and percentage. *Journal of Education and Innovation, 26*(1), 1–14.
- Deslauriers, M., Schelew, L., & Wieman, C. (2011). Improved learning in a large-enrollment physics class. *Science, 332*(6031), 862–864. https://doi.org/10.1126/science.1201783
- Khan, Q. (2022). The role of asking questions in Islamic pedagogy and Muslim teachers' practice. *Journal of Integrated Sciences, 3*(1), 8–43.
- Thompson, M. B., & Mus, B. (2018). Project-based/inquiry-based learning in junior high music classrooms: Enhancing Alberta Education Music Program of Studies. *Canadian Music Educator, 60*(2), 17–21.
- Lor, R. (2017). Design thinking in education: A critical review of literature. *International Journal of Art & Design Education, 36*(3), 243–251. https://doi.org/10.1111/jade.12129
- Holland, W. H. (2019). *Investigating experiential wilderness-based professional development for K-12 educators* (Doctoral dissertation, Clemson University).
- Motumi, K. T. (2021). *Practicalising the significance of the "history-is-all-around-us" approach in and out of the classroom* (Doctoral dissertation, North-West University, South Africa).
- Department of Education. (2017). *DO No. 42, s. 2017: National Adoption and Implementation of the Philippine Professional Standards for Teachers, Domain 1, Content Knowledge and Pedagogy*.
- Baek, C., Saito-Stehberger, D., Jacob, S., Nam, A., & Warschauer, M. (2023). Computer science framework to teach community-based environment literacy and data literacy to diverse students. *Information and Learning Sciences, 124*(5/6), 351–364. https://doi.org/10.1108/ILS-02-2023-0024
- In'am, A. (2014). The implementation of the Polya method in solving Euclidean geometry problems. *International Education Studies, 7*(7), 149–158. https://doi.org/10.5539/ies.v7n7p149
- Kuhn, T. (2023). Integrating problem-based education into teaching methodologies: Enhancing students' understanding and problem-solving skills. *Journal of Education Innovation, 28*(4), 112–125.
- Merill, M. (2015). Students involved in place-based education are better equipped to identify, analyze, and verify community

problems and solutions. *Journal of Place-Based Education, 12*(3), 45–60.

- Smolinsky, W. G. (2023). *Place-based education: A qualitative study of definitions, opportunities, and barriers in a small K-12 school district* (Doctoral dissertation, Washington State University).
- Hata, N., Kondo, J., Allen, D., Singer, J., & Furihata, S. (2021). The role of place-based education in strengthening community resilience against climate change. *Japanese Journal of Environmental Education, 31*(2), 14–24.