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Enhancing Senior High School Students' Mathematical Understanding through an Experiential Learning-Based FunMath Camp: A Community Service Program

I Gede Adhitya Wisnu Wardhana[1*], Ghazali Semil Ismail[2], Marwan[3], Syamsul Bahri[4], Irwansyah[5], Gifani Putri Setiandini[6], Lalu Muhammad Faiz Zikri[7], Resa Putri Fibriyanti Subiyanto[8], Nanda Lestari[9], Alfian Putra Ardana[10], De Siroj Ragil Ahmad[11], Intan Nadilah[12], Luluk Kartika[13], Irene Salsabila[14], Irene Rainbow Kewa Somi[15], Rizka Purnama Sari[16], Qurratul Aini[17], Fariz Maulana[18]

[1,3-18]Faculty of Mathematics and Natural Sciences, Universitas Mataram, Indonesia
[2]Faculty of Computer and Mathematical Sciences, Universitas Teknologi MARA, Malaysia
[*]*Corresponding Author: adhitya.wardhana@gmail.com*

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Abstract. Mathematics plays a fundamental role in developing students' logical, analytical, critical, and problem-solving skills. However, many senior high school students perceive mathematics as difficult and uninteresting due to teacher-centered instruction that provides limited opportunities for active engagement and authentic learning experiences. This community service program aimed to enhance students' mathematical understanding through an Experiential Learning-based FunMath Camp conducted collaboratively by the Mathematics Study Program of the University of Mataram and Universiti Teknologi MARA (UiTM), Malaysia. The program was held over two days, 27–28 June 2026, at Gunung Jae Nature Tourism Park, West Lombok, involving 20 selected senior high school students from across Lombok Island. The activities followed four stages of Experiential Learning: concrete experience, reflective observation, abstract conceptualization, and active experimentation. Activities included interactive lectures, Treasure Map Games, a Mini Mathematics Quiz Competition, and collaborative outdoor learning. Program effectiveness was evaluated using pre-test and post-test scores. As the data were not normally distributed based on the Shapiro–Wilk test, the Wilcoxon Signed-Rank Test was employed. The results showed a statistically significant improvement in students' mathematical understanding, with the mean score increasing from 6.85 to 7.80 ($p = 0.012$). Although the average N-Gain score was 0.19 (low category), students demonstrated greater engagement, collaboration, and confidence in solving mathematical problems. These findings indicate that the Experiential Learning-based FunMath Camp provides an engaging and meaningful learning environment that supports mathematical understanding and active learning.

1. INTRODUCTION

Education is one of the most important foundations for making our society more advanced and of higher quality . Through education, individuals are equipped with the knowledge, skills, and thinking abilities necessary to face various challenges in the global era (Setyawan, 2025). One subject that plays a crucial role in supporting these goals is mathematics. Mathematics is a subject that plays a vital role in developing logical, analytical, critical, and systematic thinking skills (Nurhaswinda et al., 2026) . In addition to serving as the foundation for various academic disciplines, mathematics also plays a significant role in

fostering the problem-solving skills needed in daily life and the workplace. Therefore, improving the quality of mathematics education is a key aspect in supporting the development of high-caliber human resources (Siswanto & Meliasari, 2024).

In reality, many students still view mathematics as a difficult, boring subject full of formulas that must be memorized (Nahdania & Ain, 2024). This perception results in low student interest in learning mathematics. Low interest in learning can affect students' motivation, participation during the learning process, and their learning outcomes (Stefani et al., 2025) . This situation remains a challenge in the mathematics learning process in various schools, including on the island of Lombok.

One factor contributing to the low interest in learning mathematics is a learning process that remains dominated by conventional methods, in which the teacher is the center of the learning process (teacher-centered) and students primarily receive information passively (Desanjaya et al., 2025) . This type of learning often fails to provide students with opportunities to explore mathematical concepts through hands-on experiences, discussions, , or collaborative activities (Pongoliu, 2025). In fact, learning that involves real-world experiences and active student participation can increase interest in and understanding of the material being studied (Kanda & Rustini, 2024) .

One learning approach that can be applied to increase interest in learning is Experiential Learning (Nuraeni & Karmana, 2025). This approach emphasizes the learning process through direct experience so that students not only acquire theoretical knowledge but also build understanding through activities, reflection, discussion, and the application of concepts in various situations (Sajiatmojo, 2022). Thus, students are expected to develop critical thinking, creativity, communication, and collaboration skills in solving various problems.

As an implementation of this approach, the FunMath Camp Program was designed as an interactive, enjoyable, and experience-based medium for learning mathematics. This program integrates various activities such as math games, logic challenges, group discussions, team building, and collaborative problem-solving. Through these activities, students not only learn mathematical concepts but also gain meaningful learning experiences, which are expected to increase their interest in mathematics.

In addition, FunMath Camp 2026 was organized through a collaboration between the Mathematics Study Program of the University of Mataram and Universiti Teknologi MARA (UiTM), Malaysia. This international collaboration enriched the learning environment by exposing participants to broader academic perspectives, cross-cultural interactions, and innovative approaches to mathematics education.

Although experiential learning has been widely implemented in classroom-based mathematics instruction, relatively few community service programs have integrated this approach into outdoor mathematics camps involving international academic collaboration. Most existing programs primarily focus on improving students' academic performance in formal classroom settings, whereas experiential mathematics camps remain underexplored as a strategy for fostering students' engagement, collaborative skills, and conceptual understanding through authentic learning experiences. Therefore, the FunMath Camp program offers a novel community service model by combining experiential learning, outdoor mathematical activities, and international collaboration within a single educational program.

Although many studies have implemented experiential learning in classroom settings, very few community service programs have integrated experiential learning into outdoor mathematics camps involving international collaboration.

Based on the above discussion, this community service program aims to enhance senior high school students' mathematical understanding through an Experiential Learning-based FunMath Camp. The program integrates authentic outdoor mathematical activities, collaborative learning, and international academic collaboration to create meaningful learning experiences that actively involve students in constructing mathematical knowledge. Through this approach, students are expected to improve their conceptual understanding, problem-solving ability, critical thinking, communication, and collaboration skills while developing a more positive perception of mathematics as an engaging and relevant discipline.

2. METHOD

his community service program was organized by the MBKM ACRG (Merdeka Belajar Kampus Merdeka – Algebra & Combinatorics Research Group) Community Service Team from the Mathematics Study Program, Faculty of Mathematics and Natural Sciences, University of Mataram. The FunMath Camp was conducted over two days, from 27 to 28 June 2026, at the Gunung Jae Nature Tourism Park, West Lombok, Indonesia. A total of 20 senior high school students from various schools across Lombok Island participated in the program after completing an administrative selection process. The program was also conducted through an international collaboration between the University of Mataram and Universiti Teknologi MARA (UiTM), Malaysia.

The program adopted the Experiential Learning approach, which emphasizes that learning occurs through direct experience, reflection, conceptualization, and the application of knowledge in authentic situations (Rahmi, 2024). This approach was selected to enhance

students' mathematical understanding by actively engaging them in meaningful learning experiences rather than passive knowledge acquisition. The four stages of the Experiential Learning cycle implemented in this program are illustrated in Figure 1.

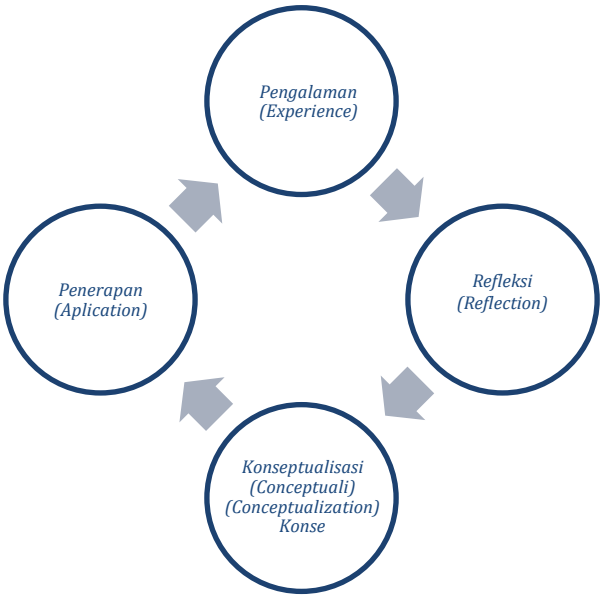

Figure 1. Flowchart of the Stages of the Experiential Learning Approach.

During the Concrete Experience stage, participants were directly involved in various mathematics-related activities, including educational games, logic challenges, and outdoor collaborative tasks designed to introduce mathematical concepts through authentic experiences. In the Reflective Observation stage, participants discussed their experiences, exchanged ideas, and reflected on the strategies they had used to solve mathematical problems. Subsequently, in the Abstract Conceptualization stage, participants connected these experiences with formal mathematical concepts presented by the facilitators, enabling them to construct a deeper conceptual understanding. Finally, during the Active Experimentation stage, participants applied their newly acquired knowledge through collaborative problem-solving activities, mini mathematics quizzes, and outdoor challenges. This sequence of activities was designed to create an engaging, student-centered learning environment that promotes conceptual understanding, critical thinking, communication, and teamwork.

The effectiveness of the program was evaluated using a one-group pre-test–post-test design. Participants completed a pre-test before participating in the learning activities and a post-test after completing the entire program. The collected data were analyzed using IBM SPSS Statistics. Descriptive statistics were first employed to summarize participants' performance. Subsequently, the Shapiro–Wilk test was conducted to examine the normality of the data distribution. Since the data did not satisfy the normality assumption, the Wilcoxon Signed-Rank Test was employed to determine whether there was a statistically significant

improvement in students' mathematical understanding after participating in the Experiential Learning-based FunMath Camp. Furthermore, the Normalized Gain (N-Gain) score was calculated to evaluate the effectiveness of the program in improving participants' mathematical understanding.

3. RESULT AND DISCUSSION

The FunMath Camp 2026 was held over two days, June 27–28, 2026, at the Gunung Jae nature tourism area in West Lombok Regency. It was attended by 20 high school students (SMA, MA, SMK, and equivalent) from various schools on the island of Lombok who had passed the administrative selection process. Most participants were already accustomed to regular academic activities and classroom instruction at school, but the majority had no direct experience learning applied mathematics outdoors. This situation aligns with the findings of Triyana & Kusno, (2025), which indicate that students who merely memorize formulas without understanding underlying concepts tend to struggle with solving complex mathematical problems and lack a strong connection between mathematical concepts and their real-world applications. The series of activities was designed in stages, beginning with a pre-test to assess participants' initial abilities ( ) and concluding with a post-test, incorporating a combination of instructional sessions, educational games, and creative performances in the great outdoors to ensure the learning environment remained enjoyable and engaging.

The highlight of this event was the collaboration between Mataram University and Universiti Teknologi MARA (UiTM) in Malaysia, which served as a form of international cooperation to support the development of mathematics education. This cross-national collaboration provided participants with a unique learning experience; in addition to gaining new insights into mathematics, they also had the opportunity to engage with a broader and more diverse academic environment. Various interactive activities designed by also provide participants with opportunities to hone their critical thinking skills, actively exchange ideas, and build teamwork in overcoming every challenge they face during the event.

The event began at the Faculty of Mathematics and Natural Sciences (FMIPA) at Mataram University with participant registration and the administration of an initial pre-test via Google Forms, which was designed to assess participants' baseline proficiency in the mathematics material to be covered during the event. The results of this pre-test will serve as an initial benchmark to assess the extent of participants' improved understanding after completing the entire series of activities. The event was designed to provide an interactive,

challenging, and practical learning experience, in line with its primary objectives of increasing students' interest and motivation to learn, as well as strengthening their understanding of mathematical logic through a nature-based approach.

Figure 2. Administration of the pre-test as an initial assessment tool to determine participants' level of understanding of the material to be presented.

After the registration and pre-test were completed, participants were transported to the event location at Gunung Jae Nature Reserve in West Lombok Regency, where the official opening ceremony of FunMath Camp 2026 was held to mark the official start of the entire series of activities.

Figure 3. The opening ceremony of FunMath Camp 2026, attended by participants, the community service team, and the organizing committee.

Following the opening ceremony, the main activity on the first day continued with a sharing session featuring alumni from the Mathematics Program at the Faculty of Mathematics and Natural Sciences (FMIPA), Mataram University. The session discussed how to begin research in mathematics from identifying interesting topics to explore to the reasons for choosing the Mathematics Program while also fostering participants' motivation and self-confidence that mathematics can be a promising choice for further study.

Figure 4. The sharing session serving as a forum for exchanging experiences and motivation with participants of FunMath Camp 2026.

This was followed by a presentation by the first speaker, Dr. Marwan, S.Si., M.Si., Coordinator of the Mathematics Study Program at the Faculty of Mathematics and Natural Sciences, Mataram University, titled "The Unexpected Mathematics." This presentation covered two main topics: exponential growth and the fixed-point theorem, which were explained using relatable, real-life examples and presented in an engaging manner to ensure participants could easily understand them. The concept of exponential growth was introduced through engaging illustrations such as the growth of aquatic plants in a lake, a paper-folding simulation to demonstrate the distance between the Earth and the Moon, and the Tower of Hanoi problem, while the fixed-point theorem was explained through visual analogies such as repeating patterns on picture frames and fractal patterns on leaves, allowing participants to understand both concepts intuitively and in practical terms.

Figure 5. Dr. Marwan presenting the material to participants of the 2026 FunMath Camp.

The session then continued with the second presenter, Dr. Ghazali Semil @ Ismail, an international speaker from Universiti Teknologi MARA (UiTM) in Malaysia. During this session, he discussed opportunities and experiences in international research collaboration between Indonesian and Malaysian students, covering how cross-national cooperation can broaden academic horizons, open up opportunities for joint publications, and foster a spirit of scientific collaboration among the younger generations of both countries. This session provided

participants with a new perspective on the importance of building international academic relationships early on as preparation for the increasingly expansive and globalized world of education and research.

Figure 6. Dr. Ghazali @ Semil presenting the material to participants of the 2026 FunMath Camp.

Following the presentation session, the activity continued with the "Treasure Map Games," in which participants were divided into several groups to solve five math problems prepared by the organizers. Each group then searched for flags that had been randomly placed at various points throughout the Gunung Jae nature tourism area in West Lombok Regency; each flag bore one of the answers to the problems. After finding a flag they believed to be the correct one, each group had to report to the organizers to verify whether the answer written on the flag was correct. Through this game, participants were not only required to directly apply the mathematical concepts they had learned but were also trained to work together as a team, think strategically, and actively explore the surrounding area to find the correct answers and complete all the given problems.

Figure 7. The Treasure Maps game being played as an interactive learning tool during the FunMath Camp 2026.

The first day's activities concluded with an Arts Performance session, providing participants with a platform to showcase their non-academic talents and creativity. This session helped strengthen the sense of togetherness among participants from various schools, while also serving as a sweet and memorable conclusion to the first day, rich with stories.

Figure 8. Participants' performances during the arts showcase as part of the FunMath Camp 2026 program.

On the second day, the event continued with a presentation by the third speaker, Prof. Dr. Syamsul Bahri, S.Si., M.Si., from the Mathematics Program, Faculty of Mathematics and Natural Sciences, Mataram University, titled "The Magic of Algebra: Unraveling Age and Shoe Size Mysteries." This session took participants on a journey through the history of algebra via the ideas of Al-Khwarizmi, before demonstrating how variables and linear equations can be transformed into entertaining mathematical tricks such as guessing a person's age and shoe size, as well as the magic of the number 1089. Through these tricks, participants are encouraged to understand that algebra is not merely a set of formulas, but a tool that can transform fear of mathematics into curiosity and confidence in applying mathematical concepts.

Figure 9. Prof. Syamsul Bahri presenting material to participants of the 2026 FunMath Camp.

The session then continued with the fourth presenter, Dr. Irwansyah, M.Si., from the Mathematics Studies Program, Faculty of Mathematics and Natural Sciences, Mataram University, with a presentation titled "Binary Numbers & Digital Technology." This session

helped participants understand how digital devices store, read, send, and receive information through the binary number system, ranging from modulo-2 addition to character representation using ASCII code. These concepts were presented through interactive "math magic" demonstrations, such as tricks for guessing numbers participants were thinking of and predicting previously selected playing cards both of which were based on binary representation and de Bruijn sequences. Through this approach, participants were encouraged to see the connection between binary numbers and various digital technology applications around them, such as image and audio transmission, robot vision, and even digital pens.

Figure 10. Dr. Irwansyah presenting the material to participants of the 2026 FunMath Camp.

After all the sessions were completed, the participants took part in the Mini Quiz Competition, which was conducted as a fast-paced question-and-answer session on mathematical knowledge and calculations. Participants were divided into 10 groups, with each group competing against one another to answer questions posed by the organizers. Through this competition, participants were trained to think quickly, accurately, and confidently when answering questions, while also fostering a spirit of sportsmanship and teamwork among participants from various schools.

Figure 11. Participants take part in a mini quiz to test their understanding of mathematical concepts in an interactive and competitive manner.

The FunMath Camp 2026 program concluded with a post-test, serving as a final evaluation to assess and measure the participants' improved understanding after completing all sessions and activities over the two-day event. The success of the event was evaluated by comparing the pre-test and post-test results. The comparison of scores between the two tests served as a key indicator for assessing the effectiveness of the outreach program, with higher post-test scores indicating an increase in participants' understanding. The event continued with the presentation of certificates to the participants and concluded with a group photo.

Based on the data presented in Table 1 below, hypothesis testing was conducted using statistical tests with the aid of SPSS software. Before conducting the difference test (hypothesis test), a descriptive analysis was first performed to determine the general characteristics of the data. Based on the results of the descriptive analysis, it was found that in the Pre-Test session, the participants' lowest (minimum) score was 3, the highest (maximum) score was 9, and the mean score was 6.85. Meanwhile, in the Post-Test session, the lowest score increased to 6, the highest score was 9, and the mean score was 7.80. In terms of group-level descriptive analysis, there was an increase in the average score of 0.95 points after the activity was conducted.

Table 1. Pre-test and post-test scores of the 20 participants in the 2026 FunMath Camp,

No.	Pre-Test Score	Post-Test Score
1	7	9
2	6	8
3	8	8
4	8	8
5	6	8
6	7	9
7	6	7
8	8	8
9	7	8
10	7	8
11	6	7
12	9	9
13	6	8
14	7	8
15	8	7
16	3	7
17	8	6
18	7	8
19	5	8
20	8	7
Average	6.85	7.80

Next, a prerequisite test the Normality Test was conducted using the Shapiro-Wilk method, given that the sample size analyzed was small (). This test was performed on the Pre-Test and Post-Test variable values to ensure the validity of the assumption regarding the data distribution. The results of the normality test are presented in Figure 12 below.

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pre-Test Score	.194	20	.046	.889	20	.025
Post-Test Score	.303	20	.000	.850	20	.005

a. Lilliefors Significance Correction

Figure 12. Output Results of the *Shapiro-Wilk* Normality Test Using SPSS.

Based on the results of the Shapiro-Wilk normality test in Figure 11, significance values of 0.025 for the pre-test and 0.005 for the post-test were obtained. Since both significance values are smaller than the significance level of$\alpha = 0{,}05$ $(p < 0{,}05)$, it can be concluded that the pre-test and post-test data are not normally distributed. This is influenced by a somewhat skewed data distribution resulting from some students experiencing a decline in scores due to physical fatigue or because the post-test scores were concentrated around a specific value. Therefore, hypothesis testing was conducted using the non-parametric Wilcoxon Signed-Rank Test. The output results of the statistical test are presented in Figure 13.

Test Statistics[a]

	Post-Test Score – Pre-Test Score
Z	-2.507[b]
Asymptotic Significance (2-tailed)	.012

a. Wilcoxon Signed-Rank Test

b. Based on negative ranks.

Figure 13. Results of the *Wilcoxon* Statistical Test Analysis Using SPSS Software.

Based on the SPSS output in Figure 13, the significance value (Asymp. Sig. 2-tailed) is 0.012. Since this significance value is smaller than the significance level (), it can be concluded that the null hypothesis () is rejected and the alternative hypothesis is accepted. This empirically proves that there is a significant difference and improvement between the students' pre-test and post-test scores after participating in the FunMath Camp 2026 program series.

To measure the effectiveness of the Experiential Learning approach that was implemented, a further analysis was conducted using the Normalized Gain Score (N-Gain). This calculation is based on the difference between the actual score and the maximum potential improvement for each participant. The results of the N-Gain calculations for each participant

are presented in Table 2 below.

Based on the data in Table 2 below, the average N-Gain score for all participants was 0.19 (or an effectiveness rate of 19%). According to Hake's classification criteria, this average score places the overall effectiveness of the FunMath Camp 2026 program in the "low" category.

Table 2. Results of the Effectiveness Category Analysis Based on Participants' *N-Gain* Scores.

No.	N-Gain Score	N-Gain (%)	Interpretation Category
1	0.67	67%	Moderate
2	0.50	50%	Medium
3	0.00	0%	Low
4	0.00	0%	Low
5	0.50	50%	Medium
6	0.67	67%	Moderate
7	0.25	25%	Low
8	0.00	0%	Low
9	0.33	33%	Medium
10	0.33	33%	Medium
11	0.25	25%	Low
12	0.00	0%	Low
13	0.50	50%	Medium
14	0.33	33%	Medium
15	-0.50	-50%	Low
16	0.57	57%	Medium
17	-1.00	-100%	Low
18	0.33	33%	Medium
19	0.60	60%	Moderate
20	-0.50	-50%	Low
Average	0.19	19%	Low

Although the group falls into the low category statistically, when analyzed on an individual basis, some participants showed a notable increase in effectiveness. For example, participant number 16 had an N-Gain score of 0.57 and participant number 19 had an N-Gain score of 0.60, both of which fall into the moderate category. This improvement demonstrates that interactive, hands-on learning methods remain effective for participants who began the program with low baseline comprehension scores. Meanwhile, the low average score was significantly influenced by negative scores from several participants who experienced a decline in their post-test scores due to factors such as burnout and physical exhaustion following a rigorous schedule of outdoor activities in the Gunung Jae nature tourism area, West Lombok Regency.

Conceptually, this improvement in scores can also be explained through the frameworks of meaningful learning and problem-solving. The FunMath Camp 2026 activities played a crucial role in developing students' ability to think logically, systematically, and in a structured manner when solving problems. This improvement indicates that students are increasingly able to break down problems, recognize patterns, abstract key information, and develop solution strategies as a group. Thus, this community service initiative not only enhances learning outcomes quantitatively but also strengthens students' critical thinking skills a crucial foundation for mathematical reasoning.

Figure 14. Group photo of the community service team, guest speakers, organizing committee, and participants at the closing ceremony of the FunMath Camp 2026.

The community service initiative through FunMath Camp 2026 has provided a new and enjoyable learning experience for high school students on Lombok Island. The participants' enthusiasm was evident in their active engagement in logic games, classroom sessions, and group dynamics during the social evening. This documentation serves as a memorable conclusion to a series of community service activities that were informative, inspiring, collaborative, and enjoyable.

4. CONCLUSION

The Experiential Learning-based FunMath Camp was successfully implemented as an innovative community service program to enhance senior high school students' mathematical understanding through authentic outdoor learning experiences. Statistical analysis using the Wilcoxon Signed-Rank Test demonstrated a significant improvement in participants' mathematical understanding after completing the program. Beyond the quantitative findings, participants showed active engagement, effective collaboration, and greater confidence in

solving mathematical problems throughout the learning activities.

The integration of experiential learning, educational games, collaborative problem-solving, and international academic collaboration created a meaningful learning environment that encouraged students to construct mathematical concepts through direct experience. These findings suggest that the FunMath Camp model is a promising approach for supporting mathematics learning while simultaneously fostering students' critical thinking, communication, and teamwork skills.

It is recommended that similar community service programs be implemented with a larger number of participants, longer intervention periods, and broader geographical coverage. Future programs may also incorporate additional evaluation instruments, such as measures of learning motivation, engagement, and attitudes toward mathematics, to provide a more comprehensive assessment of the program's educational impact.

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