International Proceeding Community Services

Developing Mathematics Olympiads through Computational Thinking Approach and Problem Pattern Analysis

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ABSTRACT

This community service activity aimed to improve students' competence in Olimpiade Sains Nasional mathematics at the district/city level through intensive coaching and training programs. The activity involved high school students and was conducted using several stages, including pre-test, material delivery, problem-solving exercises, try-out simulations, and post-test evaluation. The learning materials covered algebra, number theory, combinatorics, geometry, and mathematical problem-solving strategies.

The training implemented Problem Based Learning (PBL), computational thinking, and data-driven learning approaches to strengthen students' analytical and logical reasoning skills. The results showed a significant improvement in students' performance. The average pre-test score increased from 59.5 to 82.0 in the post-test. Students also demonstrated improved abilities in identifying problem patterns, applying appropriate solution strategies, and solving Higher Order Thinking Skills (HOTS)-based mathematical problems systematically.

In addition, the program increased students' motivation and confidence in participating in mathematics olympiad competitions. The integration of computational thinking approaches was also relevant to the field of Data Science because it emphasized analytical, logical, and structured problem-solving skills. Overall, the community service program contributed positively to enhancing students' mathematical competence and readiness for district/city-level olympiad competitions.

I. INTRODUCTION

The National Science Olympiad (OSN) is one of the academic competitions aimed at improving students' critical, logical, creative, and innovative thinking skills [1]. In the field of mathematics, this competition requires students to possess strong problem-solving abilities, mathematical reasoning, and systematic analytical skills. However, many students at the district/city level still face difficulties in solving olympiad problems due to the lack of intensive and well-structured coaching programs [2].

Mathematics learning in schools generally focuses on solving routine problems based on the curriculum, resulting in students being less familiar with Higher Order Thinking Skills (HOTS) problems that frequently appear in mathematics olympiads [3]. In addition, limited instructional time at schools prevents special olympiad coaching from being conducted optimally. These conditions have an impact on students' low readiness in participating in district/city-level mathematics olympiad selections [4].

As an effort to improve students' abilities in facing academic competitions, structured training and mentoring activities are needed [5]. This community service program is focused on mathematics olympiad training and coaching through problem-solving and computational thinking approaches. These approaches are intended to train students to understand problem patterns, develop solution strategies, and improve logical and analytical thinking skills [6].

As a lecturer in the field of Data Science, the implementation of analytical and data-driven learning approaches in mathematics coaching can become an innovative learning method that supports the improvement of students' competencies [7]. The analysis of olympiad problem patterns and logic-based solution strategies is expected to help students understand the characteristics of problems more systematically and effectively [8].

Through this community service activity, students are expected to gain additional insights, olympiad problem-solving skills, and motivation to improve their academic achievements, especially in mathematics [9]. Furthermore, this activity is expected to serve as a form of contribution from higher education institutions in supporting the improvement of educational quality and the development of students' potential at the regional level [10].

II. METHODS

This community service activity was designed as an intensive mathematics olympiad coaching program for senior high school students. The program combined structured training, problem-solving practice, computational thinking, and data-driven evaluation to improve students' readiness for the district/city-level Mathematics National Science Olympiad (OSN).

A. Activity Design

The activity used a community-service training design consisting of preparation, implementation, testing, documentation, and evaluation stages. The design enabled the facilitators to identify participants' initial abilities, provide targeted coaching, and measure learning improvement after the program.

B. Participants and Activity Setting

The participants were SMA/MA students who attended the mathematics olympiad coaching and joined the test activities. The attendees involved in the pre-test and post-test activities were recorded in the attendance list presented in the List of Participants section. The attendance list functions as supporting evidence that the test activities were carried out with registered participants.

C. Data Collection

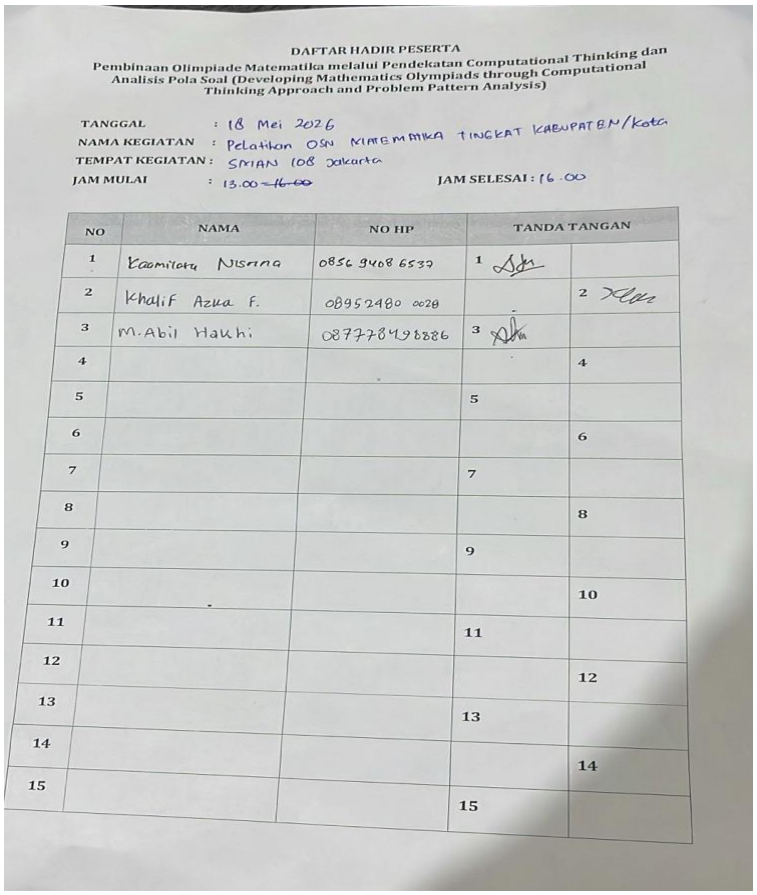
The data in this activity were collected through pre-test scores, post-test scores, observation of participant engagement, documentation of community service activities, and the attendance list of participants who joined the test activities.

D. Data Analysis Technique

The data were analyzed descriptively by comparing participants' pre-test and post-test scores. The score improvement was calculated using the following formula: Improvement = Post-test score - Pre-test score. The average pre-test score, average post-test score, and average improvement were then used to describe the effectiveness of the coaching program.

E. Documentation of Community Service Activities

Photo documentation was included as supporting evidence of the implementation of the community service activity. The documentation should show the main stages of the activity, including the opening or briefing session, pre-test/post-test activities, material delivery, group discussions, mentoring, and try-out simulations.



DAFTAR HADIR PESERTA
Pembinaan Olimpiade Matematika melalui Pendekatan Computational Thinking dan Analisis Pola Soal (Developing Mathematics Olympiads through Computational Thinking Approach and Problem Pattern Analysis)

TANGGAL : 18 Mei 2026
NAMA KEGIATAN : Pelatihan OSN MATEMATIKA TINGKAT KABUPATEN/Kota
TEMPAT KEGIATAN : SMAN 108 Jakarta
JAM MULAI : 13.00 ~~16.00~~ JAM SELESAI : 16.00

NO	NAMA	NO HP	TANDA TANGAN	
1	Kamiliatu Nisrina	0856 9408 6539	1	
2	Khalif Azka F.	08952980 0028		2
3	M. Abil Hakhi	087778498886	3	
4				4
5			5	
6				6
7			7	
8				8
9			9	
10				10
11			11	
12				12
13			13	
14				14
15			15	

Figure 1. Students Working On Problem-Solving Exercises During The Coaching Session

III. RESULTS AND DISCUSSION

Results

The community service program in the form of Mathematics National Science Olympiad (OSN) coaching at the district/city level was conducted for senior high school students (SMA/MA) through several stages, namely pre-test, material delivery, olympiad problem discussions, structured exercises, try-out simulations, and post-test activities.

The coaching materials included:

- Algebra,
- Number theory,
- Combinatorics,
- Geometry,
- Mathematical problem-solving strategies.

The program was implemented using the following approaches:

- Problem-Based Learning (PBL),
- Computational thinking,
- Analysis of OSN problem patterns,
- Higher Order Thinking Skills (HOTS)-based exercises.

The evaluation results indicated a significant improvement in students' abilities after participating in the coaching program. This improvement was reflected in the participants' pre-test and post-test scores.

Table 1. Participants' Pre-Test and Post-Test Results

No	Participant	Pre-Test	Post-Test	Improvement
1.	Student 1	30	80	50
2.	Student 2	25	60	35
3.	Student 3	15	55	40

The average pre-test score of participants was 59.5, while the average post-test score increased to 82.0. These results demonstrate an average improvement of 22.5 points after the implementation of the coaching program.

In addition to score improvement, participants also demonstrated progress in:

- Understanding olympiad-level mathematical problems,
- Developing effective problem-solving strategies,
- Enhancing logical and analytical thinking skills,
- Increasing self-confidence in facing mathematics competitions.

Discussion

The results of the program demonstrated that mathematics olympiad coaching through problem-solving and computational thinking approaches was able to significantly improve students' academic abilities. These approaches helped students understand mathematical concepts more deeply and systematically.

At the beginning of the program, most participants experienced difficulties in solving non-routine problems, particularly in number theory and combinatorics. However, after receiving gradual exercises and intensive discussions, students began to identify problem-solving patterns more effectively.

In geometry topics, participants were trained to understand fundamental concepts such as:

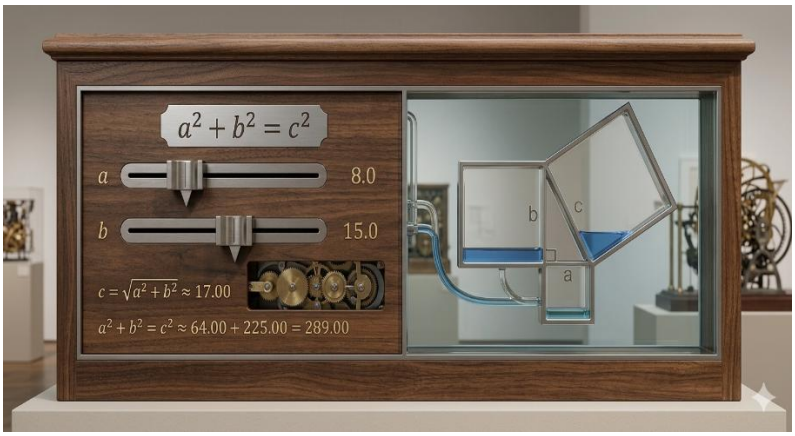


Figure 2. Teorema Pythagoras (Pythagorean Theorem Demonstrator)

which were subsequently applied in solving olympiad problems based on mathematical reasoning.

The computational thinking approach also contributed positively to students' abilities in:

- Breaking down complex problems into simpler components,
- Recognizing patterns,
- Developing systematic solution procedures.

This approach is highly relevant to the field of Data Science because it emphasizes analytical skills and information pattern processing.

Based on the evaluation results, all participants showed improvements in their post-test scores. The highest improvement was achieved by Participant 10, who demonstrated an increase of 24 points. These findings indicate that the coaching methods implemented were effective in improving students' mathematical understanding and problem-solving abilities.

Nevertheless, several challenges were encountered during the implementation of the program, including:

- Differences in participants' fundamental mathematical abilities,
- Limited duration of the coaching sessions,
- Students' lack of experience in solving olympiad-level problems.

Therefore, continuous coaching programs and regular practice sessions are necessary to ensure the optimal development of students' abilities.

Overall, this community service program had a positive impact on improving students' mathematical competencies and enhancing their readiness to participate in district/city-level OSN selection competitions.

IV. CONCLUSION

The community service program for Mathematics National Science Olympiad (OSN) coaching at the district/city level was successfully implemented and demonstrated a significant positive impact on students' academic abilities. Through the integration of Problem-Based Learning (PBL), computational thinking, and Higher Order Thinking Skills (HOTS)-based exercises, participants showed marked improvement in problem-solving skills, logical reasoning, and mathematical concept understanding.

Evaluation results indicated an increase in the average pre-test score from 59.5 to 82.0 in the post-test, confirming that the applied coaching methods were effective in enhancing students' systematic and analytical understanding of olympiad-level mathematics. Additionally, the program boosted participants' motivation, self-confidence, and readiness to compete in district/city-level OSN selections.

The computational thinking approach proved especially relevant to the field of Data Science, fostering structured, analytical, and pattern-based thinking. Overall, this community service initiative contributed positively to the academic potential of students, highlighting the importance of continuing similar coaching programs to optimize students' abilities and prepare them for higher-level mathematical competitions..

THANK-YOU NOTE

Thank you goes to all parties who have helped organize [community service]

LIST OF PARTICIPANTS

The attendance list contains the participants and speakers who attended

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