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Study Camp Based Computational Thinking Assistance to Improve Mathematical Literacy at Madrasah Tsanawiyah, Padang City

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Abstract

Literacy is an essential competency in responding to rapid technological advancements. Mathematical literacy enables students to understand, analyze, and apply mathematical concepts in various real-life contexts. This community service program aimed to strengthen students' mathematical literacy through computational thinking assistance implemented in a study camp format. The activity adopted a Community-Based Research (CBR) model consisting of four stages: laying the foundation, planning, information gathering and analysis, and acting on findings. The study camp was conducted in a laboratory setting, beginning with the introduction of basic programming concepts and continuing with computational thinking exercises integrated into mathematical literacy problems. This approach is expected to foster students' critical thinking skills and enhance their mathematical competencies through interactive and technology-based learning experiences.
Kata Kunci: Computational Thinking, Literacy mathematic, Study Camp

Abstrak

Literasi merupakan kemampuan esensial dalam menghadapi perkembangan teknologi yang semakin pesat. Literasi matematika membantu siswa memahami, menganalisis, dan menerapkan konsep matematika dalam berbagai konteks kehidupan sehari-hari. Penguatan literasi matematika dalam kegiatan ini dilakukan melalui asistensi Computational Thinking berbasis study camp. Computational Thinking merupakan proses berpikir yang melibatkan empat tahapan utama, yaitu dekomposisi, pengenalan pola, abstraksi, dan perancangan algoritma. Kegiatan pengabdian ini menggunakan pendekatan Community-Based Research (CBR) yang meliputi tahap peletakan dasar, perencanaan, pengumpulan dan analisis informasi, serta tindak lanjut temuan. Pelaksanaan study camp dilakukan di laboratorium melalui penguatan pemrograman dasar dan latihan penyelesaian soal literasi matematika yang terintegrasi dengan Computational Thinking. Kegiatan ini diharapkan dapat mengembangkan kemampuan berpikir kritis serta meningkatkan kompetensi matematika siswa secara kontekstual dan berbasis teknologi.
Keywords: Computational Thinking, Literasi matematika, Study Camp

INTRODUCTION

The development of the 21st century is marked by the extensive use of information and communication technology in various aspects of life, including the learning process (Putri et al., 2022). The Indonesian Ministry of Education and Culture formulates that the 21st-century learning paradigm emphasizes students' abilities to seek information from various sources, formulate problems, think analytically, and collaborate to solve them (Mu'minah, 2021). Therefore, education is expected to develop students' creative and flexible thinking, problem-solving skills, collaboration, and innovation, which are essential for success in both

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professional life and everyday living (Pare & Sihotang, 2023). Ideal education encourages learners to discover concepts independently, develop autonomous ways of thinking, and work effectively both individually and in groups.

The ability to learn independently, work autonomously, and collaborate should be integrated into every subject taught in schools. In Madrasah educational institutions, one of the routine activities supporting the development of these competencies is the Madrasah Science Competition (In Indonesia: Kompetisi Sains Madrasah/KSM). This competition requires the integration of various subjects with other scientific disciplines. However, such integration poses challenges for students whose literacy skills, particularly mathematical literacy, remain low. Therefore, the learning process should emphasize approaches that strengthen literacy-oriented thinking as a foundation for learning.

Mathematical literacy plays an essential role in helping students understand, analyze, and solve problems related to the application of mathematics in daily life (Hasibuan et al., 2023). In line with this, the Programme for International Student Assessment (PISA) emphasizes that mathematical literacy is not limited to computational skills but also includes the ability to reason, interpret, and communicate mathematical ideas effectively in various contexts (Stadler et al., 2020). Students are considered successful in solving mathematical problems when they are able to explain the reasoning and thinking processes behind their answers, rather than merely stating the final result.

This ability to explain reasoning and problem solving processes can be developed through a Computational Thinking (CT) approach. Informally, computational thinking is defined as a mental process involved in formulating problems and developing solutions that can be executed systematically (Palts & Pedaste, 2020; Shute et al., 2017). Selby (2013) explains that computational thinking involves the formulation of problems and solutions that can be represented in forms suitable for effective processing by information-processing agents (Selby & Woollard, 2013). Computational thinking consists of four main components: decomposition, pattern recognition, abstraction, and algorithm design (Tsai et al., 2021). A thinking process can already be categorized as computational thinking even if not all components are fully implemented.

Several studies indicate that students' computational abilities at the secondary school level remain relatively low, and that computer science standards are not yet evenly implemented across many countries (Özmutlu et al., 2021). This condition highlights the importance of integrating computational thinking into learning processes across various subjects, including mathematics. The application of computational thinking is expected to assist students in systematically analyzing problems, designing solution steps, and drawing logical conclusions.

Based on these conditions, this Community Service Program (In Indonesia: Pengabdian kepada Masyarakat/PkM) focuses on computational thinking assistance to strengthen mathematical literacy through a study camp approach. The participants of this PkM activity were students of Madrasah Tsanawiyah in Padang City, selected using a purposive sampling technique, namely the selection of students who demonstrate interest and potential in science and are being prepared for academic enrichment and participation in madrasah science competitions. This sampling technique was employed to ensure that the assistance provided was targeted and aligned with participants' needs.

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The implementation of this PkM activity was conducted through several stages, namely planning, implementation, and evaluation. During the planning stage, the PkM team conducted a needs analysis with the partner institution, developed computational thinking assistance materials, and designed structured study camp activities. The implementation stage involved study camp activities consisting of guided learning sessions, group discussions, hands-on problem-solving activities, and intensive mentoring by the service team. The evaluation stage was carried out to assess the achievement of program objectives, participants' improvement in understanding mathematical literacy concepts, and the effectiveness of computational thinking application in solving mathematical problems.

Through a study camp based computational thinking assistance approach, students are expected not only to understand mathematical literacy concepts theoretically but also to apply them practically in various contexts. This rationale underpins and motivates the implementation of this PkM activity as an effort to strengthen the mathematical literacy of Madrasah Tsanawiyah students in Padang City.

METHOD

The subjects of this Community Service Program (PkM) were Madrasah Tsanawiyah students who actively participated in mathematics extracurricular activities, particularly mathematics olympiads and the Madrasah Science Competition (In Indonesia: Kompetisi Sains Madrasah/KSM). In addition to students, this program also involved extracurricular mathematics teachers as key partners, as their role is crucial in continuing student mentoring and development after the completion of the PkM activities at school.

The sampling procedure in this PkM activity employed purposive sampling, in which participants were deliberately selected based on specific criteria relevant to the objectives of the program. The selection criteria included: (1) students actively involved in mathematics extracurricular activities or KSM, (2) students demonstrating interest and potential in mathematical problem-solving, and (3) teachers serving as mentors for mathematics extracurricular activities. This sampling technique was used to ensure that the computational thinking assistance provided was targeted and aligned with the participants' needs.

The PkM activity was conducted at MTsN 3 Padang City. This location was selected because MTsN 3 Padang City has active extracurricular programs, particularly in mathematics and robotics, and has been recognized as a promoter of mathematical literacy. Furthermore, the relatively large number of student groups enabled the effective and sustainable implementation of the study camp activities.

The method applied in this PkM activity was Community-Based Research (CBR). CBR is an approach to community service that actively involves researchers and the community in a collaborative manner throughout the program. One methodology closely aligned with CBR is cooperative inquiry, a participatory action-oriented approach that emphasizes conducting activities jointly with the community. According to Joanna (1996), CBR consists of four stages: (1) laying the foundation, (2) planning, (3) information gathering and analysis, and (4) acting on findings.

The CBR stages were implemented and aligned with the planning, implementation, and evaluation phases, as described below:

1. Planning Phase (Laying Foundation and Planning)

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The planning phase began with the laying foundation stage, which aimed to establish a shared understanding between the PkM team and the madrasah community regarding the importance of strengthening mathematical literacy through a computational thinking approach. This stage was conducted through Focus Group Discussions (FGDs) involving the principal, vice principal for curriculum, madrasah team members, extracurricular teachers, and the PkM team.

Subsequently, the planning stage involved designing the study camp program, determining computational thinking assistance materials, assigning roles between the PkM team and partners, and adjusting activities based on time and facility constraints.

2. Implementation Phase (Information Gathering and Analysis)

The implementation phase was carried out through a computational thinking–based study camp. Activities included guided learning sessions in classrooms and laboratories, group discussions, and hands-on mathematical problem-solving tasks using a computational thinking approach. Students were trained to develop logical thinking through problem decomposition, pattern recognition, abstraction, and simple algorithm design, including introductory programming activities.

During this phase, data were also collected through observations of student activities, group discussions, and documentation to assess students' engagement, responses, and progress in mathematical literacy.

3. Evaluation Phase (Acting on Findings)

The evaluation phase focused on reflecting on the outcomes of the study camp activities in collaboration with the madrasah community and extracurricular teachers. Evaluation emphasized the achievement of program objectives, improvements in students' understanding of mathematical literacy, and the effectiveness of computational thinking application in the learning process. The evaluation results were disseminated to partners as a basis for follow-up actions and continued student mentoring at the school level.

In this PkM activity, implementation was limited to the stages of laying the foundation, collaborative planning with the community and stakeholders, and the execution of study camp activities as a form of program implementation and data collection. This approach is expected to provide a strong foundation for strengthening the mathematical literacy of Madrasah Tsanawiyah students through sustainable computational thinking assistance.

RESULT AND DISCUSSION

Community Service conducted using the Community-Based Research (CBR) approach aims to establish a mathematical literacy community at MTsN 3 Padang City through Computational Thinking–based reasoning. The stakeholders involved in this program include the school principal, the vice principal for curriculum affairs, and mathematics extracurricular mentor teachers. At the laying foundation stage of the CBR approach, the focus was on students who were already involved in mathematics extracurricular activities, while designing a mathematical literacy strengthening program through a study camp scheme.

Study camp–based learning is an educational approach that integrates the learning process with camping or outdoor group activities (Dorfman, 1979). In this method, students participate in programs designed to enhance both their academic and social skills, with an

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emphasis on self-development in a more informal and interactive learning atmosphere (Alasbahi & Melzig, 2012).

A distinctive characteristic of study camp–based learning is the integration of academic activities with direct experiences that can strengthen understanding, teamwork, as well as students' social and emotional competencies (Richmond et al., 2019) . These activities typically involve discussions, simulations, challenges, and games designed to encourage students to solve problems, work collaboratively, and enhance creativity.

1. Planning Phase (Laying Foundation and Planning)

The activity began with meetings and coordination with the Principal of MTsN 3 Padang City and the Vice Principal for Curriculum Affairs. One of the key topics discussed during this foundation stage was how to instill a culture of mathematical literacy among the students at the school. The documentation of this activity can be seen in Figure 1.

Figure 1. Meeting with the Principal and the Vice Principal for Curriculum Affairs of MTsN 3 Padang City

The initial meeting began with a discussion about the aims and objectives of the Community Service Program (PkM) to be carried out. The discussion also covered the school's initial condition, particularly regarding students' literacy in mathematics. From the discussion, it was found that the school has several extracurricular activities related to mathematical literacy, including mathematics olympiads, the Madrasah Science Competition (KSM), and Myrest. According to one mathematics teacher for Grades X and XI, students' interest in participating in mathematics olympiad activities is very low. As a result, the number of students involved in these activities is relatively small compared to other extracurricular programs.

This situation was identified as an initial assumption by the teacher, who stated that learning models that are only school-centered tend to make students feel bored, indicating the need for innovation. Mathematical literacy levels were also considered low across classes in the school.

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In addition, during the discussion, the school explained that it is currently running a robotics program that does not use application-based systems but instead uses self-assembled devices controlled by remote control. This foundation stage can begin with the preparation of a cooperation agreement document between institutions.

During the planning stage, the PKM team held discussions with the Vice Principal for Curriculum Affairs regarding follow-up actions from the foundation stage. The planning focused on selecting students who would participate in the study camp from those involved in mathematics olympiad extracurricular activities. This was followed by an agreement to use computational thinking as an approach to strengthen mathematical literacy. This activity is documented in Figure 2.

Figure 2. Planning / Follow-up Meeting of the PKM Team with the Vice Principal for Curriculum Affairs

The planning and follow-up activities carried out with the Vice Principal for Curriculum Affairs were also communicated to the university students assisting in this PkM program. The discussion with these students covered follow-up actions for the implementation process of the PkM activities.

Figure 3. Planning/Follow-up of the PKM Team with Mathematics Study Program Students

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The results of the discussions with the Vice Principal for Curriculum Affairs and the assisting university students led to several agreements as follows:

a. The implementation involves students participating in extracurricular activities in mathematics olympiads and the Madrasah Science Competition (KSM) in mathematics.
b. The activities begin with strengthening computational thinking using Scratch logic, and students are also provided with a companion book related to computational thinking.
c. Students are brought to school on the days when they have extracurricular activities.
d. The activities take place in the laboratory and in the classroom, accompanied by instructors.

2. Implementation Phase (Information Gathering and Analysis)

The information gathering and analysis stage began with the implementation of the activities. The first session was conducted in the laboratory, where students were trained by an instructor in computational thinking logic using a Scratch guidebook. This Scratch-based way of thinking can also be accessed through the Scratch platform.

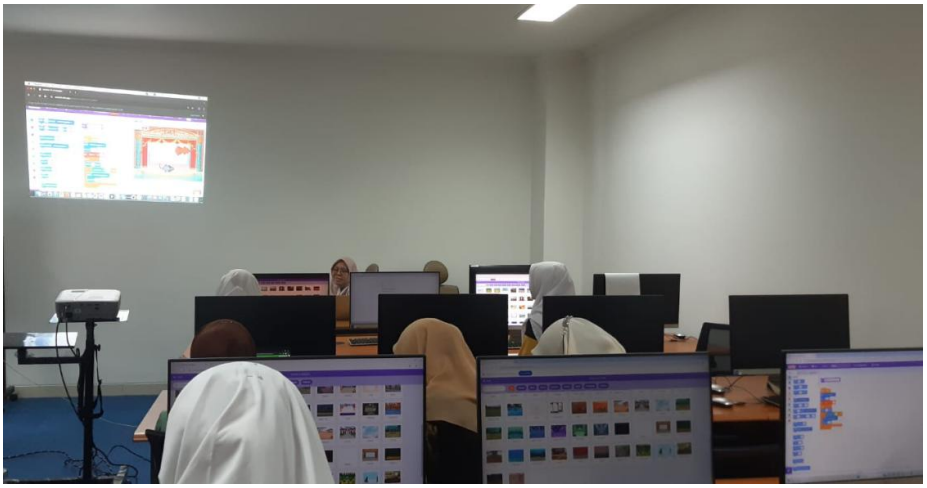

Figure 4. Implementation of Activities to Train Computational Thinking Logic Using Scratch

As shown in the figure, the training activities ran smoothly, and the students were guided by instructors who are competent in the fundamentals of programming. The basics of Scratch programming are considered a starting point for developing computational thinking skills to enhance mathematical literacy. After the instructor presented the Scratch material, the students practiced their computational thinking skills independently using the computers provided. The documentation can be seen in Figure 5.

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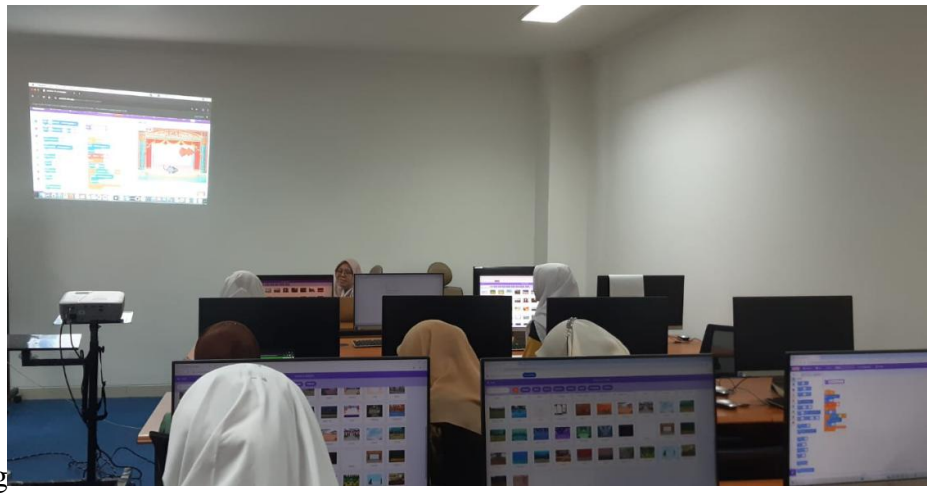

Figure 5. Students Conduct Independent Testing of Computational Thinking Logic with Scratch

The students were enthusiastic about trying basic programming, which forms the foundation of computational thinking, using the computers. While the students practiced independently, the instructor continued to guide the activities in the laboratory. In addition to the laboratory sessions, the students' computational thinking patterns were further developed through mathematics literacy problems. They were assigned to work on mathematics literacy questions that had been integrated with computational thinking elements.

Figure 6. Students are Trained to Work on Math Literacy Problems with Instructor Guidance

3. Evaluation Phase (Acting on Findings)

At the action and findings stage, the PkM team attempted to summarize the results obtained from the foundation, planning, and data collection stages. Nevertheless, this stage also took into account teachers' experiences in providing reinforcement, particularly in the area of mathematical literacy. As highlighted in previous research (Hasibuan et al., 2024), mathematical literacy needs to be instilled in students from an early age. Schools also play an active role in fostering a love for literacy, for example through improving reading spaces or

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school libraries. The influence of smartphone technology that is not used wisely has a significant impact on students' reading interest (Waningyun et al., 2023). The questions given to students should be designed in an engaging way to attract their attention to read and solve them. The content of the questions should also be closely related to students' daily lives.

During the FGD, teachers who mentor extracurricular olympiad activities also stated that mathematics teachers have not yet optimally utilized interactive and technology-based learning media. The school also expressed the hope that this community service program can continue with further strengthening of computational thinking in mathematics and computational applications in robotics.

Although this community service activity (PkM) showed positive responses from both students and teachers, it has several limitations. The program was primarily qualitative and action-based, and therefore was not accompanied by quantitative measurements of improvements in students' mathematical literacy skills. In addition, the participants were limited to students already involved in mathematics extracurricular activities, meaning they do not represent the full range of student characteristics in the school. The relatively short duration of the study camp scheme also means that the long-term impact of strengthening computational thinking could not yet be observed. Another limitation concerns technological facilities, which still rely on the school laboratory, so technology-based learning cannot yet be carried out independently by all students outside the activity.

The findings of this activity provide practical implications for schools, particularly in strengthening mathematical literacy based on computational thinking. First, the study camp approach proved to increase students' enthusiasm and engagement compared to conventional classroom learning. Second, the use of Scratch as an introductory programming tool can serve as a bridge for students to understand structured logical thinking that supports mathematical problem-solving. Third, teachers need to be encouraged to gradually integrate technology-based learning media into mathematics instruction. Schools can also develop technology-based mathematics literacy communities through extracurricular activities as practice spaces for students. In this way, computational thinking becomes not merely an additional topic, but a culture of thinking within mathematics learning.

Based on the results of this activity, further PkM initiatives or research are needed to strengthen the program's impact. Future activities can focus on developing mathematics learning modules based on computational thinking that are integrated into the school curriculum. In addition, training mathematics teachers to use interactive technology-based media is essential to ensure program sustainability. Further research may also adopt a mixed-method approach to quantitatively measure improvements in students' mathematical literacy following computational thinking interventions. The development of computational thinking can also be expanded into the school's robotics field, thereby forming an integrated ecosystem of mathematical and technological literacy.

CONCLUSION

The Community Service Program (PkM) conducted using a Community Based Research (CBR) approach shows that strengthening mathematical literacy through computational thinking assistance based on a study camp model is a relevant strategy to support mathematics learning at MTsN 3 Padang. The stages of laying the foundation, collaborative planning with

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the school, and the implementation of computational thinking training using Scratch demonstrated strong student enthusiasm as well as active support from teachers and school stakeholders. The integration of programming logic with mathematics literacy problems helped students practice structured thinking through problem decomposition, pattern recognition, abstraction, and the development of step-by-step solutions. Qualitatively, this activity made learning more interactive, contextual, and technology-based, providing an innovative alternative to address students' low interest and mathematical literacy levels.

However, this activity has several limitations. It was conducted using a qualitative, action-based approach without quantitative measurement of improvements in students' mathematical literacy. The participants were limited to students involved in mathematics extracurricular activities, so the findings cannot yet be generalized to all students. In addition, the relatively short duration of the program did not allow for observation of long-term impacts. Despite these limitations, the findings offer practical implications, indicating that schools can begin integrating computational thinking into mathematics learning through simple technological tools such as Scratch, the development of contextual and engaging problems, and collaborative learning approaches such as study camps.

Future PkM activities and further research can be directed toward developing a more structured mathematics literacy learning model based on computational thinking, conducting quantitative measurements of its impact on students' mathematical literacy skills, and expanding the application of computational thinking to other areas such as robotics and different subject fields. Therefore, this activity represents an initial step in building a mathematics literacy community that is adaptive to technological developments and the demands of 21st-century learning.

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