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Enhance Teacher Competency Through Training in Compiling Mathematical Problems to Improve Students' Critical Thinking Skills

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Abstract

Critical thinking skill is one of the important skills that students must have in the 21st century learning. However, in reality, students' critical thinking skills tend to be low because current learning does not involve it. Hence, teachers are expected to be able to compile mathematical problems that can improve students' critical thinking skills. This community service project aims to provide teacher training in Roudlotul Mu'allimin Laban Menganti Gresik elementary school to compile mathematical problems that can improve students' critical thinking skills as an effort to enhance teachers' pedagogical competence. The method used in this community service project is Service Learning (SL) with three stages, such as planning, implementation, and evaluation. The results that have been achieved in the training implementation are that the teacher knowledge about how to compile mathematical problems to improve students' critical thinking skills is increasing as evidenced by the difference between pre-test and post-test results. Before the training, there were no training participants who were able to compile mathematical problems that can improve students' critical thinking skills. However, after the training, 77,78% of the training participants were able to compile it well.

INTRODUCTION

The integration of 21st century skills in the learning process can be seen from the changes in the curriculum implemented in schools. The skills in the 21st century that must be mastered by students, including communication, collaboration, critical thinking, and creative thinking (Fitriati et al., 2023; Herlinawati et al., 2024). These skills are needed by students in the future workplace, because they can improve their employability, marketability, and readiness for citizenship (Redhana, 2019).

Critical thinking skill is one of the important skills that students must have in the 21st century (Widodo, S., & Wardani, 2020). As Rachmantika & Wardono (2019) explained, students need to be equipped with high-level thinking skills which cover various skills, including critical thinking skills. Therefore, critical thinking skills must be prioritized to be

fulfilled to support students' future needs. Apriliani, et al. (2021), Irhamni, et al. (2022), and York, et al. (2015) also asserted that critical thinking skill is essential skill that become the indicators of learning success and have a major influence on academic and professional success in the future.

However, in reality, students' critical thinking skills still tend to be low due to the lack of empowerment of students' abilities to think critically in learning and students are not used to practicing problems that are in accordance with critical thinking indicators (Agnafia, 2019; Rahayu & Dewi, 2022). One of the government's efforts to respond to this is by implementing a school mover program in the independent curriculum. In this program, teachers are required to become teachers movers, one of which aimed at stimulating students to think critically (Dewi et al., 2023). This is because students' success in developing their critical thinking skills depends on the teacher's ability to design, plan, and manage the learning process. On the other hand, this is also the role of schools in the field of education, schools must be able to produce high and superior quality human resources (Saputri, 2022; Subarkah et al., 2023).

In the implementation of the independent curriculum, critical thinking skills are considered highly important, which can be seen from the dimensions of the Pancasila students profile, namely critical reasoning. It plays an important role, especially in mathematics learning in the independent curriculum, including in mathematical problem-solving activities, student independence in understanding mathematical material, and in discussion and collaboration activities (Silwana & Widayanti, 2024). In an effort to develop students' critical thinking skills in mathematics learning, teachers are expected to be able to compile mathematical problems that can improve students' critical thinking skills. In addition, teachers must also be able to design appropriate instructions on what students should do regarding the problems that have been presented so that their critical thinking skills increase. Mathematical problems that can develop critical thinking skills are important to be given to students in order to determine the development of students' critical thinking skills when learning has been completed. However, the implementation of critical thinking ability assessments in general is very low (Mukti & Istiyono, 2018). This is one of the factors in students' low critical thinking skills.

The implementation of low critical thinking ability assessment is the result of teachers who are not being accustomed to providing the types of mathematical problems that are suitable for encouraging the development of critical thinking skills and what instructions are suitable for each type of problem that has been given so that students' critical thinking skills can develop rapidly. There are many types of mathematical problems that can be developed by teachers and have been proven to enhance critical thinking skills, such as Problems With Contradictory Information (PWCI), Problems With No Specified Universal Set Given (PWNSUS), and etc. (As'ari et al., 2019). These problems can provide opportunities for the formation of critical thinking dispositions that have an impact on increasing students' critical thinking skills.

Mathematical problems that can develop students' ability to think critically will not make students only use mathematics formulas, but also empower students' critical thinking skills. Thus, teachers really need to master the ability to develop mathematical problems that can help students improve their critical thinking skills. Besides, there are no many trainings conducted in compiling mathematical problems to improve students' critical thinking skills. Mostly, the topic of teacher training is the training about compiling mathematical problems based on Higher Order Thinking Skills (HOTS) (Handican et al., 2024; Khotimah et al., 2021; Sinta et al., 2022) but it is not specific to compiling problems to improve students' critical thinking skills. Based on a preliminary study conducted at the

school where community service was conducted, teachers have also never received training related to compiling mathematical problems to improve students' critical thinking skills.

Based on this background, this community service project aims to provide training to teachers in compiling mathematical problems that can improve students' critical thinking skills, especially mathematical problems as an effort to enhance teachers' pedagogical competence.

IMPLEMENTATION METHOD

The method used in this community service project is Service Learning (SL). Service learning is a method of service by providing services to partners through assistance in solving problems or providing knowledge according to partner's needs (Muhassanah et al., 2022). This teacher training was held on Tuesday, October 29, 2024 at Roudlotul Mu'allimin Laban Menganti Gresik elementary school. Participants in this teacher training were all teachers at Roudlotul Mu'allimin Laban Menganti Gresik elementary school.

There are three stages in this community service, such as planning, implementation, and evaluation. The planning stage includes identifying problems and determining the time and place of community service activities. The implementation stage includes participants activity to fill out pre-training questionnaire and pre-test to compiling mathematical problems that can improve students' critical thinking skills, training materials delivery session on compiling mathematical problems to improve students' critical thinking skills by speaker, question and answer, discussion session, and giving assignment in the form of post-test to compile mathematical problems that can improve students' critical thinking skills, and participants activity to fill out satisfaction questionnaire related to training. The evaluation stage is carried out through discussion of the community service team regarding the evaluation of activities and the level of achievement of community service activities. The flow of this community service project presented in Figure 1 below.

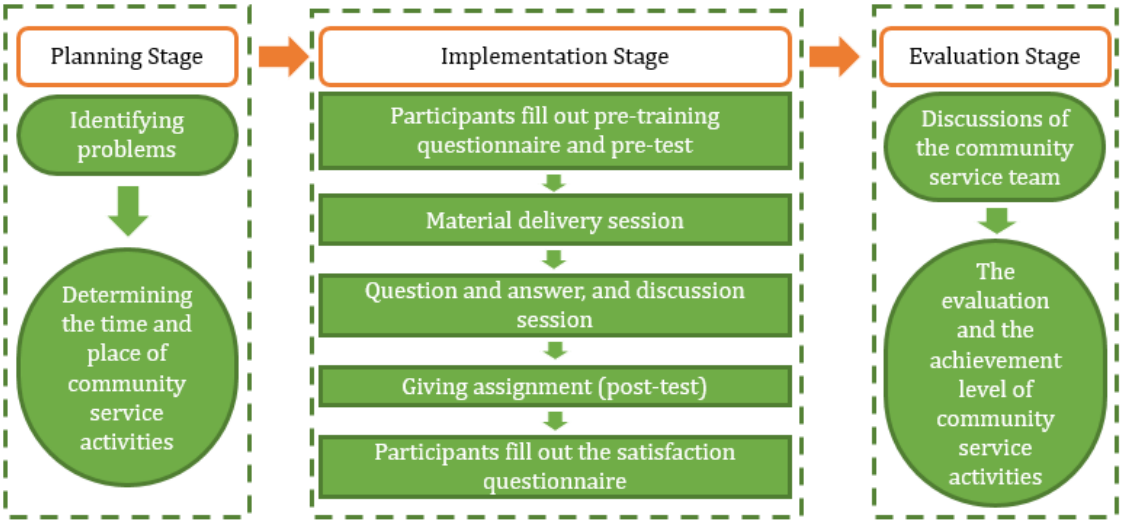

Figure 1. The Flow of Community Service Project

The level of achievement of this training is in the form of participants' participation and enthusiasm, the percentage of each indicator in the pre-training questionnaire and satisfaction questionnaire, and the difference in the percentage of participant success in the pre-test and post-test activities. The pre-training questionnaire and satisfaction questionnaire used a five-point Likert scale with score described in Table 1 below.

Table 1. Likert Scale Categories

Category	Score
Strongly Agree (SA)	5
Agree (A)	4
Neutral (N)	3
Disagree (D)	2
Strongly Disagree (SD)	1

(Pranatawijaya et al., 2019)

The percentage of each Likert scale category for each indicator in the pre-training questionnaire and satisfaction questionnaire was calculated in the following way.

$$Percentage = \frac{Number\ of\ participants\ who\ chose\ the\ category}{Total\ participants} \times 100\%$$

RESULT and DISCUSSION

The objectives of this community service project is to enhance teacher's competence, especially in compiling mathematical problems with special instructions in order to improve students' critical thinking skills. The advantages of this community service project are the latest theme and are rarely discussed in teacher training. This theme is also adjusted to current learning needs, such as learning that focuses on developing students' thinking skills, especially the skills needed in the 21st century. To realize this goal, the community service team conducted community service activities in one of the elementary schools, namely Roudlotul Mu'allimin Laban Menganti Gresik elementary school.

The training design is well-prepared and mature. This training design is related to the preparation of the training program related to how the training is structured and the training methods used, because this will affect the effectiveness of the training (Sela et al., 2018). This community service began with problem identification and continued with coordination with the principal of Roudlotul Mu'allimin Laban Menganti Gresik elementary school. This coordination related to permits and agreements on the time, place, and target of the community service. The results of the coordination obtained that the agreement on the time of implementation of the community service on Tuesday, October 29, 2024 took place in one of the classrooms of the school with the target of the community service being all teachers at the school.

The next stage is the implementation stage. At the beginning of the training activity, there was a speech from the principal of the school, and a speech from the representative of the community service team. The next activity is filling out the pre-training questionnaire and doing the pre-test by participants, followed by the training materials delivery session on compiling mathematical problems to improve students' critical thinking skills as an effort to enhance teachers' pedagogical competence. This material was delivered by Amalia Silwana, M.Pd., one of the lecturers in the Mathematics Education department at STKIP Bina Insan Mandiri as shown in Figure 2 below.

Figure 2. Material Delivery Session

The training activities continued with a question and answer session and discussion between participants and speaker. There were three training participants who asked questions related to the training tittle. Figure 3 below is the question and answer, and discussion session.

Figure 3. Question and Answer and Discussion Session

The next activity is giving assignment in the form of completing post-test. Afterwards, it continued with filling out the satisfaction questionnaire by participants. The activity of compiling mathematical problem to improve students critical thinking skills as a post-test is presented in Figure 4 below.

Figure 4. Post-test activity

The evaluation stage was carried out through a discussion of the community service project team regarding the evaluation and the achievement level of community service activities. The first level of achievement of training activities was in the form of participant participation and enthusiasm. All teachers of Roudlotul Mu'allimin Laban Menganti Gresik elementary school attended this training activity from the beginning to the end of training. The enthusiasm of the participants can be seen from the activeness of filling out the pre-training questionnaire and completing the pre-test, asking questions during the question and answer session, and filling out the satisfaction questionnaire and completing the post-test. As Sukmanasa, et al. (2020) stated, if training participants are enthusiastic and take part in training activities from the beginning to the end of the training, it can be stated that the training has received a positive response from the participants.

The achievement level of training was also seen from the percentage of each indicator in the pre-training questionnaire and satisfaction questionnaire, as well as the difference in the percentage of participant success in the pre-test and post-test activities. The results of the pre-training questionnaire are presented in Table 2 below.

Table 2. The Results of Pre-Training Questionnaire

No	Statement	Answer Percentage				
		SD	D	N	A	SA
1	I often compile mathematical problems that can improve students' critical thinking skills.	0%	0%	33,33%	44,44%	22,22%
2	I often develop learning designs and teaching materials that can improve students' critical thinking skills.	0%	0%	22,22%	66,67%	11,11%
3	I am interested in compiling mathematical problems that can improve students' critical thinking skills well.	0%	0%	11,11%	22,22%	66,67%

Based on Table 2, it can be seen that the majority of teachers stated that they often create mathematical problems that can enhance students' critical thinking skills, and frequently create learning designs and teaching materials that can enhance students' critical thinking skills. However, from the results of the pre-test, there are still no teachers who are able to compile mathematical problems that are in accordance with the indicators of critical thinking skills. Figure 5 below is the result of a pre-test from one of the teachers as a training participant.

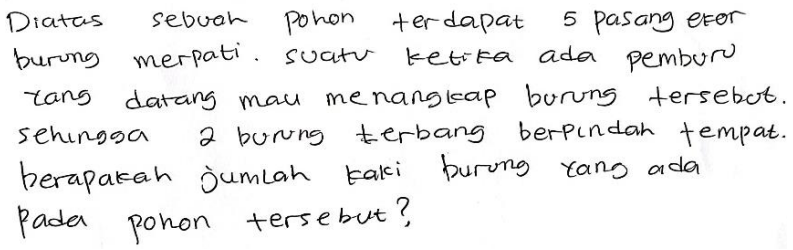

Figure 5. One of The Pre-test Results

Furthermore, the results of the satisfaction questionnaire distributed by the community service team to training participants are presented in Table 3 below.

Table 3. The Results of The Satisfaction Questionnaire

No	Statement	Answer Percentage				
		SD	D	N	A	SA
1	I understand the material presented by the speaker regarding how to compile mathematical problems that can improve students' critical thinking skills.	0%	0%	11,11%	66,67%	22,22%
2	I feel that the training in compiling mathematical problems to improve students' critical thinking skills supports my teaching duties.	0%	0%	0%	55,56%	44,44%
3	Training in compiling mathematical problems to improve students' critical thinking skills helped me improve my professionalism and pedagogical competence.	0%	0%	0%	55,56%	44,44%
4	Training in compiling mathematical problems to improve students' critical thinking skills help me implement 21st century learning.	0%	0%	0%	55,56%	44,44%

5	Training materials in compiling mathematical problems that can improve students' critical thinking skills according to my expectations.	0%	0%	0%	55,56%	44,44%

From the results of the satisfaction questionnaire, regarding the indicator of training participants' ability to understand the material presented by the speaker, there were 11,11% of participants were neutral, 66,67% of participants agreed, and 22,22% of participants strongly agreed. For the second indicator, participants felt that this training supported their teaching duties: 55,56% agreed and 44,44% strongly agreed. The third indicator, participants thought that this training could help them improve their professionalism and pedagogical competence: 55,56% agreed, and 44,44% strongly agreed. The fourth indicator, this training was considered being able to help participants in implementing 21st century leaning: 55,56% agreed, and 44,44% strongly agreed. The fifth indicator, namely the training materials was in accordance with participants' expectations: 55,56% agreed, and 44,44% strongly agreed. From the results of this satisfaction questionnaire, it can be assessed that training participants have high satisfaction with this training.

The results of the satisfaction questionnaire showed that this training material can help teachers implement 21st century learning. This is a challenge for teachers in the 4.0 era that teachers must have strong competencies to equip students with 21st century skills through 21st century learning (Riskha, 2019). In addition, through these results, the majority of teachers as participants agreed that the material provided helped them carry out their duties as teachers. This is because the ability to compile mathematical problems is part of pedagogical competence. This competence is a competence that must be mastered by teachers in carrying out their duties and distinguishes teachers from other professions and described the teacher's quality (Akbar, 2021).

Furthermore, Figure 6 and Figure 7 below are mathematical problems that were successfully compiled by teachers as training participants to improve students' critical thinking skills.

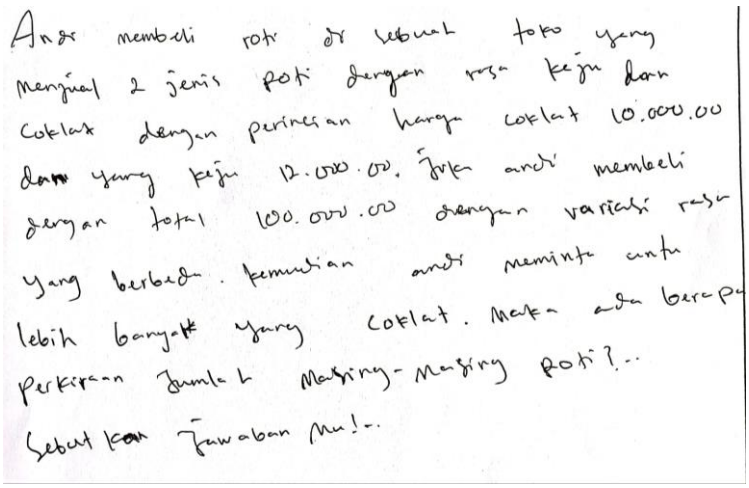

Figure 6. One of The Post-Test Results

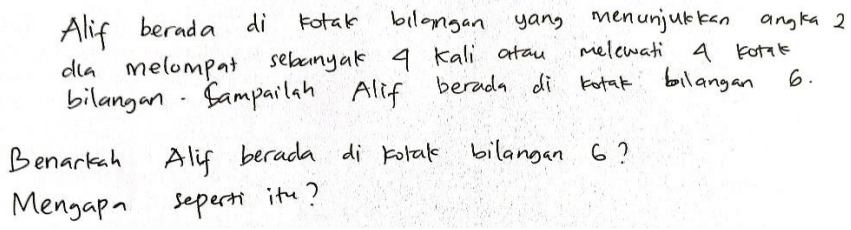

Figure 7. One of The Post-Test Results

The results of the post-test stated that 77,78% of participants succeeded in compiling mathematical problems that were in accordance with the indicators of mathematical problems to enhance critical thinking skills. This shows that there is a significant increase after the training. It is because before the training, none of the participants was able to compile mathematical problems related to critical thinking well.

Hence, through the material presented in this study, teachers get knowledge of how to compiling mathematical problems that are in accordance with critical thinking ability indicators so that efforts to enhance students' critical thinking skills can be achieved optimally. Furthermore, through this training, teacher competencies can be developed and developing it improves the quality of education and learning (Solechan et al., 2023). In line with the opinion of Sulastri, et al. (2020) and Novelti, et al. (2023), efforts to improve the quality and competence of teachers in carrying out their duties have a positive effects, such as improving the quality of content, input, process, and learning outcomes; improving the ability to solve real educational problems; and improving teacher professionalism.

CONCLUSION

This community service project is considered having positive responses and significant effects on the training participants, namely teachers at Roudlotul Mu'allimin Laban Menganti Gresik elementary school. All participants were enthusiastic about the material provided and they had high satisfaction with the training that had been carried out because they considered this training to be able to support their duties as teachers, develop their professionalism and pedagogical competence, and help them implement 21st century learning. The results that have been achieved in the training implementation are that the teachers' knowledge about how to compile mathematical problems to improve students' critical thinking skills in increasing as evidenced by the difference between the pre-test and post-test results. Before the training, there were no training participant who were able to compile mathematical problems that can improve students' critical thinking skills according to the right critical thinking problem indicators. However, after the training, there were 77,78% of the training participants who were able to compile mathematical problems that can improve students' critical thinking skills.

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