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Teachers' Training in Designing Mathematics Literacy Questions at SMP and SMK Putra Juang Cianjur

Masta Hutajulu[1]*, Asep Ikin Sugandi[2]
[1]Program Studi Pendidikan Matematika, IKIP Siliwangi, Indonesia, masthahutajulu@ikipsiliwangi,ac.id
[2]Program Studi Pendidikan Matematika, IKIP Siliwangi, Indonesia, asepikinsugandi@gmail.com

*masthahutajulu@ikipsiliwangi.ac.id

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Abstract

This community service activity aims to enhance the competence of teachers at *SMP* and *SMK Putra Juang* in designing mathematics literacy questions aligned with the demands of the Merdeka Curriculum and the national assessment. The training was initiated due to the teachers' limited understanding of the characteristics of mathematics literacy questions, which emphasisis on critical thinking skills, contextual problem-solving, and conceptual interconnections. The activity was implemented using a participatory approach through workshops, group discussions, and intensive mentoring. The results of the activity indicate an improvement in teachers' ability to develop questions with relevant contexts, diverse representations, and appropriate competency indicators. Furthermore, this activity had a positive impact on teachers' preparedness for the national assessment and the implementation of literacy-based learning. Based on these findings, this article recommends the continuation of similar training programs as part of efforts to support teachers' competence development.

Keywords: Assesment, Mathematical literacy, Teachers, Training

Abstrak

Kegiatan pengabdian kepada masyarakat ini bertujuan untuk meningkatkan kompetensi guru SMP dan SMK Putra Juang dalam merancang soal-soal literasi matematika yang selaras dengan tuntutan Kurikulum Merdeka dan asesmen nasional. Pelatihan ini dilatarbelakangi oleh rendahnya tingkat pemahaman guru terhadap karakteristik soal literasi matematika yang mengedepankan kemampuan berpikir kritis, pemecahan masalah kontekstual, serta keterkaitan antar konsep. Pelaksanaan kegiatan dilakukan melalui pendekatan partisipatif, dengan metode workshop, diskusi, dan pendampingan secara intensif. Hasil kegiatan menunjukkan adanya peningkatan kapasitas guru dalam menyusun soal yang kontekstual, bervariasi dalam bentuk representasi, serta sesuai dengan indikator kompetensi yang relevan. Selain itu, kegiatan ini memberikan dampak positif terhadap kesiapan guru dalam menghadapi asesmen nasional serta dalam pelaksanaan pembelajaran berbasis literasi. Berdasarkan temuan tersebut, artikel ini merekomendasikan perlunya pelaksanaan program pelatihan serupa secara berkelanjutan sebagai bagian dari upaya pengembangan profesionalisme guru.

Kata Kunci: *Asesmen, Literasi Matematika, Guru, Pelatihan*

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Introduction

The Mathematic education today is directed not only at mastering concepts and procedures but also at developing critical thinking and problem-solving skills in real-life contexts. One important indicator of this is mathematical literacy, which is a core component of the Minimum Competency Assessment. According to the Organisation for Economic Co-

operation and Development (OECD, 2019) mathematical literacy is defined as an individual's capacity to formulate, use, and interpret mathematics in various contexts. Furthermore, the latest PISA 2022 results revealed a significant global decline in students' performance in mathematics and reading, highlighting the urgent need to improve foundational skills. Indonesia, in particular, scored 366 in mathematics, which is below the OECD average, reinforcing the relevance of emphasizing mathematical literacy in national assessments (OECD, 2023).

Based on the definition provided by the Programme for International Student Assessment (PISA) organized by the OECD, mathematical literacy refers to an individual's ability to formulate, use, and interpret mathematics in a variety of contexts. This competence includes mathematical reasoning skills and the use of mathematical concepts, procedures, facts, and tools to describe, explain, and predict phenomena. PISA results indicate that Indonesian students' level of mathematical literacy remains relatively low compared to other countries, reflecting a gap between curriculum expectations and classroom practices. One contributing factor is the teaching approach, which often lacks support for the development of reading and numeracy literacy. Teachers tend to focus on routine problems, making learning overly procedural, emphasizing memorization of formulas and concepts with minimal understanding of real-life applications. In fact, teachers play a central role in shaping students' knowledge and competencies (Kadarisma & Amelia, 2018; Kadarisma et al., 2019; Hutajulu, 2024). Therefore, teachers need to develop teaching materials, including assessment instruments, that are based on mathematical literacy to support meaningful and contextual learning objectives.

A major cause of low mathematical literacy is the underutilized role of teachers in designing tasks or learning activities that foster literacy development. Most teachers still emphasize routine, procedural problems that do not reflect real-world contexts. In contrast, designing high-quality, contextual problems is crucial for helping students grasp mathematical concepts deeply and meaningfully.

Initial observations and discussions with *SMP* and *SMK Putra Juang* indicate that most mathematics teachers have not yet received specific training in constructing mathematical literacy tasks, especially those employing contextual approaches aligned with the national assessment or PISA. Teachers reported difficulties in understanding the characteristics of literacy-based items, designing relevant and contextual stimuli, and developing challenging yet curriculum-aligned problems.

This statement aligns with Toropova et al (2019), who emphasized that teachers have a strategic role in enhancing the quality of mathematics learning. Teachers who can think reflectively and creatively in designing problems are believed to foster higher-order thinking skills in students. Similarly, Stacey & Turner (2015) stated that training in literacy-based item development helps teachers learn how to present mathematical content in relevant and engaging contexts for learners.

As a concrete contribution to improving teacher competence, a community service activity in the form of a Mathematical Literacy Problem-Writing Workshop was conducted for mathematics teachers at *SMP* and *SMK Putra Juang*. This activity aimed not only to provide conceptual understanding of mathematical literacy but also to offer hands-on training in designing contextual problems, developing visual and narrative stimuli, and evaluating item quality through peer discussion and feedback.

Through this workshop, teachers are expected to develop practical skills in designing high-quality mathematical literacy tasks that align with the curriculum and relate to the students' real-life experiences. Furthermore, this initiative contributes to improving educational quality at the partner school and strengthens collaboration between higher education institutions and schools in implementing the Tri Dharma of Higher Education, particularly in community service within the education sector. Enhancing teachers' capacity in constructing literacy-based problems is expected to support more meaningful and transformative learning processes, and also improve assessment outcomes at national and international levels that reflect students' mathematical literacy comprehensively.

Several studies on literacy and numeracy have been conducted by Zuhra et al., (2021), Setyaputri et al., (2022), Deda et al., (2023). Zuhra stated that teachers play a vital role in shaping students' character and abilities, and significantly influence the learning process (Zuhra et al., 2021). Therefore, teacher competency training is essential. Their community service results showed that participants became familiar with various types of literacy and were able to implement them in their teaching.

Meanwhile, the community service activity conducted by Setyaputri et al., (2022) at *SD Negeri Kragilan 2* aimed to introduce and apply literacy and numeracy skills in elementary-level learning. The results showed that students were able to understand and apply literacy and numeracy concepts in everyday life. Data also revealed improvements in students' reading and arithmetic fluency.

Based on the above description, a community service activity in the form of a "Mathematical Literacy Problem-Writing Workshop" is needed. This training aims to equip teachers with the knowledge and skills to develop mathematical literacy problems based on real-life contexts that reflect students' everyday experiences.

Method

This training activity was conducted at *SMP* and *SMK Putra Juang Cianjur* on February 7–8, 2024, involving 12 teachers, consisting of 6 teachers from *SMP Putra Juang* and 6 teachers from *SMK Putra Juang*. The activity spanned two days, starting on Friday from 13.00 to 16.00 WIB, and continuing on Saturday from 08.00 to 16.00 WIB. The first day focused on conceptual material delivery, while the second day was dedicated to practical sessions on problem writing and participant presentations.

This community service program adopted a participatory and collaborative approach, involving teachers as active partners in every phase of the training. This approach was chosen to ensure that teachers are not merely passive recipients of information, but also active participants engaged in learning, exploration, and skill development. As a result, the training was not only theoretical but also practical and reflective, aligned with the actual needs in the field.

The training was carried out in the form of an intensive two-day workshop, consisting of a combination of material delivery sessions, group discussions, hands-on problem writing practices, and reflective activities. Each session was designed to be interactive and to promote full engagement from the participants. The stages of the activity included:

1. Opening and Orientation

The activity began with welcoming remarks from the school representatives and the implementation team as a formal opening. This was followed by a briefing on the objectives, benefits, and stages of the training. A brief pre-test was also conducted to identify participants' initial understanding of the concept of mathematical literacy.

2. Conceptual Material Presentation

At this stage, participants were given theoretical insights into the basic concepts of mathematical literacy, including its definition, scope, and significance in the context of 21st-century education. The material presented included the characteristics of literacy-based math problems, principles of contextual problem construction, and their relevance to the Merdeka Curriculum, as well as national and international assessments such as PISA. The session was delivered interactively using digital presentations, accompanied by authentic problem examples that illustrated various forms and complexities of literacy tasks. This session aimed to provide a strong theoretical foundation before moving into the practical stages of problem writing.

3. Practical Problem-Writing Session

In this session, participating teachers were given the opportunity to apply the knowledge they had acquired by designing mathematical literacy problems based on real-life contexts. The problems were tailored to the subjects taught and the educational levels of each teacher, ensuring that the outcomes were relevant and applicable. Throughout the process, participants received intensive assistance from the community service facilitators, who provided guidance, clarification, and constructive feedback. This session aimed to build teachers' practical skills in designing evaluation instruments that reflect students' mathematical literacy comprehensively.

4. Presentation and Peer Feedback

After completing the problem-writing tasks, each participant group presented their work to the other participants and facilitators. This session was designed to facilitate idea exchange, foster open discussion, and provide an opportunity for teachers to receive direct peer feedback. The activity was intended to improve problem quality through collective evaluation, and to cultivate reflective and collaborative attitudes in the development of literacy-based learning instruments.

5. Reflection and Closing

At the end of the training, participants were invited to reflect on their experiences throughout the sessions, followed by the administration of a post-test and evaluation questionnaire. The event concluded with the distribution of certificates and documentation of the activity, marking the final stage of this program.

Results and Discussion

The implementation of the community service activity followed the stages outlined in the service methodology. The results of the training activity are described as follows:

1. Opening and Orientation Session

The activity began with an opening session aimed at creating a conducive initial atmosphere, introducing all involved parties, and clearly explaining the objectives and purpose of the activity. This session was led by the organizing committee and opened with a welcome speech from the school principal as the host, followed by a representative of the university's community service team.

After the speeches, participants received an orientation about the training activities. This orientation included an explanation of the importance of literacy and numeracy skills in teaching mathematics at the junior high school level, as well as the rationale for conducting the training. Participants were encouraged to recognize the urgency of being skilled in designing questions that can measure critical thinking, conceptual understanding, and context-based problem-solving skills. The following are the criteria for teacher responses: (Widoyoko, 2018)

Percentage	**Criteria**
90%-100%	Excellent
80%=89%	Very Strong
70%-79%	Strong
<69%	Weak

Additionally, participants were provided with an overview of the training flow, including the materials to be covered, the learning approaches used, and the expected final products. This orientation session aimed to motivate participants to actively engage throughout the training process.

2. Conceptual Material Presentation

Following the opening and orientation, the training continued with the delivery of conceptual material to provide a theoretical foundation and comprehensive understanding of the nature of mathematical literacy. The material was delivered by a qualified speaker with academic expertise in mathematics education, particularly in literacy approaches and contextual assessments.

In this session, participants were introduced to the concept of mathematical literacy as defined by the OECD through the Programme for International Student Assessment (PISA) framework, which is the ability of individuals to formulate, apply, and interpret mathematics in various real-life situations. Emphasis was placed on the importance of linking mathematical concepts with real-world contexts, making the learning process more meaningful and not merely mechanical.

The material covered characteristics of mathematical literacy questions, the competencies being assessed (formulating, using, interpreting), as well as the content and context domains used as references in question development. The speaker also presented various sample questions, ranging from low to high difficulty, and analysed how those questions were designed to develop higher-order thinking skills in students.

Throughout the presentation, a participatory method was employed. Participants were not merely passive listeners but were also actively involved in discussions, analysing sample questions, and comparing characteristics between conventional and literacy-based questions. This activity encouraged participants to gain a deeper and more reflective understanding of question development principles.

The delivery of this conceptual material served as a foundation before participants engaged in the practical session of question development, ensuring that each drafted item adhered to the correct principles of appropriate, contextual, and measurable literacy.

***Figure 1**. Presentation of conceptual material*

3. Question Development Practice

After participants received theoretical knowledge through the presentation of conceptual material, the activity proceeded to its core stage: the practical session of developing mathematical literacy questions. This stage aimed to enable participants to implement the concepts and principles of literacy they had learned into contextual and meaningful questions, tailored to the characteristics of junior high school students.

At the beginning of the session, facilitators provided technical guidelines on the procedures for question development, starting from identifying the basic competencies (*Kompetensi Dasar/KD*), formulating indicators, determining the context of the questions, to designing the question items based on the three main competency domains in mathematical literacy: formulating problems, employing mathematical concepts, and interpreting results. Participants were also given a worksheet format prepared by the organizing team.

To facilitate discussion and collaboration, participants were divided into small groups. Each group was tasked with designing one to two mathematical literacy questions relevant to their teaching material, specifically focusing on the topic of Systems of Linear Equations in Two Variables. In developing the questions, participants were encouraged to explore real-life situations familiar to students, such as shopping, budget management, or scheduling activities, as the context for their questions.

During session, facilitators rotated among the groups to provide guidance, to answer questions, and to ensure that the questions being developed reflected the principles of literacy. The assistance focused on ensuring clarity of context, meaningfulness of content, and the alignment between the question items and the competencies to be assessed.

Once the development process was completed, each group presented their work to the other participants. This activity served not only as a platform for sharing experiences but also as an opportunity to receive constructive feedback from both facilitators and fellow participants. The ensuing discussions enriched the participants' understanding of the strengths and weaknesses of the designed questions.

Through this practical session, it was expected that participants would not only understand the theory of mathematical literacy but also acquire practical skills in developing questions that stimulate students' critical thinking and are relevant to real-life situations.

Figure 2*. Question development practice*

4. Presentation and Peer Feedback

After participants completed the task of developing mathematical literacy questions in groups, the activity continued with the presentation and peer feedback session. The aim of this stage was to provide participants with the opportunity to present their developed questions, while also fostering critical and reflective discussions among peers to improve the quality of the questions created.

Each group was given the chance to present their questions, including an explanation of the context, basic competencies used, learning indicators, and the question's alignment with mathematical literacy elements as outlined in the PISA framework (OECD, 2019) Participants were also asked to explain how their questions could stimulate higher-order thinking skills, such as problem-solving and data interpretation.

This was followed by an open peer feedback session, in which other participants were invited to provide comments, suggestions, and questions about the presented questions. Facilitators also offered input, both conceptually and technically, regarding the quality of the questions, clarity of context, relevance to real-life situations, and the alignment between learning objectives and the question format.

This approach aligns with Brookfield (2017) perspective that peer feedback plays a key role in developing deeper understanding, as it involves critical reflection and discussion among colleagues. Similarly, Sadler (2013) emphasized that peer feedback helps participants identify gaps between current performance and expected goals, while also providing opportunities for immediate improvement.

Through this session, participants not only learned from the facilitators, but also from their peers who brought diverse teaching experiences. This fostered a collaborative atmosphere that strengthened the professional identity of teachers as lifelong learners.

The presentation and peer feedback stage proved to be crucial in ensuring that the developed questions not only met cognitive standards, but also had contextual depth and meaningfulness in line with the principles of mathematical literacy. Additionally, the activity helped participants build metacognitive skills to evaluate and revise their questions independently.

***Figure 3**. Presentation and peer feedback*

5. Activity Evaluation

The evaluation of the mathematics literacy question development training was conducted to assess the extent to which program objectives were achieved and how effectively the activity enhanced teachers' competencies. Two evaluation approaches were used, those are formative and summative.

Formative evaluation was carried out throughout the training through direct observation by facilitators, focusing on participants' engagement in discussions, active participation in question development, and understanding of mathematical literacy principles. Observations indicated that most participants were highly enthusiastic and collaborated well in their groups. They also demonstrated progress in grasping the structure and characteristics of literacy-based questions, as reflected in their drafted items.

Meanwhile, summative evaluation was conducted at the end of the training by collecting the literacy questions developed by participants and administering a reflective questionnaire. This questionnaire measured participants' satisfaction and perceptions regarding the benefits of the training. The results of the questionnaire are presented in Table 1 below:

***Tabel 1**. Percentage of teacher responses*

Number	Indicator	Percentage	Criteria
1	Usefulness of the training	92%	Excellent
2	Interest in writing mathematical literacy questions	83%	Very Strong
3	Mentoring method for learning activities	83%	Very Strong
4	Mentoring method enhances learning creativity	83%	Very Strong
5	Participant attitudes towards learning	75%	Very Strong
	Average	**83%**	**Very Strong**

Table 1 showed more than 92% of participants stated that the training was highly beneficial in helping them understand the concept of mathematical literacy and provided practical experience that could be applied in classroom instruction. This finding is in line with the results of community service conducted by Sugandi et al., (2021), which also reported that training participants perceived the activities to be highly beneficial.

Conclusion

The mathematical literacy problem-writing training for *SMP* (Junior High School) and *SMK Putra Juang* (Vocational School) had a significant positive impact on enhancing participants' understanding of literacy concepts as well as their practical ability to design context-based problems. Through conceptual presentations and hands-on problem-writing exercises, participants gained experiences that were not only theoretical but also directly applicable.

This training demonstrated that with a structured approach, teachers can develop problems that not only assess computational skills, but also stimulate critical thinking, problem-solving, and the ability to interpret mathematics in real-life contexts. This aligns with the demands of the Merdeka Curriculum and the strengthening of numeracy competencies in classroom learning.

It is expected that similar activities can be conducted continuously, whether through follow-up training or mentoring in school implementation, so that the enhancement of mathematical literacy does not stop at the training level, but also brings a tangible impact to the teaching and learning process in the classroom.

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