Improving Mathematics Teachers' Skills in Designing Context-based Tasks for Lower Secondary School Learning

Sri Rejeki[*], Christina Kartika Sari, Muhamad Toyib, Meladia Salsabila Ulfah
Department of Mathematics Education, Faculty of Teacher Training and Education, Universitas Muhammadiyah Surakarta, Sukoharjo, Indonesia

*Corresponding Author
Jl. Ahmad Yani, Pabelan, Kartasura, Surakarta 57162, Jawa Tengah, Indonesia
E-mail: sri.rejeki@ums.ac.id

Abstract

Using context-based problems is essential to mathematics learning, especially with implementing the Minimum Competency Assessment or Asesmen Kompetensi Minimum (AKM). However, this has not been supported by learning resources that provide context-based math problems optimally. Therefore, there is a need for efforts to improve the skills of mathematics teachers in designing context-based problems. This community service or Pengabdian kepada Masyarakat (PkM) activity aims to enhance teachers' skills in designing context-based math problems based on numeracy AKM. This PkM activity was carried out as training involving ten mathematics teachers of Muhammadiyah Junior High School (SMP) in Kartasura District, Sukoharjo Regency, Central Java, Indonesia as training participants. In the first stage, the training was conducted online via Zoom Video Conference. Furthermore, the second phase of the activity focused on assisting the teachers of the training participants in compiling context-based junior high school math problems in numeracy AKM, especially on number content. The assistance was carried out using the Schoology Learning Management System (LMS). The results of PkM showed that based on the post-training survey, 75% of participants stated that they understood the concept of numeracy AKM and 100% of participants were ready to integrate numeracy AKM in the implementation and assessment of mathematics learning, especially in number content. The achievement of PkM targets is also reflected in training products as a collection of AKM-oriented mathematics problems on number content. Furthermore, further assistance is needed, focusing on the design of AKM context-based questions on geometry, algebra, and statistical content.

Keywords: Context-based Tasks; Minimum Competence Assessment; Numeracy

INTRODUCTION

In today's era of globalization, students in Indonesia must be able to compete with other students in various countries. Various types of tests held internationally can be used as a benchmark for how to portray education in Indonesia. One that is getting significant attention in mathematics education. However, mathematics education in Indonesia still gets a red report card in the international curriculum. This phenomenon can be seen from surveys conducted by international institutions such as the *Program for International Student Assessment* (PISA) and *the Trend in International Mathematics and Science Study* (TIMSS), which put Indonesia's ranking at the bottom of the list.

The TIMSS survey, conducted by *The International Association for the Evaluation and Educational Achievement* (IAE) based in Amsterdam, focuses on the domain of students' mathematical and cognitive content. The content domain includes numbers, algebra, geometry, data and uncertainty, while the cognitive domains have knowledge, application, and reasoning. The survey, which is conducted every four years held starting in 1999, puts Indonesia in 34th position out of 48 countries, in 2003 in 35th position out of 46 countries, in 2007 at 36th out of 49 countries, and in 2011 at position 36th out of 40 countries (Setiadi et al., 2012).

Meanwhile, the three annual PISA study, organized by *the Organization for Economic Cooperation and Development* (OECD), a United Nations agency based in Paris, aims to determine students' mathematical literacy. The focus of PISA studies is the ability of students to identify and understand and use the basics of mathematics necessary in everyday life. Studies conducted starting in 2000 placed Indonesia in 39th position out of 41 countries, in 2003 in 38th out of 40 countries, in 2006 at 50th out of 57 countries, in 2009 at 61th out of 62 countries, in 2012 at 64th out of 65 countries, and the last in 2015 at 63rd out of 70 countries (OECD, 2016; Stacey, 2011). Meanwhile, when viewed from the question level, all Indonesian students can only master lessons up to level three, while students from other countries can master tasks up to level four, five, or even six (Stacey, 2011).

Through the Ministry of Education and Culture, the Indonesian government has tried to anticipate this by making several changes to the education curriculum in Indonesia (Subadi et al., 2016). From 2000 to 2013, at least three types of the curriculum were implemented, namely the 2004 curriculum, the 2006 curriculum, and the 2013 curriculum (which is currently reformed into the Merdeka curriculum). The curriculum change refers to the results of several international surveys on the ability of Indonesian students are still low (Fitriyani & Nurhikmayati, 2020).

The low student outcomes in PISA studies are indeed due to many factors. One is that Indonesian students are not trained to do questions with characteristics such as in the questions in PISA. The presence of the 2013 curriculum, one of the reasons is to answer the low mathematics calculations of Indonesian students in international forums as shown by the TIMSS and PISA test results. One of the means of supporting curriculum implementation is the presence of textbooks. A good textbook can provide good learning resources so students can succeed optimally (Milati et al., 2013).

In numeracy competence, numbers are one of the contents tested in Grade 8 (Pusat Asesmen dan Pembelajaran, 2020). These components include representations, sequence properties, and number operations (Pusat Asesmen dan Pembelajaran, 2020). According to the Pusat Asesmen dan Pembelajaran (2020), numeracy competencies in AKM involve cognitive processes that include understanding, application, and reasoning levels. In addition, numeracy competencies in AKM also contain personal, socio-cultural, and scientific contexts (Pusat Asesmen dan Pembelajaran, 2020). This condition causes the importance of developing learning resources to support students' readiness to face the AKM, especially learning resources on several contents that involve cognitive processes (understanding, application, and reasoning) and contain contexts (personal, socio-cultural, and scientific). Based on the description of the content, cognitive processes, and context in AKM, it can be said that the characteristics of the AKM question are adaptations of the attributes of the PISA problem. Based on this presentation, this Community Service or *Pengabdian kepada Masyarakat* (PkM) problem is focused on training and designing mathematics problems for junior high schools based on the AKM's contexts in the content of numbers.

The preliminary survey results show that 50% of all teachers who participated in the training never integrated AKM-oriented problems into their learning. Furthermore, four out of

ten teachers do not yet understand AKM-oriented problems. Hence, based on the analysis of the situation, it can be identified that the similar problem exists at Muhammadiyah Junior High School in Kartasura District, Sukoharjo, Central Java, Indonesia, which is the lack of references to numeracy AKM-oriented problems in the material of integer and fractional calculation operations to support the implementation of mathematics learning, especially learning in the era of the Covid-19 pandemic which is carried out online. This impacts the lack of motivation to participate in mathematics learning which involves routine questions and questions that are less related to students' daily lives. Based on these problems, the solution offered to overcome them is to conduct training and assist in developing AKM-oriented numeracy junior high school math problems on number content (integer and fractional count operations).

METHODS

This training activity is carried out online and consists of two stages. The first stage is a training activity through Zoom Video Conference, and the second phase is a mentoring activity through Learning Management System (LMS) Schoology. The first phase of this PkM was held on Saturday, September 18, 2021, in a virtual meeting room on the Zoom application. The participants were ten mathematics teachers at Muhammadiyah Junior High School in Kartasura District, Sukoharjo, Central Java, Indonesia. This activity began with an opening delivered by the Head of the Mathematics Education Study Program at FKIP UMS. Furthermore, the core activity is the presentation of material on the components of AKM and the design of AKM-oriented questions. After the presentation of the material, the activity continued with the development of AKM-oriented questions on number content.

The development activity of this question was continued with discussions and collection of assignments at LMS Schoology. In this activity, PkM participants work on projects individually. Considering the initial conditions of the trainees, this PkM activity targets at least 75% of all trainees to have a proper understanding of numeracy AKM and be ready to integrate numeracy AKM in learning and assessment.

RESULTS AND DISCUSSION

The first stage of the training was carried out online through Zoom Video Conference. The presenting team explained the theory and examples of context-based task design, especially the mathematical problems of context-based number material in AKM-numeracy. Figure 1 shows the implementation of training at that stage.
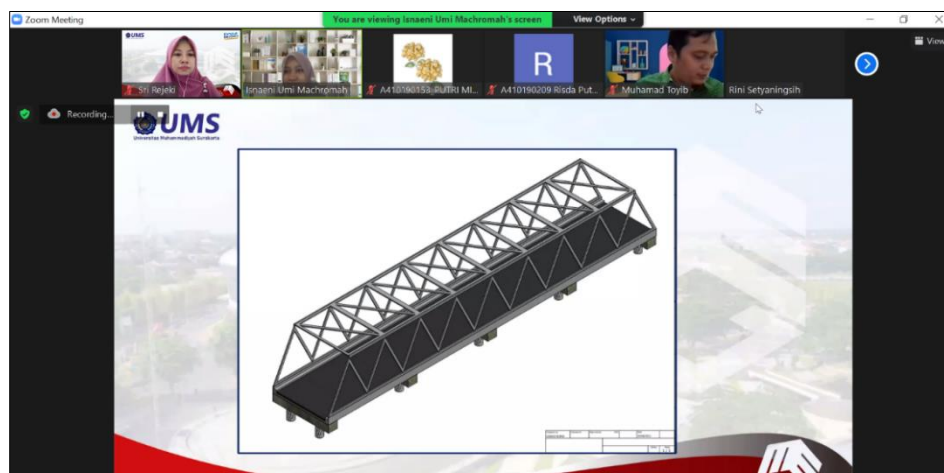

Figure 1. Implementation of Training in the First Stage.

In the second stage, each trainee uploaded a draft of the questions prepared in a discussion forum at LMS Schoology. Furthermore, other participants and the presenting team provided feedback on each draft that had been uploaded. The revised draft of the AKM-oriented contextual tasks was uploaded at the end of the training. It is one of the external products of this PkM. Figure 2 shows the implementation of activity in the second stage.
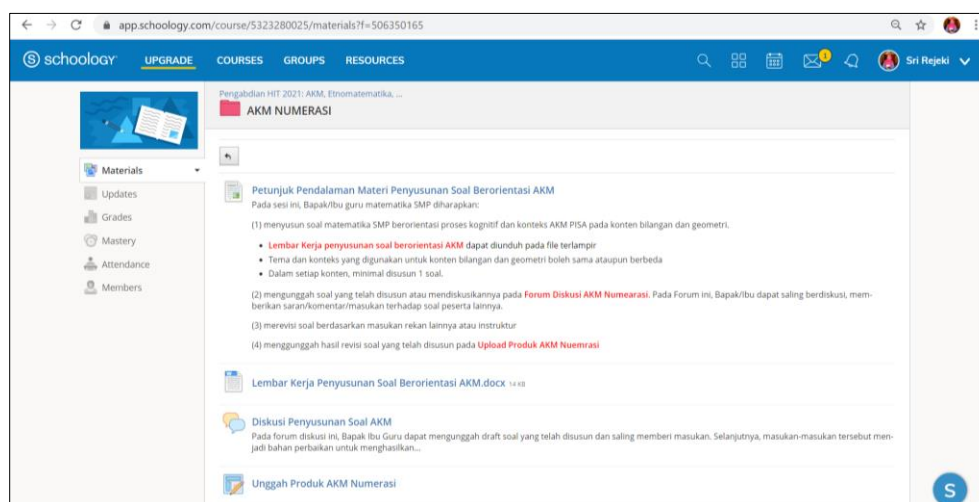

Figure 2. Implementation of Training in the Second Stage.

Indicators of the success of this training activity refer to the results of post-training questionnaire surveys and analysis of questions based on the numeracy AKM context that teachers have prepared. The survey was conducted online through a google form. Table 1 shows the results of the survey on all ten trainees.

Table 1. Post-Training Survey Results

No	Aspects of the Question	Percentage
1.	Understanding of AKM numeracy.	75%
2.	Readiness to integrate cognitive process-based questions and AKM contexts in learning.	100%
3.	Readiness to integrate cognitive process-based questions and AKM contexts in value.	100%

In addition to closed surveys related to understanding and readiness in integrating AKM-oriented contextual questions, training participants were also given open questionnaires related to obstacles in designing AKM-based contextual questions. Most participants stated that the lack of creativity in designing stories is a challenge in designing contextual questions based on AKM. Some examples of the trainees' work are presented on Figure 3 and Figure 4.

Figure 3. The First Example of Context-based Task Designed by the Trainee.

<table>
<tr><td colspan="4" align="center">***Penggunaan Gaji***</td></tr>
<tr><td colspan="4">

Konteks

Dewi, Putri, dan Nisa adalah teman yang bekerja di sebuah perusahaan BUMN. Mereka bertiga sudah bekerja di perusahaan selama 3 tahun. Besaran gaji mereka setiap bulannya yaitu Rp 5.000.000,00. Setiap bulan mereka selalu menyisihkan gajinya untuk ditabung. Penggunaan gaji mereka disajikan dalam table berikut:

</td></tr>
</table>

No.	Nama	UntukMakan	Ditabung
1.	Dewi	50%	15%
2.	Putri	40%	20%
3.	Nisa	60%	12,5%

Sisa dari gaji mereka masing-masing digunakan untuk keperluan lainnya.

Soal 1

Berilah tanda S/B (Salah/Benar) pada setiap pernyataan berikut:

    A. Sisa gaji Dewi lebih besar dari sisa gaji Putri (…………)

    B. Sisa gaji Putri lebih besar dari sisa gaji Nisa (…………)

    C. Sisa gaji Nisa lebih kecil dari sisa gaji Dewi (…………)

    D. Total sisa gaji ketigannya kurang dari Rp 5.000.000 (…………)

Figure 4. The Second Example of Context-based Task Designed by the Trainee.

Overall, this training activity has achieved the planned target, where 75% of the trainees have understood the concept of numeracy AKM and 100% of the trainees stated that they are ready to integrate numeracy AKM in the implementation and assessment of mathematics learning. However, it is necessary to carry out continuous assistance to obtain more optimal results. This finding follows several similar assistances carried out in previous PkM activities (Ishartono et al., 2017; Khotimah, 2017; Toyib et al., 2021). In addition, the very positive results of the questionnaire showed the high motivation of teachers in integrating numeracy AKM in the implementation and assessment of learning. This finding can positively impact the process of increasing these competencies (Andriani & Rasto, 2019; Ricardo & Meilani, 2017).

In addition, the products produced by the trainees showed increased skills in designing numeracy AKM-oriented math problems. These products offer the importance of question designing training as has been carried out in previous PkM, for example, Toyib et al. (2021), which organizes training on the preparation of multiple solution tasks, as well as Cahyaningtyas et al. (2020) and Sari et al. (2019) which conducted training on the practice of HOTS-oriented questions. Therefore, further assistance is needed to design AKM context-based questions on geometry, algebra, and statistical contents.

At the end of this training, there was an evaluation stage by surveying the trainees' responses about the activities. All trainees confirmed satisfied or extremely satisfied with all aspects of the training, as shown in Table 2. Moreover, the qualitative comments said that more prolonged and intensive assistance is needed to increase mathematics teachers' skills in designing and integrating context-based tasks in mathematics learning. This finding also shows

teachers' high motivation and can also support increasing their skills (Andriani & Rasto, 2019; Ricardo & Meilani, 2017).

Tabel 2. Teachers' Responses on the Training

No.		1	2	3	4
1	The material delivered is as expected.	0%	0%	0%	100%
2	I gain knowledge that I have never had before.	0%	0%	25%	75%
3	The facilitator delivers the material well and is easy to understand.	0%	0%	25%	75%
4	The organizing committee gave a good response to the questions and obstacles faced by the participants.	0%	0%	12.5%	87.5%
5	The schedule prepared by the organizing committee is running effectively.	0%	0%	12.5%	87.5%
6	This workshop was useful for me as a teacher.	0%	0%	0%	100%

CONCLUSION

The results of PkM showed that based on the post-training survey, 75% of participants stated that they understood the concept of AKM-numeracy and 100% of participants were ready to integrate AKM-numeracy in the implementation and assessment of mathematics learning, especially in number content. The achievement of PkM targets is also reflected in training products as a collection of AKM-oriented mathematics problems on number content. The products produced by the trainees showed increased skills in designing numeracy AKM-oriented math problems. These products show the importance of conducting training in designing context-based tasks based on AKM-numeracy. Furthermore, further assistance is needed, focusing on the design of AKM context-based questions on geometry, algebra, and statistical content.

All trainees confirmed satisfied or extremely satisfied with all aspects of the training. Moreover, the qualitative comments said that more prolonged and intensive assistance is needed to increase mathematics teachers' skills in designing and integrating context-based tasks in mathematics learning. It shows the high motivation of all trainees in improving competencies regarding developing context-based mathematics tasks.

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