



Problem-Posing Minimum Competency Assessment to Promote Numeracy Skills of Elementary Preservice School Teachers

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Abstract. Nowadays, literacy and numeracy are the main ability in the 21st century. The Indonesian Ministry of Education, Culture, Research and Technology has been conducting National Assessments since 2021. Numeracy assessment result is very low. Two out of three students have not reached minimum numeracy skills. Teachers have an important role in improving students' numeracy skills. However, preparation is needed since preservice teachers are given numeracy knowledge and problem-posing minimum competency assessment workshop. This study was conducted based on students' tasks. This study focuses on analyzing problem-posing minimum competency assessment task to promote numeracy skills of elementary preservice school teachers (PSTs). Qualitative descriptive the method of this study. PSTs class consists of 31 students. Researcher only chose three PSTs in the three distinct mathematics competency levels: low, middle, and high based on their average scores of Mathematics for Elementary School subjects for one semester. The result of this study is that almost all PSTs are competent in posing realistic numeracy problems with appropriate content, suitable contexts, and cognitive processes, across various subjects, except art subject. It is suggested to add the exposure of the art subject to the prospective teachers' mathematics experiences. This also can enrich their understanding of numeracy across the subjects they will be teaching.

Keywords: problem posing · minimum competency assessment · numeracy

1 Introduction

Numeracy, also called mathematical literacy, can be defined as the ability to apply mathematical concepts and skills to solve practical problems in various contexts of everyday life, for example, at home, work, and participation in community life and as citizens [1]. In addition, numeracy also includes the ability to analyze and interpret quantitative information around us which is displayed in various forms (graphs, tables, charts) and use their analysis interpretation result to predict and make decisions [1]. Based on the definition of numeracy from Minister Education Department of Indonesia numeracy is the key for students to access and understand the world, prepare students with awareness and understand the important role of mathematics in the modern world. A numerate person must

have personal mathematics knowledge and know how to apply it in specific context [2]. Furthermore, numeracy is connecting school mathematics and real life situations requiring problem solving, critical judgment and making sense of non-mathematical context [3].

The result of Minimum Competency Assessment (MCA) or *Asesmen Kompetensi Minimum* in 2021 has been published on the website <https://raporpendidikan.kemdikbud.go.id/app>. The numeracy assessment result is very low. Two out of three students have not reached minimum numeracy skills. The result of learning outcomes achievement is less than 50% of students have reached the minimum competency limit of numeracy. Elementary school students' numeracy skills are in the category of needing special intervention. It means most of the students have not reached the minimum competence for numeracy. The result of teaching learning processes quality in the category of teacher index reflection have not been structured. Teachers have not been consistent in reflecting on learning, have not been exploring new teaching references, and have not been making new innovations. Lower result of numeracy has a negative impact on the sustainability of society such as difficulty for students to continue studying at the next level because numeracy is foundation learning ability, low competitiveness in the technology and digital era, especially in the international area, and low awareness of hoaxes spread in society. The result of Survey of Adult Skills (PIAAC) compared to the OECD average of 31.8%, shows only 9.1% of adults reach Level 3. Adults have a good sense of space and number at this level. They can comprehend and apply mathematical patterns, relationships, and proportions expressed verbally or numerically. Moreover, they can read texts, tables, and graphs and perform basic statistical and data interpretations [4].

Previous study showed that the numeracy knowledge of preservice teachers is low but they quite understand the component of numeracy questions [5]. This result study is contrast and the researcher needs to conduct the further study. To improve MCA result to become proficient, preservice school teachers (PSTs) need to be prepared since they study in the university level. Problem posing MCA is one way to understand numeracy skills. Problem posing is important to deepen mathematical understanding, advance mathematical problem-solving skills, develop mathematical aptitude and learn autonomy [6]. Another benefit of problem posing has been used to promote and evaluate creative thinking [7].

Lack of research discussing problem posing to promote numeracy skills is another reason of this study. By problem posing MCA questions of numeracy, PST able to practice creative thinking and solving problems that they design themselves according to the components of MCA questions of numeracy. While PSTs propose questions, they indirectly learn numeracy elements such as content knowledge (quantity, uncertainty and data, space and shape, and algebra), cognitive processes (understanding, employing, and reasoning) and contexts (personal, societal culture, and scientific) [8]. One of the components of numeracy teacher professional knowledge is establishing connections across mathematics topics and between mathematics and other disciplines [2]. Students have opportunities to apply their mathematical knowledge and skills outside of the mathematics classroom when teachers identify curriculum-wide numeracy demands. These opportunities encourage students to use their mathematical skills in a variety of contexts and assist them in recognizing the interconnected nature of mathematical knowledge, other subject areas, and the wider world [9]. In this study, PSTs propose

MCA questions of numeracy in other mathematics disciplines: science, art, language, and religion (Islam).

2 Methods

This study is a qualitative descriptive [10]. Researcher was teaching a mathematics for elementary school class in one of the Islamic state universities in Indonesia. There were 31 students that consist of 3 males and 28 females of students. PSTs have been given knowledge of numeracy delivered by researcher. PSTs had tasks to propose problems of MCA questions of numeracy in other mathematics disciplines such as science, art, language, and religion (Islam). MCA questions have some types such as multiple choice, complex multiple choice, matching question, short essay, and essay. PSTs is given the freedom to choose the type of MCA questions. While proposing problems, PSTs identified their questions into numeracy component, such as content knowledge (quantity, uncertainty and data, space and shape, and algebra), cognitive process (understanding, employing and reasoning) and contexts (personal, societal culture, and scientific). PSTs also identified the level questions and gave the solution for every problem posing that they made. Thus, the researcher analyzed MCA problem posing and solution of numeracy that has been done by PSTs.

PSTs were categorized according to their competence. It has been done by giving them tests and observing them in each day class Since the most gender in class were female, in this paper, we analyzed three particular PSTs works in four subjects: science, art, Bahasa Indonesia, and religion. These three female PSTs are referred to as PSTML-low, PSTML-medium, and PSTML-high, to indicate their corresponding mathematics level (ML). Before PTS got problem-posing of MCA numeracy questions, PTS got numeracy material based on Ministry Education of Indonesia and how to propose problem of MCA numeracy questions. The task of problem posing of MCA numeracy questions below (Fig. 1):

3 Result and Discussion

3.1 Proposing MCA Numeracy Problems in Science

PSTML-Low wrote wrong title of the problem as Penjumlahan – Addition (Fig. 2). PSTML-Low problem posing is about cherry blossoms. PSTML-Low write content as uncertainty and data, but the question of problems is quantity content (Cherry blossoms bloom once every 4 months, if in June the cherry blossoms bloom, when the cherry blossoms will bloom again?). PSTML-Low categorized her problem in the employ process. It was true, because to solve the problem only use counting the number of months after June. PSTML-Low categorized her problem in Scientific context and it was correct (Fig. 3).

PSTML-middle did not write the title of questions. The question was about air balloons. A hot air balloon flies at a certain altitude with an air temperature of about 5 C. When it drops 50 m, the air temperature will rise 0.5 C. If the altitude of the air

Task Problem Posing of Minimum Competency Assessment (MCA)

Propose problems of MCA questions of numeracy in other disciplines of mathematics on science, sports, bahasa, and religion (islam). Problem posing of MCA numeracy questions must meet the following requirements:

- MCA questions have some types such as multiple choice, multiple choice complex, match question, short essay, and essay. You can choose any type of MCA questions while proposing problems.
- Identify your problem posing of MCA questions of numeracy into numeracy component such as content knowledge (quantity, uncertainty and data, space and shape, and algebra), process cognitive (understanding, employing and reasoning) and contexts (personal, societal culture, and scientific).
- Identify level questions and give the solution for every problem posing.
- You allow to adapt MCA numeracy questions in the website <https://hasilun.pusmenjar.kemdikbud.go.id/akm/>

Fig. 1. Task Problem Posing of Minimum Competency Assessment (MCA) in other disciplines subjects.

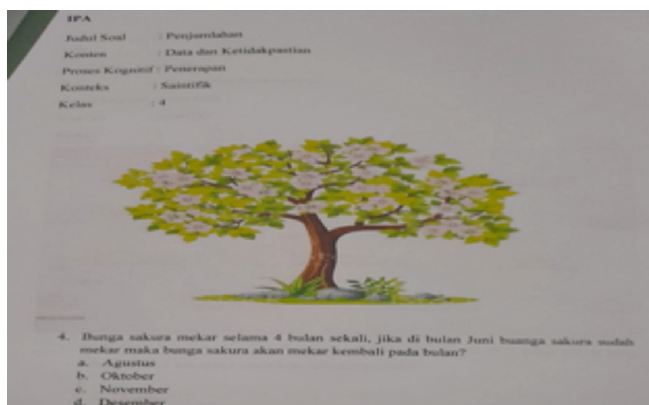


Fig. 2. Proposing MCA Numeracy Problems in Science by PSTs mathematics low level (PSTML-low)

balloon in 2000 m, what is the temperature of the air around the air balloon? PSTML-middle categorized her problem content as quantity, context as scientific, and process as understanding. All MCA components proposed by PSTML-middle were right and appropriate with her problem posing (Fig. 4).

PSTML-high wrote the right title of her problem. PSTML-high wrote question about running speeds from some animals. PSTML-high categorized her problem content as

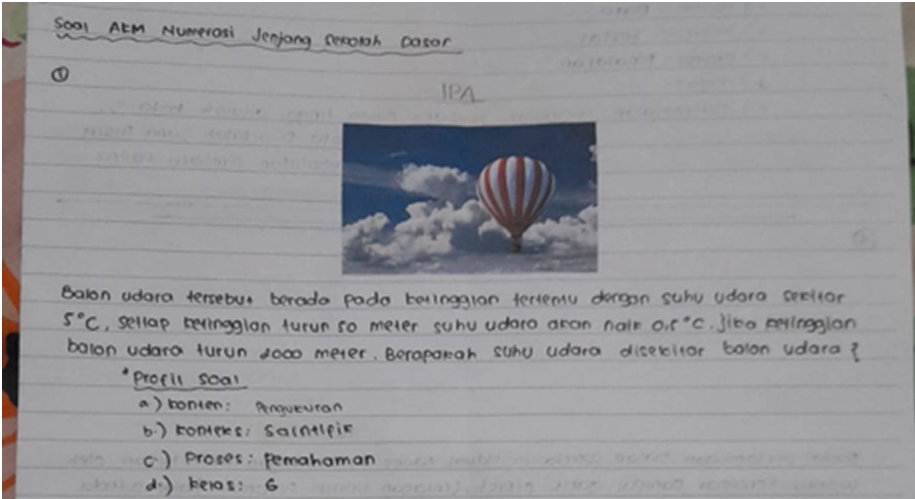


Fig. 3. Proposing MCA Numeracy Problems in Science by PSTs mathematics middle level (PSTML-middle)

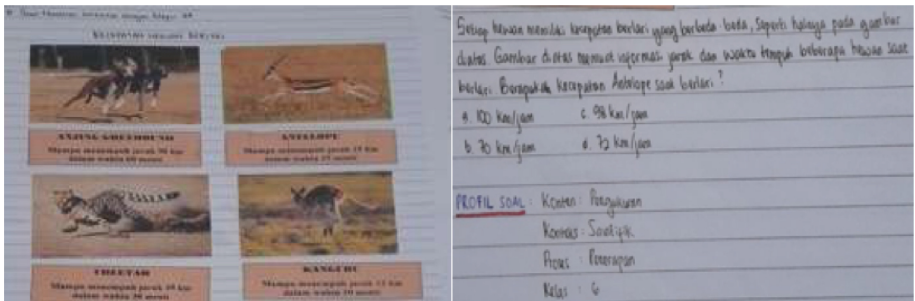


Fig. 4. Proposing MCA Numeracy Problems in Science by PSTs mathematics high level (PSTML-high)

quantity, context as scientific, and process as understanding. All MCA component that proposed by PSTML-high was right and appropriate with her problem posing (Table 1).

Almost all subjects were done correctly in all MCA numeracy elements problems in science, except MCA title. This happened because subjects did not used to write the title of the problem or question (Fig. 5).

3.2 Proposing MCA Numeracy Problems in Religion

PSTML-low wrote question about qurbani on Eid al Adha. He wrote the right title of her problem. PSTML-low categorised her problem content as quantity, context as personal, and process as understanding. All MCA element that proposed by MLL was right and appropriate with her problem posing (Fig. 6).

Table 1. Comparison Result of Proposing MCA Numeracy Problems in Science

MCA Numeracy Elements	Subjects		
	PSTML-low	PSTML-middle	PSTML-high
Title MCA	x	x	✓
Content	x	✓	✓
Context	✓	✓	✓
Cognitive Process	✓	✓	✓
Appropriate Subject	✓	✓	✓
Realistic Problem	✓	✓	✓



Fig. 5. Proposing MCA Numeracy Problems in Religion by PST mathematics low level (PSTML-low)

The question is about bathroom water tank owned by a Moslem family. PSTML-middle did not write the title of MCA problem. She proposed problems as personal context. PSTML-middle categorized right on content as quantity. PSTML-middle did wrong on categorizing her MCA understanding as cognitive process. Employ as cognitive process is the right categories. The question asked the length of bathtub, which can be solved by employing the formula of volume (Fig. 7).

PSTML-high wrote right title of her problem. PSTML-high categorized her problem content as quantity, context as personal, and process as employ. All MCA elements that proposed by PSTML-high were right and appropriate with her problem posing (Table 2).

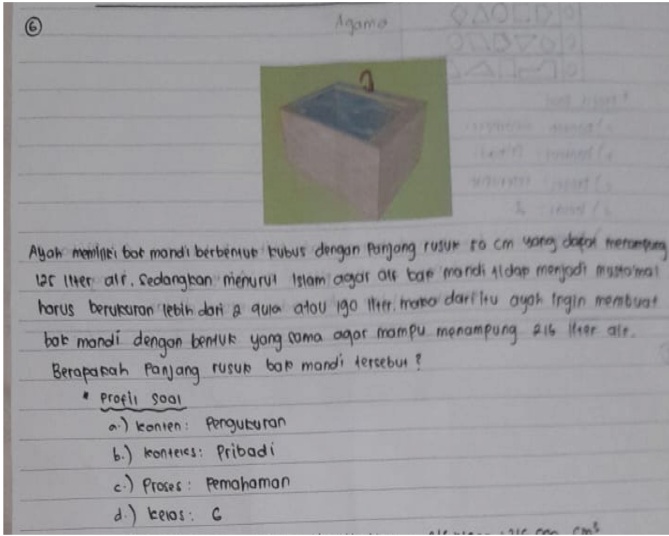


Fig. 6. Proposing MCA Numeracy Problems in Religion by PSTs mathematics middle level (PSTML-middle)

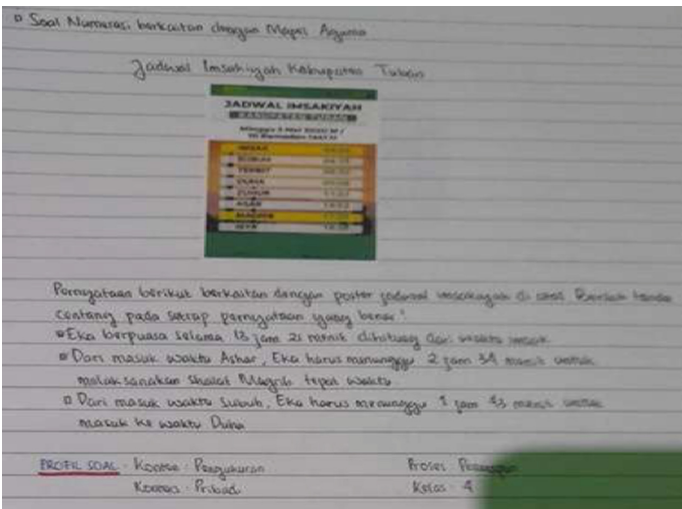


Fig. 7. Proposing MCA Numeracy Problems in Religion by PSTs mathematics high level (PSTML-high)

The comparison result of proposing MCA numeracy problems in religion was very interesting. PSTML-LOW has correct answer in all components rather than PETSMMML who did wrong in cognitive process and did not write the title of MCA numeracy problems. However, all subjects have almost done correctly to categorize all elements. It can be happened because all subjects have Islamic boarding school background (Fig. 8).

Table 2. Comparison Result of Proposing MCA Numeracy Problems in Religion

MCA Numeracy Elements	Subjects		
	PSTML-low	PSTML-middle	PSTML-high
Title MCA	✓	x	✓
Content	✓	✓	✓
Context	✓	✓	✓
Cognitive Process	✓	x	✓
Appropriate Subject	✓	✓	✓
Realistic Problem	✓	✓	✓

3.3 Proposing MCA Numeracy Problems in Language

PSTML-low wrote the wrong title of MCA problem. She wrote the title of MCA problem as addition which is the process to solve her problems. She categorized component MCA correctly. PSTML-low categorized her MCA problem as quantity, employ as cognitive process, and social culture as context. All MCA components that proposed by PSTML-low were right and appropriate with her problem posing (Fig. 9).

PSTML-low did not write the title of MCA problem. She proposed problems personal as context. It was not appropriate with Bahasa. Her problem context was more appropriate for the Science subject. PSTML-low categorized her MCA correctly on content and cognitive process (Fig. 10).

PSTML-high wrote the right title of her MCA problem. PSTML-high categorized her problem content as quantity, context as social culture, and cognitive process as employ.

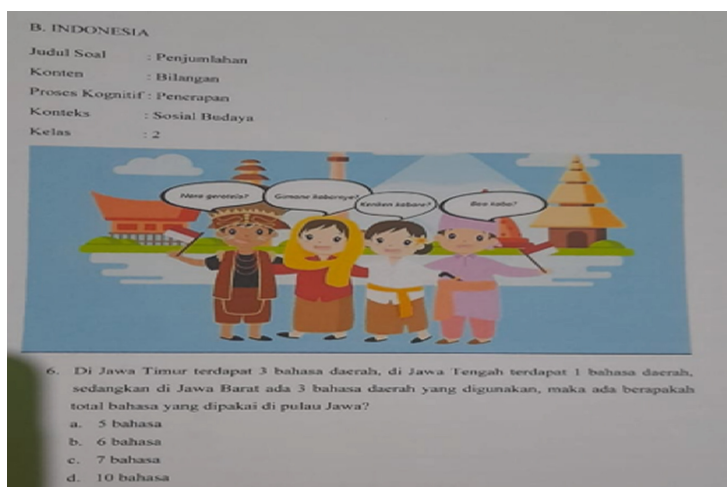


Fig. 8. Proposing MCA Numeracy Problems in Bahasa by PSTs mathematics low level (PSTML-low).

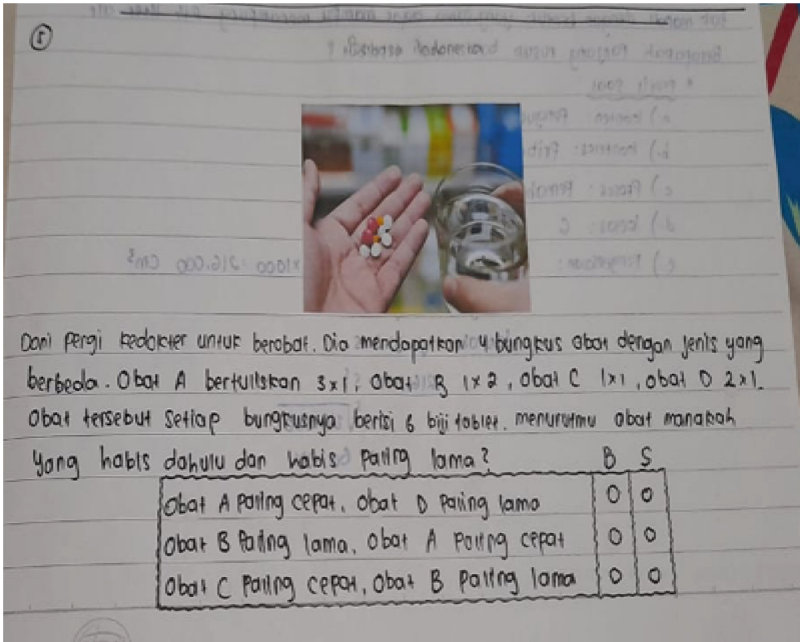


Fig. 9. Proposing MCA Numeracy Problems in Bahasa Indonesia by PSTs mathematics middle level (PSTML-low)

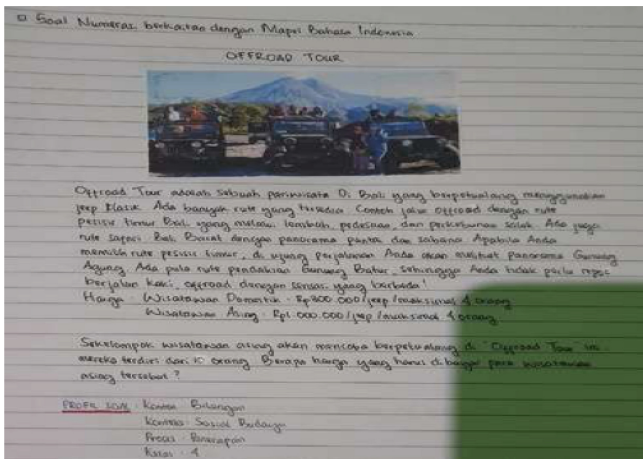


Fig. 10. Proposing MCA Numeracy Problems in Bahasa by PSTs mathematics high level (PSTML-high)

All MCA components proposed by PSTML-high was right and appropriate with her MCA problem posing (Table 3).

Table 3. Comparison Result of Proposing MCA Numeracy Problems in Bahasa Indonesia

MCA Numeracy Elements	Subjects		
	PSTML-low	PSTML-middle	PSTML-high
Tittle MCA	x	x	✓
Content	x	✓	✓
Context	✓	✓	✓
Cognitive Process	✓	✓	✓
Appropriate Subject	✓	✓	✓
Realistic Problem	✓	✓	✓

The result was exactly equal with problem posing MCA numeracy in science. Almost all subjects have done correctly in all MCA numeracy elements problems in Bahasa, except MCA title. This happened because subjects did not use to write the title of problem or question (Fig. 11).

3.4 Proposing MCA Numeracy Problems in Arts

PSTML-low wrote the right title of her problem. PSTML-low categorized her problem content as geometry and measurement, context as personal, and process as understanding. All MCA components proposed by PSTML-low was right but not appropriate with

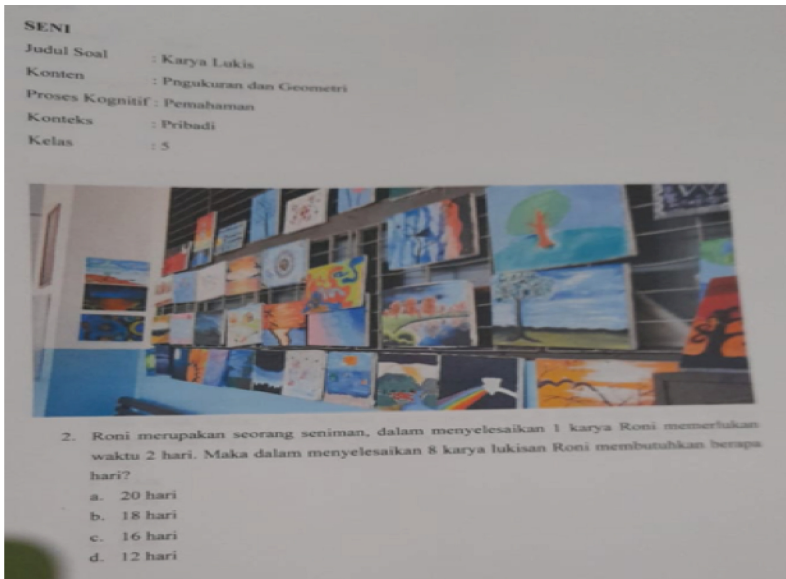


Fig. 11. Proposing MCA Numeracy Problems in Arts by PSTs mathematics low level (PSTML-low)

Arts as subject. PSTML-low problem posing was suitable for mathematics itself. The story background PSTML-low MCA numeracy problems look like Arts but do not deal with Arts. Numeracy is also related to Arts such as using sequences and patterns, accurate measurements and understanding of shapes, sizes, dimensions, and perspectives. Collecting, interpreting and analysing data in relation to audiences, and user behaviour are another example of numeracy in arts (Fig. 12).

PSTML-middle wrote right title of her problem. PSTML-middle categorized her problem content as geometry, context as personal, and process as employ. All MCA elements proposed by PSTML-middle were right and appropriate with her problem posing (Fig. 13).

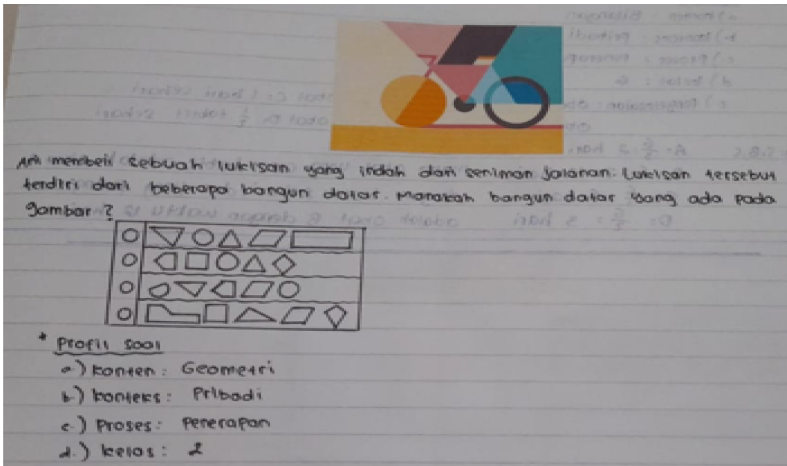


Fig. 12. Proposing MCA Numeracy Problems in Arts by PSTs mathematics middle level (PSTML-middle)

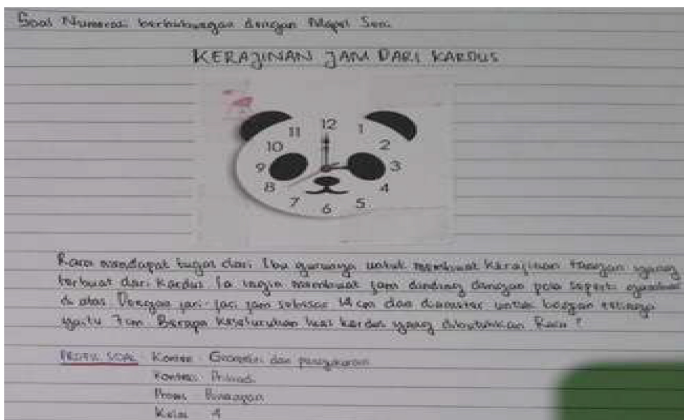


Fig. 13. Proposing MCA Numeracy Problems in Arts by PSTs' mathematics high level (PSTsML-high)

Table 4. Comparison Result of Proposing MCA Numeracy Problems in Arts

MCA Numeracy Elements	Subjects		
	PSTML-low	PSTML-middle	PSTML-high
Title MCA	x	x	✓
Content	x	✓	✓
Context	✓	✓	✓
Cognitive Process	✓	✓	✓
Appropriate Subject	x	✓	✓
Realistic Problem	✓	✓	x

PSTsML-high wrote the right title of her problem. Categorized her problem content as quantity, context as personal PSTsML-high, and process as employ. All MCA numeracy elements proposed by PSTsML-high were right and appropriate with her problem posing. However, her problem posing was not realistic. Making a clock does not need to know the area of the material. It just needs to know the diameter of Panda's face, diameter of Panda's ears and the circle point (Table 4).

Of all numeracy activities on other disciplines, Arts is a discipline in which many PSTs' did wrong problem posing. It might be because Arts has less time allocation in PSTs' schools (elementary to high school).

4 Conclusion

Most of PSTML-low and PSTML-high have no mistake does not write the title of MCA problems posing. Almost all PSTs competence level can pose numeracy problems with correct content, context, cognitive process, and the appropriate subject. Interestingly, almost all PSTs competence level got correct in determining the suitable context and pose the problem as realistic as possible while posing the MCA numeracy question in all subjects, except art. It is suggested then to add the exposure the art subject to the mathematics prospective teacher experiences. This also can enrich their understanding about numeracy across other subjects.

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