Analysis of Problem-Solving and Mathematical Communication Ability Levels and Students' Readiness to Use Augmented Reality (AR) Technology in Class VII Yunior High Schools and MTS

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Keywords: Preliminary Research, Problem Solving, Matematical Comunication Ability, Augmanted Reality (AR).

Abstract: This research was conducted to analyze the level of problem-solving and mathematical communication abilities of class VII students, carried out in May-June 2023 in 3 schools, namely MTS Al Khikmah Kerinci, SMPN 2 Sungaipuh, and SMPN 1 Kerinci. The research subjects consisted of 1 class from each school with 46 students. The method used in this study is a qualitative approach. This study focuses on the level of students' abilities related to students' problem-solving and mathematical communication abilities in understanding the concept of flat shapes in class VII Junior High School with descriptive analysis. The instrument used in this study was a test instrument that described the ability to solve problems and mathematical communication in flat shapes with as many as 3 items. The results showed that the problem-solving abilities of MTS Al Khikmah students were still low, namely 26.91%, while their communication skills were 18.05%, also in the low category. At the same time, the ability to communicate is 19.41% in the low category. Likewise, with SMPN 1 Kerinci, students' problem-solving skills are in a good category, namely 55.55%, while their communication abilities are 22.68% in the low category. Based on these results, a new learning model or method is needed to improve the students' problem-solving and mathematical communication skills.

1 INTRODUCTION

Mathematics is a form of culture (Madusise, 2015; Bishop, 1994). and local wisdom (Yustinaningrum, Nurliana, and Rahmadhani, 2018). Culture-related problems will surround the process of learning mathematics, even all forms of mathematics (Sroyer, Nainggolan, and Hutabarat, 2018). It means that culture and mathematics education can be connected and have a close relationship (D'ambrosio, 1995; Normina, 2017; Safitri, 2022), is also closely related to the cultivation of character in learning mathematics through ethnomathematics (Engen, 2021). Mathematical knowledge and teaching cannot be separated from historical background, games, artifacts, music, customs, technology, and daily activities, and develop mathematical concepts through these cultural values and customs to solve life problems. (Prahmana and D'Ambrosio, 2020 ; Embong *et al.*, 2010). It is supported by the determination of the 2013 curriculum that the teaching and learning of mathematics must be relevant to the daily lives of students (contextual) or contextual problems. (Brier and lia dwi jayanti, 2020 ; Wahyudi, Suyitno and Waluya, 2018 ; fransisco, 2020 ; Machali, 1970).

One of the subjects which is a form of culture is Mathematics, and Mathematics has been integrated into every aspect of people's lives wherever they are (Bishop, 1994). Mathematics nowadays is not only about formulas and theorems but already uses

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technology and culture in the learning process. Therefore, teachers must be able to show students that mathematics has a close relationship with culture and everyday life, both in the process and in the learning content.

Learning using cultural elements has several obstacles, including difficulty bringing students to places of cultural objects to be observed. One application that can be used to overcome this problem is Augmented Reality (AR). Several researchers (Azuma, 1997; Sırakaya and Alsancak Sırakaya, 2022) define AR as a combination of real and virtual objects in a real environment in three dimensions. The use of AR technology is proven to increase the interaction of learning activities, understanding concepts, and visualizing geometry (Lestari, 2022), support teaching and learning about geometric topics to be more interesting (Kirner, Reis and Kirner, 2012; Corrêa *et al.*, 2013) because AR allows users to see objects in books in real terms (Yasin, Isa and Endut, 2016).

Mathematics is an activity that must be related to the reality of everyday student life (Adjie, Putri, and Dewi, 2020; Sunzuma and Maharaj, 2021). In learning mathematics, one of the abilities that students must have is the ability to solve problems and mathematical communication.

Problem-solving ability is the potential a person or student possesses to solve story problems, solve non-routine (different) questions, and apply mathematics in everyday life to find solutions or solve problems in mathematics (Setiawan *et al.*, 2022). Lack of student problem-solving abilities causes students only to be able to work on routine questions or questions that are the same as those given by the teacher so that students are not used to working on questions that are not routine which results in students experiencing mistakes in solving math problems.

Mathematical problems that begin with the context of story questions, culture, and daily life are believed to improve students' mathematical problem-solving and communication skills (Setiawan, Fauzan, and Arnawa, 2021; Fauzan and Yerizon, 2013). However, the assumption that mathematics is far from culture and everyday life and is only numerical and abstract still exists among mathematics teachers. (Fredy, Riwu and Purwanty, 2022 ; Ulya and Rahayu, 2022 ; Setiawan *et al.*, 2023).

The 2018 PISA assessment showed that as many as 71.9% of Indonesian students could only complete PISA questions below level 2 (OECD, 2019). It means that more than half of students in Indonesia are only able to solve level 1 questions and cannot answer PISA questions correctly at all. While the PISA questions consist of 6 questions, where level 1 is the lowest and level 6 is the highest. Considering that the PISA study mostly measures the ability to reason, solve problems and argue rather than measure memory and calculation abilities, this shows that the problem-solving abilities of Indonesian students are still low, as well as the mathematical communication abilities of students. In contrast, the ability to reason is still low.

This study aims to see whether the low level of students' mathematical problem-solving and communication abilities at the national level is the same as in the field. Therefore the researcher took the title Research Analysis of Levels of Mathematical Problem Solving and Communication Ability and Student Readiness in Using Augmented Reality Technology (AR) in Class VII SMP and MTS in Kerinci Regency and Sungai Full City.

2 METHODOLOGY

The method used in this study is a qualitative approach. This study focuses on students' ability related to students' problem-solving and mathematical communication abilities in understanding the concept of flat shapes in class VII SMP using descriptive analysis and students' readiness to use the Augmented Reality (AR) application. The instrument used in this study was a test instrument that described the ability to solve problems and mathematical communication in flat shapes with as many as 3 items. The research was conducted in May-June 2023 in 3 schools: MTS Al Khikmah Kerinci, SMPN 2 Sungai Penuh, and SMPN 1 Kerinci.

3 RESEARCH RESULTS AND DISCUSSION

Based on the results of tests that have been carried out in 3 schools, namely MTS Al Khikmah Kerinci, SMPN 2 Sungaipuh, and SMPN 1 Kerinci, the level of problem-solving and mathematical communication abilities of students is obtained using the following categories:

Table 1: Criteria Level of problem-solving ability.

Percentage	Category
80<X≤100	Very good
60<X≤80	Good
40<X≤60	Moderate
20<X≤40	Low
0<X≤20	Very low

Table 2: Criteria for Mathematical Communication ability level.

Percentage (%)	Category
81 - 100	Very good
61 – 80	Good
41 - 60	Moderate
21 - 40	Low
0 – 20	Very low

Furthermore, after the test results of students' problem-solving abilities and mathematical communication were examined, the following results were obtained:

3.1 Level of Problem-Solving and Mathematical Communication Ability at MTS Al Khikmah Kerinci and Readiness to Use the Augmented Reality (AR) Application

MTS Al Khikmah Kerinci is one of the best private MTS in Kerinci. Based on the results of observations, interviews, and giving tests of students' mathematical problem-solving and communication skills, the following results are obtained:

Table 3: The level of problem-solving and mathematical communication abilities of students at MTS Al Khikmah Kerinci.

Question Number	The average level of mathematical ability	
	Problem-solving	Communication
Question 1	25,73 (Low/Less)	
Question 2	28,10 (Low/Less)	
Question 3		18,05 (Very low/very less)

Table 3 shows that the level of problem-solving skills at MTS Al Khikmah is still in the low/deficient category, while the level of communication skills is also in the low/deficient category. Based on the results of the interviews, it was also known that students had never known about Augmented reality (AR) as well as with teachers, so before carrying out further research, it was necessary to conduct socialization and training in advance for teachers and students.

The following is an example of student answers in solving mathematical problem-solving and communication questions:

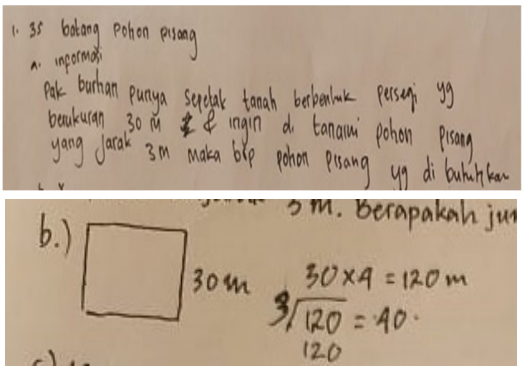

Figure 1: The correct answer to question number 1.

In question number 1, indicator 1, there was 1 student who could answer correctly, like picture 1, by mentioning what was known from the question and what was asked.

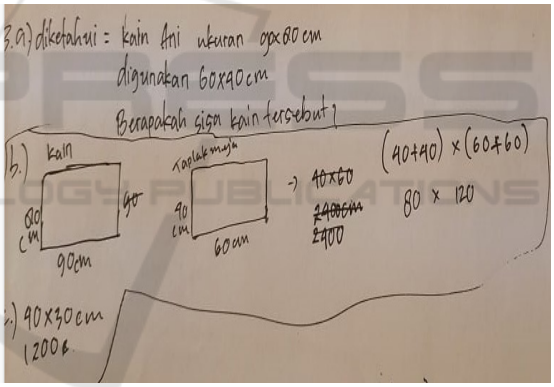

Figure 2: Students' Answers to Mathematical Communication Skills.

Figure 2 shows that the students can describe the questions through pictures and diagrams. Most students do this.

Based on the analysis of students' difficulties in solving problem-solving questions, many lie in indicators 2, 3, and 4, wherein determining strategies and confirming answers, students still experience difficulties.

Meanwhile, there are many communication skills in indicators 1 and 3.

3.2 Level of Problem-Solving and Mathematical Communication Ability at Sungai Penuh Yunior High School 2 and Readiness to Use the Augmented Reality (AR) Application

SMPN 2 Sungai Penuh is the leading SMPN in Sungai Penuh. Based on the results of observations, interviews, and giving tests of students' mathematical problem-solving and communication abilities, the following results are obtained:

Table 4: The level of problem-solving and mathematical communication ability of students at SMPN 2 Sungai Penuh.

Question Number	The average level of mathematical ability	
	Problem-solving	Communication
Question 1	50,00 (Moderate)	
Question 2	39,41 (low/less)	
Question 3		19,41 (very low/very less)

Table 4 shows that the problem-solving ability level at SMP 2 Sungai Penuh is already in the Enough category, while the level of communication skills is still in the low/less category. It means that SMPN 2 is better than MTS Al Khikmah in terms of mathematical ability, but considering that SMPN 2 Sungai Penuh is a top school, it should be able to do more than this. In addition, based on the results of the interviews, it was also known that students had never known about Augmented Reliability (AR) as well as teachers, but students and teachers were familiar with the use of technology in the mathematics learning process because they had used applications such as Geogebra, etc. so that students and teachers are believed to be able to use the AR application with the tutorial given later.

The following is an example of student answers in solving mathematical problem-solving and communication questions:

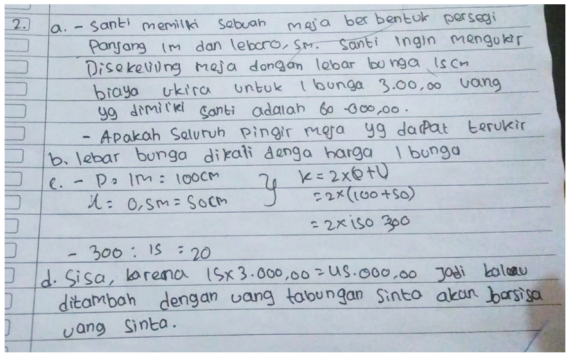

Figure 3: Student Answers Problem-Solving Ability.

In Figure 3, it can be seen that the students could answer correctly until they got the desired answer. Even though there were still deficiencies in the answers, the final results were correct and explained in detail.

However, some students answered incorrectly, as shown in Figure 4.

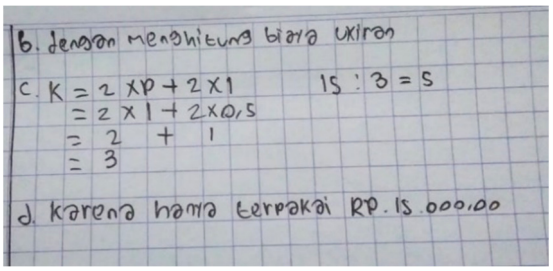

Figure 4: Student Answers Problem-Solving Ability.

In Figure 4, it can be seen that students cannot answer correctly, starting from the strategy to the final result. Some students also answered in the same way resulting in wrong results.

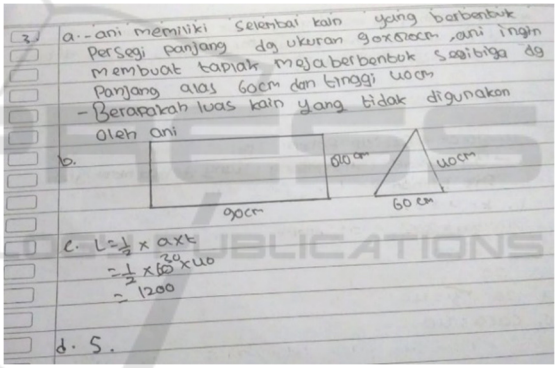

Figure 5: Students' Answers to Mathematical Communication Skills.

Figure 5 shows the students can describe the questions through pictures and diagrams. Most students do this.

Most students' difficulties lie in indicators 2, 3, and 4 for problem-solving abilities and indicators 1 and 3 for mathematical communication skills.

3.3 Level of Problem-Solving Ability and Mathematical Communication at SMPN 1 Kerinci and Readiness to Use Augmented Reality (AR) Applications

SMPN 1 Kerinci is the leading and best SMPN in the Kerinci district. Based on the results of observations, interviews, and giving tests of students' mathematical problem-solving and communication skills, the following results are obtained:

Table 5: Level of problem-solving and mathematical communication abilities of students at SMPN 2 Sungai Penuh.

Question number	The average level of mathematical ability	
	Problem-solving	Communication
Soal 1	50,00 (Moderate)	
Soal 2	61,11 (Moderate)	
Soal 3		22,68 (very low/very less)

Table 5 shows that the problem-solving ability level at SMPN 1 Sungai Penuh is in the Moderate category, while the level of communication skills is still in the low/less category. It means that SMPN 1 is better than MTS Al Khikmah and SMPN 2 Sungai Penuh in terms of their mathematical abilities, but considering that SMPN 1 Kerinci is an excellent school, it should be able to do more than this. In addition, based on the results of the interviews, it was also known that students had never known about Augmented Reliability (AR) as well as teachers, but students and teachers were familiar with the use of technology in the mathematics learning process because they had used applications such as Geogebra, Modules, LKPD, Digital Books. So that students and teachers are believed to be able to use the AR application with the tutorial given later.

The following is an example of student answers in solving mathematical problem-solving and communication questions:

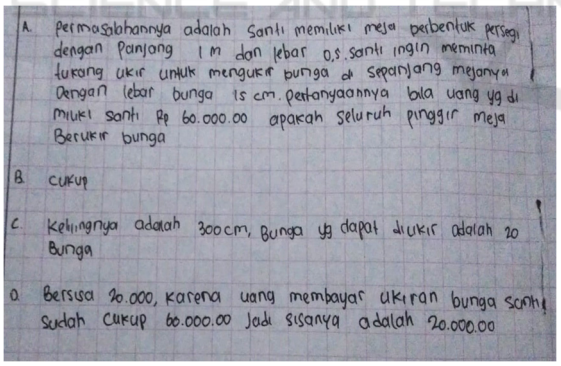

Figure 6: Students' inaccurate answers to problem-solving abilities.

From Figure 6, it can be seen that students have been able to work on problem-solving questions. However, many students have difficulty providing arguments and reasons for their answers, so student answers are incomplete.

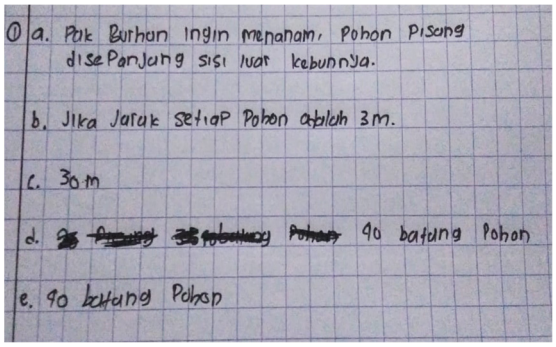

Figure 7. Student's wrong answer in problem-solving abilities.

In Figure 7, it can be seen that the students were wrong in working on the questions. Many students answered similarly, so they were wrong in solving the problem.

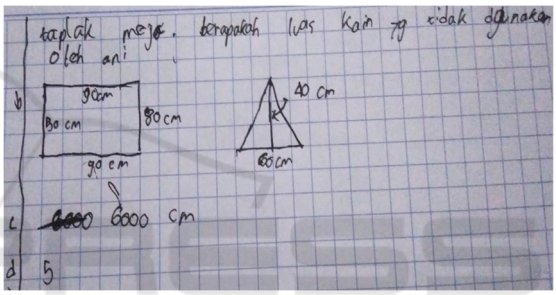

Figure 8: Students' Answers to Mathematical Communication Skills.

Similar to the previous school in solving students' mathematical communication problems at SMPN 1 Kerinci, there were also many difficulties in indicators 1 and 3, while in indicator 2, namely explaining mathematical situations and relations in the form of pictures/diagrams, students could do it.

4 CONCLUSION

Based on the results of the above research, it can be concluded that the problem-solving and mathematical communication abilities of students at MTS AL Khikmah Kerinci, SMPN 2 Sungai Lilin, and SMPN 1 Kerinci are still lacking. The results showed that the problem-solving abilities of MTS Al Khikmah students were still low, namely 26.91%, while their communication skills were 18.05%, also in the low category. At the same time, the ability to communicate is 19.41% in the low category. Likewise, with SMPN 1 Kerinci, students' problem-solving abilities are in a good category, namely

55.55%, while their communication abilities are 22.68% in the low category. Based on these results, it is necessary for the teacher's active role in choosing a new learning model or method that can improve the students' mathematical problem-solving and communication abilities.

Meanwhile, based on interviews and observations, it can be concluded that students and teachers in Kerinci are unfamiliar with Augmented Reliability (AR). However, students and teachers are familiar with the use of technology in the mathematics learning process because they have used applications such as Geogebra, Modules, LKPD, and Digital Books. So that students and teachers are believed to be able to use the AR application with the tutorial given later.

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