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An Investigation Of Best Practice On Students' Mathematical Communication Using Presentation Boards

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A B S T R A C T

Tulisan ini merupakan best practice yang dilakukan di SMA Model Madani Palu. Sebelumnya alur pembelajaran yang dilakukan yaitu mengerjakan tugas dibuku, menuliskan di papan tulis dan dan mempresentasikan dengan membacakan hasilnya. Kemudian ditemukan media papan presentasi yang sederhana dan inovatif. Selain itu biaya untuk membuat papan presentasi relative murah. Media ini dapat dipergunakan berulang-ulang karena ditulis dengan spidol dan dapat dihapus. Metode yang dilakukan, siswa menuliskan pekerjaannya pada papan presentasi. Penggunaan media ini dapat menggali komunikasi matematis siswa, karena siswa terlatih menyampaikan dan menuliskan langsung hasil yang diperoleh. Hal ini diperkuat berdasarkan hasil pengisian angket bahwa penggunaan papan presentasi (1) dapat memotivasi siswa sehingga terlibat dalam menjawab soal atau selama kegiatan pembelajaran di kelas, (2) memberanikan diri tampil kerja/tugas yang diberikan di kelas, (3) merasa tertantang untuk mengerjakan tugas matematika yang diberikan karena kolaborasi (4) Menyelesaikan tugas-tugas dalam pembelajaran ini membuat siswa merasa puas terhadap hasil yang mereka capai, (5) Siswa terlibat aktif dalam kelompok, (6) berani menyampaikan ide gagasan secara tertulis dan lisan dan(7) melakukan suatu hal lebih detailsi.

This study aims to investigate the best practice of mathematical communication carried out at SMA Model Madani Palu. In mathematical communication, the learning flow was conducted by doing assignments in books, writing on the board, and presenting the results through reading. Then, a media in the form of presentation board which is simple and innovative was found. In addition, the cost of making a presentation board is relatively cheap. This media can be used repeatedly because it is written with erasable markers. The method used, students write their work on the presentation board The use of this media is expected to be able to explore students' mathematical communication as they are trained to convey and write down the results obtained directly on it. This statement is reinforced by the results of the questionnaire that was disseminated in this study. From this study, it was found that the use of a presentation board (1) can motivate students to be involved in answering questions or during learning activities in class, (2) make students to be braver to perform work/assignments given in class, (3) challenge students to work on the given collaborative mathematical assignments, (4) make students feel satisfied by completing the assignments, (5) involve students in a group, (6) make students dare to convey ideas in writing or orally, and (7) encourage students to do something more detailed.

1. Introduction

The curriculum in an education unit, from elementary until higher education, is implemented in the form of learning. The learning process emphasizes a teacher's role to encourage and facilitate students to learn. In a learning process, students have more roles in constructing their knowledge, so it can be said that knowledge construction is not the result of the transformation process from the teacher. The 2013 curriculum in Indonesia is implemented through activity-based learning with an integrative scientific and thematic approachres in order to make students become more creative, innovative, and productive1. The curriculum is also believed to be able to foster student competencies with several learning models, for example

Contextual Teaching and Learning (CTL), cooperative based learning, problem-based learning, inquiry based learning, Value Clarification Technique (VCT) learning, and E-learning.

The learning term identified as the 4Cs (critical thinking, communication, collaboration, and creativity) are the four skills deemed as the 21st century skills. A critical thinking student can be seen when students are able to filter, analyse and question any information they get in various media. This can be oral, written or broadcast. Furthermore, they can synthesise until it matches their understanding. Communication is the ability to express ideas and information in a clear and meaningful way. In addition, communication has four main purposes, namely 'informing, instructing, motivating, and persuading' the audience. [1]. Collaboration refers to the way students use different personalities, talents, and knowledge to work together and produce something new. Creativity, refers to the ability of students to utilise their knowledge and talents to create something new, or produce something in a new way. Furthermore, two aspects, which are connectivity and citizenship, have been added as well2. Fullan and Duckworth in Anugerahwati (2019) also added the terms character and culture education3. In mathematics education, the Programme for International Student Assessment or PISA [3] has considered mathematical communication as one of the competencies of mathematical literacy3. PISA states that the domain of mathematical literacy is the ability to analyze, reason, and communicate ideas effectively.

Communication carried out by two people in general can be stated as interacting. There are three types of interaction, namely students interaction with material, with the teacher, and with each other4. Furthermore, interaction is always related to communication5. Effective interaction and communication in class can help make the learning process more effective. However, the fact is that most students are not accustomed to communicating their works. Most students can complete the tasks or answer questions given but are unable to explain their answers. This study aims to investigate the best practice of mathematical communication carried out at SMA Model Madani Palu.

The best practice is the best success story in solving problems when carrying out tasks as an educator. Writing the best practice for an educator means developing professionally. However the term "best practice" implies that the practice is considered the best when compared to any alternative course of action and designed to achieve some deliberative end. Hence, three important characteristics are associated with the "best practice": comparative process, an action, and a linkage between the action and some outcome or goal. This means that there are three characteristics in best practice, namely: the comparison process, activities, and there is a relationship between these activities and the results or goals to be achieved.

Mathematical communication is one of the abilities that must be possessed by students to learn mathematics, which is also one of the standards recognized by NCTM as an international mathematics educator organization. Mathematical communication is the process by which students learn and use mathematical language to communicate and understand the world, such as using specific mathematical symbols and terminology [4]. That mathematics has its own symbols and grammatical rules, and it is also written in a symbolic language designed to express mathematical thought (7. Therefore, students can usually read the mathematical expressions used in symbolic communication in any language. Wilson (2009) also emphasizes the importance of good mathematical symbolic communication in providing opportunities for students to display ideas and strategies to solve mathematical problems accurately. Teachers can divide mathematical communication into four categories, namely verbal communication (including speaking and listening), listening (including verbal communication through reading), and written communication, including writing tasks [5]–[7]

Therefore, efforts to explore students' mathematical communication continue, one of which is improving the process when students present their work. Previously, the learning flow was done by doing assignments in the book (Figure 1), writing on the board (Figure 2), and presenting

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the results (Figure 3). In Figure 1. things that students often do when doing assignments. Students work individually. Sometimes this method makes students stop if they have difficulty. Figure 2. is also often done, students write back what they have done in their books. Sometimes this method is unfocussed. This is because more than one student is simultaneously writing on the board. Working on tasks in the book and writing answers on the board, is more likely to be one-way communication, namely between the student and the media in front of him. In Figure 3, students present directly or convey directly what they have discussed. This will be multidirectional communication.

Figure 1.Doing tasks in the book

Figure 2. Writing Answers

Figure 3. Presenting the results on the whiteboard

Based on the three activities that students have done, here the research team prefers the third activity. When students do exercises in the book or on the board, they will be more focused on what is written and more likely to try to complete the problem correctly. Oftentimes, students can only write down the mathematics symbols, but are not able to read and understand the symbols they just wrote. However, when they are asked to present the results of the exercises, they seem to be better because they start reading what they have written. This will make them try to understand what is written better. Furthermore, in Figure 4, several presentation methods have been utilized, such as using a smartboard, projector/lcd, chart, and presentation board.

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Figure 4. Several methods of presentation

Furthermore, it is selected to use the presentation board for the reason that it can be used repeatedly and requires less cost to make. The delivery methods of presentation are also based on learning problems related to mathematical communication and motivation. This made the present study to be a comparative study of mathematical communication practices using various media.

Media as a means to make it easier to convey information to many people, a medium must be made effectively. In addition, media can also function as a means of non-verbal communication. Meanwhile, learning media is a tool or means used during the learning process ((Tiwow, dkk., 2022). So that it makes it easier to convey information and facilitate students during learning. Media can increase interest in learning so that students will more easily concentrate on the material being taught. This will affect the interaction between learning media and learning interest on student learning outcomes [8]. A teacher must be creative and innovative when choosing models, methods, strategies and learning media that are suitable for teaching materials so that the objectives of learning can be achieved [9]. Furthermore, teachers have a very important role in increasing students' interest in learning so that students feel comfortable and the knowledge they get will be easy for them to accept [10]. Different types of communication will occur in the mathematics classroom [11]. Involvement in classroom activities in the form of interaction with the teacher, working in small groups, or standing in front of the class to make presentations to clarify ideas found. Teachers can organise the classroom so that students face each other during discussions [11]. So the purpose of this researcher is to gain valuable insight into the use of presentation boards in an effort to improve students' mathematical communication. This is because presentation boards serve as an effective tool to develop it. This study involved comparing several classes and analyzing the students' characteristics when presenting in front of the class. In addition, the results of this study are expected to be used as a source of information for the implementation of best practices in various contexts which can improve students' mathematical communication. So the purpose of this researcher is to gain valuable insight into the use of presentation boards in an effort to improve students' mathematical communication. This is because presentation boards serve as an effective tool to develop it.

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2. Research Method

The current research was a comparative study, because it compares several activities that have been carried out. Furthermore, we chose the use of presentation board media which aims to see how students' motivation and mathematical communication. There were 19 students in grade II of SMA Model Madani Terpadu Palu. Furthermore, divided into 4 groups. One group was used as the subject of the study. The design utilized in this study was a qualitative research design as it conducted classroom observations, systematically on the students' interactions, behaviors, and dynamics to gain a deep understanding of the processes and phenomena of symbolic mathematical communication. The presentation board used in the classroom had been designed and made by the teacher according to the learning needs before the commencement of the research. The tools and materials used for the use of the presentation board, namely plywood, saw, tape, and meter, are shown in Figure 5 below.

Figure 5. Tools and materials for making the presentation boards.

Presentation Board Size

The tools and materials that need to be prepared to make presentation board media are plywood boards, saws, masking tape, sandpaper, markers as shown in Figure.5, then start making presentation boards. One sheet of plywood board can be made into six presentation boards. The size of one presentation board is 81 cm x 61 cm. After the plywood is cut to this size, to make it look attractive, tape is added to the edges of the board. The colour of the tape on each edge is different. Figure 6a shows the presentation board. The cost used to make this media is relatively cheap and very effective when in use. This is because after use it is stored and can be used again in the next lesson. Furthermore, to illustrate the solution, why use a presentation board in Figure 6b.

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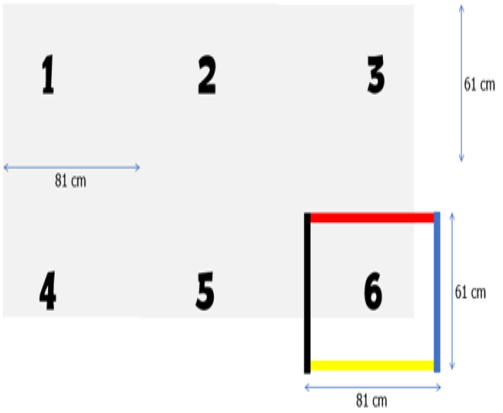

Figure 6a. Presentation Board

Figure 6b. Solusion: Presentasi Board

3. Finding and Discussion

The students, as research participants, were divided into several groups, each group consisted of 4-5 students. First, these students were given derivative material assignments. Next, they began to work on the assignments collaboratively. After completing the assignments, they were instructed to present the results in front of the class. The sequence can be seen in Figure 7.

Figure 7. The Use of Presentation Boards

When students started working on the assignments, they read the questions shared. Here is the problem that students will work on in groups.

Given a function $f(x) = 6x^4 - 4x^3$

Determine where the given function increases and where it decreases.

Each student looked active as each one of them participated according to their own capacity and potency. Some participated in writing, while some directed the exposure layout, as seen in Figure 8.

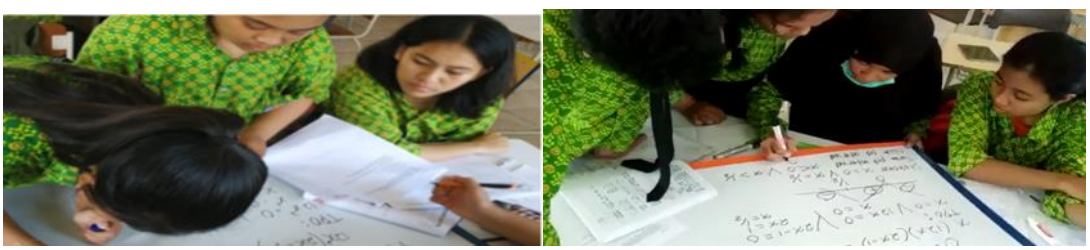

Figure 8. Writing participation

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When writing their answers to the assignments, they simultaneously read what was being written, for example:

Student: Stationary at or x equals a half.
decrease at intervals of x less than zero and x greater than a half

increase at intervals of x less than a half, more than zero

The students wrote first, followed by in Figure 8 below.

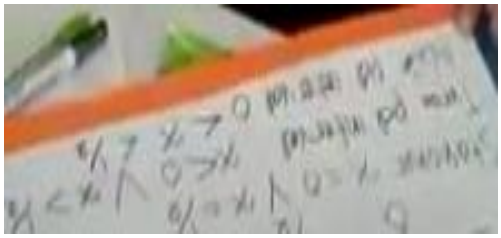

Figure 9.

Using Presentation Boards

When observing the presentations done by the students, detailed understanding of their mathematical communications could be comprehended. The learning strategies and interaction patterns the students did strongly supported effective communication. Each group presented the results of their discussion using a presentation board. The students explained enthusiastically and seemed to grow their confidence. Each member in the group alternately explained what they had discussed and poured it into the presentation. Therefore, all members in each group have active roles in the discussion. Moreover, when there was a student who incorrectly mentioned the symbol, the other students would correct the mistake. The following is a snapshot of student presentations in Table 1Berikut cuplikan presentasi siswa pada Tabel 1.

Figure 10. Presentation Task

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Table 1. Snippets of conversations from the presentations of senior high school students in grade XI

Siswa 1	Okay. We will present the results of our discussion on increasing functions and decreasing functions. We have written the results of our discussion on the presentation board.
Siswa 2	*Holding the presentation board*
	Students look at each other
Guru	*Please begin*
Semua Siswa	Yes sir (*simultaneously answer*)
Siswa 3	We know the function $f(x) = 6x^4 - 4x^3$ Next, we will determine where the function will increase and the function will decrease
Siswa 1	First we determine the stationary point by determining the accent x equal to zero. Formula form $f'(x) = 0$ We continue by determining the first derivative of the function $f(x)$ and the function f becomes an accent equal to 24 x to the 4th power minus 4x to the third power. We write it like this (*students show on the presentation board*) $f'(x) = 24\,x^3 - 12x^2$ $f'(x) = 0$ $f'(x) = 24\,x^3 - 12x^2 = 0$ Next we factorise, so it becomes the form $0 = 12x^2(2x - 1)$ $0 = x(x^2)(2x - 1)$ Next we obtained x equals zero, and x equals half. $x = 0\ V\ 12x = 0$, maka $x = 0$ v $2x - 1 = 0$ maka $x = 1/2$ We read 'v' as 'or'
Siswa 3	The stationary point is satisfied when $x = 0$ and $x = 1/2$ Kami melakukan uji terhadap kedua titik ini. Uji terhadap titik x =0 $f(x) = 6x^4 - 4x^3$ $f(0) = 60^4 - 40^3 = 0$ We test these two points. Test for the point $x = 1/2$ $f\left(\frac{1}{2}\right) = 6(1/2)^4 - 4(1/2)^3$ $= -\frac{1}{8}$ Based on the test results, the maximum and minimum values can be determined. As we marked on this board
Siswa 2	*Pointing to the presentation board when their friends hesitate.* *On their part write the maximum and minimum.*
	You can see on this board $x = 0$ and $x = 1/2$ (pointing to the board)
Siswa 4	This point is often referred to as the separation point. We usually abbreviate it as TP
	This point is placed on the number line. As we wrote this.
Siswa 5	On this number line will be drawn an increasing or decreasing function

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	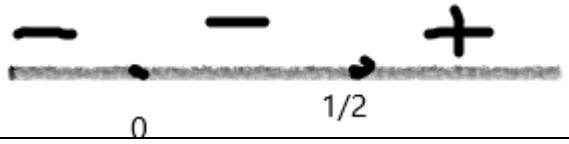
Siswa 2	When determining an increasing function, the first derivative of the function is greater than zero. Therefore, the right side of the number line is positive. Meanwhile, to determine a decreasing function, the first derivative of the function is smaller than zero. Based on that we get that: When the function $x > 1/2$ is said to be increasing (on the interval $x > 1/2$) When the function $x < 1/2$ is said to decrease (on the interval $x < 1/2$) We haven't drawn this function yet sir.
	This is the result of our presentation. thank you

During the presentation, the students were enthusiastic. Although at first they were shy and afraid of misreading. So at this time it needs reinforcement from the teacher that the presentation is done so that students not only know the symbols. However, they must also be able to read them. From the results of student presentations, several things can be seen which are explained in the following section. The mathematical communication aspect in solving derivative problems that first showed up was when the subjects mentioned "interval", "up", and "down". Furthermore, the subject also mentioned the words "less than" and "more than". The subjects also mentioned the words "function" and "stationary point". These words also facilitated the process of completing the next question. Words and their meanings are said to be a link in the chain of communication and often represent mental constructs10. Discursive perspective has its roots in the writings of 11, who argued that understanding and meaning can only be seen by looking at what people actually do with words and other sign systems.

Visual mediator was the second aspect. The subjects used symbols more, in addition to using fingers to point. As seen in Figure 9. Students use their fingers to point at what they are reading. An object such as symbols, graphs, or algebraic formulas that relate relationships and operations to mathematical objects that was used in the interviews is called a visual mediator [12]–[14]. In the aspect of endorsed narratives, the students used mathematical definitions to mediate problem solving. Moreover, endorsed narrative is better known as mathematical theory. The last aspect was the subject's routines in some conditions, for example when imitating the work of other subjects or repeating the answers that had been mentioned. In line with Lavie et al., (2019), it relates to how one decide which actions previously taken must be repeated and what needs to be changed. The mechanism of repetition may differ greatly from case to case.

Mathematical communication skills include mathematical dialogue, writing and reading.When two or more people have a conversation about mathematics, it is called mathematical dialogue. It is a two-way process that involves listening and speaking. For example, teacher-student dialogue and dialogue among students in the classroom when learning mathematics are mathematical dialogues. According to Pimm (1987) discusses the purpose of student dialogue in mathematics classrooms. He categorised mathematical dialogue as mathematical dialogue with others and mathematical dialogue of self-reflection. Students use mathematical dialogue with others to convey their own mathematical ideas. Through mathematical dialogue, students can be self-reflective. Because effectively students can organise their thinking and can clarify mathematical meanings and ideas. By this they will gain further understanding of mathematics. For example, when solving mathematical problems, students read the mathematical questions repeatedly to clarify or refine the problem-solving model. The

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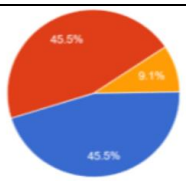
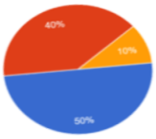
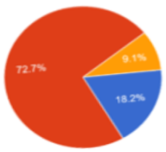
repeated reading method shows that self-reflective dialogue can promote students' reflection on mathematical thinking. Self-reflective dialogue is implicit and serves as the basis for conversations with others [11].

Furthermore, verbal communication can take the form of mathematical writing. Mathematical writing is an important complement to verbal communication. When students write in mathematics, they are actively involved in the process of absorbing mathematical knowledge, developing mathematical understanding, and improving mathematical learning attitudes. Mathematical reading involves reading and understanding texts that contain words, shapes, numbers, illustrations, schedules, etc. (OECD, 2009). In mathematical reading, students need to process and transition between multiple representations, including symbols, diagrams, graphs and forms. This is a nonlinear process and is the main difference between mathematical reading and other reading (Bosse & Faulconer, 2008). After learning is completed, the students were asked to fill out a questionnaire about the use of the presentation board. This questionnaire had 7 question items, with a choice of strongly agree (blue), agree (red), somewhat disagree (yellow), and disagree (green). Furthermore, it was also made in the form of a circle chart, as seen in Table 2.

Table 2. The results of student questionnaires about the use of presentation boards.

No.	Statement	Strongly agree	Agree	Somewhat disagree	Disagree	Graph
1	I like to learn at the moment using the presentation board because it motivates me to get involved in answering questions or during learning activities in class	45.5%	45.4%	9.1%	-	
2	I am happy to learn using the presentation board as I am more dare to perform the work/tasks given in class	50%	40%	10%	-	
3	I feel obliged to do the given math assignment because of the collaboration with the presentation board	18.2%	72.7%	9.1%	-	
4	Completing the tasks in this lesson makes me feel satisfied with the results I achieved.	27.3%	63.3%	9.1%	-	

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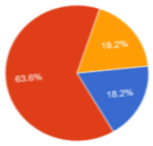
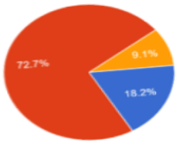
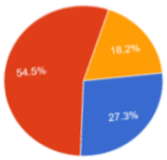
5	During the learning activities using the presentation board, I was actively involved in the group	63.6%	18.2%	18.2%	-	
6	During the learning activities using the presentation board, I dared to convey ideas in writing and verbally	72.7%	18.2%	9.1%	-	
7	During the learning activity with the presentation board, I did the assignment in more detail.	27.3%	54.4%	18.2%	-	

Based on the results in Table 1. it can be seen that students' answers in the category strongly agree and agree with using the presentation board. In the first item, 45.5% of students agreed and felt happy learning with the presentation board. They felt motivated and involved in answering questions during discussion activities. Only 9.1% disagreed. When the interview was conducted, students did not provide answers. In the second item, 50% of students felt happy learning at this time. According to them, by using the presentation board they became motivated and ventured to perform the work/tasks given by the teacher. Students who disagreed were only 10%, saying that they preferred to write in a book.

In the third item, more students agreed, namely 72.7%. According to the students, they felt challenged to work on the mathematics assignments given collaboratively and then present using the presentation board. According to students, by using the presentation board they quickly find out mistakes in reading mathematical symbols. In the fourth item, 63.3% of students agreed to use the presentation board when completing the tasks. They felt satisfied with the results they had achieved. Furthermore, in the fifth item, 63.6% of students strongly agreed that during learning activities using presentation boards. This made them actively involved in the group. It is also in the sixth item, 72.2% of students strongly agreed that during learning activities using presentation boards made them dare to convey ideas in writing and orally. In the last item, more students gave agree statements, namely 54.4% because during activities with presentation boards, they did things in more detail. Furthermore, interviews were conducted with students who disagreed. they often find it difficult with symbols and the process of working on mathematical problems.

4. Conclusion

Based on the results of the bestpractice of using presentation boards that have been carried out at the Integrated Madani Model High School of Palu. In general, students are happy and motivated to learn. This is based on a questionnaire filled out by students. The process carried out is to give assignments in the form of derivative material problems. Students worked on this problem collaboratively. It can be seen when working on them seriously. After all students have

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finished working on the problem, a presentation is made. One group came forward to present in front of the class using a presentation board. Using a presentation board, where students directly explain what they have written. This can explore students' mathematical communication skills so that they understand more about their own writing. In addition, it will also increase students' learning motivation.

The presentation board includes learning media. Learning media is one of the forms so that the learning process becomes vibrant and varied. The media does not have to be something expensive, it will be able to help students to communicate well. Learning media is a communication tool used in the learning process. So it is recommended to use a presentation board as a medium to explore students' mathematical communication. . Mathematics is a unique language that consists of words, tables, and illustrations such as graphs and symbols to improve students' communication skills. Students will be more steady and effective in using their mathematical knowledge when they are asked to investigate and explain mathematical problems, write or talk about the results, and argue. Mathematical communication is one of the skills currently relevant to the 21st century education model. Low communication skills hinder effective information sharing. This can lead to misunderstandings. This bestpractice can inspire teachers by using presentation board media. So that it can explore students' mathematical communication. can express mathematical ideas orally, in writing, and visually through various media, understand, interpret, and evaluate mathematical ideas and conclusions drawn orally or visually, and use mathematical notation and terms to present ideas, describe relationships, and model situations. The learning media used in this article are media made by teachers and used by students during presentations

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