



## Analysis of Mathematical Literacy Ability Based on Learning Style of Middle School Students

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### Article History:

Received: Jun 22, 2023

Revised: Jun 28, 2023

Accepted: Jul 18, 2023

Online First: Jan 01, 2024

### Keywords:

David Kolb,

Learning Style,

Mathematical Literacy

Ability.

### Keywords:

David Kolb,

Gaya Belajar,

Kemampuan Literasi

Matematis.

### How to cite:

Dwiyanto, A. R., & Kurniasih, M. D. (2024). Analysis of Mathematical Literacy Ability Based on Learning Style of Middle School Students. *Edunesia : Jurnal Ilmiah Pendidikan*, 5(1), 1-13.

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**Abstract:** This research was conducted at SMP Negeri 204 Jakarta with research subjects, namely class VIII-B students. This study aimed to determine students' mathematical literacy skills based on Kolb's learning style. The method used in this study is descriptive qualitative, using instruments like questionnaires, test questions, and interview guides. Questionnaires are used to categorize Kolb's learning styles. At the same time, the mathematical literacy test was given as many as four description questions with Circle material and interview guidelines to find more in-depth information related to the mathematical literacy abilities possessed by the subjects in this study. Based on the research that has been done, students with diverging learning styles tend to use concrete experiences they have learned and are not afraid to try. Subjects with an assimilation learning style tend to emphasize theory, subjects with a convergent learning style look more active and have high self-confidence, and accommodation subjects tend to have concrete problem-solving experiences. Subjects with the Kolb learning style can show the process of mathematical literacy, which is suitable for the context of still common questions.

**Abstrak:** Penelitian ini dilakukan di SMP Negeri 204 Jakarta dengan subjek penelitian yaitu siswa kelas VIII-B. Adapun tujuan dari penelitian yaitu untuk mengetahui kemampuan literasi matematis siswa berdasarkan gaya belajar David Kolb. Penelitian ini menggunakan metode kualitatif deskriptif, instrumen yang digunakan berupa angket, soal tes, dan pedoman wawancara. Angket digunakan untuk mengkategorikan gaya belajar Kolb. Sedangkan tes literasi matematis diberikan sebanyak empat soal uraian dengan materi Lingkaran dan pedoman wawancara yang memiliki tujuan untuk mengetahui informasi lebih dalam terkait dengan kemampuan literasi matematis yang dimiliki oleh subjek dalam penelitian ini. Berdasarkan penelitian yang telah dilakukan maka siswa dengan gaya belajar divergen dalam pembelajarannya lebih paham menggunakan pengalaman konkret yang telah dipelajari dan tidak takut mencoba. Subjek dengan gaya belajar asimilasi cenderung mementingkan teori, subjek dengan gaya belajar konvergen terlihat lebih aktif dan memiliki percaya diri tinggi, dan subjek akomodasi cenderung pada pengalaman konkret dalam memecahkan masalah. Subjek dengan gaya belajar kolb mampu menunjukkan proses literasi matematis yang dapat dikatakan baik untuk konteks soal yang masih umum.

## A. Introduction

Education is the need of every individual who aims to equip with knowledge, insight skills, and unique expertise to develop their abilities when encountering all changes caused by scientific advances in technological knowledge (Azizah, 2019). One form of education is mathematics education, and to improve the quality of education, one way is to improve the quality of mathematics education in schools. Mathematics is a tool in life and a scientific servant for other sciences. Students need to learn and explore mathematics so that later they will quickly solve a problem (Siagian, 2016).

Indonesia still needs to improve its educational rankings compared to other countries (Supraptinah et al., 2015). This can be seen from PISA (Program for International Student Assessment) in 2018, which positioned Indonesia at 73 out of 79 countries. This shows that the academic proficiency of students in Indonesia is still relatively low, especially in mathematics. That is why Indonesia is classified as a country with relatively low mathematical literacy. The International Study has researched 9th-grade children worldwide who are members of the OECD with an age range of 15 to 15 years 11 months.

Data on mathematical literacy skills provided by PISA shows that in Indonesia, student achievement in mathematical literacy skills is still far from students in other countries. Mathematics is one of the branches of science that plays a significant role in mastering science and technology, and both applied and logical (Ningsih, 2014). Although mathematics is a compulsory subject at the elementary school level up to the secondary level, many students still think that mathematics is a complex subject to understand. Students find it challenging to understand the teacher is teaching, and most students feel bored when learning math. The problem of math learning difficulties must be overcome as soon as possible by consistently providing good support and motivation so that students can participate in math learning with a happy heart (Yeni, 2015).

Mathematics cannot be separated from basic mathematical skills or mathematical literacy. Literacy is an ability and skill that must be possessed (Widiastuti & Kurniasih, 2021). One of the most essential basic literacies is mathematical literacy. The word literacy comes from the English "literacy" which means being able to read and write. The word 'literacy' comes from the Latin word "litter", which means letters. This means that all humans must have essential reading and writing skills. Because literacy is the foundation of all knowledge. Being able to read and write allows a person to develop their various abilities and have a good understanding of all existing knowledge, including mathematics.

Seven skills underlie the mathematical literacy process in solving problems in everyday life, namely: 1) communication, 2) mathematization, 3) representation, 4) reasoning and argument, 5) formulating strategies to solve problems, 6) the use of language and symbolic, formal, and technical operations and operations, 7) the use of tools (Putra & Vebrian, 2019). Use of tools, communication skills are needed in mathematical literacy because good communication can help students explain their ideas to others (Kusniati, 2018). Furthermore, mathematization skills are skills in converting a problem into a mathematical model and vice versa. Representation skills are a skill in re-presenting a mathematical problem in graphs, tables, diagrams, and others. Reasoning and argument are the basic skills of the logical thinking process in analyzing information to reach conclusions.

Then the skill in formulating strategies to solve problems is the ability of students to apply problem-solving strategies. Furthermore, the skills of using language and symbolic, formal, and technical operations are the ability of students to use symbols and formal language when solving problems. Then the last ability to use mathematical tools is the ability of students to use mathematical tools in solving a problem. Based on the description above, mathematical literacy in this study is the ability of students to formulate, use, and interpret mathematics in various situations with four indicators including: 1) formulate real problems, 2) use mathematical concepts, 3) interpret solutions, 4) evaluate solutions in mathematical literacy.

Mathematical literacy skills include asking questions, formulating and solving context-based problems. This shows that student's ability to solve mathematical problems varies in their approach to learning situations and learning styles. Internal factors have yet to be considered in improving student learning, namely students' learning styles (Widayanti, 2013). Therefore, a teacher must recognize each student's learning style by preparing a suitable strategy to achieve a maximum learning process.

Every individual tends towards one learning style when the learning process takes place. This tendency is called a learning style. Individuals have different abilities to absorb, organize and process the information they receive. That ability is a learning style (Amin & Suardiman, 2016). Learning styles also make it easier for someone when they do learning (Agustama, 2013). In addition, the background experience certainly describes the characteristics of students and affects the effectiveness of the student learning process. Therefore, each student has different abilities and learning styles (Widayanti, 2013). It can be concluded from the above understanding that learning style is how students respond to stimuli and assimilate, organize and process information in the learning process.

Four learning styles are proposed by David Kolb: divergent, convergent, assimilation, and accommodation (Chasanah et al., 2020). Someone with a divergent learning style leads to a more remarkable ability to process information into imaginative and creative ideas. Furthermore, someone with an assimilation-type learning style can build various theoretical models, reason inductively, and combine various information they receive. A person with a convergent learning style tends to master superior skills when deciding on a decision, problem-solving, and creating practical functions from thoughts. Meanwhile, someone with an accommodation learning style likes to engage in new experiences, is adaptable, and can act on their intuition (Daimaturrohmatin & Rufiana, 2019).

In research (Chasanah et al., 2020) analyzing mathematical literacy skills based on student learning styles. This study analyses students' mathematical literacy skills based on learning styles. From the results of this study, it can be concluded that mathematical literacy skills have a relationship with learning styles, where mathematical literacy skills with divergent learning styles only reach the formulating step, convergent learning styles can go through the mathematical literacy process, assimilation learning styles up to interpreting but for interpreting have not been able to solve well, and accommodation learning styles have been able to formulate and interpret but in making plans or expressing reasons at the employing stage in solving problems has not been appropriately achieved. The similarity between this research and the research that researchers will do is to discuss the relationship between mathematical literacy activities and student learning styles. While the difference

between this study and the research that the researcher will do lies in the study material and the research object. In addition, this study uses the object is college students, while researchers will use junior high school students as the object of research.

In line with research conducted (Furqon et al., 2021) with the theme of characteristics of mathematical literacy skills in terms of the learning styles of high school students. According to David Kolb, this study used an analytical descriptive method to know the characteristics of mathematical literacy skills in terms of learning styles. The results of his research found that the mathematical literacy skills and learning styles of students were different. The similarity between this research and the research that the researchers will do is discussing the relationship between students' mathematical literacy activities based on student's learning styles. While the difference between this study and the research that the researcher will do lies in the research object. This research uses the object of high school students, while researchers will use junior high school students as the object of research.

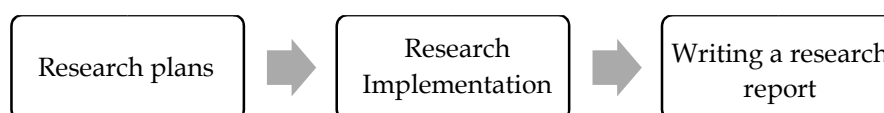
Based on several references related to the research to be studied, the researcher can find out the novelty in this study, namely analyzing students' mathematical literacy skills in terms of learning styles based on David Kolb, with the research object being junior high school students in grade VIII. With this research, it is hoped that it will become a reference material that influences the mathematical literacy skills of junior high school students based on David Kolb's learning style. From the description above, this study aims to determine students' mathematical literacy skills in terms of Kolb's learning style. Considering that learning styles have a significant influence on students' mathematical literacy skills. However, this has yet to be discovered. Theoretically, learning styles play a role in students' mathematical literacy skills.

## B. Method

This research was conducted by applying a descriptive type of qualitative method, and this research was focused on students' mathematical literacy skills in terms of learning styles proposed by David Kolb. Therefore, this research cannot use statistical methods or other calculations (Gunawan, 2013). This research was held at SMP Negeri 204 Jakarta with the research subjects, namely students of class VIII-B SMP Negeri 204 Jakarta, with a sample of 35 students. The subjects selected were eight students with two people in each type of Kolb learning style.

The data collection technique applied in this study is by giving test questions that aim to measure students' mathematical literacy skills, filling out questionnaires in order to categorize students in terms of their learning styles, and interviews to help researchers understand students' mathematical literacy skills based on the tests that have been given previously. When this research was conducted, the data analysis process began with analyzing data obtained from interviews, observations, and others (Safrianti, 2017). Therefore, in this research, the data analysis technique is divided into three streams: 1) Data reduction. Data reduction in this study consists of summarizing activities, focusing on important things only, and discarding unnecessary data. When this research took place, data reduction was used in the form of mathematical literacy test data and interviews. This helps researchers get a clearer picture and facilitates further data collection. 2) Data Exposure: Data

exposure in this study involves classifying and identifying data. By describing the data set in an organized manner, conclusions will be obtained from the data. 3) Drawing Conclusions, the expected conclusion from qualitative research is new findings from an insight that has never existed before. This can take the form of an explanation or sketch of an object that is still unclear. Furthermore, this research was carried out in several stages, namely:



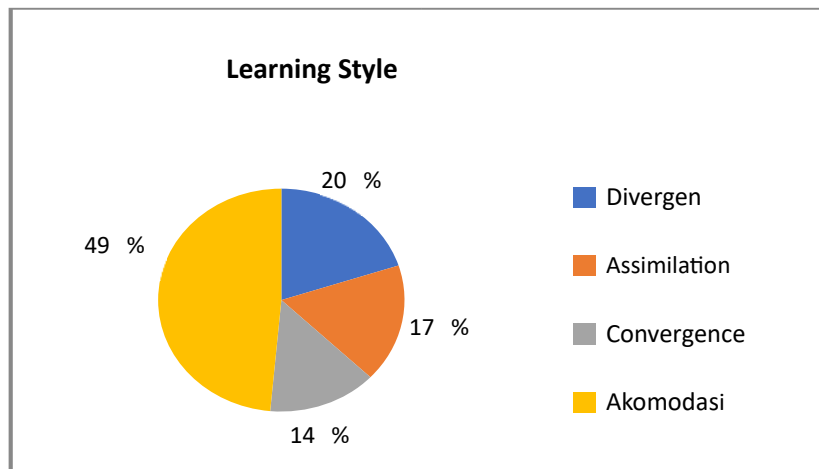
**Figure 1.** Research flow

1. Research Plan, before conducting research, researchers must make a research plan. During the research planning stage, several activities will be carried out, including: a) compiling test instruments, b) making interview guidelines, c) carrying out test validation, d) preparing equipment for interviews, and e) preparing equipment for documentation.
2. Implementation of research, even though this research has been carefully prepared and planned, the research results will only be accurate and satisfactory if the research is carried out carelessly or follows established rules. Therefore, when conducting research, of course, researchers need to take appropriate actions in order to get satisfactory results. Therefore, the stages of implementing this research are a) running tests, b) analyzing and evaluating the test results of students and carrying out observations during research activities, and c) conducting interviews.
3. Writing a research report, report writing is the most essential part of research. This activity is strongly influenced by language skills, reasoning skills, and consistency and is further related to reading habits, commenting or reviewing habits. In addition, this research report is based on the analysis of students' test results and the results of interviews with selected subjects.

## C. Results and Discussion

### Result

Data collection in this study was carried out using a mathematical literacy test and a learning style questionnaire test. After giving the mathematical literacy test, students were given a questionnaire test to find out each student's learning style. After that, students were grouped based on convergent, divergent, assimilation, and accommodation learning styles. Of the 35 students who took the test, six students had an assimilation learning style, five had a convergent learning style, seven had a divergent learning style, and 17 had an accommodation learning style.



**Figure 2.** Percentage of Student Learning Styles

Before conducting the questionnaire-style test, the researcher prepared the tools that would later be used to implement the mathematical literacy test. Later the value of the students' mathematical literacy test will be used as an indicator of students' mathematical literacy skills. Indicators of mathematical literacy processes include communication, mathematization, representation, reasoning and argumentation, design, use of symbols, use of formal language, technical and operations, and use of mathematical tools. Three general aspects of the seven processes must be done in mathematical literacy: 1) formulating problems from existing problems logically regarding language and mathematical steps, 2) writing explanations in working on problems, and 3) interpreting and re-evaluating from solving mathematical literacy problems.

Students with divergent learning styles have different levels of written mathematical literacy test proficiency, and this is obtained from their mathematical literacy test scores. Students with divergent learning styles have yet to be able to build their understanding of mathematics. When subjects with divergent learning styles face a problem, they take it seriously. At first, the subjects could not understand the problems they faced, but when they were allowed to review the questions, they could understand it all even though it took quite a long time. Here are some interview excerpts with divergent subjects:

*Researcher* : Did you find it difficult when working on these problems?

*S1* : At first, some questions confused me, but after I re-read the questions and material in the book, I could finally solve them.

*S2* : Yes, my brother, too. I was perplexed when solving this problem.

In solving the problems in the problem, this divergent learning style has yet to be able to use appropriate methods and strategies. One of the factors that cause divergent subjects to have difficulty in solving problems is that the subject needs to write down the strategy or method completely and unsystematically. As argued (Fuad, 2016) in his research, divergent learning styles are less imaginative. When conducting questions and answers with the subject, the divergent subject explained several designs he wanted to use to solve

mathematical literacy problems. Below is an excerpt of the question and answer with the divergent subject in solving the problem:

- Researcher : *What strategy or method did you use in solving the problem?*  
 S1 : *I read the question carefully and then identified the problem by writing known, asked, and the solution steps. However, I needed clarification about which formula to use.*  
 S2 : *Solve it using the appropriate formula and write known, asked and solution.*  
 Researcher : *Did you recheck your answer?*  
 S1 : *Yes, but only at a glance and see if it is all filled in or not because I did the question was difficult.*  
 S2 : *No, I immediately collected my answers.*

From the results of the question and answer, it was found that students with a divergent learning styles are very good at planning, but they need to be more careful when re-evaluating their answers.

**Table 2.** Mathematical Literacy Skills in Divergent Students

No.	Indicator	Written Tests
1	Formulate or write problems from the problem logically and by the language and mathematics math	From the problem presented, you can write the problem, and it is just that the use of the word is less effective
2	Writing down explanations in working on problems	Already correct in writing the flow problem solving
3	Interpreting and evaluating the solution of mathematical literacy problems	When writing the conclusion of the problem is still incomplete

Convergent learning styles have been able to utilize information from existing problems well. In addition, they have also been able to write what they know about the problem and what is asked from the problem, and students who have this type of convergent learning style have a good understanding of the problems they face when working on mathematical literacy problems.

- Researcher : *What strategies or methods do you use in solving the problem?*  
 S3 : *I wrote down the known questions first, and then I used the circle formula to solve this problem*  
 S4 : *By writing the known and questioned first*  
 Researcher : *Did you recheck your answer?*  
 S3 : *Yes, I rechecked my answer.*  
 S4 : *Seeing all my answers, have they been filled in or not*

**Table 3.** Mathematical Literacy Skills in Convergent Students

No	Indicator	Written Test
1	Formulate or write problems from the problem logically and by the language and mathematics math	When solving the problem, the subject was able to write down the information in the problem
2	Write an explanation for working on the problem	In writing, the problem-solving steps are correct
3	Interpreting and evaluating solutions to mathematical literacy problems	Can you write the conclusion of the problem

The following learning style is assimilation. Students with the assimilation type of learning style are very good at mastering problems related to mathematical literacy. The students can use the information obtained in the task well. Furthermore, students with this assimilation learning style can explain the process from mathematical literacy to problem-solving well. In addition, students with this assimilation learning style think seriously about how to solve a problem, even though the process takes a long time. This is what makes the assimilation subject rush to recheck the answer. Below is a fragment of the interview with the assimilation subject:

- Researcher* : Did you find it difficult when working on these problems?  
*S5* : At first, I did not understand kak, but after I read it repeatedly, thank God I understood and could work on it.  
*S6* : It was challenging and took me quite a long time to work on this problem.

When working on mathematical literacy problems, subjects with this accommodation type of learning style can only write down what is known and asked from the existing problems. However, these students have yet to be able to apply various appropriate methods to solve the problem, and the methods compiled still need to be completed. This makes students with the accommodation learning style model often experience problems in solving problems rather than re-evaluating.

Analysis of students' mathematical literacy skills, if translated into indicators in the mathematical literacy method, can include communication, mathematization, representation, reasoning and argumentation, design, use of symbols, use of formal, technical and operational language, use of mathematical tools against divergent learning styles (D), convergent learning styles (K), assimilation learning styles (A), and accommodation learning styles (AK) as follows:

**Table 4.** Mathematical Literacy Ability Based on Learning Style on Problem 1

No	Process Indicator Mathematical Literacy	D	K	A	AK
1	Communication	√	√	√	√
2	Mathematization	√	√	√	√

No	Process Indicator Mathematical Literacy	D	K	A	AK
3	Representation	x	√	√	x
4	Reasoning and Argument	x	√		x
5	Design	x	√	√	√
6	Use of symbols, formal language and technical operations	x	X	√	x
7	Use of mathematical tools	x	√	√	x

Table 4 states that students with a divergent learning style tend to fail when fulfilling some processes, meaning that this divergent learning style only achieves communicative and mathematical indicators. It is different with convergent subjects that can achieve almost all existing indicators. Meanwhile, assimilation and accommodation subjects achieved indicators that could be pretty balanced in question 1, Mathematical Literacy Competency Test.

**Table 5.** Description of Mathematical Literacy Skills in Terms of Learning Style on Question 2

No	Process Indicator Mathematical Literacy	D	K	A	AK
1	Communication	√	√	√	√
2	Mathematization	√	√	√	√
3	Representation	x	√	√	x
4	Reasoning and Argument	√	√	x	x
5	Design	x	√	√	√
6	Use of symbols, formal language and technical operations	x	x	√	√
7	Use of mathematical tools	x	√	√	x

Table 5 shows changes in divergent learning styles and accommodations by mathematical literacy skills for question 2. Divergent subjects can improve their thinking skills and express ideas when solving problems. At the same time, the accommodation subject met the indicators of symbol use, formal language use, and the use of appropriate language and operations.

**Table 6.** Description of Mathematical Literacy Skills in Terms of Learning Style on Questions 3 and 4

No	Process Indicator Mathematical Literacy	D	K	A	AK
1	Communication	√	√	√	√
2	Mathematization	√	√	√	√
3	Representation	x	√	√	x
4	Reasoning and Argument	√	√	x	x
5	Design	x	√	√	√
6	Use of symbols, formal language and technical operations	x	x	√	√
7	Use of mathematical tools	x	√	√	x

Table 6 shows that literacy skills for questions 3 and 4 in each subject remain the same. Therefore, a student's mathematical literacy ability can be understood and known in terms of his/her learning style.

## Discussion

From the mathematical literacy questions that I tested, starting from questions 1 to 4, it was found that each student's learning style differed. Of course, their mathematical literacy skills were different too. Students with a divergent learning styles can reach the formulating stage, and this is because students feel insecure when answering questions. This is to the view (Riau & Junaedi, 2016) that the divergent learning style when solving problems in a problem fails to reveal the problem-solving steps when rechecking the answer. Students with divergent learning styles also tend to become bored when they need help understanding the problem (Jalinus et al., 2020).

Students with convergent learning styles are very confident when solving mathematical literacy problems. Therefore they can solve problems up to the evaluation stage. As mentioned (Tandiayuk, 2012), this convergent learning style has excellent problem-solving skills. This statement is in line with the characteristics of students with a convergent learning style, namely problem-solving skills and making excellent decisions.

Furthermore, students with this assimilation learning style can achieve all indicators, namely formulating, describing the explanation of problem-solving (employing), and evaluating from solving mathematical literacy problems (interpreting). This is because students with an assimilation learning style are more focused on books, listening to the teacher when explaining the material, and are more individualistic when learning is done. This is commensurate with the opinion (Tandiayuk, 2012). Namely, students who have a style of learning assimilation prefer the activities they want without listening to what others say, and the results are also specific and more complete. This statement is concrete, with some characteristics of the assimilation learning style. Students accustomed to this learning style have an excellent understanding of various data presentations and can summarize them logically, concisely, and clearly.

Whereas students with an accommodation learning style, when they solve a problem on a mathematical literacy problem, can only achieve the indicators of formulating the problem in the problem (formulating) and writing an explanation when working on the problem (employing). This is because, during learning, students with an accommodation learning style tend to focus on their friends and like to pay attention to their friends' work but are reluctant to give up when working on problems. To prevent the act of looking at friends' work, it can be overcome by giving different test questions. This is by research (Zulfiani et al., 2020) that a combination of different tools can develop skills in learning for each learning style. This is by the accommodation type learning style. The characteristics of accommodation students have an excellent ability to learn from real-life experiences from their own experiences, to plan and engage directly in a variety of new and more challenging experiences, and in solving problems, must consider more human factors (participation and importance of information) than technical analysis.

## D. Conclusion

From some discussions, the results of this study are that students with divergent learning styles prefer social activities. Therefore, it is recommended that learning for students who have divergent learning styles should be carried out using group learning methods. Students with convergent learning styles will prefer to solve a problem and face it with various challenges. So students with convergent learning styles prefer hands-on activities, so it is recommended that learning is done with hands-on practice. It is different with students who have an assimilation learning style, where students will prefer to read by themselves. Therefore, in the learning process, allow students to read independently and understand their part during the learning process. On the other hand, students with an accommodation learning style tend to prefer learning through activities and events they experience. Therefore, the researcher suggests that the learning given to students should be based on experiences that are in students' lives.

Students' ability in mathematical literacy can be viewed from their learning style in the type of divergent learning style only reaches the stage of formulating problems in the problem (formulating). While the ability of students with an assimilation learning style occurs until the stage of interpreting and re-evaluating the answer (interpreting), it has yet to go well. Furthermore, the accommodation learning style in mathematical literacy skills has reached the stage of formulating and re-evaluating the answer (interpreting). However, the stage of writing an explanation (employing) has yet to be achieved well.

Based on the results of this study, there is input from researchers for educators to apply mathematics learning more contextually. Ask questions that help students develop aspects of their mathematical literacy skills at this point. Every student has mathematical literacy skills, but the level is certainly different. In addition, educators must also recognize the differences in learning styles between students. It is hoped that with this research, schools can reflect on students' mathematical literacy skills and be inspired further to develop the mathematical literacy skills of all students. As for future researchers, it can be done by connecting or linking with areas that are not the same. In addition, researchers should also pay attention to the urgency to be achieved and then identified as a research topic. Moreover, researchers need to examine the results of previous research to find updates that can support learning, especially mathematics learning.

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