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ANALYSIS OF STUDENTS MATHEMATICAL LITERACY ABILITY IN SOLVING PISA PROBLEMS IN TERMS OF STUDENT LEARNING INDEPENDENCE

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ABSTRACT

Mathematical literacy skills are one of the essential aspects that students need to master because, through this ability, they can solve problems in everyday life. Providing *Programme for International Student Assessment* (PISA) questions is one of the teachers' efforts to develop students' mathematical literacy skills. This study aims to describe the observed mathematical literacy ability of students learning independence and analyze the difficulties experienced by students in solving PISA problems. The study subjects consisted of 20 students of SMPN 02 Siak Hulu. The research method used is descriptive. The research instrument is PISA test questions oriented to quantity content, learning independence questionnaires, and interview guidelines. The data obtained is analyzed by reducing, presenting, and drawing conclusions. The result of this study is that students doing PISA questions are still experiencing difficulties. This difficulty occurs because students are unfamiliar with PISA model questions. They do not understand the meaning of the problem, do not understand the material in the problem, are confused about determining mathematical concepts, and cannot apply problem-solving strategies.

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1. INTRODUCTION

The era of the industrial revolution 4.0 demands a change in the context of learning. The paradigm of implementing learning that focuses on the ability to think critically, connect

knowledge with everyday life, communicate and collaborate and participate in using sabila technology, 2022). The 21st century is a time marked by advances in science, technology, information and communication, global competition and free competition so that the basic abilities that students must have are not just counting skills but mathematical thinking and reasoning skills in solving problems and learning new ideas faced by students in the future (Janah et al, 2019). These things are contained in mathematical literacy skills that are important for students to master. Mathematical literacy skills help students to solve problems related to everyday life using mathematical concepts. Mathematical literacy skills include the ability of individuals to reason mathematically, formulate problems, apply concepts, and interpret mathematics to solve various problems in various real-world contexts (Yudi &; Rajab, 2019).

In line with what was expressed by Kusumawardani et al. (2018) Mathematical literacy ability is said to be the ability to formulate, use and interpret mathematics in various real-world problem-solving contexts effectively. Kusniati (2018) explains mathematical literacy skills as mathematical thinking skills that use concepts, procedures, facts, and tools to describe, communicate, and estimate a phenomenon they face.Interpreting the statement above that mathematical literacy ability as the ability to connect relevant mathematical concepts tosolve various problems in the real world. Students who have mathematical literacy skills will tend to be active in learning, able to ask a series of questions, formulate problems in mathematical form, be able to communicate ideas effectively that aim to solve everyday problems (Kamila, 2022). It is important for students to have mathematical literacy skills because this ability makes it easier for students to solve complex problems in the real world effectively. One of the efforts to build students' mathematical literacy skills is by practicing doing context-based math problems and PISA-based problems (*Programme for International Student Assessment*). Understand the importance of mathematical literacy skills as mathematical skills that help solve PISA problems.

PISA classifies students' levels of mathematical literacy ability into 6 levels from the highest and lowest. The problem of mathematical literacy ability level is divided into three groups, namely levels 1 and 2 as the lower scale, levels 3 and 4 including the medium scale, and levels 5 and 6 including the high scale. PISA content is divided into four main materials, namely, *quantity*, space and shape, *uncertainty and data*, and change and *relationship* (Setiawan &; Dores, 2019). PISA references in presenting problems using problems that contain context (Lutfianto &; Sari, 2017).

Table 1. Indonesia's PISA Ranking

Year	Literacy Assessment	Indonesia Average Score	Indonesia Ranking	Number of Participating Countries
2012	Mathematics	375	64	65
	Read	396	62	
	Science	382	64	
2015	Mathematics	386	63	69
	Read	397	61	
	Science	403	62	
2018	Mathematics	379	73	79
	Read	371	74	
	Science	396	71	

Source: Hewi & Shaleh, 2020

PISA problems emphasize students' ability to connect the context of the problem with mathematical concepts in order to obtain solutions from malasah (Rusmining, 2019). The results of the PISA study published by the OECD that assessed mathematical literacy skills showed in table 1.

Based on Table 1 that the mathematical literacy ability of Indonesian students from year to year has not improved significantly and is still in the low category. The condition occurs because students are not accustomed to doing questions related to the context of daily life. Through giving PISA questions regularly, students can practice understanding a problem quickly and use the basics of mathematics needed to solve problems in everyday life (Masjaya &; Wardono, 2018).Regarding in equipping students' mathematical literacy skills, teachers should provide opportunities for students to build their own knowledge and relate mathematics to life because through understanding concepts and the ability to apply concepts in everyday life problems become part of mathematical literacy competence (Susanti &; Syam, 2017). Related to mathematical literacy skills, according to Ahmad & Ni'mah (2019) stated that many students experience difficulties in the literacy process that applies mathematical concepts by 71.68%. The low ability of mathematical literacy is due to the quality of mathematics learning which is still relatively low.

Mathematics learning is not too emphasized aspects of knowledge and understanding, aspects of application, analysis, and evaluation so that students are less trained to hone their mathematical literacy skills (Martalyna et al, 2018). Kholifasari et al (2020) stated that the factor that affects the low ability of mathematical literacy is because students have difficulty understanding and planning strategies to solve problems so that they do not provide the right steps in solving problems. As for Wulandari &; Azka in (Habibi &; Suparman, 2020) stated that there are many determinants that affect students' mathematical literacy abilities, namely learning provided by teachers, classroom environment, family support, readiness in learning implementation and independent attitude in learning. Students' independent attitude in learning can be formed in a condition known as learning independence. Learning independence as one of the basic abilities needed by students in learning because it can increase student motivation in controlling behavior and using their cognitive to learn to beresponsible for the learning process and in overcoming various problems (Aryanti, 2020).

Basically, learning independence as behavior built by knowledge and competencies possessed by students who provide provisions for students in carrying out active learning activities that are driven by the intention or motive of mastering competencies to solve a problem (Huda et al., 2019). Independent learning skills need to be honed and familiarized in student activities, because learning independence becomes animportant actor that also determines learning success in learning mathematics. As one of the efforts to determine students' mathematical literacy skills, researchers examine students' mathematical literacy abilities in solving PISA problems, number content (*Quantity)* in terms of student learning independence. Johan (Rokhima et al, 2021) that the content of numbers becomes one of the most challenging and most essential mathematical content. This content deals with the relationship of numbers and number patterns including the ability to understand sizes, number patterns, and everything related to numbers in everyday life, such as counting and measuring certain objects. Operating numbers is an important aspect in learning mathematics because if students do not have a good understanding of number material, it affects the sub-material in other PISA contents.

2. METHOD

This research uses a qualitative approach with a descriptive method. The descriptive method is a research method carried out to get an overview of ongoing events or problems or events in the present with an effort to explain or describe the things that happen (Siti et

al, 2020). Researchers chose the descriptive research method because it was in accordance with the purpose of the study, which was to describe and see an overview of students' mathematical literacy abilities in solving PISA problems. This research was conducted in the even semester of FY. 2023/2024 with the subject of this study, SMPN 02 Siak Hulu class IX as many as 20 students. The subjects of the study were selected using *pusposive sampling techniques.* The instruments used were PISA *quantity* questions, learning independence questionnaires, and interview guidelines. The PISA question model, content *quantity* was adopted from Noviana & Budi's (2020) research which has met the valid category consisting of 6 questions.

Researchers took one student from each learning independence category as a sample who was analyzed and interviewed. The interview guidelines used are semi-structured. Theanalysis technique used in this study refers to data analysis techniques according to Miles and Hubersman which are carried out with steps, namely, data reduction, data exposure and conclusions. The activities that the researchers carried out were resistant to data reduction, namely: collecting data on students' mathematical literacy skills obtained and solving PISA questions and learning independence data from questionnaires, collectingthe results of mathematical literacy ability tests andquestionnaires and interviewing research subjects. The dataobtained are neatly arranged and grouped into three categories, including learning independence in the high, medium, and low categories.

Furthermore, the data presentation stage, namely presentingthe data that has been obtained from the PISA question test results and presenting the answer sheet into descriptive form, tables, and pictures about student abilities in accordance with learning independence. The following indicators of mathematical literacy ability arepresented in table 2:

Table 2. Indicators of Students Mathematical Literacy Ability

Level	Indicators
1	Identify aspects in mathematics of real-context situations
2	Identify situations for categories that require immediate resolution
3	Implement and resolve issues using procedures
4	Identify information from the problem that involves context assumptions
5	Implement strategies based on modeling on complex situations
6	Interpret and reflect on the results of work based on the model

Source: (OCED, 2016)

3. RESULTS AND DISCUSSION

3.1 RESULT

This study obtained data on the results of filling out student learning independence questionnaires and PISA test results. Based on the results of the student learning questionnaire analysis, there are 3 criteria grouped, namely students with high, medium, and low learning independence. The following is the number of students who have been grouped based on the criteria of learning independence:

Table 3. Group Learning Independence Questionnaire Results

Categories Learning Independence	Number of Students
High	2
Medium	15
Low	3

Based on the acquisition of Table 3 shows that students have different levels of learning independence, including 2 students with high learning independence, students for the medium learning independence category and 15 low learning independence category there are 3 students. After knowing the learning independence of 20 students, the researcher continued by taking 3 students where 1 subject represented the category of learning independence to examine their mathematical literacy skills in doing PISA problems.

Table 4. List of Research Subjects

Subject Initials	Categories Learning Independence	PISA Test Scores
RSD	High	51
NAA	Medium	43
RS	Low	31

Research subjects grouped by learning independence category were analyzed based on indicators of mathematical literacy.

3.2 DISCUSSION

Level 1 Question

A chef is preparing salad dressing dough for a wedding. Here is a recipe for making 150 milliliters (mL) of salad dressing dough:

Material	Dosage
Oil Salad	90 mL
Vinegar	45 mL
Soy Sauce	15 mL

If the chef wants to make mL of salad dressing, determine how much each ingredient does? 500 (PISA level: 1, *context: personal, process: formulate*)

The number of students who can do question number 1 correctly is 8 students. Students with high learning independence are RSD subjects withthe score of question number 1 is 8 out of 10. Based on the score, grades and answer sheets, RSD subjects can understand and identify the information contained in the questions by writing them correctly. Students with moderate learning independence were NAA subjects earning a sscore of 5 out of 10. Based on the score and answer sheet, the NAA subject showed that it was able to identify the information contained in the question but was not accurate in writing back the information into the solution. Students with low learning independence were RS subjects obtaining a score of 3 out of 10. Based on the grade score and answer sheet, the RS subject shows that students are able to take the information contained in the question but there are still errors in writing back into the solution.

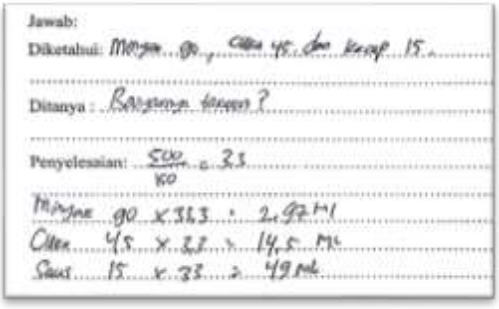


Figure 1. RS Answer to Question Number 1

Figure 1 shows that students have not been able to identify complete information on the question as it is known and asked in the question there is still something that has not been written. Based on the results of the work of hospital students, it indicates that they are not careful in reading the questions so that there are parts of information that have not been written. The subject of the RS hastened in writing down the settlement as a result of misstating the known information again. Based on this presentation, it shows that hospital students can identify the information contained in the question but still cannot understand the meaning of the question so that there are still errors in solving it.

Level 2 Question

John works at a shop that rents DVDs and computer games. In this store there is a fee to become a permanent member for zeds which is valid for a year. DVD rental fees are cheaper than non-member rental fees 10 , asshown in the following table:

Non-member rental fee for one DVD	Member rental fee for one DVD
4,20zeds	3,50zeds

Last year Hary was a member of a DVD rental store. Last year Hary spent zeds including his membership fee. How much would it cost Harry a total if he wasn't a member, but Harry had rented the same amount of DVDs? 64,50 (PISA level:2, *context: personal, process:formulate*)

Many students have difficulty in doing question number 2 so that no student answers correctly. Students with high learning independence are RSD subjects on question number 2 obtaining a score of 3 out of 10. Based on grade scores and answer sheets, RSD subjects show that students have not been able to know the situation for categories that require solving problems directly. Students with moderate learning independence are NAA subjects obtaining a score of 3 out of 10. Based on grade scores and subject answer sheets, NAA indicates students cannot recognize situations for categories that require immediate completion. Students with low learning independence scored 3 out of 10. Based on the grade scores and answer sheets, the RS subjects showed that students were unable toknow the situation for the category thatneeded immediate completion.

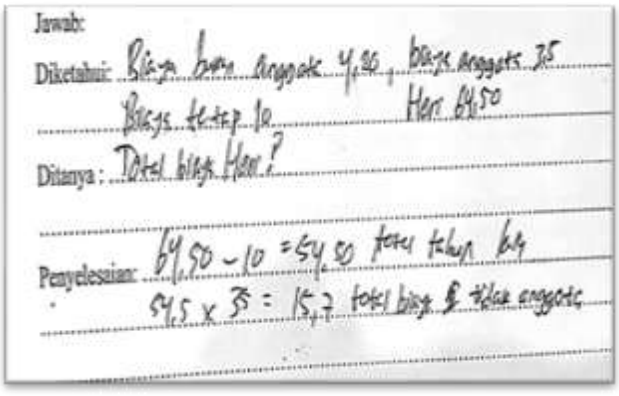


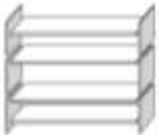
Figure 2. RS answer to question number 2

Figure 2 shows that hospital students have not been able to recognize the problem contained in the problem seen in the inaccuracy in choosing relevant information to solve the problem. Based on the work of the hospital students, the part asked was the total cost spent by Harry as a member, in fact, the question asked for the total cost of Harry if he did not become a member by renting the same number of DVDs. RS students admitted that they

did not read the whole question because they were stuck in time so they did not understand the meaning of the question well. RS students are not detailed in writing down the solution, it seems that they do not make a solution formula and make a final conclusion. Based on this presentation, it shows that hospital students cannot recognize the problems contained in the questions.

Level 3 Question

To make a bookcase, a craftsman needs materials, namely, long wooden plank fruit, short wooden board fruit, small tongs, large tongs and screw fruits. The craftsman keeps a stock of long wooden boards, short wooden planks, small tongs, large tongs and screw fruits. How many bookshelves can a craftsman possibly make? (Level PISA: 3, *context: educational and occupational*)



The number of students who can do question number 3 correctly is 3 students. Students with high learning independence are RSD subjects on question number 3 obtained a score of 10 out of 15. Based on grade scores and answer sheets, RSD subjects show that students are able touse mathematical concepts according to algorithms. Students with moderate learning independence were NAA subjects obtaining a score of 10 out of 15. Based on grade scores and answer sheets, NAA subjects show students are able to solve mathematical concept problems according to algorithms, however, there are errors in writing the final results. While students with low learning independence were RS subjects with ascore of 10 out of 15. Based on the score and answer sheet, the RS subject shows that students are able to use mathematical concepts according to the algorithm, but in solving there are still errors in writing the final answer so that the value is not right.

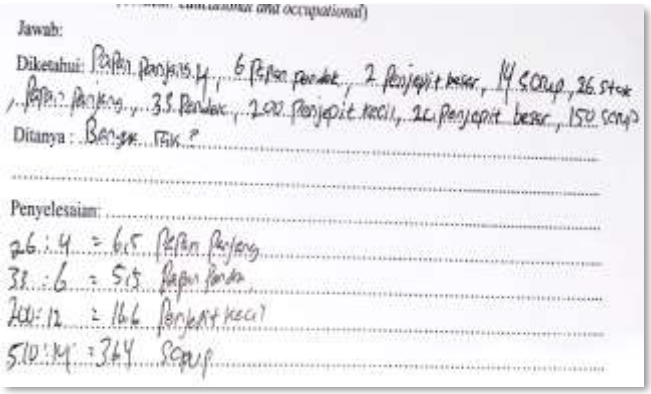


Figure 3. RS Answer Question Number 3

Figure 3 above shows that students can already use the scoring operation according to the algorithm but are incomplete in writing the answer to the solution. RS students lack detail in writing down the elements contained in the problem and are incomplete in describing the answer to the solution such as the number of shelves for small tongs is not written. Based on the presentation, it shows that students can solve problems using mathematical concepts according to the algorithm but there are still errors in writing the final answer.

Level 4 Question

A pizzeria offers pizza with two basic toppings: cheese and tomato. Customers can also order pizza with extra toppings. There are four choices for extratoppings, namely meat, mushrooms, salami, and olives. Bela wanted to order a pizza with two kinds of toppings rattling. How many topping combinations can Bella order? (PISA level: 4, *context: educational and occupational*)

The number of students who can do question number 4 well is only 1 student. Students with high learning independence are RSD subjects obtaining a score on question number 4 of 12 out of 15. Based on the score, grades and answer sheets, it shows that students can write down the elements contained in the problem and relate the elements to the problem solving. This indicates that the RSD subject has been able to identify the information contained in the problem that involves context assumptions. Students with moderate learning independence were NAA subjects obtaining a score of 8 out of 15. Based on scores, grades and answer sheets, NAA subjects have been able to write down the elements contained in the question but have not been able to relate these elements to problem solving. This suggests that NAA subjects are still unable to involve context assumptions in the settlement.

Thosewith low learning independence were RS subjects who scored 5 out of 15. Based on the score, grades and answer sheet, the RS subject has been able to write down the elements on the question but has not been able to relate them to the problem solving. This shows that the subject of NAA is still unable to engage context assumptions so that the answers are wrong.

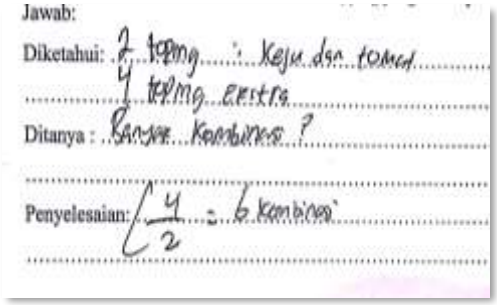


Figure 4. RS Answer Question Number 4

Figure 4 above shows that the RS subject has been able to recognize known information but has not been able to understand the meaning of the question looks inaccurate in determining what is asked in the question. RS subjects are still not optimal in doing the problem, look not detailed in describing the solving steps and wrong in writing symbols from combinations. Based on the presentation of the answers, students showed that they could not yet relate known elements to the solution.

Level 5 Question

A cheese factory in Bandung can produce cheese every day as shown in the table with a fixed pattern in the day. Mr. Abas as an employee of the cheese factory who is in charge of inspecting damage to cheese products. What was the amount of production and a lot of damage that Mr. Abas found on the day?1010(Level PISA: 5, *context: occupation*)

Day To	Production Quantity	Lots of Damage
1	1500	30
2	1400	28
3	1550	31

4	1500	30
5	1600	32
6	1600	32

Many students have difficulty in doing question number 5 so no one manages to solve it correctly. Students with high learning independence are RSD subjects getting a score of 10 out of 25. Based on scores, grades and answer sheets, RSD subjects show that students can design strategies to solve problems, but are less careful in doing calculations, so they are still not precise in applying strategies based on modeling to complex situations. Thosewith moderate learning independence were NAA subjects obtaining a score of 10 out of 25. Based on grade scores and answer sheets, NAA subjects show students are less precise in choosing strategies to solve problems so that the solution is wrong. This indicates that NAA subjects have not been able to apply strategies based on modeling to complex situations. Meanwhile, studentswith low learning independence obtained a score of 4 out of 25. Based on the score and answer sheet, the RS subject shows that students are not right in choosing strategies to solve the problem so that the solution is wrong. This indicates that NAA subjects have not been able to apply strategies based on modeling to complex situations.

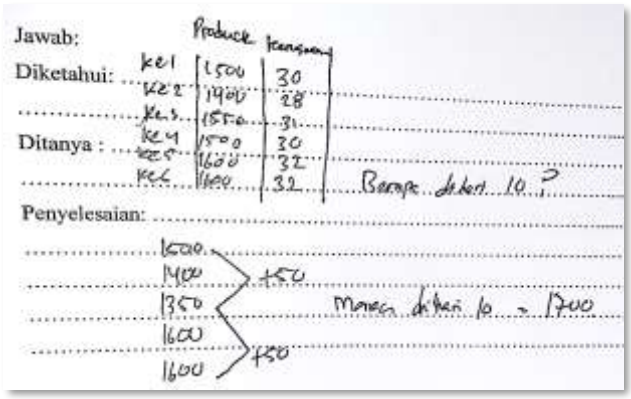
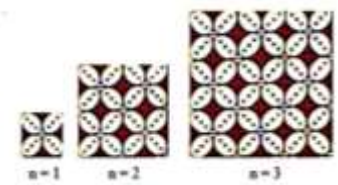


Figure 5. RS Answer Question Number 5

Based on Figure 5 shows that students have been able to design strategies, namely by using number patterns to solve the above problems but there are errors in doing calculations. The RS subject was correct in choosing a strategy using a number pattern, but the pattern formed by students in the form of determining the amount of production in day-10 was still not right because students were incomplete in writing down the number sequence so that the wrong solving results were obtained. The subject of RS is also in writing the solution is still less detailed so that there are parts that are not elaborated. The RS subject did not write down the calculation process directly making conclusions so as to confuse 1700 and 36 obtained from where. Based on this presentation, it shows that RS subjects can design strategies but are not precise in the calculation process+50 .

Level 6 Question

Here is a picture of Javanese batik motifs.



A fabric with a wide area 6 cm^2painted white flower fruit consisting of petals14. Then, for fabrics with area 12 cm^2 Painted white flower fruit consisting of 4 petals and so 16 on. Suppose is the number of rows of white flowers then n^2 as the number of flowers is white and is a broad fabric. If the fabric used is wider with the same white floral motif as the previous pattern, which one increases faster. Number of white flowers or area of fabric? Prove and explain your answer! (PISA Level: 6, *context: occupation*)

Many students have difficulty in doing question number 6 so no one manages to solve it correctly. Students with high learning independence are RSD subjects obtaining a score of 3 out of 25. Based on the score and answer sheet, the RSD subject shows that students can understand the model of the question, but there are still errors in using their reasoning for problem solving so that the conclusions on the questions given are still incorrect. This indicates that the RSD subject has not been able to interpret and reflect on the results of work based on the model. Then, for students with moderate learning independence, NAA subjects scored 2 out of 25. Based on the score and answer sheet, NAA subjects do not understand the model of the questions so they have difficulty in solving the problem. This shows that NAA subjects cannot interpret and reflect on the results of work based on models. While students with low learning independence were RS subjects scored 3 out of 25. Based on the score and answer sheet, the RS subject showed that they were not able to understand the meaning of the question so that it was not optimal in solving the question.

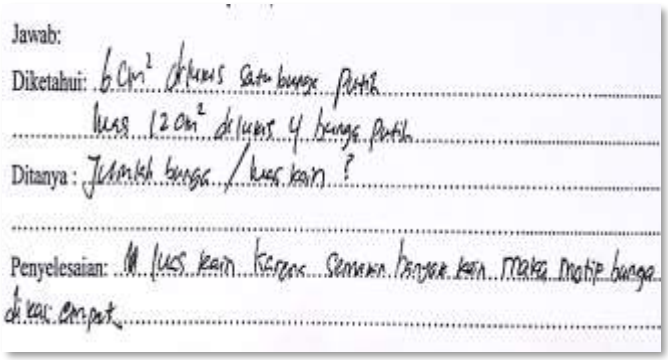


Figure 6. RS Answer Question Number 6

Based on Figure 6, it shows that students cannot understand what is asked in the question and in using their reasoning to solve the problem, the problem is still not appropriate so that it is not optimal in making final conclusions. The RS subject in solving the problem immediately concluded that the fabric area increased faster, without giving exposure to the calculation process of the final answer. Based on the explanation that RSD subjects cannot interpret and reflect on the results of work based on the model.

Based on the data obtained, most students are not optimal in solving level 2, 4, 5, and 6 questions, the reason is that they do not understand the meaning of the questions well because they do not read the questions thoroughly and limited processing time. The results of interviews with students with high category learning independence, namely RSD subjects experience difficulties and obstacles in doing PISA questions because they have never done these questions so that students feel foreign. RSD subjects also experience confusion in using the right mathematical concepts for each problem. Then for students of moderate learning independence, namely NAA subjects have difficulty in solving PISA questions because the questions given are long and difficult to understand. NAA subjects still have difficulty in choosing a solution strategy because they feel confused about which mathematical formula to use to solve the problem. NAA subjects find it difficult to do because the form of the problem has never been studied before.

As for students with low learning independence, namely the subject of RS experiencing problems in working because the questions in the form of long stories will be difficult to understand so that they do not understand the meaning of what is asked in the questions. Limited processing time makes the RS subject rush to do the problem, making him less careful to do calculations and write down the information contained in the problem. The RS subject claimed not to remember the formula so he was confused about determining the mathematical concepts used to solve the problem. The results obtained by the researchers are in line with the research of Sujadi et al. (2022) states that students' lack of understanding of the problem is because they are not used to doing math practice problems with PISA characteristics and do not know mathematical concepts make students experience confusion in solving problems. According to Mutia et al, (2021) teachers more often give rut in questions compared to non-routine questions to students so that students are not trained in solving non-routine problems such as those found in PISA. Because there are still many students who are not familiar with doing and understanding PISA characteristic questions, teachers are expected to include discussions about the PIS A model in thelearning process.

Through the provision of practice questions or tasks that are acteristic, PISA can help students to improve their mathematical literacy skills (Madensi et al, 2020). In line with research conducted by Susanti & Syam (2017) that teachers play a role in improving students' mathematical literacy skills. One of the efforts so that students have good mathematical literacy skills is to challenge students in solving more PISA-based math problems so as to force students to obtain mathematical information from real-world problems. It tries to help provide opportunities for students to engage in real-world problems aimed at making maths more interesting and relevant to students and can develop broader mathematical competencies. Efforts to improve students' mathematical literacy skills are the need for changes in learning design that can support the achievement of mathematical literacy indicators. In this regard, it is necessary to pay more attention to teachers developing students' mathematical literacy skills. Seeing mathematical literacy skills is one of the abilities needed by students to answer PISA questions.

4. CONCLUSION

Based on the presentation and discussion of the study results, the ability of student learning independence varies with the high category learning independence of as many as two students. For the medium category, as many as three students with low categories. Students with high learning independence can identify aspects in mathematics of real context situations, implement and solve problems using procedures, identify information from problems that involve context assumptions and are not yet able to recognize situations for categories that require direct solutions, implement strategies based on modelling complex situations and interpret and reflect on the results of work model-driven. Students with moderate learning independence can identify aspects in mathematics of real context situations and implement and solve problems using procedures and are not yet able to recognize situations for categories that require direct resolution, identify information from problems involving context assumptions, implement strategies based on modelling complex situations and interpret and reflect on results Model-driven artistry.

Students with low learning independence are not yet able to identify aspects in mathematics of real-context situations, recognize situations for categories that require direct resolution, implement and solve problems using procedures, identify information from problems involving context assumptions, implement strategies based on modelling complex situations and interpret and reflect on the results of work based on models. This condition is caused because students are not used to being faced with questions that refer to the PISA model. Students' low mathematical literacy ability is caused by not understanding the

concepts in the material contained in the problem. They need help understanding the meaning of the problem, are confused about determining the mathematical concepts used, and cannot apply solving strategies.

5. SUGGESTION

It is expected that teachers can train students by providing PISA model questions as a step to develop students' mathematical skills so that students can utilize mathematical literacy skills in solving various problems of daily life and be better prepared to do PISA problems. There are suggestions to other researchers who will conduct similar studies to examine mathematical literacy skills at the high school level and above on all PISA content.

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