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Students' Mathematical Literacy Ability in Calculus Courses in Online Learning at the University of Semarang

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Abstract. Learning calculus in an online class is very challenging for students. This type of research is qualitative with the aim of explaining students' mathematical literacy skills in calculus courses. The sample for this study were three students out of 38 students who took electrical engineering courses. The students consisted of different levels of initial mathematical ability, namely high (score 80), medium (scores between 50 to 80) and low (less than 50) in calculus courses. Test and interview methods were used to collect data. The results showed that students with high mathematical abilities (S1) were at level 4 of their literacy skills and the percentage score reached 78.3%. Students with medium mathematical abilities (S2) are at level 3 of mathematical literacy skills with a score percentage reaching 62.5% and for students with low mathematical abilities (S3) are at level 2 literacy skills and the percentage score reaches 46.6%.

Keywords: calculus, mathematical literacy, online learning

Abstrak. *Belajar kalkulus di kelas online sangat menantang bagi mahasiswa. Penelitian ini adalah deskriptif kualitatif dengan tujuan untuk menjabarkan kemampuan literasi matematika mahasiswa dalam menyelesaikan permasalahan untuk mata kuliah kalkulus. Penelitian ini mengambil sampel sebanyak tiga mahasiswa dari 38 mahasiswa yang mengambil teknik elektro. Siswa terdiri dari berbagai tingkat kemampuan awal matematika, yaitu tinggi (skor 80), sedang (skor antara 50 sampai 80) dan rendah (kurang dari 50) dalam mata kuliah kalkulus. Metode tes dan wawancara digunakan untuk mengumpulkan data. Berdasarkan hasil penelitian diperoleh bahwa mahasiswa dengan kemampuan matematika tinggi (S1) berada pada level 4 kemampuan literasinya dan persentase skornya mencapai 78,3%. Mahasiswa dengan kemampuan matematika sedang (S2) berada pada level 3 kemampuan literasi matematika dengan persentase skor mencapai 62,5% dan untuk mahasiswa dengan kemampuan matematika rendah (S3) berada pada level 2 kemampuan literasi dengan persentase skor mencapai 46,6%.*

Kata kunci: *kalkulus, literasi matematika, pembelajaran online*

INTRODUCTION

Mathematics is the basis of science and technology. This shows that mathematics as a science is always evolving in response to the needs that exist in society Therefore, mathematics education is expected not only provide the ability to use formulas to solve test questions, but also to be able to use their thinking and analytical skills in solving everyday problems (Prabawati, 2018).

One of the knowledge used to know and apply mathematics in everyday life is mathematical literacy. Mathematical literacy is a person's ability to maintain his life in society by applying the basic knowledge of mathematics (Mansur, 2018). A person's mathematical literacy ability is seen from his skills in formulating and applying mathematics to situations in various contexts. This ability is used to reason systematically with concepts, procedures and facts in describing phenomena in everyday life (Utaminingsih & Subanji, 2021)

Mathematical literacy assessment uses an international assessment, namely the Program for International Student Assessment (PISA) (Wardono & Kurniasih Ary Woro, 2015). PISA has a focus on literacy that emphasizes the skills and competencies students acquire from school for use in real-life situations. PISA identifies three components in mathematical literacy, namely content components, process components, and context components. The content component is the content or material studied in mathematics. The process component is a person's step to solve a problem by applying mathematics as a means of solving it. Process ability is a person's ability to formulate, employ and interpret mathematics to solve problems (Chasanah et al., 2020).

Calculus is a compulsory subject for students of the Electrical Engineering Study Program at the University of Semarang. The purpose of studying calculus courses is so that students gain knowledge of mathematics contained in calculus. In calculus courses there are mathematical materials such as matrices, derivatives, integrals, and trigonometry which are all related to the field of electrical engineering. So that by studying calculus, students can apply learning experiences and increase mathematical literacy skills in the electrical field.

However, the reality is that students who study calculus only memorize mathematical formulas and are less able to solve problems that contain mathematical literacy. According to (Mansur, 2018), In Indonesia, the low mathematical literacy is caused by the lack of providing literacy-based mathematical problems in learning. So that students have difficulty when dealing with mathematical literacy problems. The results of the study (Yustitia & Juniarso, 2020) show that students often have difficulty solving problems if the questions given are slightly different from the problems in the examples given.

This difficulty is supported by the results of the Final Semester Examination in the 2020/2021 Academic Year of electrical engineering students that only 14% of those who score more than 80 get. Students who score between 50-80 are 45% and scores below 50 are 40%. This is because students have difficulty in working on calculus problems based on literacy in electrical engineering.

One of the causes of these problems, because learning is done online. According to (Yustitia, 2015), stated that online learning affects students' ability to solve math problems. Learning which is usually face-to-face with various methods that actively involve students must turn into virtual or online so that learning interactions between lecturers and students and students and students are reduced. Thus, the mathematics material received by students is not optimal.

According to research (Muzaki, 2019), that students with high initial abilities obtained 19% in completing mathematical literacy with a literacy level of 4. Meanwhile, moderate early mathematics abilities obtained 66% in completion of mathematical literacy level 3 and those with low initial mathematical abilities obtained 15 % in completing level 1 mathematical literacy. Research (Annur & Hermansyah, 2020), that students have difficulty learning mathematics online. In line with (Chasanah et al., 2020), learning styles affect students' mathematical literacy skills. Based on the description above, this research has a purpose, namely to analyze students' mathematical literacy skills in the Calculus course in online learning at the University of Semarang.

RESEARCH METHODS

This research is a qualitative descriptive type, where the purpose of this study is to find information about existing events. The incident was taken according to the circumstances at the time of the research. (Sugiyono, 2017).

This study uses test and interview methods to collect data. The test method is used to measure students' mathematical literacy knowledge level seen from the process of answering the question. The test consists of 6 description questions with different literacy levels. The interview method serves to determine the achievement of the indicator of the level of mathematical literacy that does not appear in the test results.

The results of the research are the percentage of students' literacy skills for calculus courses. The literacy ability is adjusted to the literacy level in PISA which consists of level 1 to level 6. PISA in assessing mathematical literacy uses 6 (six) levels. Where the lowest level is 1 and the highest is level 6. The description for each level in mathematical literacy can be seen in table 1 below:

Level	Description
1	Students can answer questions from all available information that is relevant to the context of a clear question. Identify general information based on clear instructions, then provide actions according to the given simulation.
2	Students can find out situations with contexts that require direct conclusions. Selecting relevant information from a single source, then solved by a basic algorithm or formula by performing the appropriate procedure. From the results of the solution can give the right reasons.
3	Students can perform procedures that require decisions in a clear order. Solve problems by applying simple strategies. Interpret and make representations from different sources of information by giving reasons directly, then being able to communicate these interpretations based on the right reasons.
4	Students can solve problems with concrete and complex situations by involving restrictions to make assumptions. Select and combine different representations, including symbols, then relate them to real situations. Use limited skills to convey reasons for multiple views in a clear context. Communicate interpretations and actions obtained accompanied by explanations.
5	Students can develop a model for a complex problem situation, then identify the problem, and establish assumptions. Choose the right strategy from complex problems related to the model. Use broad thinking and reasoning to work strategically with, linking symbolic representations and formal characteristics and knowledge held. Reflect on the results of their work and can communicate interpretations with appropriate reasons.
6	Students can make concepts and generalizations from the information obtained, then examine and create models using above-average knowledge in complex situations. Connect and represent different sources of information, flexibly. Students at this level have high mathematical reasoning abilities. They apply knowledge, mastery and symbols of mathematical operations to develop new strategies and approaches in dealing with existing situations. Students can also reflect on the actions that have been taken and communicate their actions appropriately and describe their findings, interpretations and opinions with real situations.

Table 1. Mathematical Literacy Ability Level at PISA

The types of literacy-based calculus questions used in this study were in the form of description questions. These questions have different literacy levels. The following are examples of calculus questions according to the level of mathematical literacy:

Level 1

An electric power has a voltage on the channel X = $(8 - 5i)V$ and voltage Y = $(6 + 5i)V$. Define : a. voltage amount between channel X and Y. b. Difference between channel X and Y

Level 2

Uncle has a refrigerator that uses 300 W of power and is turned on for 20 hours every day. How much energy (in kwh) is used in one day? If the electricity tariff per kwh is Rp500, calculate the electricity bill that must be paid by Uncle for one month (30 days)?

Level 3

Electronic company project in X days by spending a daily project cost of (4x-240+10,000/x) hundred thousand rupiah. What is the minimum project cost required by the electronics company? (In Million Rupiah)

Level 4

One day, Andi was walking in the park. He saw an electrical substation that was not used. Andi was curious to calculate the volume of the substation. The data obtained by Supri is that the upper and lower radii of the substation are 30 cm and the middle radius is 40 cm, and the height of the substation is 1 m. What is the volume of the substation?

Level 5

Father has two similar electrically charged objects repel each other with a force that is inversely proportional to the square of the distance between them. If the repulsive force is 10 dyne when the distance between the objects is 2 cm, determine the amount of work required to bring the 5 cm object closer to 1 cm

Level 6

Water leakage from a 55 gallon tank at a rate V'(t) 11−1.1t where t is in hours and V is in gallons. How much water leaks from the tank between t = 3 hours and t = 5 hours and how long does it take to get to 5 gallons?

The object of this research are students in the Electrical Engineering study program, Semarang University Semester 1 Academic Year 2021/2022. The research subjects were 3 students out of a total of 38 students with different levels of mathematical ability, namely high (score ≥ 80), medium (scores between 50 to 80) and low (less than 50) in calculus courses taken in the Mid-Semester Examination (UTS).

The data analysis of this research uses the opinion of Miles and Huberman. The data analysis is through data reduction, data presentation, and drawing conclusions (Sugiyono, 2017). The first step after data collection is to make a transcript of all the recordings. The results of the transcript are reduced, then selected according to the research objectives. Meanwhile, transcripts that do not match are discarded. The reduced data is then tested for credibility and analyzed to draw a conclusion

RESULTS AND DISCUSSION

Mathematical literacy test was given to research subjects in the form of 6 questions according to literacy level. Furthermore, interviews were conducted to support the test results. The results of the mathematical literacy ability test can be seen in table 2 below:

Student	**Questions / Literacy Level**						**Mean (%)**
	1	2	3	4	5	6	
S1 (High)	100	100	100	100	50	20	78,3%
S2 (Medium)	100	100	100	45	30	0	62,5%
S3 (Low)	100	100	60	20	0	0	46,6%

Table 2. Results Test Student Mathematical Literacy

Based on the table above, undergraduate students, namely students who have high initial mathematical abilities are able to work on 4 questions out of 6 literacy-based calculus test questions given with a score of 100, while for question no 5 with

a score of 50 and question no 6 with a score of 20. So S1 is able to answer questions that can measure mathematical literacy skills level 1 to 4 correctly and have fulfilled all indicators with a percentage score of 78.3%

The results of interviews with S1 obtained that students could not complete level 5 and 6 questions to completion. At level 5 questions, students are only able to complete half of all answers. As for level 6 questions, new students make mathematical models of the problem. So it can be said that students who have high initial mathematical abilities (S1) are at literacy skills at level 4 for calculus courses. In line with research (Muzaki, 2019) that students who have high mathematical abilities are at the literacy level of level 4. This is because they can solve mathematical problems in the real world with their reasoning and abilities. But they have not been able to solve problems with complex real problems.

Students S2, namely students who have moderate early math skills, are able to work on 3 questions out of 6 literacy-based calculus test questions given with a score of 100, while for question no 4 with a score of 45 and question no 5 with a score of 30, question no 6 is not done. So that S2 is able to answer questions that can measure mathematical literacy skills level 1 to 3 correctly and have fulfilled all indicators with a score percentage of 62.5%

The results of interviews conducted with Masters showed that students could not solve level 4, 5 and 6 questions. This was because the level questions were complex questions. The design of the model is the main thing for solving these problems. S2 had difficulty in determining the model, so he could only partially solve level 4 and 5 questions, while question 6 was not done. Based on this, students who have moderate initial mathematical abilities (S2) are at literacy skills at level 3 for the calculus course. In line with research (Andes S.A, 2017) that students with moderate abilities can reach the literacy level of level 3. This is because students have not been able to design real-world problems into mathematical models.

Students S3, namely students who have low initial mathematical abilities, are able to work on 2 questions out of 6 literacy-based calculus test questions given with a score of 100, while for question no 3 with a score of 60, question no 4 with a score of 20, and questions no. 5 and 6 do not. done. So that S3 is able to answer

questions that can measure mathematical literacy skills level 1 to 2 correctly and have fulfilled all indicators with a percentage score of 46.6%

The results of interviews conducted by Doctoral Degrees showed that students could only solve problems with a general level of problem (level 1) and questions that were directly processed using the formula (level 2). Students have difficulty when faced with complex problems such as level 3,4,5 and 6 questions. Based on this, students who have low initial mathematical abilities (S3) are at literacy skills at level 2 for calculus courses. In line with research (Buyung & Dwijanto, 2017) that students with low math skills are at literacy level 2. This is because students can only solve math problems that have clear information in the problem.

Based on the description above, the ability of mathematical literacy in higher education must be improved so that students have the ability to reason, connect, solve problems, generalize, and be creative. Mathematical literacy skills are needed so that students' mindsets can develop logically, rationally, creatively, innovatively and can find solutions to problems to prepare them for work after graduation.

CONCLUSION

Based on the research that has been done, it is found that students who have high mathematical abilities (S1) are at level 4 literacy skills with the percentage score reaching 78.3%. Students with moderate mathematical abilities (S2) are at level 3 of mathematical literacy skills with a score percentage reaching 62.5% and for students with low mathematical abilities (S3) are at level 2 mathematical literacy skills with a percentage score of 46.6%. This shows that the mathematical literacy ability of electrical engineering students for calculus courses is improved, especially in online learning

Based on this research, suggestions can be given that lecturers should get used to developing learning and evaluation measuring tools based on mathematical literacy according to the context of PISA. To support student learning activities, it is necessary to use learning media such as interactive videos.

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