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Analysis of errors in solving mathematical literacy analysis problems using newman

Neneng Nuryati✉, Siti Syamsiah Purwaningsih & Endang Habinuddin

Politeknik Negeri Bandung, Bandung, Indonesia, 40559
✉Corresponding Author: neneng.nuryati@polban.ac.id

ABSTRACT

The purpose of this study was to find out student errors in solving problems about mathematical literacy. This study uses a qualitative research approach with sampling method is purposive sampling. The study subjects were three students who were taken based on KAM (Student Initial Ability), namely high, medium, and low ability categories. Each subject is one person per category from the Department of Accounting, Bandung State Polytechnic. This study analyzes student errors in solving mathematical literacy problems in the statistics course for the subdiscussion of hypothesis testing. The error analysis method used is Newman analysis. This study uses two instruments, namely a test instrument with four questions in the form of descriptions and interviews. The data will then be classified into five error categories according to Newman's analysis. The conclusions in this study indicate that there are errors in answering questions, especially for mathematical literacy questions; students are expected to be able to analyze questions in the form of story questions; Understanding the problem instructions and information contained in the problem is the first step in working on mathematical literacy problems so that the level of errors and errors in working on the questions is more resolved. Of the five errors that became the standard for Newman Error Analysis assessment, three errors were made by respondents, namely errors in understanding story questions correctly, errors in transforming story questions into mathematical sentences, and errors in writing the final answer

Keywords: mathematical literacy; newman analysis; error analysis; problem-solving

1. INTRODUCTION

The era of globalization demands the fulfillment of human resources capable of competing with the outside world. Human resources (HR) who have good knowledge and have analytical skills and think critically and logically are needed and proficient in solving problems. This is in line with Agung's statement (2022) which states that the era of globalization as a result of the development of information and knowledge systems must be balanced with the readiness of human resources in facing the era of the industrial revolution 4.0. One of the successes of a country in preparing superior human resources is in producing people who have a logical mindset and are skilled in solving the problems they face. The connection with creating superior human resources certainly cannot be separated from the role of a country's education. The readiness and success of students in solving learning challenges is one of the most crucial things. Prayitno (2021) reveals that the readiness of schools in solving educational problems in schools is to pay attention to several aspects, one of which is from the technical aspect. That is the readiness of students in the face of learning including in completing the test questions given. The ability to solve problems in the mathematics test for the type of description questions has a fairly high level of difficulty compared to the questions in the form of multiple choice. Difficulties in solving story form problems are still found not only among students, but even among prospective teachers, this is still the case. Güner (2021) in his research states that problem solv-ing skills are still lacking. This is complemented by the finding of difficulties in finding the right solution strategy for non-routine questions. This opinion is in line with that conveyed by Schukajlow, et al. (2022) who said that the strate-gy in solving math problems is one of the important things in growing motivation to learn.

The essence of having the ability to solve nonroutine questions is to familiarize students with improving the criti-cal thinking process so that this thinking pattern can be used in the next life. Abidin, et al. (2021: 109) revealed that one's mathematical literacy ability can help in everyday life, especially in solving real-world problems into mathematical language. This is because mathematical literacy skills emphasize a person to think critically, logically, and openly. Susilo, et al.. (2022) revealed that students' critical thinking patterns can be built by providing stimuli in the form of learning strategies, variations of questions, and guidelines for working on the questions themselves. Based on this, students are expected to have good literacy skills, especially in mathematical literacy. Abidin, etc. (2021: 3) reveals that literacy is a skill in using

various ways and tools in expressing and understanding an idea or problem. Thus, students are expected to be able to have good literacy skills, especially in mathematical literacy skills. This is supported by the statement of Hanum, et al. (2020) revealing that mathematical literacy is an ability that must be possessed in solving problems using logical, realistic, and good reasoning ways so that they can communicate and explain problems.

In fact, students' mathematical literacy skills in solving problems based on PISA standards are still lacking. Not accustomed to critical and analytical thinking so that it affects the logical thinking pattern in communicating ques-tions into the right solution. Bana (2021) emphasizes that it takes a lot of preparation from students in learning to solve more analytical problems so that their literacy skills can be honed. Andriatna (2021) in his research confirms that stu-dents' mathematical literacy skills are still not evenly distributed. This has an impact on the readiness of students when they enter the world of education. In line with these findings, Sulistiawati (2021) in her research revealed that students' literacy skills are still not optimal. This is evidenced by the students' mathematical literacy ability which shows the medium category. Indrawati (2020) suggests that research on mathematical literacy needs to be improved, con-sidering the role of literacy skills that are beneficial for everyday life. Thus, literacy skills become an ability that is considered globally.

Errors in solving mathematical literacy based problems are certainly an interesting study material and there needs to be disclosures regarding the underlying causes. Student errors in doing questions are certainly influenced by many factors, one of which is the level of intelligence and habits in solving story problems. The level of error and difficulty is very diverse so we need a method to analyze it. So, the right solution can be taken. Newman error analysis method is one of the detailed methods in classifying error types to solve problems. Hoon, et al. (2020) revealed that in the Newman method there are five stages, namely errors in reading questions, errors in the concept of understanding questions, errors in transforming problems into mathematical language, errors in processing skills, and errors in writing solutions. Noutsara (2021) revealed in his research that the Newman error analysis method originated from a mathematics teacher named Anne Newman in 1977 in Australia. The Newman procedure is one of the procedures for investigating errors in solving story problems, the procedure includes five stages of analysis. Starting from misunderstanding, reading, transformation, process, skills, and coding. Essay questions are questions that require strong analysis before making an answer. One of these problems is found in the statistics course, especially in solving story problems related to hypothesis testing material. Based on the preliminary research, the researcher conducted interviews with several students. They revealed that the difficulty in solving math problems was in translating the problems in the form of stories and in arranging the right stages of work. Based on the description above, the purpose of this study is to find out student errors in solving problems about mathematical literacy.

2. RESEARCH METHOD

This study uses a qualitative research approach with research sampling method with purposive sampling. The research subjects were three students who were taken based on KAM (Student Initial Ability), namely the high, medium, and low ability categories, one person from the Accounting department, Bandung State Polytechnic. This study analyzes student errors in solving mathematical literacy problems in the statistics course for the subdiscussion of hypothesis testing. The error analysis method used is Newman analysis. This study uses two instruments, namely a test instrument with four ques-tions in the form of a description, and an interview. The data is then classified into five error categories according to New-man's analysis.

3. RESULTS AND DISCUSSION

3.1 Results

Based on the results of the analysis of questions given to students as many as four questions in the form of descriptions for the topic of hypothesis testing in the applied statistics course. Shows that the questions compiled are standardized with the preparation of mathematical literacy questions based on PISA. The scoring results based on the standard of mathematical literacy assessment show that there are still many mistakes made by respondents in answering mathematical literacy questions. For more details, an error analysis was carried out using Newman's analysis. The results of working on the questions were analyzed based on the error category according to Newman. The scoring criteria are presented in **Table 1**.

The results of this study reveal several findings based on the Newman error analysis. ***First***, errors from the aspect of reading the questions. In general, among the three re-spondents there were no errors in reading the questions. This was confirmed from the results of interviews which showed that the respondents had no difficulty in reading the questions because the instructions for working on the questions were very clear and in order. Putri (2021) revealed that both respondents who have reflective cognitive abilities and impulsive cognitive abilities both have the ability to understand reading questions well. ***Second***, the analysis of errors in understanding the problem. Some students have difficulty in determining the part that is asked in the problem so that the solution is not correct. This includes errors in capturing information and identifying known and asked parts of the problem. Of the three respondents, it is known that all three experienced errors in understanding question number two. These errors and misconceptions are shown in Figure 3. In this question, the number of samples, average, and standard deviation of the two data is known with a confidence level of 0.05, respondents are asked to find the best option to make a decision. The first respondent assumes that it is enough to answer the question by translating or describing the data that is known, so that in writing the answers the respondent makes a lot of mistakes. Among them do not formulate hypotheses, do not perform statistical calculations, and do not make a picture for the decision making area. Respondents directly analyze answers from known raw data so that the final decision is not right. The second respondent had difficulty in solving the problem. Respondents should have looked for the standard deviation, but instead they were looking for the average deviation. Meanwhile, the third respondent had misconceptions in

doing the questions. The error is seen in the selection of the test formula which should use the student t test, but the respondents instead use the z test, and in the process the process is not complete.

Table 1. Newman error analysis indicators

No	Error type		Indicator
1	Error in reading question	a	Student errors in reading symbols, terms, information and words contained in the questions
2	Error in understanding the question	a	Student errors in understanding the problem so that students do not know what the question is asking
		b	Errors in understanding the questions so that students can't do bad luck to the next stage
3	Errors in transforming the work process	a	Student error in doing calculations
		b	Student mistakes when they do not solve the problem or continue to the next stage of work.
4	Error in writing the final answer	a	Student error not making/writing the final answer requested in the question
		b	Student errors by not writing down and concluding the final answer.
		c	Student errors in lack of accuracy in working on questions so that it has an impact on inaccuracy in doing calculations

Based on the description of the answers to the three respondents, the error occurred in translating the questions by not writing systematic work steps. In testing the correct hypothesis, the respondent should do it with five stages of completion: 1) the determination of the null hypothesis and the alternative hypothesis; 2) determine the level of significance; 3) perform statistical test calculations; 4) compare statistical tests and critical values; 5) decision making and conclusion.

Figure 1 shows the steps of working on respondents who tend to want to answer simply and quickly so that the stages in hypothesis testing are not used. Thus, it can be concluded that this error occurred because respondents were not accustomed to working on questions with regular and detailed work so that they focused more on calculations. In fact, in working on mathematical literacy questions, respondents should pay attention to step by step so that understanding of the concept can be achieved. In line with the conclusions above, Lubis (2022) and Yazidah (2022) reveal that most students are weak in terms of understanding the problem as well as in systematic work.
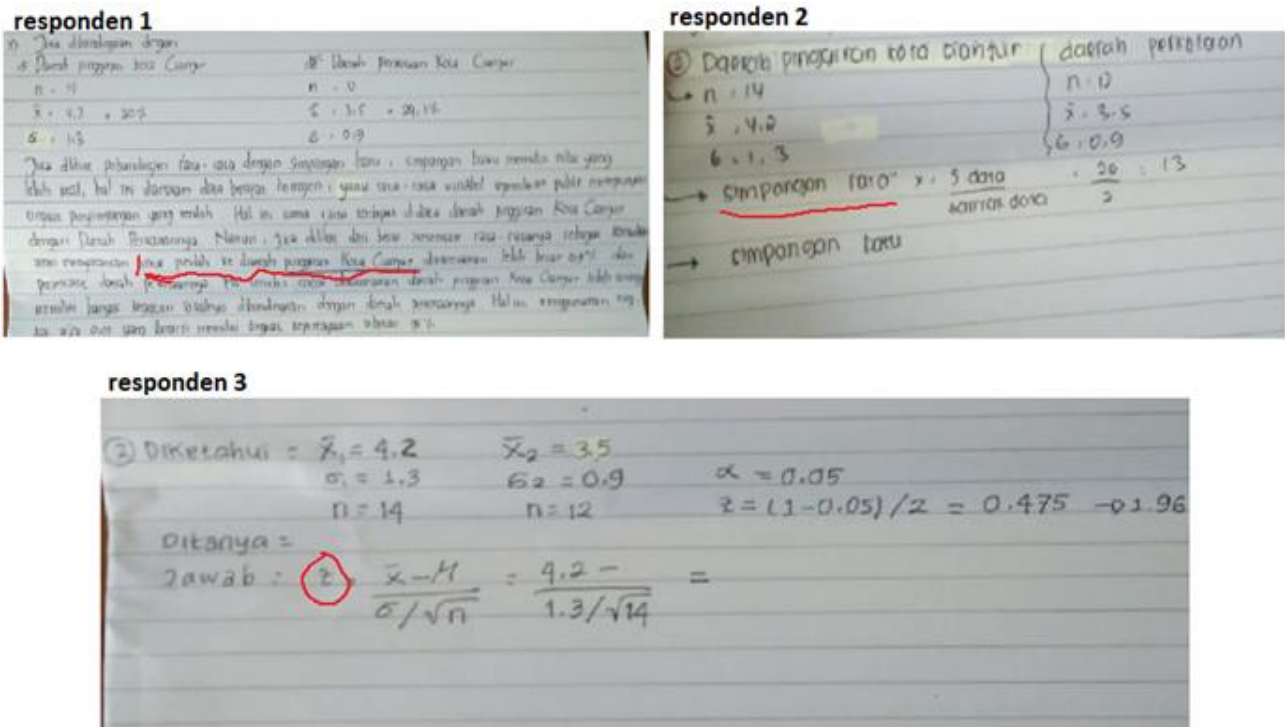

Figure 1. The results of the answers to mathematical literacy questions from respondents

Third, the error made was an error in the transformation of the process of identifying the problem, namely in changing the problem in the problem into the form of mathematical language such as graphs, formulas, or pictures. The error in this study can be seen in Figure 3 below. Respondent two made an error in answering the first question, namely when transforming the question into using the right formula. Respondents should use the proportion formula in determining the combined proportion, while respondents write it in the average symbol. In addition, the respondent was also wrong in using the Z test formula. The last mistake made was in drawing the hypothesis acceptance area which should have been tested by one party, but the respondent instead drew the average test of two parties. Thus, it can be concluded that this error occurred because the respondents did not have a good understanding of manipulating story problems into mathematical language. Yolanda (2021) revealed the results of his research that most students experienced errors from the aspect of error in using formulas and labels for the problem. Gustianingrum (2021) adds that many errors occur due to lack of accuracy in doing calculations. Ikashaum (2021) concludes that many errors occur in the use of formulas so that the calculations are wrong, especially in making decisions.
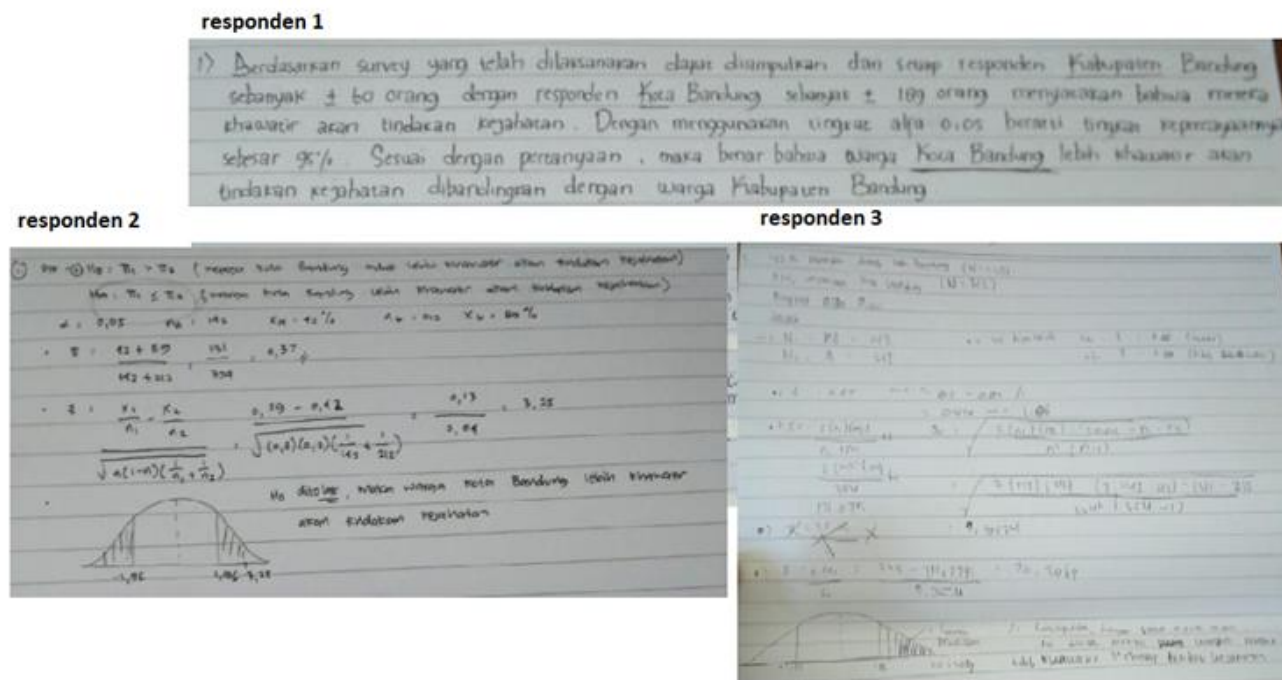

Figure 2. The results of the answers to mathematical literacy questions from respondents

Fourth, error in process skills is a type of error that looks at the aspect of the respondent's error in choosing the procedure in solving the problem or the respondent's error in the calculation process. An example is shown by the picture below which shows the respondent's errors in doing the questions. Namely the selection of the right formula and the correct calculation. At the end of the problem solving there was an error in writing the sign. The respondent should have written -3.1, but instead the respondent wrote 3.1. Next is in writing a series of work in testing the hypothesis that there should be five stages of work, but the respondent only wrote one stage. This shows that respondents do not practice much in solving problems and are less careful in carrying out the calculation process. Musyadad (2021) confirmed that one of the weaknesses in working on the problem was in solving the problem, but had difficulty in solving the problem as requested in the problem. Likewise, Rosaria (2022) concludes from the results of her research that most of the misconceptions in working on the questions in the form of stories so that students have difficulty in translating the questions. Likewise, Setiawan (2021) revealed from the results of his study that around 70% of students experienced errors from the aspect of process skills. Astutik (2021) revealed that students' mistakes and errors in working on questions resulted from a less thorough processing process, errors in counting and accuracy in allocating time to work on questions. So, in general, students have difficulty in correctly answering a question.

Fifth, errors in writing the final answer. The picture above shows the respondent who did not write down the final answer that was ordered by the question, and in making inappropriate conclusions and the carelessness of the respondent. This can be seen from the work on the questions given indicating that each respondent on average makes mistakes in making the final decision, namely making decisions. Respondent three in Figure 4 above shows an error in drawing the final conclusion, namely by not writing a conclusion from the work. In fact, the command of the question is clear, that is, respondents are asked to test hypotheses and make decisions. Likewise with the other respondents, for each question the decision was not made. In line with the statement above, Indriani (2021) revealed that most students experienced errors in writing the final conclusion in solving story problems. Likewise, Factfan (2022) concluded in his research that the final mistake that students often make is in taking conclusions that are always missed so that the scores given are not perfect. It is the same with the statement from Sanapiah (2021) that his findings show that students have weaknesses in translating

questions and symbols so that in the final solution they have difficulties. From the description of the analysis of the findings above, it shows that respondents have difficulty in working on questions in the form of story questions based on mathematical literacy. This finding was confirmed by the results of interviews with the three respondents who conveyed their difficulties in working on the description form. One of the results of the interview is presented in the image below;

Figure 3. The results of the answers to mathematical literacy questions from respondents

17. **Bagaimana menurut sodara terkait soal tes yang diberikan? Jelaskan!**

    Jawab :

    Sulit, karena berbentuk cerita sehingga harus dibaca lagi sampai paham dan juga kesulitan lainnya adalah menentukan rumus yang dipakai apakah menggunakan rumus probabilitas, teori penaksiran, hipotesis, korelasi, dan lain-lain.

18. **Apakah sodara menemukan kesulitan dalam menerjemahkan soal tes? Jelaskan!**

    Jawab :

    Tidak ada, karena bahasa yang ada di soal tersebut mudah dipahami dan jelas.

19. **Pada langkah manakah menurut sodara ketika menyelesaikan soal cerita? Jelaskan!**

    Jawab :

    Ketika menentukan rumusnya (rumus dari materi mana yang digunakan) dan juga pada langkah pengambilan keputusan dalam soal cerita yang caranya memakai rumus hipotesis.

Figure 4. Interview draft

Based on the results of the interviews from **Figure 4**, respondents are not accustomed to working on questions in the form of descriptions, this is because there are difficulties in transforming questions into mathematical language and in choosing the right formula in solving the problems given. Thus, based on the five errors according to Newman's error analysis, it can be concluded that most respondents experienced errors in problem solving. Among them are errors in understanding the questions, errors in the process of transforming the questions, and errors in writing the final answer.

4. CONCLUSION

The conclusions in this study indicate that there are errors in answering questions, especially for mathematical literacy questions; students are expected to be able to analyze questions in the form of story questions; Understanding the problem instructions and information contained in the problem is the first step in working on mathematical literacy problems so that the level of errors and errors in working on the questions is more resolved. Of the five errors that became the standard for Newman Error Analysis assessment, three errors were made by respondents, namely errors in understanding the story questions correctly, errors in transforming story questions into mathematical sentences, and errors in writing the final answer. Based on this, the authors suggest that students in the lecture process should be given a thorough understanding of the process of understanding story questions and should be accustomed to working on problems in mathematical literacy format. By solving story problems, students are expected to be able to apply them in solving reallife problems. With many mistakes made by respondents in this study, the author recommends returning to conduct further research in order to get stronger confirmation, especially students' mathematical literacy skills.

AUTHOR'S CONTRIBUTIONS

The authors discussed the results and contributed to from the start to final manuscript.

CONFLICT OF INTEREST

There are no conflicts of interest declared by the authors.

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