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Newman Error Analysis To Identify Student Errors In Solving High-Order Thinking Skills Problems Based On Self-Confidence

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Abstract. This paper aims to analyze the mistakes of primary teacher education Universitas Negeri Semarang (UNNES) students in solving high order thinking skills problems with the Newman procedure. Mixed research methods were used in this study. Students are given a self-confidence questionnaire and then categorized into three levels, namely students with low, medium and high self-confidence (SC). Then by using purposive sampling, 2 students were selected in each the low group, the medium group, and the high group. The six students were given HOTS questions and then analyzed their errors according to the Newman Procedure. In results for questions C4 and C5, students with low self-confidence missed important information in the questions so that it was difficult to understand the questions and the next steps. Students with moderate self-confidence tend not to experience problems in reading and understanding the questions, but their weak points are in the process skills in C4 questions and the transformation in the C5 and C6 questions. Students with high self-confidence did not have difficulty solving C4 questions but experienced difficulties in the transformation of C5 questions and process skills in C6. This paper concludes that students with low SC are weak in terms of reading and understanding questions, students with moderate SC in terms of transformation, students with high SC are weak in terms of process skills.

Key words: hots; newman error analysis.

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INTRODUCTION

High Order Thinking Skill is of concern to the government because according to several references the ability of Indonesian students is low. The TIMSS and PISA results also support this statement. Several analyzes from several sources stated that the students' ability to do low order thinking skills was very good, but had low scores in the high order thinking skill category. Bloom divides the level of thinking into 2, namely low order thinking skills (LOTS) and high order thinking skills(HOTS). LOTS are related to students' ability to remember, understand, and apply. Meanwhile, HOTS are related to students' abilities in analyzing, evaluating, and creating. Everyone must collect, analyze, evaluate, and synthesize all important information, and imagine the consequences of the course of each alternative before making a decision. (Arazo et al., 2018). One of the measures for this ability is by giving a test question oriented LOTS or HOTS. Questions that contain commands for analyzing, evaluating, or creating creativity in the problem-solving step are characteristics of mathematical problem-solving tasks which are categorized as HOT problems(Meryansumayeka et al., 2019).

Self-confidence (SC) is a sense of trust in one's abilities and feelings. Self-confidence is very substantial in the success of study mathematics. Students with high SC will be more motivated in learning mathematics so that they will get good learning outcomes as well. Students' SC in learning mathematics has an effect on mathematics learning achievement has been shown in various research results (Kunhertanti & Santosa, 2018). Students' SC and attitudes are closely related to achievement which affects their future potential in the labour market which results in the overall prosperity of the country especially in countries with intense economic and social crises(Pitsia et al., 2017). Self-confidence will affect his learning outcomes as well as his life in the future.

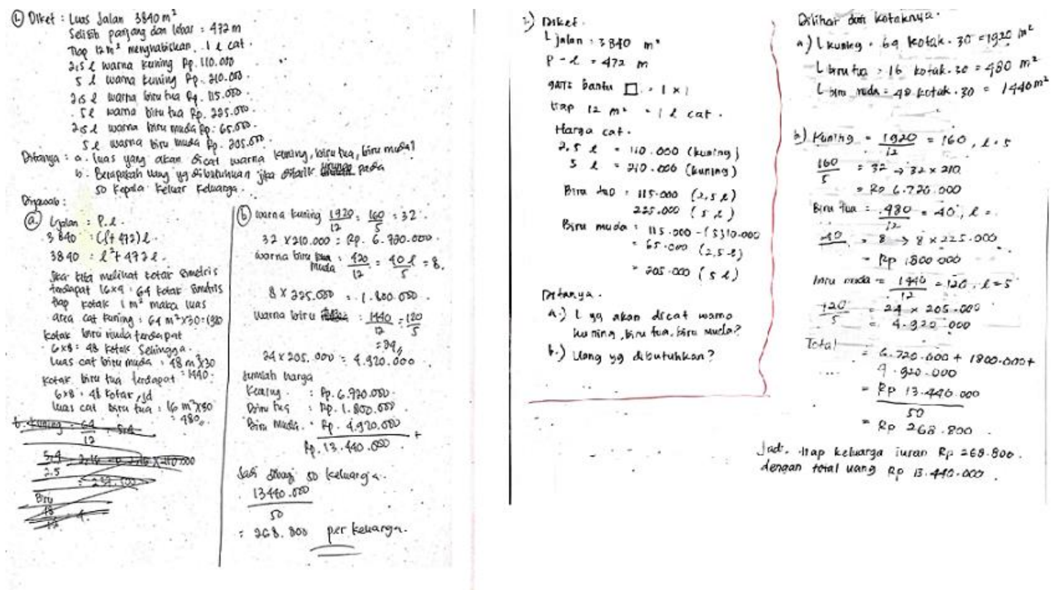
A finding shows that the assessment of students' thinking is obligatory but insufficient so that teachers require support in the development of the skills required to make effective use of student reasoning in learning, in particular, the skills of productively determining faulty student reasoning(Yeon & Cross, 2017). So analyzing student mistakes is also important to find the right steps in overcoming them. To analyze student errors, a procedure called the Newman error analysis procedure is used. Involving teachers in analyzing students 'written work and documenting what they notice about students' mathematical thinking is a common way of identification. (Stockero et al., 2017). The data analysis technique used in this study used the error analysis method according to Newman, namely analyzing the answers to the written test that had been given to students then dividing the students' mistakes into 5 types of errors. (Mahmudah, 2018). The 5 types of errors are reading, understanding, transformation, process skills, and notation writing. The purpose of this paper is to analyze the mistakes of primary teacher education UNNES students in solving HOTS questions with the Newman error analysis procedure.

METHODS

The research method is mixed research. Quantitative research is used to determine the level of student's SC. Then 6 students are selected in the qualitative research to be given HOTS questions and analyzed for their errors using the Newman error analysis procedure. The self-confidence questionnaire was tested on 125 students and was declared valid and reliable. 6 students were selected based on their level of self-confidence, consist of two low SC's students, two moderate SC's students, and two high SC's students.

RESULTS AND DISCUSSION

One aspect of personality that influences the learning process is self-confidence because SC students are confident in their competencies and thinking positively, although they are faced with a new problem (Yaniawati et al., 2020). SC in mathematics has been researched as a substantial dimension of mathematics achievement in international studies such as PIRLS, PISA, and TIMSS (Çiftçi & Yildiz, 2019). Indicators of self-confidence are belief in one's competencies, making decisions independently have self-concept positively, brave to express opinions(Hendriana et al., 2017). The results of the questionnaire categorized students into three categories, namely students with low SC, students with moderate levels of SC, and students with high SC. The results showed that there were 4 students in the low SC category, 95 students in the moderate SC category, and 22 students in the high SC category. From these results, 2 students with low SC, 2 students with moderate SC, 2 students with high confidence were selected. The six students were then given HOTS questions to analyze their mistakes. Respondents 1(R1) and 2(R2) were students with low SC, respondents 3 (R3) and 4(R4) were students with moderate SC, respondents 5(R5) and 6(R6) were students with high SC. Figure 1 is the answer of Respondents 1 and 4 for C4 analysis questions. Figure 2 is Respondent 6's answer to question C4 for analysis. Figure 3 is the answer of Respondents 1 and 4 to question C5 evaluation. Figure 4 is Respondent 6's answer to C5 evaluation questions. Figure 5 is the answer of Respondents 1 and 4 for question C6 creations. Figure 6 is Respondent 6's answer to question C5 creations.



(a) (b)

Figure 1. Student's answer of C4 question (a) Respondent 1, (b) Respondent 4

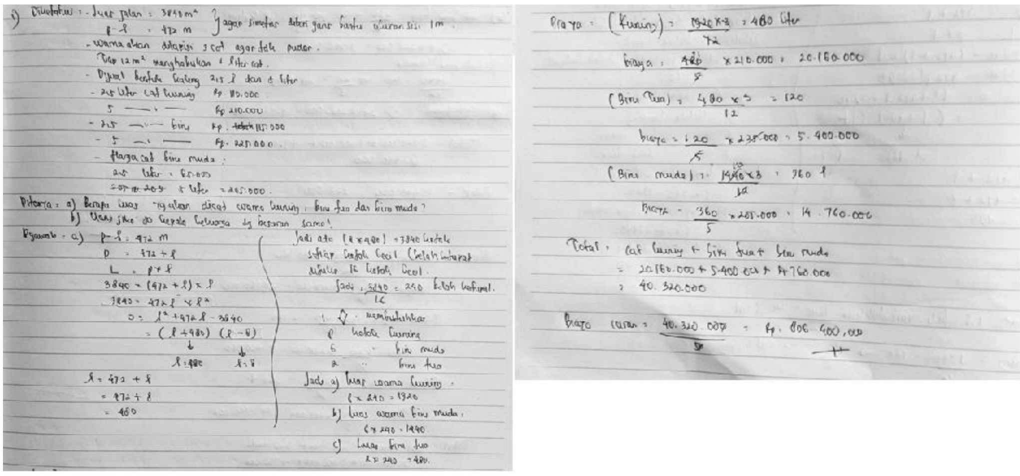
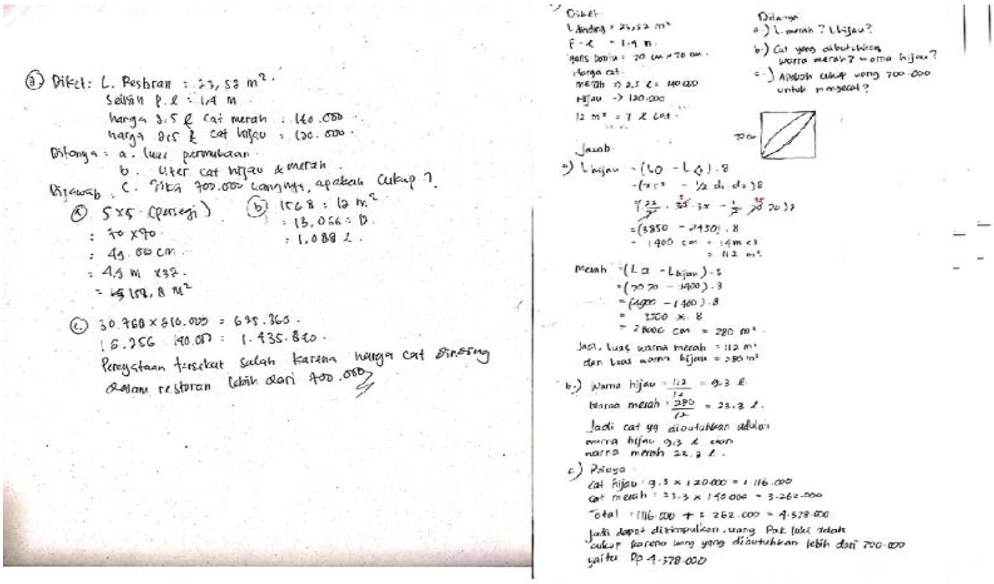


Figure 2. The answer of Respondent 6 to C4 question



(a) (b)

Figure 3. Student's respon of C5 question (a) Respondent 1, (b) Respondent 4

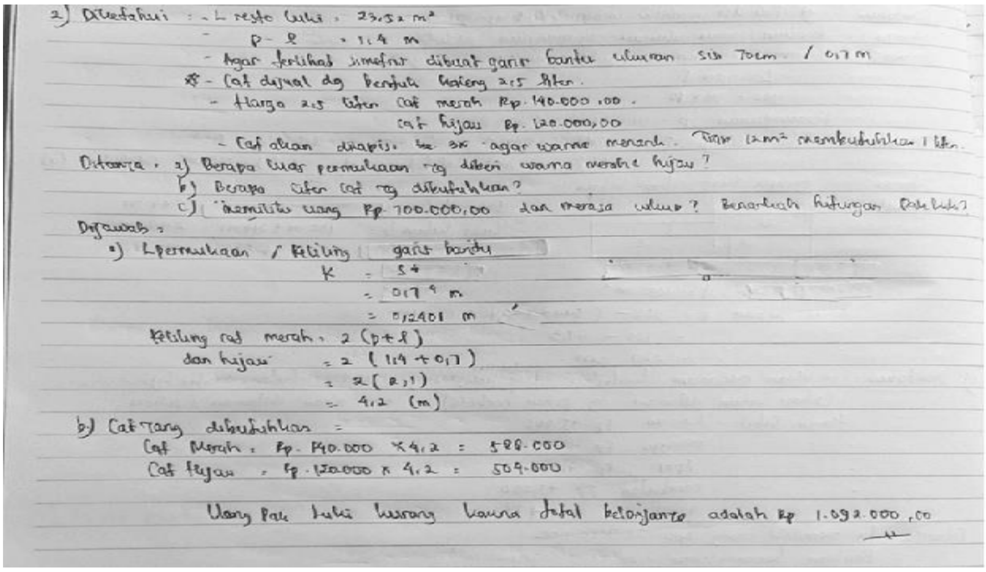


Figure 4. Student's (Respondent 6) answer to C5 question

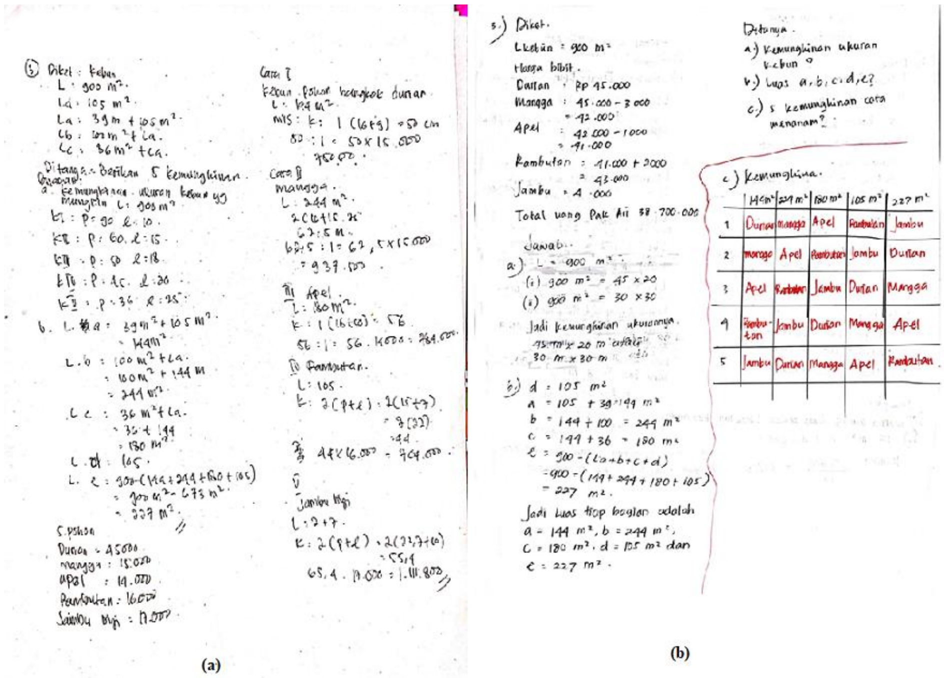


Figure 5. Student's respon of C6 question (a) Respondent 1, (b) Respondent 4

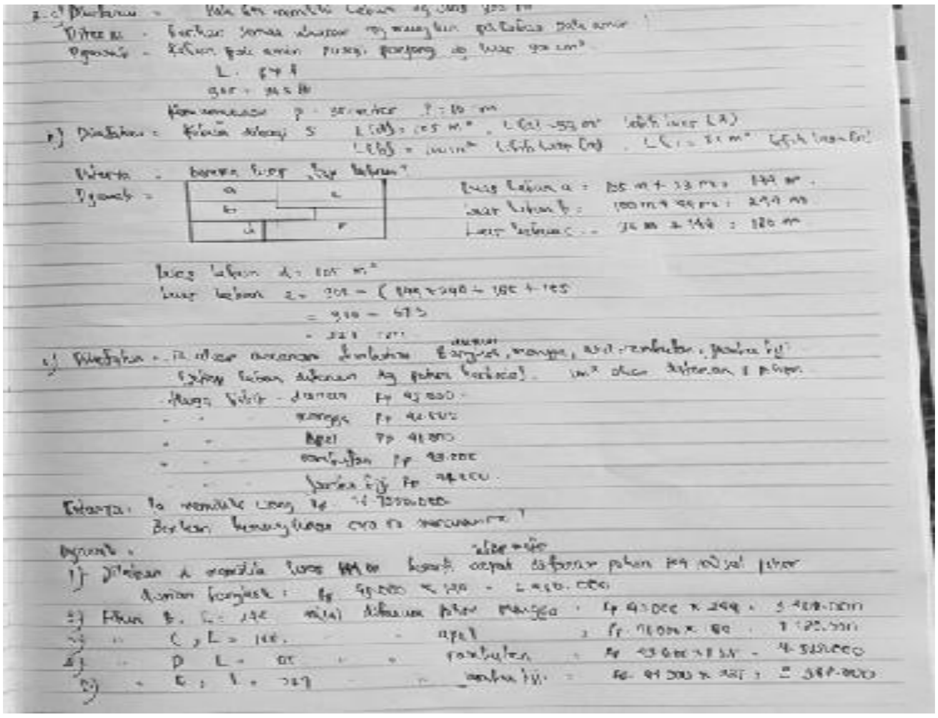


Figure 6. Student's answer to C6 question Respondent 6

Reading, comprehension, transformation, process skills, coding were described by Newman in 1977 as the five sequential steps (hierarchy) someone needs to go through in an attempt to answer a written math task (Singh et al., 2010). Reading errors are writing down incomplete information, or there is incorrect or missing information in a problem. Misunderstanding is the mistake of writing down what is known or the command of the problem Transformation error is not knowing how to solve the problem, not knowing what formula to use. Process skills errors are errors in computing, not continuing problem-solving procedures. Encoding error is the inability to conclude solving the problem. These 5 types of errors will identify what types of mistakes are made by students. Table 1 summarizes the analysis of students in solving the form of analysis questions (C4). Table 2 summarizes the analysis of students in completing the form of evaluation questions (C5). Table 3 summarizes the analysis of students in finish up the form of creative problems (C6).

Table 1. Analysis of Student Errors in completing the form of Problem C4 (analysis)

Newman Error Indicator	R1	R2	R3	R4	R5	R6
Reading	There is info missed	There is info missed	There is no information that is wrong or overlooked	There is no information that is wrong or overlooked	There is no information that is wrong or overlooked	There is no information that is wrong or overlooked
Comprehensio n	Clearly understandin g the questions	Clearly understandin g the questions	Clearly understandin g the questions	Clearly understandin g the questions	Clearly understandin g the questions	Clearly understandin g the questions
Transformation	Know how to completing problems	Know how to completing problems	Know how to completing problems	Know how to completing problems	Know how to completing problems	Know how to completing problems
Process Skill	Stuck in the middle of the process	Stuck in the middle of the process	Stuck in the middle of the process	Stuck in the middle of the process	Can solve the problem correctly	Can solve the problem correctly
Encoding	Cannot write conclusions correctly	Cannot write conclusions correctly	Cannot write conclusions correctly	Cannot write conclusions correctly	Can write conclusions correctly	Can write conclusions correctly

With C4 criterion questions, students with low self-esteem tend not to read carefully, so that both of them have difficulty solving the mathematical problems faced, students with the moderate confidence category are unable to continue the calculation process. It can be said to have stopped in the middle of the process so they cannot continue the conclusion process, Students with high self-confidence do not experience problems both from reading questions, understanding questions, transforming processing skills, and inference.

Table 2. Analysis of Student Errors in completing Form C5 (evaluation)

Newman Error Indicator	R1	R2	R3	R4	R5	R6
Reading	There is info missed	There is info missed	There is no information that is wrong or overlooked	there is information missing	There is no information that is wrong or overlooked	There is no information that is wrong or overlooked
Comprehensio n	There is no difficulty understandin g the questions	There is no difficulty understandin g the questions	There is no difficulty understandin g the questions	There is no difficulty understandin g the questions	There is no difficulty understandin g the questions	There is no difficulty understandin g the questions
Transformation	Do not know how to complete the problem	Do not know how to complete the problem	Do not know how to complete the problem	Do not know how to complete the problem	Do not know how to complete the problem	Do not know how to complete the problem
Process Skill	Stop in the middle of the process	Stop in the middle of the process	Stop in the middle of the process	Stop in the middle of the process	Stop in the middle of the process	Stop in the middle of the process
Encoding	Cannot write conclusions correctly	Cannot write conclusions correctly	Cannot write conclusions correctly	Cannot write conclusions correctly	Cannot write conclusions correctly	Cannot write conclusions correctly

With the C5 criterion (evaluation) question, students with low SC still have difficulty reading the questions accurately so that they are unable to solve the mathematical problems at hand. Students with moderate SC, 1 person still has problems in reading the questions accurately so that they are unable to solve the mathematical problems they are facing correctly, while the other one does not have problems with accuracy in reading the questions but also has not been able to solve the problems correctly. Students with high SC are careful in reading the problems, also understand the problems well, but have difficulty finding ways to solve math problems so they are unable to solve them correctly.

Table 3. Analysis of Student Errors in completing Form C6 (creations)

Newman Error Indicator	R1	R2	R3	R4	R5	R6
Reading	There is no information that is wrong or overlooked	There is no information that is wrong or overlooked	There is no information that is wrong or overlooked	there is information missing	There is no information that is wrong or overlooked	There is no information that is wrong or overlooked
Comprehension	Unable to understand the question	Unable to understand the question	There is no difficulty understanding the questions	Unable to understand the question	There is no difficulty understanding the questions	There is no difficulty understanding the questions
Transformation	Do not know how to solve the problem	Do not know how to solve the problem	Do not know how to solve the problem	Do not know how to solve the problem	Do not know how to solve the problem	Know how to solve problems
Process Skill	Stop in the middle of the process	Stop in the middle of the process	Stop in the middle of the process	Stop in the middle of the process	Stop in the middle of the process	Stop in the middle of the process
Encoding	Cannot write conclusions correctly	Cannot write conclusions correctly	Cannot write conclusions correctly	Cannot write conclusions correctly	Cannot write conclusions correctly	Cannot write conclusions correctly

With the C6 criterion question (creation), students with low SC are careful in reading the questions but are unable to understand the questions so they are unable to solve the problems well. Students with moderate confidence criteria, 1 person skipped information when reading a question while the other had carefully read the question. Neither of them knew how to solve the problem so they couldn't continue the process. Students with high SC are careful in reading the questions and understand the questions well. One of them did not know how to solve the problem so that they could not continue the process, while the other one knew how to solve the problem, but had not finished solving the problem.

From the three questions of high order thinking skills, information was obtained that students with low self-confidence had difficulty reading and understanding the questions. To differentiate in the interpretation of symbols and the purpose in activities when working on problems, students need to articulate their thoughts (Weinberg et al., 2016). Reading and understanding the question is the main thing in solving the question of high order thinking skill. If they are weak in this regard, they will certainly have difficulty in continuing the problem-solving process. intelligence may not be involved in metacognitive monitoring or self-assessment by students with low math self-esteem because they have previously determined their level of achievement(Hosein & Harle, 2018). They feel they can't do it so their efforts are not maximal. Students who lack self-confidence are consistently lower than others, it seems that lack of confidence can undermine motivation (Sheldrake, 2016). Students with moderate self-confidence often experience difficulties in terms of transformation. The subject studied by practising formulas, equations, and calculations are mathematics (Wang et al., 2017). Knowing what formula to use is a success factor in solving HOTS questions. Students can communicate when and why the chosen strategy is appropriate, or why a mathematically correct solution demonstrates their mathematical fluency (Cartwright, 2020). Choosing the right problem-solving strategy is an important step in the process of solving HOTS questions. Students with high self-esteem often have difficulty in processing skills. In relating which cognitive activity causes the problem, mathematics teachers need to pay attention to common mistakes made by their students (Raduan, 2010). Also, lecturers' efforts to increase student confidence are important. A person can be prevented prematurely from escaping challenging cognitive tasks by increasing self-confidence (Stankov & Lee, 2017).

CONCLUSION

This paper concludes that students with low SC are weak in terms of questions reading and understanding, students with moderate SC in terms of transformation, students with high SC are weak in terms of skills of process. This information can help lecturers in helping students improve their high order thinking skills.

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