Problem-solving analysis in solving HOTS problems judging from self-confidence

Luthfia Azzahra*, Nurhanurawati

Universitas Lampung, Indonesia

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ABSTRACT

This study analyzes the process of solving students' mathematical problems based on Polya's level and self-confidence. This research is a type of qualitative research with a case study approach. The subjects used in this study consisted of three students representing the level of confidence. Data collection in this study was conducted using triangulation techniques, which included tests, non-tests, and interviews. The results of the study were obtained based on the Polya level: Students with a high level of confidence will understand the problem clearly, plan steps to solve it, implement the solution plan, and check the results obtained. Students with moderate confidence only understand the problem clearly and plan the solution steps. Students with low self-confidence can only meet a few levels of Polya. Therefore, students with a high level of confidence do not hesitate and maximize their potential in solving problems so that they can solve them.

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INTRODUCTION

To improve the quality of education, teachers and the education system have the same goal: to pay serious attention to the importance of developing problem-solving skills for students (Ananda et al., 2023). In line with the development of time, overcoming problems remains important for the world of education and industry as a basis for finding various solutions to achieve desired goals (Pebrianti et al., 2023). By facing different problems, students have the opportunity to develop the various competencies they have (Fauzia & Ramadan, 2023). Problem-solving is important for math students (Siswanto & Meiliasari, 2024).

Problem-solving is the student's ability to use mathematical concepts that have been learned (Rahman & Nur, 2021). It is also an activity that improves students' thinking skills (Anaktototy & Lesnussa, 2022). Problem solving can connect concepts learned by students before (Azhar et al., 2021). So, problem solving can improve the quality of

education by using mathematical concepts and students' thinking skills more widely.

Self-confidence is the main factor for students in solving HOTS questions (Simbolon et al., 2022). Self-confidence is a sense of confidence in one's own abilities in the form of advantages and disadvantages that an individual has (Nurmalasari et al., 2023). Self-confidence is a belief that every student must have in doing something expected (Akbari & Sahibzada, 2020). Therefore, self-confidence is the main factor that every student needs to have in completing various tasks, one of which is solving HOTS questions.

Higher-level thinking skills, better known as HOTS, are part of the cognitive aspects of Bloom's taxonomy by involving levels of analysis, synthesis, and creation (Fikriani & Nurva, 2020). HOTS is a high-level thinking skill possessed by students, involving skills in solving real problems (Anwariyah & Nurhanurawati, 2023). Some of the characteristics of HOTS are as follows: a). Provide stimulation to promote the ability to draw conclusions and critical reasoning; b). Involves more complex thinking to incorporate cognitive knowledge; c). Links to unusual contexts; d). Relevance to real world situations; e). In the form of non-routine questions (Saraswati & Agustika, 2020). Therefore, HOTS poses new challenges in learning and requires the development of questions that match these characteristics.

Problem-solving is an important aspect that students need to have when learning mathematics. The results of the Program for International Student Assessment or better known as PISA in 2023 show that Indonesia scored 366, ranked 68 out of 81 countries (OECD, 2023). This is due to the problem solving skills in students which are still low and supported by the level of confidence.

The results of Trends in International Mathematics and Science Study (TIMSS) Indonesia in 2015 show that it is still low for three periods, seen from the average score of 397 out of the average international score of 500 (Ina et al., 2021). Based on this, the mathematical skills of Indonesian students are in the low category, which affects their problem solving abilities.

Analysis of several literature reviews found that student problem solving still needs to be improved. Students need help doing non-routine questions, so their skills in solving HOTS questions are low (Faizzah & Sutarni, 2023). This is because students are not used to solving problems that require them to analyze, evaluate, and create solutions (Dalman & Junaidi, 2022). In addition, students also need help checking the answers they construct (Nafi'an & Pradani, 2019; Pirmanto et al., 2020). Students are only used to facing situations where they have to memorize mathematical definitions and formulas (Andriani & Andhany, 2023). With problem solving skills, students can develop higher level thinking skills that help them solve problems (Rismawati et al., 2022). Students who have the ability to solve high and medium math problems show strong confidence in facing mathematics (Astutiani, 2021). Student confidence plays a very important role in the ability to solve mathematical problems (Waliq et al., 2021). Students who lack confidence will feel anxious and afraid to answer the teacher's questions (Noerilah & Puspitaloka, 2022). To anticipate this, teachers create better learning guidelines.

Based on previous studies and supported by existing facts, the following study focuses on students' problem-solving abilities in solving HOTS questions on statistical materials, taking into account students' confidence levels. This study aims to analyze students' mathematical problem solving skills in terms of self-confidence.

METHOD

This type of qualitative research uses a case study approach to explain problem solving in solving HOTS problems in terms of self-confidence. Before carrying out the activity procedure, students were given a questionnaire to determine their level of confidence and were classified into high, medium, and low categories.

After the students were given the confidence questionnaire, they were then given questions with statistics to find out their problem-solving abilities. The research procedure carried out consists of four stages (Bungin, 2022). Illustration of the research design as follows:
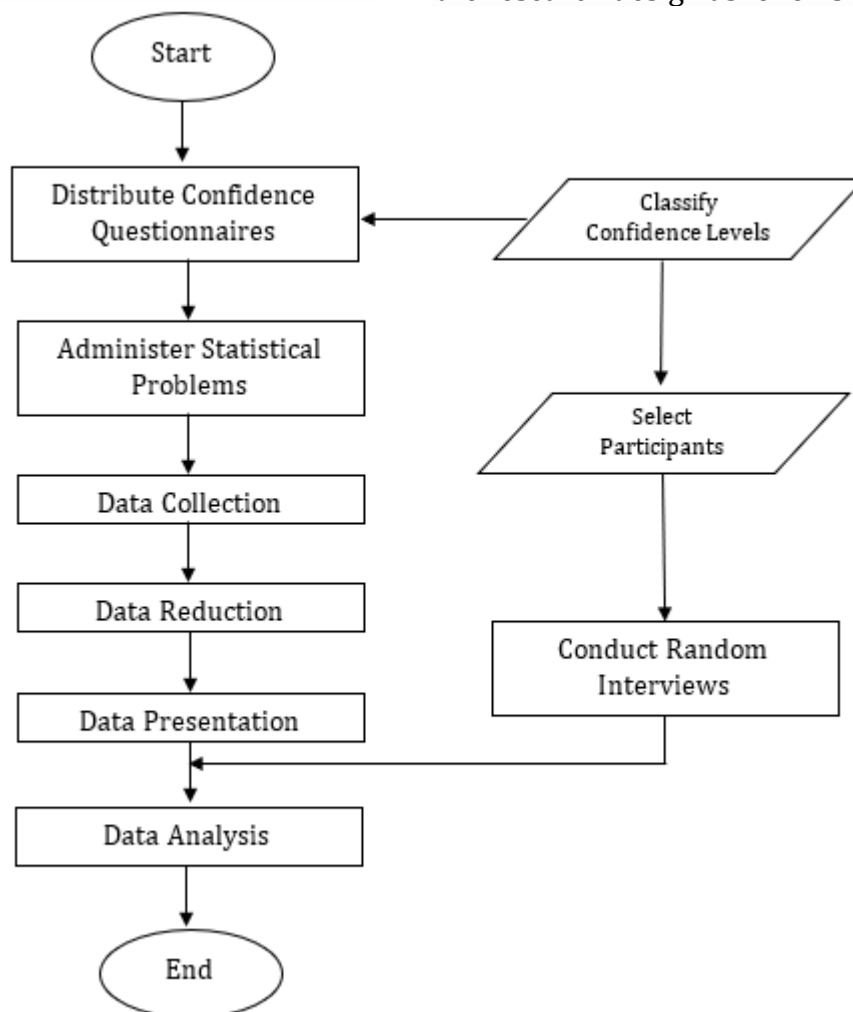

Figure 1. Research Design

Based on Figure 1, this study uses a purposive sampling technique (Sugiyono, 2019), where participants are selected based on certain criteria. The criteria for participation in this study is that the students must be enrolled in grade XI-4 at SMA Negeri 4 Kotabumi in the academic year 2023-2024. Thirty-four students were ranked according to their level of confidence. After that, three subjects were selected that met the confidence level category. Classification is based on average results and standard deviations, as can be seen in Table 1.

Table 1. Confidence Questionnaire

High Self-Confidence	Medium Self-Confidence	Low Self-Confidence
$x \geq \bar{x} + 1.SD$	$\bar{x} - 1.SD \leq x \leq \bar{x} + 1.SD$	$x < \bar{x} - 1.SD$

Based on Table 1, they obtained the results of grouping subjects into self-confidence categories. Subjects with a high level of self-confidence show that they truly believe in their abilities. Subjects with a moderate level of confidence showed balance, meaning they felt confident in their abilities but remained realistic and aware of their limitations.

Subjects with low levels of confidence show doubts about their abilities, so they are less confident when faced with challenges.

Next, random interviews were conducted with students who have high, medium and low levels of self-confidence. The data obtained from the interviews were then collected and analyzed according to the data received. The results of this data analysis become the main reference in assessing the ability to solve problems and self-confidence of students. The problems presented are as follows:

An experiment was conducted to measure the height of a ball's bounce (Y) depending on the height (X) at which the ball was dropped to the floor. Observational data from six experiments are given in the following table:

Ball	X(m)	Y(m)	X^2
A	1	0,7	1
B	2	1,3	4
C	3	2,3	9
D	4	3	16
E	5	3,8	25
F	6	4	36

From the above statement, then determine:
a. Determine the linear regression model of the presented data?
b. What is the predicted height of the first bounce of the ball when the height increases by 1 meter?

Figure 2. Problem-Solving Ability

RESULTS AND DISCUSSION

The results of the self-confidence questionnaire given to XI grade students can be grouped into three levels, as shown in Table 2.

Table 2. Self-Confidence Level

No	Self-Confidence Level	Low Self-Confidence
1	High	6
2	Moderate	18
3	Low	10

Based on Table 2, the results of the self-confidence questionnaire after being collected found that a total of six students scored above 84, which means that these students have a high level of confidence. A total of 18 students scored between 71 and 84, meaning that these students have a moderate level of confidence. A total of 10 students scored below 70, meaning that the students have a low level of confidence.

After administering a questionnaire instrument to measure students' confidence levels, the researcher selected three subjects representing different self-confidence groups.

MN subjects were selected to represent the high self-confidence group, AR subjects represented the moderate self-confidence group, and DA subjects represented the low self-confidence group.

Next, the researcher gave an explanation test using HOTS (Higher Order Thinking Skills) questions. They conduct interviews to better understand the problem-solving skills of each subject. The problem-solving results of the three selected students are then described based on Polya's steps, which are contained in Table 3. In the table, the "M" code indicates that the student can meet the set guidelines, while the "BM" code indicates that the student has not been able to meet the troubleshooting instructions.

Table 3. Student Problem-Solving

No	Subject	Understanding The Problem	Developing a Settlement Strategy	Do Account	Checking Back
1	MN	M	M	M	M
2	AR	M	M	BM	BM
3	DA	BM	BM	BM	BM

Table 3 shows that students who have a high level of self-confidence (MN) can achieve all indicators of problem-solving ability. However, students with moderate levels of confidence (AR) and (DA) cannot meet all indicators of problem-solving ability. The following are the results of the problem solving analysis according to the classification of confidence level categories:

Based on the analysis of HOTS questions based on Polya level, it is known that MN subjects have high self-confidence. This can be seen from the results of the analysis as follows:

MN subjects, who have a high level of self-confidence, can formulate what they know and what is asked of them in the problem. It can be seen from the following picture:
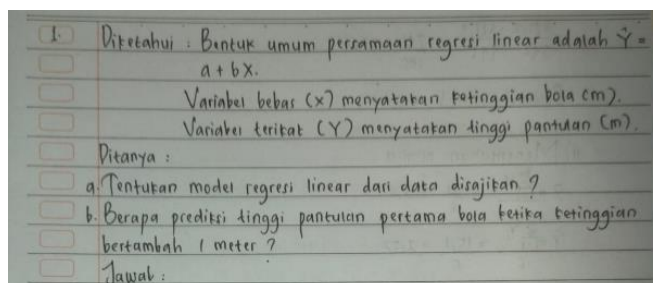

Figure 3. MN Subjects Can Understand Problems Clearly

Based on Figure 2, it can be seen that the MN subject can meet the first Polya level indicator, which is to understand the problem clearly. This can be seen from the results of the MN subject's interview to ensure whether it is true that the MN subject wrote the answer correctly:

P : *"Try this matter. What do you know?"*

MN : *"What I know in question number 1 is that there is an independent variable (x) and a variable (y),*

then I write down the general form of the linear regression equation".

P : *"Okay, then what to ask about it?"*

MN : *"In that question, mom will be asked, there are 2 points. Point a about determining the regression model and point b about the predicted height of its first reflection".*

MN subjects who have a high level of confidence can determine the formula used in solving problems in statistical materials, which is the linear formula $\hat{Y} = a + bx$. It can be seen from the following picture:
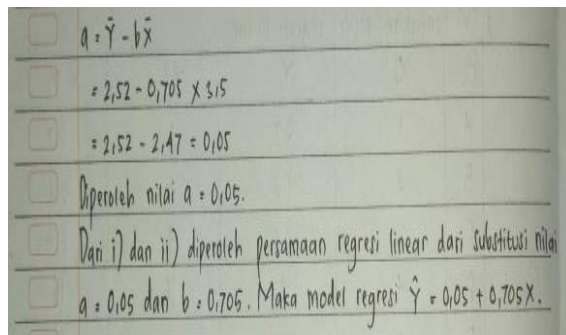

Figure 4. MN subjects can plan completion steps

Based on Figure 4, it can be seen that the MN subject was able to meet the indicator of the second Polya stage, which is to plan the steps to complete. This can be seen from the results of the MN subject interview to ensure whether it is true that the MN subject wrote the answer correctly:

P : *"What is the formula used to answer the question?"*

MN : *"Using the formula of the linear regression, that is, $\hat{Y} = a + bx$."*

MN subjects, who has a high level of confidence, can use the linear regression formula and calculate the values of a and b correctly to predict the first bounce on the ball at every height of 1 meter. It can be seen from the following picture:

Figure 5. MN subjects can carry out the completion plan

Based on Figure 5, it can be seen that the MN subject can meet the third Polya stage indicator, which is to implement the completion plan. This can be seen from the results of the MN subject interview to ensure whether it is true that the MN subject wrote the answer correctly:

P : *"Using a formula, how to solve the problem?"*

MN : *"Using the linear regression model formula, bu, but previously looking for the value of a and b was just substituted into the linear regression model."*

P   :   *"Then, for point b, what formula is used?"*

MN : *"For point b determines the prediction of the bounce. So, keep using the linear regression formula, but because b is positive, the x value increases by a, and the linear regression value increases by b".*

P   :   "That is right, then how do you do it?"

MN : *"For point, an of the linear regression formula Y=a+bx, first find the values of a and b obtained a = 0.05 and b = 0.705, after which it is substituted. For point b, the regression model is because the value of b is positive, so the linear regression increases by b as well, which is 0.705, so $\hat{Y} = 0{,}05 + 0{,}705x$".*

MN subjects, who have a high level of confidence, can double-check the results of the answers that have been done to conclude what is sought in the HOTS question. It can be seen from the following picture:
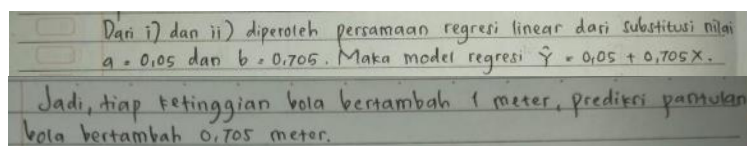

Figure 6. MN subjects are capable of reconsideration

Based on Figure 6, it can be seen that the MN subject can meet the fourth Polya stage indicator, which is to review the results obtained. This can be seen from the results of the MN subject interview to ensure whether it is true that the MN subject wrote the answer correctly:

P   :   *" When you answer the question, there is an obstacle?"*

MN : "No, ma'am".

P   :   "Okay, then what can you conclude about your answer?"

MN : *"So, the conclusion from question number 1 is, ma'am, that the linear regression model from the known data Y=0,05+0,705x and each height of the ball increases by 1 meter, which is an increase of 0.705 meters".*

Based on the analysis results that have been described, it can be concluded that MN subjects have high confidence and can solve HOTS problems at the Polya stage. MN students have a high level of confidence, supported by problem-solving skills in solving problems. Students with high self-confidence quickly avoid mistakes in answering questions and can try new things (Ifada & Ruli, 2022). Students who have high self-confidence will be helped in solving problems (Saputra et al., 2023). Students do not hesitate to do the tasks given and can maximize their potential and abilities (Riyadi, 2019).

Based on the analysis of HOTS questions based on the Polya level, it is known that AR subjects are in the moderate confidence category. This can be seen from the results of the analysis as follows:
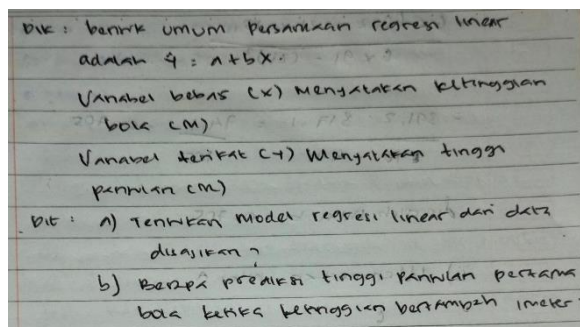
Figure 7. AR subjects can understand problems clearly

AR subjects, who had a moderate level of confidence, were able to summarize what was known and what was asked in the problem. It can be seen from the following picture:

Based on Figure 7, it can be seen that the AR subject can fulfill the indicator of the first Polya stage, which is to understand the problem clearly. This can be seen from the results of the AR subject's interview to ensure whether it is true that the AR subject wrote this answer correctly:

P : *"Try this matter. What do you know?"*

AR : *"In the problem, there is an independent variable and the dependent variable, but I also write down the general form of linear regression preparation."*

P : *"Okay, then what should I ask about it?"*

AR : *"There are 2 points in the question. Point a is about determining the regression model, and point b is about the predicted height of its first reflection".*

AR subjects who have a moderate level of confidence can determine the formula used in solving problems in statistical materials which is the formula for linear regression $\hat{Y} = a + bx$. It can be seen from the following picture:
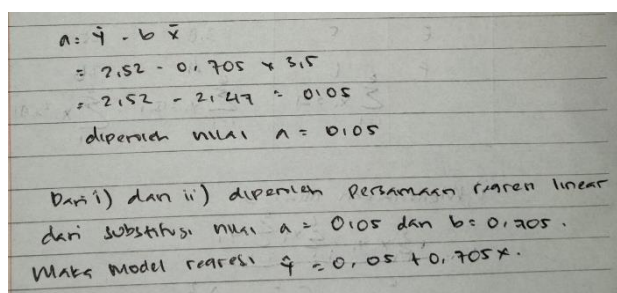

Figure 8. AR subjects can plan completion steps

Based on Figure 8, it can be seen that the AR subject can meet the indicator of the second Polya stage, which is planning the steps to complete. This can be seen from the results of AR subject interviews to ensure whether it is true that MN subjects wrote the answers correctly:

P : *"What is the formula used to answer the question?"*

AR : *"Using the formula of the linear regression model, that is,*

$$\hat{Y} = a + bx"$$

AR subjects with a moderate confidence level cannot yet use the linear regression formula and perform calculations correctly. This is because AR subjects still need to be more confident in determining the values of a and b. It can be seen from the following picture:
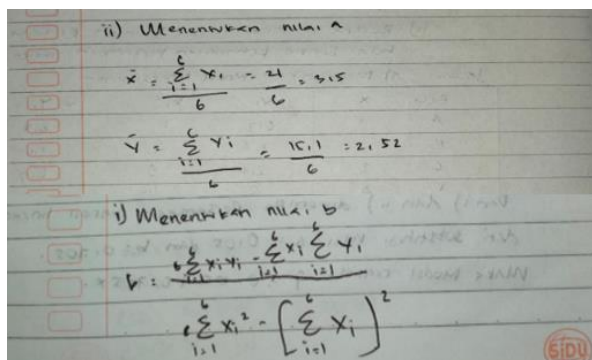

Figure 9. AR subjects have not been able to carry out the completion plan

Figure 9 shows that the AR subject has yet to meet the indicators of the third Polya stage, which still needs to be able to implement the completion plan. This can be seen from the results of the interview of AR subjects to ensure whether it is true that AR subjects have not been able to answer correctly:

P : *"How is the process of finding linear regression values?"*

AR : *"To find the linear regression value, first find the b and a values,ma'am. However, I still have doubts about the formula I wrote."*

AR subjects who have a moderate level of confidence have not been able to review the results of the answers that have been given. It can be seen from the following picture:
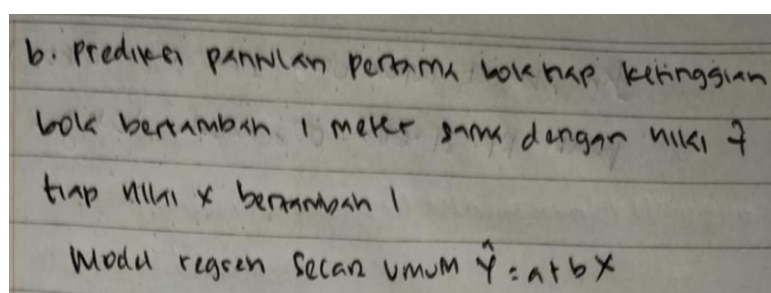

Figure 10. AR subjects have not been able to conduct a review

Figure 10 shows that the AR subject has been unable to meet the fourth Polya stage indicator; that is, it has not been able to review the results obtained. This can be seen from the results of AR subject interviews to ensure whether it is true that AR subjects have not been able to conclude correctly:

P : *"Have you corrected it back?"*

AR : *"Not yet, ma'am.".*

P : *"Why haven't you corrected it yet?"*

AR : *"Because I still have doubts and fear being wrong. That is why I do not correct anymore".*

Based on the analysis, it can be concluded that AR subjects have a moderate level of confidence. This can be seen from his hesitation to implement the completion plan and check the results obtained. This finding is in line with previous research, which shows that students with moderate confidence will affect their ability to perform calculations and re-examine the answer results (Hali et al., 2022). Students who have a moderate level of self-confidence sometimes feel confident and unsure of their abilities (Synthiawati & Ma'arif, 2021). Students who have a moderate level of confidence will be careful in making decisions and ask for opinions from teachers (S. Dewi, 2022).

Based on the analysis of HOTS questions based on the Polya level, it is known that DA subjects are in the low self-confidence category. This can be seen from the results of the analysis as follows:
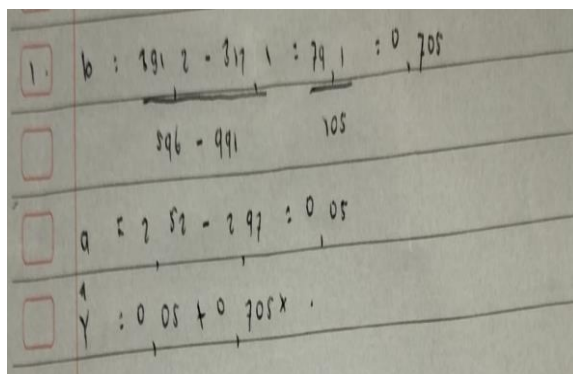

Figure 11. DA Subject Answer

Based on Figure 11, it can be seen that the DA subject has not been able to meet all the indicators of the Polya stages, namely not being able to understand the problem clearly, not being able to plan resolution steps, not being able to implement the resolution, and not being able to conduct a review. This can be seen from the results of the DA subject interview to ensure whether it is true that the DA subject has not been able to answer the question correctly:

P : *"Why is this question directly the answer?"*

AR : *"Because I do not understand, ma'am.".*

P : *"Let you read that question first: What is known?"*

AR : *"Do not understand, Ma'am, what is known."*

P : *"What do you ask about it?"*

AR : *"Do not understand either, ma'am."*

Based on the analysis, it can be concluded that DA subjects have low self-confidence. This can be seen in solving problems based on the Polya level. The

findings of the study are in line with previous studies, which show that students who have low self-confidence affect their ability to solve mathematical problems (Badriyah & Sopiany, 2023). Students with low confidence must be more confident in their abilities and avoid problems (Puspitasari et al., 2022). Students who have a low level of self-confidence need motivation and direction in learning to increase self-confidence (Riyadi, 2019).

CONCLUSION AND SUGGESTION

Based on the results and discussions, students with high confidence will understand the problem clearly, plan the solution steps, implement the solution plan, and check the results obtained. Students with moderate confidence only understand the problem and plan the solution steps. Students with low self-confidence cannot understand the problem clearly, cannot plan the solution steps, cannot implement the resolution plan, and cannot check the results obtained. Students who have a high level of confidence do not hesitate to answer the teacher's questions to maximize their potential and problem-solving abilities.

The researcher's suggestion for further research is to increase the number of student samples involved. It involves students from one grade level and multiple grade levels. Apart from self-confidence, researchers then pay attention to other factors such as cognitive abilities, metacognitive skills, and learning styles. Then, the next research conducted a longitudinal study to better understand the dynamics of the relationship between self-confidence, problem-solving skills, and HOTS.

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