
Analysis of Junior High School Students' Pseudo-Thinking Processes in Solving Problems on Exponential Numbers

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Abstarct. *This study aims to analyze the pseudo-thinking processes of eighth-grade students as they solve problems on the topic of powers. This study employs a qualitative approach using a descriptive research design. The study was conducted at a school in Palu City, with the research subject consisting of one eighth-grade student selected through purposive sampling based on test results. Data were collected through written tests and semi-structured interviews. Data validity was ensured through techniques such as extending the observation period, increasing diligence, and member checks, while data analysis was conducted through the stages of data condensation, data presentation, and drawing conclusions. The results of the study indicate that research subjects were categorized as exhibiting pseudo-correct thinking when they were able to arrive at the correct answer but were unable to provide a conceptual justification for the solution steps they used, as they relied more on their memory of previously learned procedures. The findings of this study indicate the importance of instruction that not only emphasizes procedures but also provides students with opportunities to explain the conceptual reasoning behind them, thereby fostering a deeper understanding of the concepts.*

Keywords: *pseudo-thinking, thought processes, powers of numbers*

INTRODUCTION

Mathematics is one of the important subjects taught in school. In addition to developing numeracy skills, mathematics also aims to foster logical, systematic, and critical thinking skills (Siregar & Adinda, 2025). Therefore, mathematics instruction focuses not only on mastering formulas, but also on students' ability to understand concepts and solve problems accurately (Tauhid dkk., 2024).

Mathematics education plays a crucial role in developing students' ways of thinking (Rachmantika dkk., 2019). However, in practice, there are still many students who prefer to memorize the solution steps demonstrated by the teacher rather than understand the reasoning behind those steps. As a result, when faced with different problems, students often feel uncertain and have difficulty solving them (Fendrik, 2019).

In mathematics, solving problems depends not only on the use of formulas, but also on the ability to understand the problem and determine the appropriate solution strategy (Siswanto dkk., 2024). In reality, not all students are able to navigate this process successfully. Some students may arrive at the correct answer but do not yet understand the underlying concepts, so they are unable to explain their thought process (Yuwono dkk., 2018). This situation indicates a discrepancy between the answers obtained and the students' thought processes, a phenomenon known as pseudo-thinking or superficial thinking (Efendi & Pratama, 2020).

Pseudo-thinking is a state in which students do not truly apply their understanding to solve problems (Vinner 1997). Subanji explains that students who engage in pseudo-thinking tend to associate problems with examples they consider similar, and thus simply follow procedures they have previously learned (Badar et al., 2025). As a result, students are able to solve problems similar to the examples but struggle when the problem format changes and do not understand the reasoning behind their answers (Siregar, 2019).

According to Subanji, pseudo-thinking consists of pseudo-correct and pseudo-incorrect responses. A pseudo-correct response occurs when a student arrives at the correct answer but is unable to explain the process used to arrive at it, whereas a pseudo-incorrect response occurs when a student gives an incorrect answer but, after reflection, is able to find the correct answer (Salsabila & Azhar, 2022).

One of the causes of pseudo-thinking is students' inability to connect their existing knowledge to the problems they face, resulting in a thought process that does not yet meet the demands of the problem (Cahirati et al., 2020). Therefore, teachers need to train and develop students' thought processes so that they can tackle various types of problems in mathematics learning (Wirnoto dkk., 2022).

Pseudo-thinking is commonly found in lessons on powers because this topic requires both conceptual understanding and precision in applying procedures (Mukti & Pratiwi, 2025). In the classroom, students often simply memorize the properties of powers without understanding their meaning (Siregar, 2025). As a result, when faced with problems that require analysis and the integration of several

concepts, students tend to use strategies based on similarities to example problems, so that their solutions appear procedurally correct but are not based on an actual understanding of the concepts (Fida, 2025).

The results of the researchers' interviews with mathematics teachers indicate that some eighth-grade students still have difficulty understanding the concept of powers in depth. Students tend to memorize the properties of powers and have difficulty when presented with problems that differ from the examples, especially in determining the steps to solve them and explaining their thought process.

At that school, questions that require higher-order thinking skills have been incorporated into the curriculum. However, there are still many students who are unable to provide the correct answers along with logical explanations of their problem-solving processes. This situation indicates the presence of pseudo-thinking in problem-solving. Therefore, research is needed to analyze students' pseudo-thinking processes regarding powers, so that it can serve as a basis for efforts to improve mathematics instruction. This situation indicates the presence of pseudo-thinking in problem-solving. Therefore, research is needed to analyze students' pseudo-thinking processes regarding powers, so that it can serve as a basis for efforts to improve mathematics instruction.

Based on the above discussion, the researcher is interested in conducting a study titled "Analysis of Junior High School Students' Pseudo-Thinking Processes in Solving Problems on Exponential Numbers."

RESEARCH METHOD

This study employs a qualitative approach using a descriptive research design, with the aim of providing an in-depth description of the pseudo-thinking processes of eighth-grade junior high school students as they solve problems on the topic of powers. The study was conducted at a junior high school in Palu during the 2025–2026 school year. The study sample consisted of 17 students who took the test; one student was selected who consistently met the indicators of pseudo-correct thinking and was willing to participate in an in-depth interview. In this study, the

researcher employed two aspects of qualitative validity as outlined by Miles et al. (2014), namely credibility and reliability. Credibility is used to ensure that the research findings reflect reality, while reliability measures the consistency of the research process and findings. According to Miles et al. (2014), validity is the primary parameter for assessing the accuracy of qualitative research, which includes confirmability, dependability, credibility, transferability, and authenticity. Data collection techniques included task sheet tests and semi-structured interviews. Data validity was ensured through extended observation, increased diligence, and member checks. The research instruments consisted of a worksheet containing two essay questions and a semi-structured interview guide. Data collection techniques included worksheet tests and semi-structured interviews. Data validity was ensured through extended observation, increased diligence, and member checks. Data analysis was conducted in three stages: data condensation, data display, and conclusion drawing/verification.

RESULT AND DISCUSSION

Result

The data to be analyzed pertains to students who exhibit pseudo-thinking when solving problems on the topic of powers. Prior to data collection, preparatory steps were taken by creating open-ended questions designed to observe the students' thought processes. The data obtained was then analyzed and sorted based on the level of pseudo-thinking errors. These results were followed up with in-depth interviews with the students to gain a comprehensive understanding of their conceptual errors.

1. Siswa B yang ingin yang benar benar semua
 angka nta anasari: Satu angka
 $16 = 2^4, 8 = 2^3, 9 = 2^2$
 $(2^4)^2 \times (2^3)^3$
 $(2^2)^5$
 $2^8 \times 2^9$
 2^{17}
 $\frac{2^{17}}{2^0} = 2^{17}$

Figure 1. SAAK Subjects' Answers to Question Number 1

Based on Figure 1, the SAAK subject chose to continue solving the problem using Student B's method and successfully arrived at the correct answer. The

written solution steps were systematically organized by applying the properties of powers, so no procedural errors were found.

To understand the thought processes used while solving problems, the researchers conducted in-depth interviews. The interview results indicate that the subjects chose this method not because they understood the concepts involved, but because they had seen a similar solution during their lessons. This is evident in the following interview excerpt. This is evident in the following interview excerpt.

PN-10 : Why did you choose to solve the problem using Student B's method?

SAAK-11 : Since I had seen that format before when I was learning about powers, and I thought Student B's method was easier to understand and the steps were similar to what I had learned, I immediately followed that method

This statement indicates that SAAK's decision-making is influenced more by prior learning experiences than by an understanding of the mathematical concepts involved. The subject did not analyze why Student B's method was correct, but instead immediately used the procedure he considered most familiar. Thus, the correct answers obtained are still based on recall of the problem-solving procedure.

When the researcher asked SAAK to explain the steps used to solve the problem, the subject was able to describe the procedure to be followed, which was to bring all bases to the same form before applying the properties of powers. However, when the researchers asked again why all bases had to be made equal, SAAK had difficulty providing an explanation based on mathematical concepts.

PN-14 : Why do we have to normalize all the bases?

SAAK-15 : I'm not quite sure, sis. As far as I remember, for a problem like that, the bases have to be made the same in order to solve it.

The results of the interview showed that SAAK was able to recall the solution procedure but did not yet understand the mathematical reasoning behind it. Their knowledge is still at the procedural level, so correct answers are obtained by applying memorized steps, rather than through an understanding of the concept of powers. This situation is one of the characteristics of pseudo-correct thinking, in which students are able to arrive at the correct answer but are not yet able to provide a conceptual justification for the procedure they used.

Handwritten work for question 2:

$$2^x - 2^x = 16 \Rightarrow \frac{2^x}{(2^8)} = (2^2)$$

$$\frac{2^x}{(2^8)} = (2^2)$$

$$\frac{2^x}{2^8} = (2^2)$$

$$2^x = (2^2)$$

$$3x - 3 = 2$$

$$3x - 3 + 3 = 2 + 3$$

$$3x = 5$$

$$x = \frac{5}{3}$$

LOCOMOTIF

B) ini di ken bilangan berpangkat dan di tambah lalu di kurangi terus

Figure 2. SAAK Subjects' Answers to Question Number

For question number 2, SAAK also arrived at the correct answer by converting the numbers to the appropriate exponential form and then simplifying the equation to find the value of x . Procedurally, the solution was correct. However, the interview results indicate that the subjects used the procedure because they recalled examples they had previously learned and did not reconsider its consistency with the concept of powers.

This was further reinforced when the researchers asked about the reasons for using that procedure. SAAK stated that this method was chosen because it was considered the easiest and had been used before on problems with a similar format. In addition, the subject admitted to using the procedure immediately without double-checking its consistency with the rules for powers.

PN-22 : Why did Ade use that method to find the value of (x) ?

SAAK-23 : Because, in my opinion, that method is the easiest to use, and I've used a similar method in a previous problem. I thought that once the exponents had been calculated and simplified, the value of (x) could be found right away. So I continued using that method

without double-checking whether the steps followed the rules for exponents.

This statement indicates that the solution was based more on memorized procedures than on an understanding of the concept of exponents. This is further supported by SAAK's acknowledgment that the steps used were not necessarily entirely correct because they merely followed the methods memorized during instruction.

PN-24 : Do you think it's possible that the approach you're using isn't quite right?

SAAK-25 : Yes, I think it's possible that the approach I used wasn't quite right. Because when I was working on it, I didn't fully understand the correct rules, so I just followed the method I remembered.

Based on the test results and interviews, SAAK was able to arrive at the correct answer but was not yet able to provide a conceptual rationale for the problem-solving procedure used. These findings indicate that SAAK's thought process exhibits the characteristics of pseudo-correct thinking, namely arriving at the correct answer by applying a memorized procedure without adequate conceptual understanding.

Table 1. Summary of Findings

Question	Test results	Interview evidence	Conclusion
Number 1	Correct answer	Following procedures that were previously learned and being unable to explain the reason for the normalization	Pseudo-correct thinking
Number 2	Correct answer	Using procedures based on memory and not yet understanding the rules for powers of numbers	Pseudo-correct thinking

Discussion

Based on the research findings, the SAAK subjects exhibited pseudo-correct thinking when solving problems involving powers of numbers. This was demonstrated by the subjects' ability to arrive at the correct answers to both problems given, but their inability to explain the conceptual rationale behind the

procedures they used. During the interview process, the subject revealed that the solution method was chosen because it had been studied previously and was considered the easiest to use. These findings suggest that success in obtaining the correct answer is influenced more by recall of the procedure than by an understanding of the concept of exponents.

During the problem-solving process, the student was able to explain the steps used, such as finding a common base and applying the properties of operations with powers. However, when asked follow-up questions about the reasons for using that approach, the subject was unable to explain the relationship between the procedure and the concept in depth. This indicates that the subjects placed greater emphasis on following procedures than on conceptual understanding.

This finding is consistent with Vinner's (1997) view that pseudo-correct thinking occurs when a person is able to produce the correct answer, but the thought process used is not yet based on conceptual understanding. Under these circumstances, students tend to apply procedures they have memorized without understanding the underlying mathematical reasoning behind them. As a result, the answers they produce appear correct from a procedural standpoint but do not reflect a true mastery of the concepts.

The research findings also show that participants found it easier to recall the steps to a solution than to explain the rationale behind those steps. When asked to explain why all bases must be made equal or why a certain property of powers can be used, the participants were unable to provide concept-based explanations. This indicates that the subject's knowledge is still at the procedural level. In other words, the subject knows how to solve the problem but does not yet understand why that procedure can be used. These findings are consistent with the research by Pradestya et al. (2020), which states that students are often able to arrive at the correct answer by recalling solution patterns they have previously learned, but are not yet able to explain the rationale behind those procedures conceptually.

The tendency to rely on memorized procedures also indicates that prior learning experiences have a significant influence on students' thinking processes. During instruction, students often encounter sample solutions that they later use as

a reference when encountering problems they perceive as similar. As a result, students rely more on the similarity of question formats than on analyzing the concepts involved. This finding is consistent with Subanji's view, who explains that students who engage in pseudo-thinking tend to relate new problems to examples they have previously studied, and then apply procedures they perceive as identical without engaging in conceptual reasoning.

Nevertheless, the interview process provides the subject with an opportunity to reflect on the problem-solving steps they have taken. When asked follow-up questions, the subject began to realize that they did not fully understand the procedure and admitted that their solution was based solely on what they had remembered during the learning process. These reflections show that interviews not only serve as a data-collection technique but also help reveal the thought processes underlying problem-solving, thereby allowing the characteristics of pseudo-thinking to be identified more clearly.

The findings of this study suggest that students' success in arriving at the correct answers cannot be used as the sole indicator that they have understood mathematical concepts. Therefore, teachers need to focus not only on the final results but also on the thought processes students use. Mathematics instruction should be designed to give students the opportunity to explain why they used a particular procedure, present arguments for their answers, and reflect on the problem-solving process they have followed. As a result, students' conceptual understanding can develop more deeply, and the tendency for pseudo-thinking to emerge can be minimized.

CONCLUSION

The results of this study indicate that SAAK subjects exhibit pseudo-correct thinking when solving problems involving powers. Although they are able to arrive at the correct answer, their solutions are still based on rote recall of learned procedures and are not yet accompanied by adequate conceptual understanding. This situation indicates that the accuracy of answers does not always reflect mastery of mathematical concepts. Therefore, identifying students' thought processes is

important for gaining a more comprehensive understanding of their comprehension, so that mathematics instruction and assessment focus not only on final results but also on the thought processes underlying problem-solving. Thus, pseudo-correct thinking is characterized by the ability to arrive at the correct answer through a memorized procedure without any conceptual understanding of the steps involved in the solution.

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