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STUDENTS' MATHEMATICAL CONCEPT CONSTRUCTION ERRORS IN EXPONENT MATERIAL BASED ON MATHEMATICS ANXIETY

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Abstract

This study aims to describe errors in the construction of mathematical concepts related to exponents in light of mathematics anxiety. This study employs a qualitative approach with two subjects, students with low and high levels of mathematics anxiety. Data analysis uses an iterative model consisting of data condensation, data presentation, and drawing conclusions. The results of the study show that students with low mathematics anxiety exhibit pseudo constructions "incorrect" that is, they provide incorrect answers but are able to correct them after reflection, construction holes in the form of correct answers that are not supported by a complete conceptual understanding, and illogical constructions involving reasoning that does not align with the concept of exponents. Meanwhile, students with high levels of mathematics anxiety exhibited conceptual construction holes because they were not yet able to fully grasp the concept of exponents. Mis-analogical construction involved the use of inappropriate analogies when applying the properties of exponents, while mis-logical construction involved flawed reasoning when solving problems involving exponents. The research findings indicate differences in the types of errors in mathematical concept construction based on students' levels of mathematics anxiety.

Keywords: mathematical concept construction, exponents, mathematics anxiety.

Abstrak

Penelitian ini bertujuan mendeskripsikan kesalahan konstruksi konsep matematika pada materi eksponen ditinjau dari kecemasan matematika. Penelitian ini menggunakan pendekatan kualitatif dengan dua subjek, yaitu siswa yang memiliki tingkat kecemasan matematika rendah dan tinggi. Analisis data menggunakan model iteratif yang terdiri dari kondensasi data, penyajian data dan penarikan kesimpulan. Hasil penelitian menunjukkan bahwa siswa dengan kecemasan matematika rendah mengalami *pseudo construction* "salah", yaitu memberikan jawaban yang salah tetapi mampu memperbaikinya setelah reflektif, lubang konstruksi berupa jawaban benar yang tidak didukung pemahaman konsep secara utuh, serta *mis-logical construction* berupa penggunaan penalaran yang tidak sesuai dengan konsep eksponen. Sementara itu, siswa dengan kecemasan matematika tinggi mengalami lubang konstruksi karena belum mampu menghubungkan konsep eksponen secara utuh. *Mis-analogical construction* berupa penggunaan analogi yang tidak tepat dalam menerapkan sifat-sifat eksponen, dan *mis-logical construction* berupa penalaran yang tidak sesuai dalam menyelesaikan soal eksponen. Temuan penelitian menunjukkan adanya perbedaan bentuk kesalahan konstruksi konsep matematika berdasarkan tingkat kecemasan matematika siswa.

Kata kunci: konstruksi konsep matematika, eksponen, kecemasan matematika

INTRODUCTION

Mathematics is a tool that can help students deal with problems and challenges in their personal, social, and professional lives (Hayati & Jannah 2024). Thus, mathematics is said to play an important role in life, especially in supporting the improvement of the quality of education (Meliasari et al., 2024). However, because mathematics is abstract, students often find it difficult and consider mathematics a difficult subject to learn, which leads to students making errors in solving mathematics problems. This is in line with the statement of Hasibuan et al., (2025) that mathematics is an abstract science, which causes students to experience difficulties in understanding mathematics, thereby leading to errors in solving mathematics problems.

One of the errors made by students in solving mathematics problems is mathematical concept construction errors. Concept construction errors are deviations from the original concept in the process of construction mathematical concepts (Putra et al., 2023). According to Wyrasti et al., (2018) concept construction errors are errors that occur when individuals build understanding incorrectly due to inappropriate analogies or representations of concepts in the learning process or in problem solving. Subanji & Nusantara, (2013) stated that students still experience difficulties in solving mathematics problems, as shown by the large number of mathematical concept construction errors made by students. Studies by Subanji, (2015) and Ni'mah et al., (2018) show that students make mathematical concept construction errors, including pseudo-construction, construction holes, mis-analogical construction, and mis-logical construction. These errors indicate that students' conceptual understanding has not yet been fully developed.

In addition to cognitive factors, students' errors in solving mathematics problems are also influenced by psychological factors, one of which is mathematics anxiety. Irfan (2017) stated that when solving problems, students experience various errors; these errors may be caused by a lack of understanding, lack of confidence, and mathematics anxiety in learning mathematics. Furthermore, Himawan & Sulaiman (2021) also stated that individuals with mathematics anxiety tend to experience difficulties in understanding concepts as well as in applying the concepts they have mastered to solve mathematics problems. Mathematics anxiety is a feeling of fear, worry, and discomfort when dealing with mathematics-related activities (Harefa et al., 2023). The study Apriyani & Imami, (2022) stated that mathematics anxiety affects students' problem-solving; students with low anxiety have better problem-solving abilities than students with high anxiety. Hakim & Adirakasiwi, (2021) also stated that very low levels of anxiety have a positive effect on students, whereas high levels of mathematics anxiety interfere with and negatively affect students' learning behavior.

Based on the description above, it can be seen that mathematical concept construction errors and mathematics anxiety are two important aspects that are interrelead in the mathematics learning process. However, studies that specifically link mathematical concept construction errors in exponent material with students’ levels of mathematics anxiety are still limited. Previous studies have generally focused only on identifying mathematical concept construction errors or the influence of mathematics anxiety on overall mathematics ability, thus the relationship between the two has not been specifically examined. Therefore, this study makes a new contribution by analyzing mathematical concept construction errors in exponent material based on students' levels of mathematics anxiety. This study is expected to contribute to enriching the literature on the relationship between cognitive and affective aspects in mathematics learning, as well as provide teachers with information regarding the characteristics of errors exhibited by students with different levels of mathematics anxiety.

METHODS

This study employed a qualitative research approach. The research subjects consisted of two tenth grade students of MAN 2 Kota Palu who were selected purposive sampling based on the results of a mathematics anxiety questionnaire adapted from Juniati & Budayasa (2020). The questionnaire consisted of 15 statements on a 4-point Likert scale, and its validity had been tested in previous studies, with a score range of 15–60. From the 26 students who completed the questionnaire, one student each from the low mathematics anxiety category (score $\leq 37{,}5$) and the high mathematics anxiety category (score $> 37{,}5$) was selected as research subjects. After the research subjects were determined, they were given a task on exponent material as shown in Figure 1. The task completed by students were analyzed based on the error indicators presented in Table 1.

Simplify the following exponential expression:

$$1.\ \left(\frac{8^{\frac{2}{3}}}{(2^{-2}\times 2^{8})^{5}}\right)\times\left(\frac{\left(3^{2}\times 3^{-3}\right)^{-1}}{9^{\frac{1}{2}}}\right)$$

Figure 1. Exponent Problem

Data quality was ensured through credibility checks, including member checks with the research subjects to verify the consistency of the interview data, as well as peer discussions to strengthen the validity of the analysis results. In addition, the principle of dependability is used to ensure the consistency of the research process. The date analysis technique in this study referred to the data analysis model proposed by Miles et al., (2014) which consist of three stages, namely data condensation, data display, and drawing/verification of conclusions.

Table 1. Indicators of Mathematical Concept Construction Errors

No	Forms of Mathematical Concept Construction Errors	Indicators of Mathematical Concept Construction Errors
1	Pseudo Construction	➢ Pseudo construction ”correct” Students provide correct answers when solving problems, but when examined further, they give incorrect reasons or are unable to justify their answers. ➢ Pseudo construction ”incorrect” Students give incorrect answers when solving problems, but during reflection, they demonstrate correct thinking and are able to correct their mistakes.
2	Construction Holes	Students provide correct answers when solving problems, but the concept construction process is not appropriate.
3	Mis-analogical construction	Students give incorrect answers when solving problems because they do not pay attention to the conditions of a concept. They consider one concept to be the same as another concept.
4	Mis-logical construction	Students give incorrect answers when solving problems due to a lack of reasoning or understanding of the given problems. They are unable to think logically when answering the questions.

Adapted from Ni’mah et al., (2018)

RESULTS AND DISCUSSION

Based on the analysis of mathematics anxiety data, the results presented in Table 2 were obtained.

Table 2. Results of the Mathematics Anxiety Questionnaire

Categories of Mathematics Anxiety Levels	Score Criteria	Number of Students
Low	$\leq 37,5$	5
High	$> 37,5$	21

Then one student with a low level of mathematics anxiety, coded AAP and one student with a high level of mathematics anxiety, coded MIZ were selected. The exponent task completed by the student was analyzed. Furthermore, interviews were conducted to identify the forms of mathematical concept construction errors made by the students.

Mathematical Concept Construction Errors of the Subject with Low Mathematics Anxiety (AAP)

Based on the analysis of the answer sheets and interviews, subject AAP exhibited three types of mathematical concept construction errors in exponent material, namely pseudo construction, construction holes, and mis-logical construction. These errors indicate inconsistencies in the understanding and application of exponential concepts. Meanwhile, no indicators of mis-analogical construction were found in subject AAP, as the subject did not show a tendency to incorrectly associate or analogize an exponential concept with other mathematical concepts.

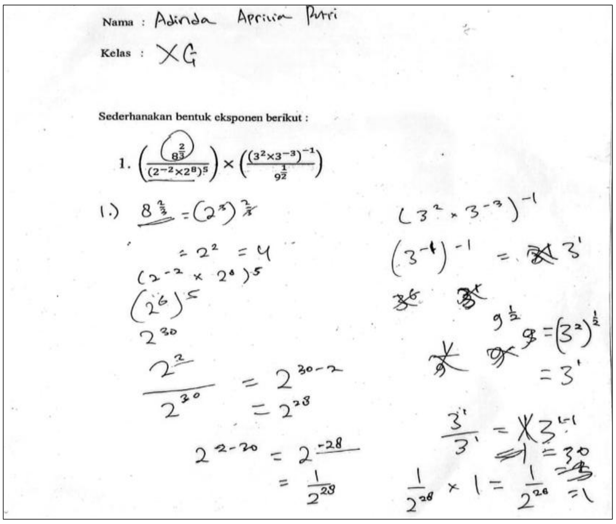


Figure 2. AAP Subject's Answer Sheet

The first error found in subject AAP with low mathematics anxiety was pseudo construction "incorrect". This error was shown when the subject gave an answer that was not in accordance with the concept of division of exponential numbers, but after reflection through interviews, the subject was able to demonstrate a correct understanding of the consept used.

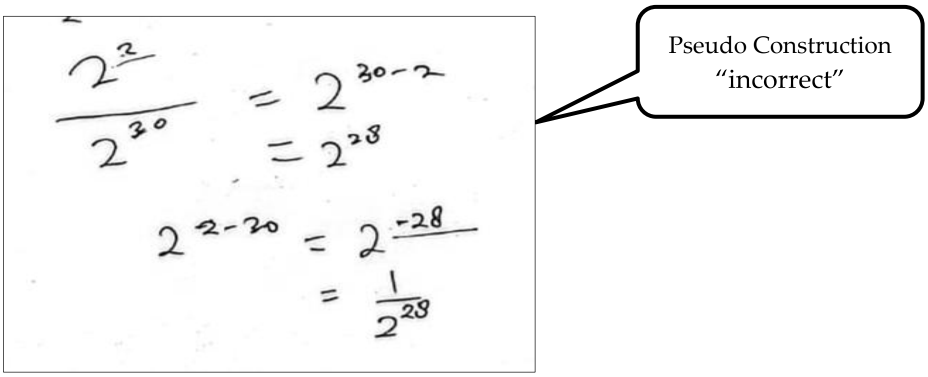


Figure 3. Pseudo Construction "incorrect" Error of Subject AAP

In Figure 3, it can be seen that the subject solved the division of exponential numbers by subtracting the exponents. However, the subject wrote the result of subtracting the exponents as $30 - 2$ resulting in 2^{28}. This step shows that the subject understood that the operation used in the division of exponential numbers is subtraction of exponents. However, the subject did not yet understand that exponent subtraction must be carried out based on the positions of the exponents in the numerator and denominator according to the property $\frac{a^m}{a^n} = a^{m-n}$. To determine the subject's reasoning for using this step, the researcher conducted an interview as shown in Table 3.

Table 3. Interview Excerpts Related to Errors

Code	Interview Excerpts
PN	Okay, please look at your answer again. Why is the final result 2^{28}?
AAP	Because the exponents are subtracted Miss, so $30 - 2 = 28$
PN	Why not $2 - 30$?
AAP	Usually the larger number is subtracted by the smaller one, Miss
PN	According to the rule $\frac{a^m}{a^n} = a^{m-n}$, how should it be?
AAP	Oh, it should be 2−30 Miss, so the result is 2^{-28}

The interview revealed that the subject used a subtraction rule that he believed was commonly used, namely subtracting the smaller number from the larger number. After being asked reflective questions, the subject was able to realize that subtraction of exponents should follow the position of the exponents in the numerator and denominator. Therefore, this error falls under the category of pseudo construction "incorrect", which is a condition where a student gives an incorrect answer but, after reflection, is able to demonstrate a correct understanding of the concept involved. This finding is in line with the study by (Indri & Widiyastuti, 2018) which stated that students who experience pseudo construction "incorrect" are caused by the habit of solving similar types of problems, so students tend to reuse previously used procedures without re-examining the correctness of the underlying concepts. This suggests that the subjects' errors were influenced more by the application of habitual procedures than by a lack of understanding of the concept of exponents, thus even with low levels of mathematics anxiety, the subjects were still able to reflect on and correct their errors after being given reflective questions.

Subject AAP also experienced a mathematical concept construction error in the form of construction holes. This error was shown when the subject was able to obtain a correct answer, but the conceptual understanding used to explain the answer had not yet been fully formed.

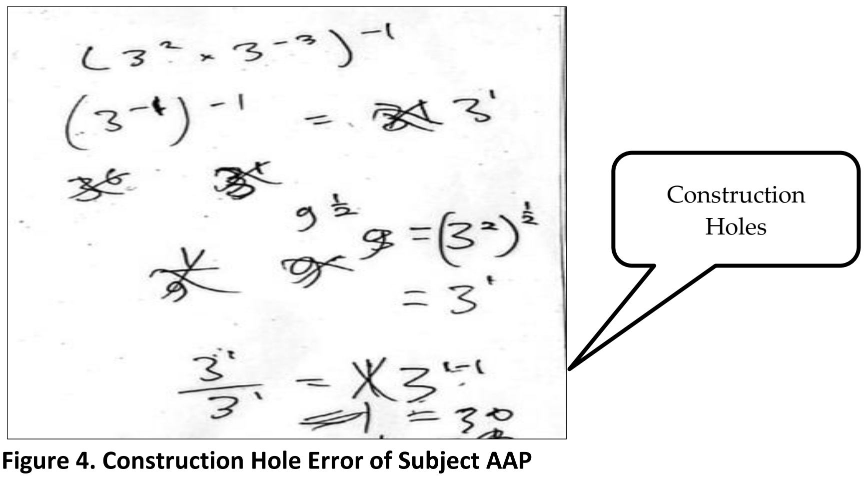


Figure 4. Construction Hole Error of Subject AAP

Based on Figure 4, the subject provided the final answer 3^0, which matches the expected solution. This indicates that the subject was able to apply the problem-solving procedure to arrive at the correct answer. However, the correctness of this answer does not yet indicate that the subject has fully understood the concept of exponents. Therefore, the researcher conducted an interview to determine the subject's conceptual understanding related to the expression 3^0. The subject's explanation during the interview is presented in Table 4 below.

Table 4 Interview Excerpts Related to Errors

Code	Interview Excerpts
PN	The answer is 3^0 right?, Can this form still be simplified?
AAP	I think it can, Miss.
PN	In your opinion, what is 3^0 equal to?
AAP	It is equal to 3, Miss, because zero is not counted
PN	So because the exponent is zero, do you assume the exponent does not exist or is not counted?
AAP	Yes, that's right, Miss.

Subject AAP stated that the zero exponent is not counted, so $3^0 = 3$. The explanation given shows that the subject has not yet understood the mathematical concept of the zero exponent. In fact, according to the properties of exponents, any non-zero number raised to the power of zero is equal to one. Thus, the correct answers given by the subjects were not supported by an accurate understanding of the concept, so this situation falls under the category of a construction hole. The subject was able to obtain the correct answer through the problem-solving procedure used; however, some parts of the concept have not yet been fully constructed. This finding is in line with Huda et al., (2024) who stated that students experience construction holes because they have not been able to build a complete conceptual understanding, resulting in errors in understanding the concepts used when solving problems. This finding suggests that errors stem more from an incomplete understanding of the concept of exponents than from an inability to follow the procedure. Nevertheless, low levels of mathematics anxiety allowed the participants to continue applying the solution procedure correctly.

Another mathematical concept construction error experienced by subject AAP is mis-logical construction. This error occurs when students use reasoning that is not in accordance with mathematical concepts in solving problems. As a result, students produce solution steps that are not in accordance with the applicable rules even though they are familiar with the procedures used.

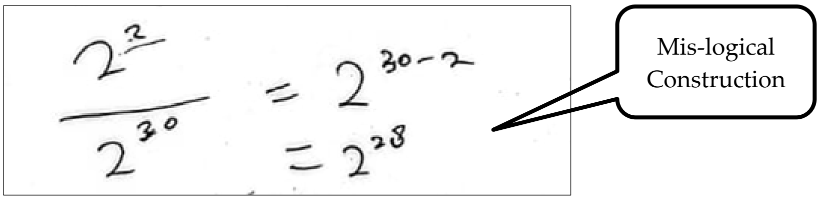


Figure 5. Mis-logical Construction Error of Subject AAP

Based on Figure 5, it can be seen that the subject solved $\frac{2^2}{2^{30}}$ by writing $2^{30-2} = 2^{28}$. This step shows that the subject reversed the order of exponent subtraction, resulting in a positive exponent. However, according to the properties of division of exponential numbers, the operation should be solved as $2^{2-30} = 2^{-28}$. To determine the subject's reasoning for using this step, the researcher conducted an interview as shown in Table 5.

Table 5 Interview Excerpts Related to Errors

Code	Interview Excerpts
PN	Why did you solve it that way?
AAP	Because the exponent on the numerator is smaller than the one in the denominator, Miss, so I reversed it so that the exponent would not become negative.
PN	What is the problem if the exponent is negative?
AAP	I think the exponent cannot be negative because the number becomes very large, Miss

Based on the interview results in Table 5, the subject believed that the result of exponentiation cannot be negative when dealing with large numbers. Consequently, the subject changed the order of exponent subtraction because they believed that a number with a smaller exponent cannot be divided by a number with a larger exponent. This indicates that the subject's reasoning does not align with the correct concept of exponents. These findings are consistent with the research by Shodikin et al., (2024) which shows that errors in logical reasoning lead to inconsistencies in the use of mathematical models. In this study, this condition indicates that errors arise because subjects rely more on intuitive reasoning than on a correct understanding of the concept of exponents. Even with low levels of mathematics anxiety, flawed reasoning can still occur when subjects interpret concepts based on their own understanding.

Mathematical Concept Construction Errors of the Subject with High Mathematics Anxiety (MIZ)

Based on the analysis of written test and interview data, subject MIZ exhibited concept construction errors in the form of construction holes, mis-analogical construction, and mis-logical construction. No indicators of pseudo construction were found because the errors were primarily due to a lack of understanding of the concept of exponents, indicating that the subject’s conceptual understanding had not yet fully developed in terms of comprehending and applying the properties of exponents.

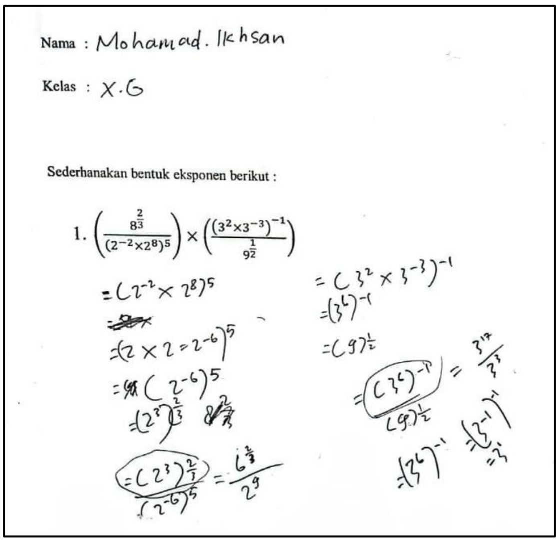


Figure 6. Answer Sheet of Subject MIZ

Subject MIZ experienced a mathematical concept construction error in the form of construction holes. This error occurs when students have understood part of the concept used in solving the problem, but their understanding has not been fully formed, so there are still parts of the concept that are missing or cannot be explained correctly. As a result, the problem-solving process carried out by students becomes incomplete or not in accordance with the actual concept.

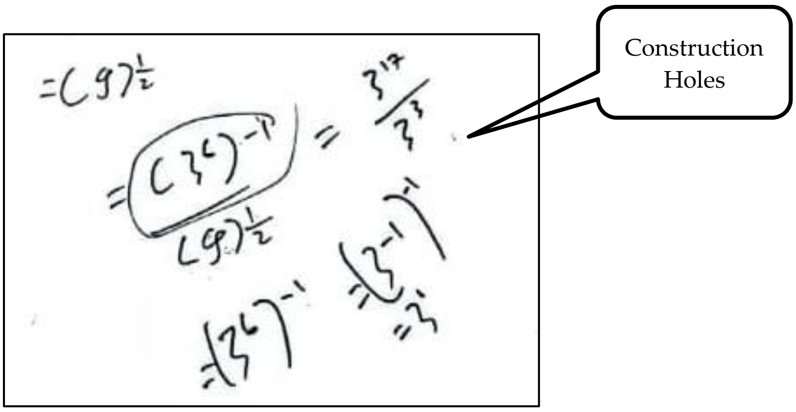


Figure 7. Construction Hole Error of Subject MIZ

Based on Figure 7, it can be seen that the subject transformed 9 into base 3 so that it has the same base as the other exponential forms. This step shows that the subject partially understands the concept of base matching in exponents. However, in the next step, the subject did not continue the exponent operation according to the applicable rules and instead wrote the final result as 3^1 without a clear justification. To determine the subject’s reasoning in solving the problem, the researcher conducted an interview as presented in Table 6 below.

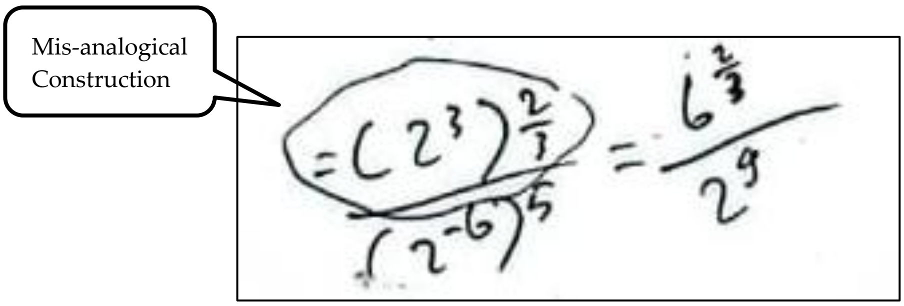
Table 6 Interview Excerpts Related to Errors

Code	Interview Excerpts
PN	Next, why did you change this form into 3?
MIZ	Because 9 can be rewritten as 3, Miss, so that it matches the one above.
PN	After changing it into the same base, what is the next step?
MIZ	I don't know anymore, Miss, so I just wrote it like that
PN	How about this one? Here the answer is already 3^{17}, why is there another 3^1?
MIZ	Yes, Miss, I redid it because the exponent 17 is too large, so I made it 3^1.
PN	Oh, so you wrote 3 because it was simplified from 9. So the final result is $\frac{3^1}{3^1}$, right?
MIZ	Yes, Miss, that's correct.

Based on the interview results, it was found that the subject understood that the number 9 can be rewritten as base 3 so that it has the same base as other exponential forms. However, after rewriting the base, the subject did not know the next step that should be taken. In addition, the subject changed 3^{17} into 3^1 because they considered the exponent 17 too large, rather than based on the correct properties or rules of exponents. This indicates that the subject only partially understands the concept of exponents but has not been able to integrate these concepts comprehensively in the problem-solving process

These findings are consistent with Azizah (2020), which showed that construction holes occur because certain schemas or conceptual components have not yet emerged in the process of students' knowledge construction. As a result, students only partially understand the concepts used in problem solving but are not yet able to integrate them fully, leading to incomplete solutions. This finding suggests that high levels of mathematics anxiety can hinder students from continuing their thinking process systematically, causing them to stop at a partial understanding of a concept and take steps that are not based on the correct rules for exponents.

Another error experienced by subject MIZ is mis-analogical construction. This error occurs when students use analogies that are not in accordance with the actual mathematical concept, so that one concept is considered to have the same rules as another different concept.



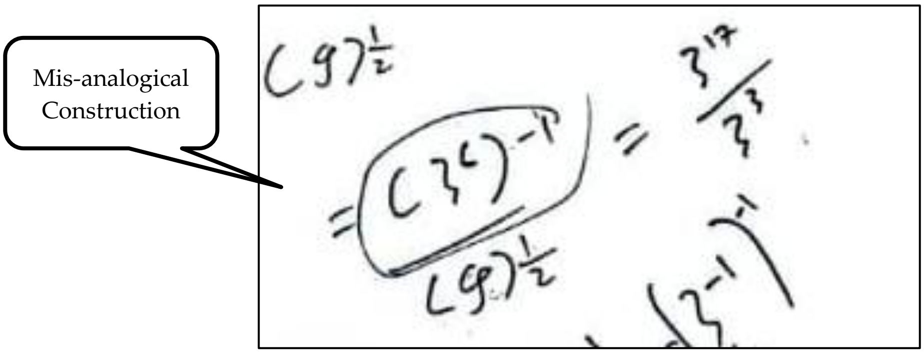


Figure 8. Mis-Analogical Construction Error of Subject MIZ

In Figure 8, it can be seen that the subject made several errors in applying the properties of exponents. In the first part, the student added the exponents $(-6+5)$ resulting in the form 2^9. In addition, the student also multiplied the bases $2 \times 3 = 6$and wrote it as $6^{\frac{2}{3}}$. In another part, the student multiplied the exponents 2 and -3 in the expression $(3^2 \times 3^{-3})^{-1}$ resulting in $(3^6)^{-1}$. These steps show that the student has not applied the properties of exponents according to the correct rules. To determine the subject's reasoning in solving the problem, the researcher conducted an interview as presented in Table 7.

Table 7 Interview Excerpts Related to Errors

Code	Interview Excerpts
PN	From your answer here, why is the result $\frac{6^{\frac{2}{3}}}{2^9}$?
MIZ	Because I subtracted the exponents, Miss, uh I added it $-6+5=9$ so it becomes 2^9. For this one, because $2 \times 3 = 6$ then the exponent is rewritten.
PN	For this one, how about it? Try to explain why the result is $\frac{(3^6)^{-1}}{9^{\frac{1}{2}}}$?
MIZ	For this one Miss, I multiplied the exponents $2 \times 3 = 6$, then applied the exponent -1. For $9^{\frac{1}{2}}$ because 1 cannot be further exponentiated, so it is like that.
PN	Why is the final result $\frac{3^{17}}{3^3}$?
MIZ	Because I multiplied it, Miss, I multiplied 3 by the exponent 6, then subtracted 1, so it became 17. For 3^3 I don't know, Miss, I just wrote it randomly.

Based on the interview results, the subject performed operations on exponents in a manner similar to integer operations. The subject added, subtracted, and multiplied exponents without considering the applicable properties of exponents. This indicates that the subject equated integer operation rules with exponent operation rules, whereas the two concepts are different. Therefore, the error made by subject MIZ is classified as mis-analogical construction, namely an error that occurs when students use inappropriate analogies between one mathematical concept and another.

This finding is in line with Muqtada et al., (2022) which showed that students use inappropriate analogies in understanding mathematical concepts. In that study, students assumed that operations on radical expressions can be performed in the same way as operations on rational numbers without considering the rules that apply to radical expressions. Similar findings were reported by Putra et al., (2023) who identified mis-analogical construction when students used inappropriate procedures in solving mathematical problems. As a result, students applied procedures that were not appropriate, leading to incorrect answers. This suggests that high levels of mathematics anxiety cause students to rely more on familiar rules, such as integer operations, rather than revisiting the properties of exponents that should be used.

The last error experienced by subject MIZ is mis-logical construction. This error occurs when students use reasoning that is not in accordance with mathematical concepts in solving a problem. As a result, students produce solution steps that are not in accordance with the applicable rules even though they are familiar with the procedures used.

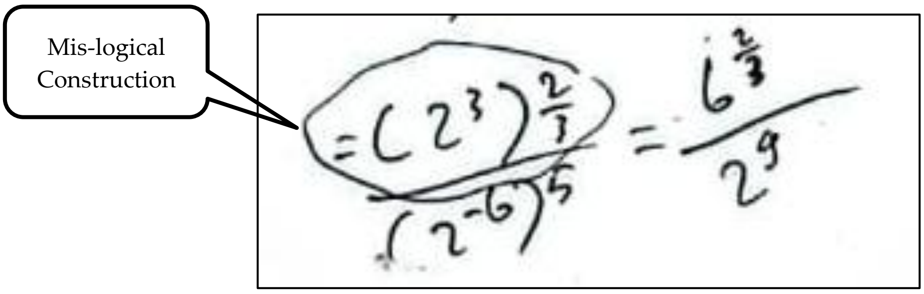


Figure 9. Mis-Logical Construction Error of Subject MIZ

In Figure 9, it can be seen that the subject did not apply the rule of multiplying exponents according to the properties of exponents. The subject chose to add the exponents instead of multiplying them because they considered that multiplying exponents would produce a value that is too large. This leads to a solution procedure that is not in accordance with the actual rules of exponents. To determine the subject's reasoning for using this step, the researcher conducted an interview as follows.

Table 8 Interview Excerpts Related to Errors

Code	Interview Excerpts
PN	Why didn't you multiply the exponents in this part?
MIZ	Actually, at first I wanted to multiply it, Miss -6×5 but I thought the number in the exponent would become too large
PN	What is the problem if the exponent is large?
MIZ	I thought it cannot be written like that, Miss, so I just added them instead

Based on the interview results, it was found that the subject avoided using the rule of exponent multiplication because they considered that the resulting value would be too large and could not be written. This assumption shows that the subject determined the solution steps based on personal considerations rather than the applicable properties of exponents.

As a result, the subject replaced exponent multiplication with exponent addition in order to obtain a result that was considered simpler. Therefore, the error made by subject MIZ is classified as mis-logical construction, namely a reasoning error that is not in accordance with the actual mathematical concept.

This finding is in line with Sulfriani et al., (2021) which showed that students experience mis-logical construction when they use reasoning that is not in accordance with mathematical concepts, resulting in the application of incorrect solution procedures. In that study, students altered algebraic operations and performed manipulations of mathematical expressions that were not appropriate due to a lack of understanding of the concepts used. A similar condition was also found in this study, where the subject changed the exponent operation procedure because they considered that large exponential results could not be used, resulting in reasoning that was not in accordance with the actual concept of exponents. This suggests that high mathematics anxiety causes subjects to focus more on avoiding results they perceive as difficult or unreasonable than on applying the rules of exponents correctly.

The differences in the characteristics of mathematical concept construction errors between the low mathematics anxiety subject (AAP) and the high mathematics anxiety subject (MIZ) indicate that the level of mathematics anxiety influences students' mathematical concept construction processes. Students with high levels of mathematics anxiety tend to have difficulty understanding, connecting, and applying the concepts they have learned, making them more prone to conceptual construction errors such as construction holes, mis-analogical constructions, and mis-logical constructions. In contrast, subject AAP, who had a low level of mathematics anxiety, was still able to understand and correct his errors after being given reflective questions. This finding indicates that high mathematics anxiety can hinder students from developing a complete understanding of mathematical concepts and applying those concepts appropriately in problem-solving.

These findings are consistent with those of Anggraini & Sutirna (2023); Kamid et al., (2025) which states that students with high levels of anxiety tend to make more errors in understanding and construction mathematical concepts, whereas students with low levels of anxiety are better able to develop a thorough understanding. Thus, the higher the level of mathematics anxiety, the more likely students are to encounter difficulties in construction and applying mathematical concepts accurately Prasetyo & Dasari (2023); (Himmi & Azni, 2017).

Therefore, teachers need to consider students' levels of mathematics anxiety in the learning process and provide appropriate guidance to help them overcome mathematical concept construction errors. In practice, teachers can create a safe learning environment, use reflective questions to help students recognize and correct their mistakes, and provide gradual scaffolding to ensure students understand the basic concepts of exponents before moving on to more complex operations.

CONCLUSION

Based on the results of the study on students' mathematical concept construction errors in exponent material viewed from mathematics anxiety, it can be concluded that there are differences in the types of mathematical concept construction errors made by students with different levels of mathematics anxiety. Students with low mathematics anxiety experienced three types of mathematical concept construction errors, namely pseudo-construction, construction holes, and mis-logical construction. Although they made conceptual construction errors, these students were still able to correct their mistakes and improve their understanding after being given reflective questions. Meanwhile, students with high mathematics anxiety experienced more complex mathematical concept construction errors, namely construction holes, mis-analogical construction, and mis-logical construction. These errors were shown through the use of inappropriate analogies in applying exponent properties, incorrect application of procedures, and reasoning that was not in accordance with exponent concepts. These findings indicate that the level of mathematics anxiety influences students' conceptual construction process when solving exponential problems. The higher the level of mathematics anxiety, the greater the obstacles students face in understanding, connecting, and applying concepts accurately.

This study involved only two subjects, so the findings cannot be generalized widely. The transferability of these findings is limited to contexts with similar characteristics, namely 10th-grade students studying exponential and using comparable mathematics anxiety instruments. Future research is recommended to involve more subjects with a wider range of mathematics anxiety levels to strengthen the transferability of the findings.

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