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STUDENTS' MISCONCEPTION ON ALGEBRAIC FUNCTION LIMITS

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ABSTRACT

Understanding the concept of limits is fundamental in calculus learning, yet many secondary school students continue to experience persistent conceptual difficulties. These difficulties often manifest as misconceptions that hinder students' ability to connect algebraic representations, symbolic meanings, and underlying theoretical ideas in limits of algebraic functions. This study aims to analyze the types of misconceptions experienced by twelfth-grade students in learning the limits of algebraic functions. A qualitative descriptive approach was employed to obtain an in-depth understanding of students' misconceptions. Data were collected using essay-type test items specifically designed to reveal misconceptions related to limits, followed by semi-structured interviews to confirm students' reasoning and clarify their conceptual understanding. The data analysis followed three systematic stages: data reduction by distinguishing correct and incorrect responses, data display by categorizing incorrect responses into specific misconception types or unanswered items, and conclusion drawing based on recurring characteristics of the identified misconceptions. The results indicate that students experienced various types of misconceptions, including correlational, theoretical, systematic, basic, computational, and language-interpretation misconceptions. A total of 30% of misconceptions occurred in Item 1, no misconceptions were identified in Item 2, and 7% of misconceptions appeared in Item 3. These misconceptions were primarily related to students' inability to connect relevant concepts, misunderstand the existence of limits, apply inappropriate procedures, and misinterpret mathematical symbols or problem statements. In conclusion, the findings emphasize the importance of instructional approaches that explicitly address conceptual understanding and symbolic interpretation to reduce misconceptions in learning the limits of algebraic functions.

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INTRODUCTION

Mathematics is a fundamental discipline that underpins human reasoning and supports the advancement of science and technology. Mathematical understanding is essential not only for solving routine problems in everyday life, such as economic transactions, but also for analyzing complex phenomena involving change, optimization, and prediction in fields such as engineering, economics, and natural sciences. Numerous studies have emphasized that strong mathematical competence is closely linked to individuals' ability to solve real-world problems and adapt to technological developments (Belbase et al., 2022; Rehman et al., 2023; Tong et al., 2021). Consequently, developing students' conceptual understanding of core mathematical ideas is a crucial goal of formal education.

Within mathematics, calculus occupies a central position because it provides formal tools for understanding change, motion, and growth. Core calculus concepts including limits, derivatives, and integrals function not only as theoretical constructs but also as essential instruments for real-life applications, such as determining instantaneous velocity, modeling population growth, and constructing scientific and computational models (Hakiki et al., 2025; Nurpadila et al., 2025). In the contemporary technological era, calculus has become increasingly relevant, serving as a mathematical foundation for algorithm design, computer programming, and the development of artificial intelligence systems (Belbase et al., 2022; Rehman et al., 2023; Tong et al., 2021). Therefore, a solid understanding of calculus concepts from the secondary school level is indispensable. In high school mathematics curricula, the learning of calculus begins with the concept of limits, which serves as a prerequisite for understanding derivatives and integrals (Sakdiah & Siregar, 2025). Weak understanding or misconceptions at this foundational stage may negatively affect students' overall comprehension of calculus.

Despite its importance, many students experience significant difficulties in learning the limits of algebraic functions. Empirical evidence from various educational contexts indicates that students frequently develop misconceptions when their constructed understanding does not align with accepted mathematical concepts (Mufit et al., 2023; Rahmiati & Roesdiana, 2021). These misconceptions may take different forms, including fundamental conceptual errors, flawed reasoning, incorrect procedural applications, and misinterpretations of mathematical symbols or language (Aydin-Güç & Aygün, 2021; Hamid, 2025; Mathaba et al., 2024a; Moru & Mathunya, 2022). In Indonesia, classroom practices often emphasize procedural fluency and formula application, which can unintentionally encourage students to treat limits as mere substitution or algebraic manipulation tasks rather than as conceptual processes describing behavior near a point. Such learning conditions contribute to persistent misunderstandings of the existence, meaning, and properties of limits.

Previous studies have identified several sources of misconceptions in learning limits. Lutfiana (2021) reported that students commonly perceive limits as direct substitution procedures, ignoring their conceptual meaning as an approach toward a value. Other studies have highlighted students' difficulties in coordinating graphical, numerical, and symbolic representations, which further exacerbates misconceptions (Aini & Wiryanto, 2020). To address this issue, Aini and Wiryanto proposed a comprehensive classification of mathematical misconceptions, consisting of correlational, theoretical, systematic, basic, calculational, and language-interpretation misconceptions. This classification offers a structured framework for analyzing students' conceptual errors more deeply.

However, the existing body of research on misconceptions in function limits reveals several limitations. Some studies have focused on specific factors such as learning styles (Saraswati, 2012) or particular difficulties in explaining definitions and properties of limits (Purba & Hutagaol, 2017). Others have identified certain misconception types, such as classification or rule-based errors (Lutfiana, 2021). Nevertheless, most previous research tends to report misconceptions in a general manner without systematically mapping them using a comprehensive categorical framework (Rakes & Ronau, 2019; Schroeder et al., 2018).

Moreover, many studies rely predominantly on quantitative test data, providing limited insight into students' underlying reasoning processes. As a result, the structure and formation of misconceptions in authentic classroom contexts remain insufficiently explored, particularly at the high school level (Sreelohor et al., 2025).

Addressing these gaps, this study aims to provide a more detailed and systematic analysis of students' misconceptions regarding the limits of algebraic functions (Ayeh, 2025; Jameson et al., 2023; Mathaba et al., 2024b; Mildret & Kakoma, 2025; Papadouris et al., 2024). By employing the misconception categories proposed by Aini and Wiryanto (2020) and adopting a qualitative descriptive approach, this research seeks to explore not only the types of misconceptions that occur but also the reasoning patterns underlying students' responses. The main purpose of this study is to analyze the forms and types of misconceptions experienced by high school students in learning algebraic function limits and to identify recurring misconception patterns based on students' responses to diagnostic tasks. The findings are expected to contribute to a deeper understanding of students' conceptual difficulties and to inform the development of more effective instructional strategies in calculus learning.

Based on the description above, the purpose of this study is to analyze the forms and types of misconceptions experienced by high school students regarding the limits of algebraic functions and to identify the patterns of misconceptions that emerge based on students' responses to diagnostic questions.

METHOD

This study employs a descriptive qualitative research method to explore the types and patterns of misconceptions regarding the limits of algebraic functions experienced by high school students (Miles et al., 2014; Naderifar et al., 2017). The participants of this study were six 12th-grade students from MAN Sibolga, selected using purposive sampling. The participants represented three academic ability levels: low, medium, and high ability. These levels were based on the students' performance in algebraic function limit problems, as discussed with the mathematics teachers at MAN Sibolga. In this study, low, medium, and high refer to the academic ability levels of students based on their understanding of limits. These categories are determined by students' performance in solving algebraic function limit problems. Low ability students struggle with the concept of limits, making frequent errors and showing major misconceptions. Medium ability students have a general understanding but still make mistakes or have incomplete understanding. High ability students grasp the concept well, make fewer errors, and apply knowledge effectively, though they may have minor misconceptions.

Data representing these categories include: (1) Test responses to assess students' ability to solve limit problems. (2) Performance analysis based on scores and accuracy in diagnostic tasks. (3) Interview data to reveal students' reasoning and misconception patterns. In short, categorization relies on test results, performance analysis, and interview insights to represent students' ability levels. Data were collected through essay-based tests designed to identify misconceptions, as well as through student interviews. The test instrument was structured based on misconception indicators.

The data collection tools used in this study included: (1) Essay-type test items designed to identify misconceptions related to the concept of limits in algebraic functions. (2) Semi-structured interviews conducted to confirm students' reasoning and provide deeper insights into their understanding and misconceptions.

Step-by-Step Research Process: (1) Test Administration: Students completed an essay test focused on algebraic function limits. This test was designed to reveal their understanding and any potential misconceptions. (2) Interviews: After completing the test, semi-structured interviews were conducted with each student. The interviews aimed to explore the reasoning behind their answers and clarify any misconceptions identified during the testing phase. (3) Data Categorization: Students' responses were categorized as correct, incorrect, or unanswered. Incorrect responses were further analyzed based on the six categories of misconceptions: correlational, theoretical, systematic, basic, computational, and language-interpretation. (4) Data Display: The data were presented by calculating the percentage of correct answers (PK), misconceptions (MK), and non-responses (TPK) for each test item. (5) Conclusions: The findings were analyzed and interpreted to identify recurring patterns in the students' misconceptions and their reasoning processes.

The data were analyzed using the Miles and Huberman model (1994), which involves three stages: (1) Data Reduction: Correct and incorrect responses were identified, and misconceptions were categorized into the six misconception types. (2) Data Display: The percentage of correct, incorrect, and non-response answers were displayed to identify trends and patterns. (3) Conclusion Drawing: The analysis concluded by interpreting the patterns of misconceptions, linking them to the six identified categories, and drawing insights into how these misconceptions affect students' understanding of algebraic function limits (Miles et al., 2014; Rijali, 2019).

RESULTS AND DISCUSSION

Results

The results of this study are presented based on each student's work on each question. Next, correct and incorrect answers are displayed for each question. The incorrect answers are then analyzed and their misconceptions are described. The results of the students' work are presented in the following table:

Table 1. Student Work Results

Subject	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6
S1	PK	PK	PK	PK	MK	PK
S2	MK	PK	PK	PK	MK	MK
S3	PK	PK	MK	MK	MK	MK
S4	PK	PK	MK	MK	MK	MK
S5	MK	PK	MK	MK	MK	MK
S6	TPK	PK	MK	MK	MK	PK
PK Percentage	50%	100%	33%	33%	0%	33%
MK Percentage	33%	0%	67%	67%	100%	67%
TPK Percentage	17%	0%	0%	0%	0%	0%

Description:

• PK = Concept Understanding

• MK = Misconception

• TPK = Not Understanding the Concept

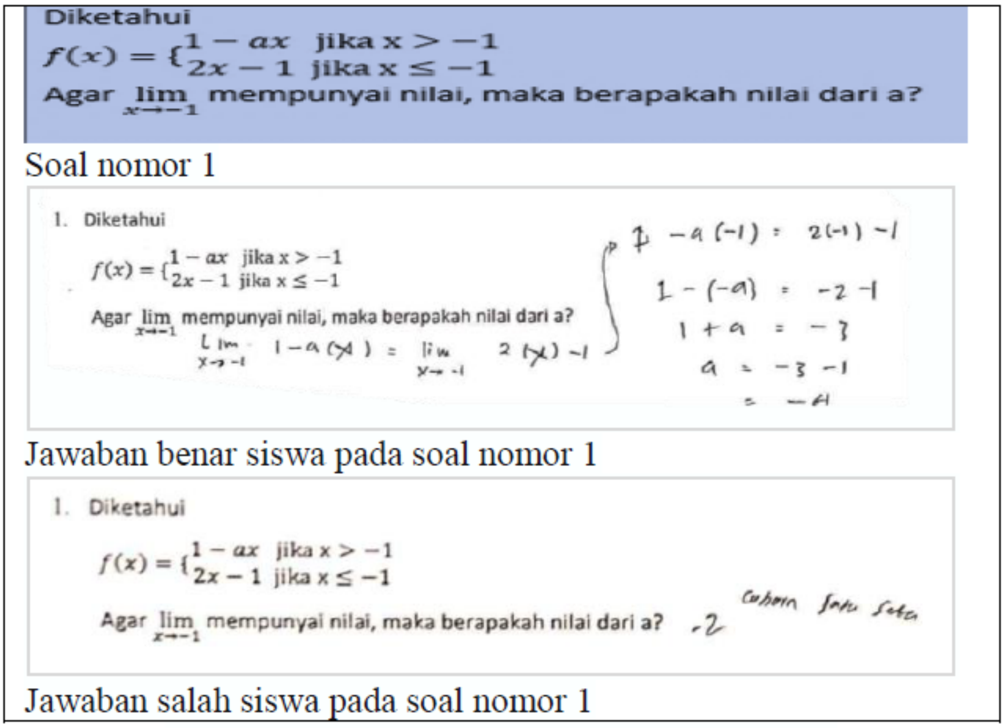


Figure 1. Question and Answer Number 1

In question number 1, students were asked to determine the value of a for the limit of the function to have a value. To meet this requirement, the limits on the left and right sides must be the same value. Based on the students' answers, 3 students answered correctly, 2 students had a misconception, and 1 student did not provide an answer. Interview results showed that students with misconceptions believed that for the limit of a function to have a value, it is necessary to find a value such that for each x fulfilled $2x - 1 \leq -1$ and $1 - ax > -1$, so that the value is obtained $a = -2$. Meanwhile, students who did not answer stated during the interview that they did not understand the meaning of the question.

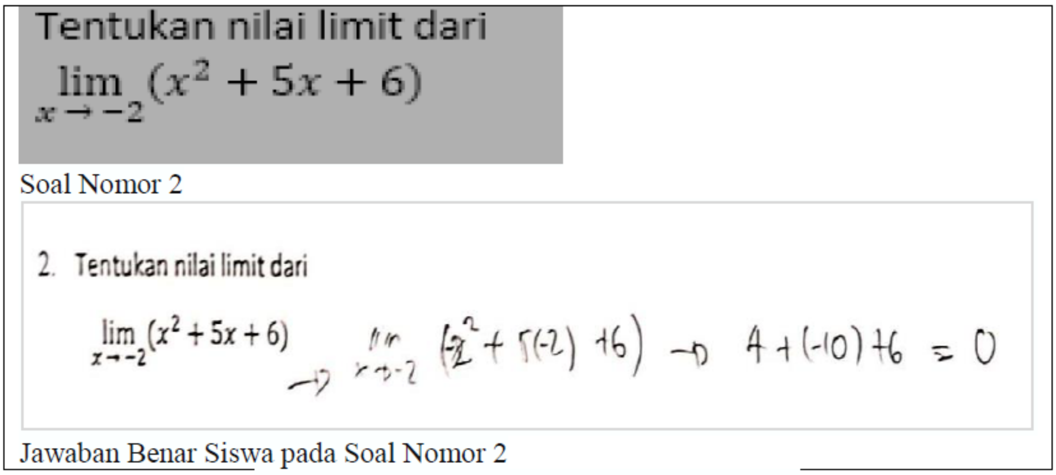


Figure 2. Question and answer number 2

In question number 2, students were asked to determine the limit value of the function using the substitution method. The results showed that all students gave the correct answer. Based on interviews, some students initially felt hesitant because their calculation result was 0. However, after trying various methods and still getting a value of 0, they ultimately maintained their answer. They also added that in the final stage of the work, they recalled that a result of 0 still indicates a limit value, while forms that have no value are indeterminate forms, such as 0/0.

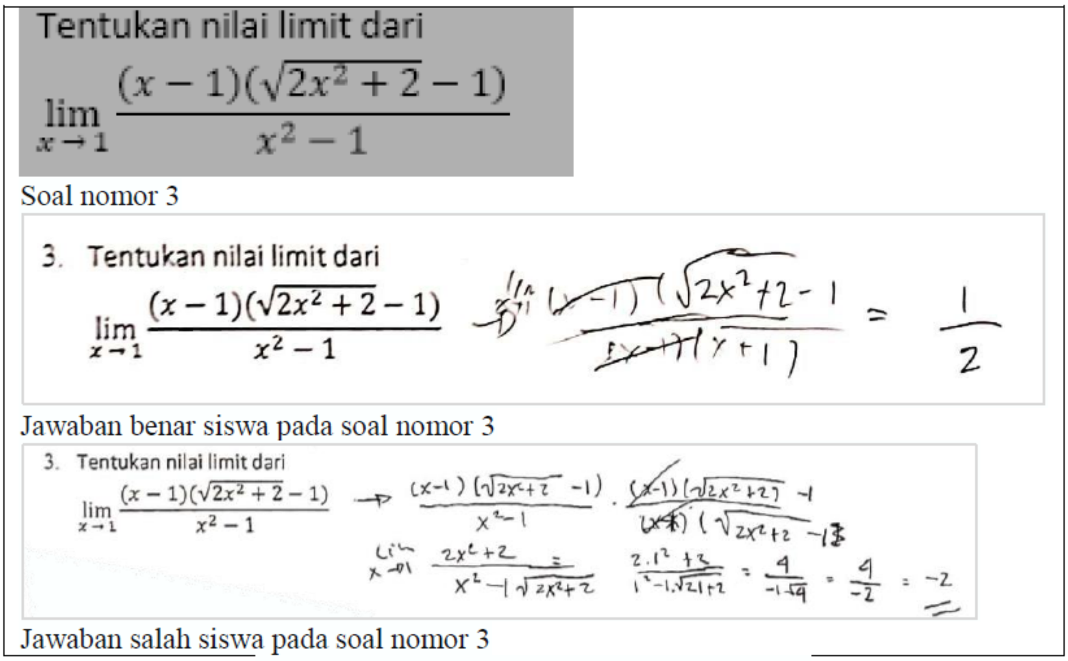


Figure 3. Question and answer number 3

In question number 3, students are asked to determine the limit value of a rational function. This problem can be solved by factoring the quadratic form of the function to obtain a common factor in the numerator and denominator.

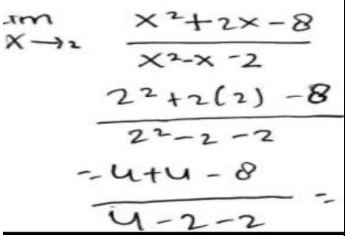
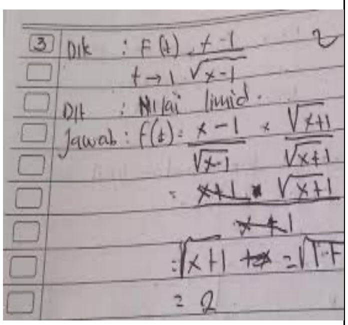
In the misconceptions of students, the strategy used is to multiply the function in the problem by its radical form. The goal of this step is to eliminate the radical form in the numerator. Interview results indicate that these students assume that if a function contains a radical form, the step must be taken to multiply it by the radical form to eliminate the radical sign.

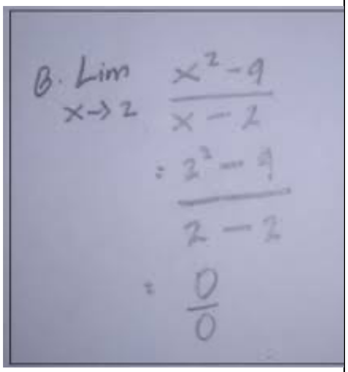
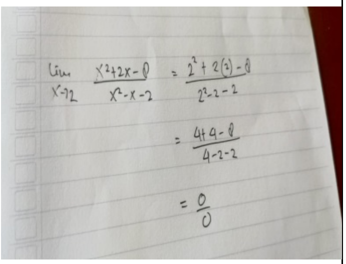
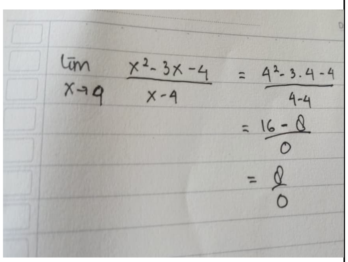
Correlational Misconceptions: Based on the results of question number 1, students were unable to understand the relationship between the concept of the limit of an algebraic function and other concepts. This was evident in students' answers, which showed they did not understand the conditions for the existence of a limit in a function, leading them to focus solely on solving algebraic equations when solving the problem. This finding aligns with several studies that suggest correlational misconceptions arise when students lack a grasp of the relationships between concepts in a problem (Lutfiana, 2021; Fardah, Lus, & Palupi, 2023; Kadarisma, Fitriani, & Amelia, 2020; Muryani et al., 2022). Research by Sholekah et al. (2017) also showed that most students experienced difficulty when working on problems requiring the connection of the concept of limits with other mathematical concepts.

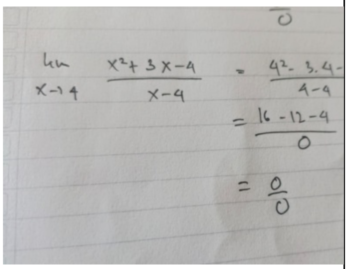
Theoretical misconceptions occur when students do not understand the concept of the limit of a function. This is evident in the results of the answers to question number 1, where students did not understand the conditions for the existence or non-existence of a limit in a function. This finding aligns with Kulsum's (2020) research, which showed that students' error rates on similar problems remained very high. Meanwhile, on problem number 2, students did not exhibit conceptual difficulties because they understood the concept of limits in polynomial functions.

An in-depth analysis of various errors made by students in solving algebraic function limit problems based on student work. The analysis focuses on conceptual, procedural, reasoning, and calculation errors.

Table 2. Analysis of Student Errors and Concept Improvement in Limit Problems

Item	Students' Work	Student Answer Format	Type of Error	Error Description	Concept Improvement
1	Figure 4. 	Direct substitution yields 0/0	Limit Concept Error	Students immediately substitute the value of x = 2 without understanding that the form 0/0 is not the final result, but rather an indication that the limit must be solved by factoring or algebraic simplification. This demonstrates a misconception about the meaning of limits as an approximation to value, not simply a substitution.	Students need to understand that the indeterminate form 0/0 must be simplified by factoring the numerator and denominator.
2	Figure 5 		Procedural Error	The student stopped at the result 0/0 without continuing the factoring process. This indicates that the student did not understand the next step in solving the limit of a rational function.	The numerator must be factored into (x − 4)(x + 1) so that it can be simplified with the denominator.

3	Figure 6 		Mathematical Reasoning Errors	Students assume that the limit cannot be determined when the result is 0/0, when in fact this should be a sign that the form can be simplified. This demonstrates a weak understanding of algebraic limits.	Teach that limits can be found by simplifying algebraic expressions to a form that can be substituted.
4	Figure 7 	Direct substitution yields 0/0	Limit Concept Error	Students immediately substitute the value of $x = 2$ without understanding that the form 0/0 is not the final result, but rather an indication that the limit must be solved by factoring or algebraic simplification. This demonstrates a misconception about the meaning of limits as an approximation to value, not simply a substitution.	Students need to understand that the indeterminate form 0/0 must be simplified by factoring the numerator and denominator.
5	Figure 8 		Procedural Error	The student stopped at the result 0/0 without continuing the factoring process. This indicates that the student did not understand the	The numerator must be factored into $(x - 4)(x + 1)$ so that it can be simplified with the denominator.

				next step in solving the limit of a rational function.	
6	Figure 9 		Mathematical Reasoning Errors	Students assume that the limit cannot be determined when the result is 0/0, when in fact this should be a sign that the form can be simplified. This demonstrates a weak understanding of algebraic limits.	Teach that limits can be found by simplifying algebraic expressions to a form that can be substituted.

The following is a transcript of the student interview:

Description:

P: Researcher

S1–S6: Students (representing low, medium, and high ability)

Interview Question 1 (Existence of Function Limits)

P: Explain how you determined the value of a so that the limit of the function in question 1 had a value.

S1: I immediately found the value of a so that all the equations in the function were satisfied. I thought that if the value of a was found, then the limit must exist.

P: Did you consider the limits from the left and right?

S1: Not really, I just focused on solving the inequality, because I thought that was what the question asked for.

P: Why didn't you provide an answer to question 1?

S2: I didn't understand the question. I wasn't sure what to look for, so I didn't dare answer.

P: Did you find the problem mathematically difficult?

S2: Not the calculation, but I didn't understand the meaning of the problem statement.

Interview Question 2 (Limits of Polynomial Functions)

P: How did you solve problem 2?

S3: I immediately substituted the value of x into the function because it's a polynomial.

P: The result you got was zero. Are you unsure about that answer?

S3: At first, I was skeptical because I thought a zero result meant there was no limit. But then I remembered, the only thing that doesn't exist is a 0/0 result.

P: Why are you still confident in the answer of zero as the limit?

S4: Because after recalculating it using the same method, the result is still zero. So I'm sure there is a limit.

Interview Question 3 (Limit of a Rational Function)

P: Explain the steps you used to solve question 3.

S5: I multiplied the numerator and denominator by the radical pair to eliminate the root above it.

P: Why did you use that method?

S5: Usually, if there are roots, the steps are like that to make it easier to calculate.

P: Did you have time to factor the function?

S5: No, I immediately used the radical pair method because I thought that was the formula.

General Reflective Interview

Q: What do you think is the most difficult part of the algebraic function limit topic?

S6: Determining which method to use. Sometimes I'm confused about when to just substitute and when to factor.

Based on interviews with 12th-grade students at MAN Sibolga, it was found that misconceptions about limits of algebraic functions arise from students' lack of understanding of the conceptual meaning of limits and the interrelationships between mathematical concepts. In question 1, students with misconceptions stated that to determine whether a function's limit has a value, the necessary step is to find a constant value so that all equations or inequalities in the function are satisfied. Students tended to focus on algebraic manipulations without considering the main requirement for a limit to exist, namely the equality of the left-hand and right-hand limits. Furthermore, some students did not provide an answer due to a lack of understanding of the question, even though the calculations were within the 12th-grade level. This indicates a misconception of language interpretation, where students have difficulty understanding the mathematical statements presented in the question.

In question 2, all students were able to correctly determine the limit of a polynomial function through direct substitution. However, interviews revealed that some students felt doubtful when obtaining a result of zero. This doubt arose because they assumed that zero was synonymous with a non-existent limit. After rechecking and recalling the concept of limits, students realized that a value of zero still indicates the existence of a limit, while a limit that does not exist is indicated by an indeterminate form such as 0/0. This finding indicates that students' understanding of this problem is still dominated by procedural understanding, even though the final result shows that students have demonstrated correct understanding.

In question number 3, interviews revealed that students with misconceptions used an incorrect solution procedure. Students directly multiplied the function by a pair of radicals, arguing that this would eliminate the radical form, without first analyzing the structure of the given function. Students assumed that every limit problem containing radicals must be solved this way. This demonstrates both systematic and fundamental misconceptions, where students apply mechanical solution strategies based on the surface features of the problem, rather than on relevant concepts.

In general, the interview results confirmed that students' misconceptions regarding limits of algebraic functions are not only caused by calculation errors, but also by weaknesses in understanding the basic concepts of limits, the relationships between concepts, selecting appropriate procedures, and the ability to interpret mathematical language and symbols. These findings reinforce the results of the diagnostic test analysis and demonstrate that interviews are an important tool for exploring students' thinking processes in greater depth..

Discussions

The results of the study indicate that 12th-grade students at MAN Sibolga still experience various forms of misconceptions regarding limits of algebraic functions, although students have demonstrated good conceptual understanding on certain indicators. This finding confirms that understanding limits depends not only on procedural skills but also on conceptual understanding and the interrelationships between mathematical concepts.

In question number 1, the most dominant misconceptions emerged, specifically correlational and theoretical misconceptions. Students were unable to connect the concept of the existence of a limit with the condition that the left-hand and right-hand limits are equal. Some students focused on algebraic manipulations without considering the meaning of the limit itself. This indicates that students understand algebraic symbols and operations separately but have not integrated them with the concept of limits as a process of approximating a value. This finding aligns with the opinions of Lutfiana (2021) and Sholekah et al. (2017), who stated that misconceptions often arise when students fail to connect the concept of limits with other relevant mathematical concepts.

Furthermore, the theoretical misconceptions in question number 1 indicate that students do not yet understand the definition of limits conceptually. Students tend to assume that limits always exist as long as a value can be calculated algebraically, without considering the function's behavior around the point under consideration. This confirms the findings of Kulsum (2020) and Purba & Hutagaol (2017), who stated that students' primary weaknesses in limits lie in understanding the basic concepts, not simply calculation errors (Azzahra & Rahayu, 2025; Khasawneh et al., 2022; Rizal, 2023).

In contrast to question 1, the results for question 2 showed that all students were able to correctly determine the limit of a polynomial function through direct substitution. This finding indicates that students have a fairly good procedural understanding of the limits of polynomial functions. However, interviews revealed initial doubts among students when obtaining a result of zero. This doubt indicates that students' understanding is still procedural and not fully conceptual, particularly in distinguishing between a zero limit value and an indeterminate form. This finding supports Sudirman's (2013) findings that students often experience confusion in interpreting final results even when the procedure is correct.

In question 3, both systematic and fundamental misconceptions were found. Students used an incorrect procedure by multiplying a function by a pair of roots, even though the problem did not require this step. This indicates a tendency for students to apply mechanical solution strategies based on the surface characteristics of the problem, rather than analyzing its mathematical structure. This finding aligns with research by Ardiyati & Murdanu (2016) and Salido et al. (2014), which found that students often choose the wrong solution strategy due to a lack of understanding of the characteristics of the function they are facing.

Misconceptions about language interpretation were also found in students who did not provide an answer to question number 1. Based on interviews, these students did not understand the meaning of the question, even though mathematically, the question was still within the ability range of a 12th-grade student. This indicates that the ability to read and interpret math problems plays a crucial role in understanding the concept of limits. These findings support the research of Waluyo et al. (2019) and Muryani et al. (2022), which stated that misconceptions do not always stem from weak arithmetic skills but also from misinterpretations of mathematical language (Rohman et al., 2023; Wakhata et al., 2023).

Overall, the results of this study indicate that students' misconceptions regarding the limits of algebraic functions are diverse and interrelated, encompassing correlational, theoretical, systematic, fundamental, calculational, and linguistic interpretation misconceptions. These misconceptions are not limited to low-ability students but also occur in students with medium and high abilities. This confirms that high academic ability does not always guarantee correct conceptual understanding, especially in abstract material such as function limits.

Thus, learning the limits of algebraic functions needs to be directed not only at mastering procedures, but also at strengthening conceptual understanding, the interrelationships between concepts, and the ability to interpret mathematical symbols and language. A learning approach that emphasizes conceptual exploration, the use of various representations, and reflective discussion is essential to minimize misconceptions among students.

CONCLUSION

Based on the results and discussion of the research, it can be concluded that students experience several types of misconceptions, namely: relational misconceptions that are evident from students' inability to understand the concept of the existence of limits in a function; systematic misconceptions that are evident from students' inability to determine the right concept to solve problems; basic misconceptions that are evident from students' inability to solve problems completely according to procedures; calculation misconceptions that are shown by students who cannot determine the final results of calculations correctly; and language interpretation misconceptions that are evident from students' inability to understand the meaning of the questions given.

Based on these findings, this study has the potential for further development and can serve as a reference for future research. Therefore, recommendations for future research include developing solutions to prevent misconceptions in students. Furthermore, the development of better diagnostic instruments is needed to identify student misconceptions more accurately and comprehensively.

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REFERENCES

Aydin-Güç, F., & Aygün, D. (2021). Errors and Misconceptions of Eighth-Grade Students Regarding Operations with Algebraic Expressions. *International Online Journal of Education and Teaching*, *8*(2), 1106–1126. https://orcid.org/0000-0002-3922-017X

Ayeh, I. G. (2025). Students' Mathematics Conceptual Challenges: Exploring Students' Thinking, Understanding, and Misconceptions in Functions and Graphs. *European Journal of Science and Mathematics Education*, *13*(3), 191–206.

https://doi.org/10.30935/scimath/16596

Azzahra, M., & Rahayu, S. D. (2025). Analisis Kesulitan Belajar Siswa Sma Dalam Memahami Konsep Materi Limit Fungsi. *JRMST | Jurnal Riset Matematika Dan Sains Terapan*, *5*(1), 23–29. https://ejournal.unibba.ac.id/index.php/jrmst/article/view/1739

Belbase, S., Mainali, B. R., Kasemsukpipat, W., Tairab, H., Gochoo, M., & Jarrah, A. (2022). At the dawn of science, technology, engineering, arts, and mathematics (STEAM) education: prospects, priorities, processes, and problems. *International Journal of Mathematical Education in Science and Technology*, *53*(11), 2919–2955. https://doi.org/10.1080/0020739X.2021.1922943;SUBPAGE:STRING:FULL

Hakiki, A. F., Livana, A., Selvianti, I., Febrianti, S. M., & Hernaeny, U. (2025). Kesulitan Mahasiswa pada Kalkulus Diferensial dengan Meningkatkan Kemampuan Berpikir Kritis. *Jurnal Pendidikan Matematika*, *2*(2), 12–12. https://doi.org/10.47134/PPM.V2I2.1187

Hamid, A. (2025). Analisis Faktor Penyebab miskonsepsi Mahasiswa pada Materi Aljabar: Perspektif Kognitif dan Pedagogis. *Venn: Journal of Sustainable Innovation on Education, Mathematics and Natural Sciences*, *4*(2), 71–80. https://doi.org/10.53696/VENN.V4I2.264

Jameson, G., Machaba, M. F., & Matabane, M. E. (2023). An Exploration of Grade 12 Learners' Misconceptions on Solving Calculus Problem: A Case of Limits. *Research in Social Sciences and Technology*, *8*(4), 94–124. https://doi.org/10.46303/ressat.2023.34

Khasawneh, A. A., Al-Barakat, A. A., & Almahmoud, S. A. (2022). The Effect of Error Analysis-Based Learning on Proportional Reasoning Ability of Seventh-Grade Students. *Frontiers in Education*, *7*, 899288. https://doi.org/10.3389/FEDUC.2022.899288/TEXT

Mathaba, P. N., Bayaga, A., Tîrnovan, D., & Bossé, M. J. (2024a). Error Analysis in Algebra Learning: Exploring Misconceptions and Cognitive Levels. *Journal on Mathematics Education*, *15*(2), 575–592. https://doi.org/10.22342/jme.v15i2.pp575-592

Mathaba, P. N., Bayaga, A., Tîrnovan, D., & Bossé, M. J. (2024b). Error Analysis in Algebra Learning: Exploring Misconceptions and Cognitive Levels. *Journal on Mathematics Education*, *15*(2), 575–592. https://doi.org/10.22342/jme.v15i2.pp575-592

Mildret, N., & Kakoma, L. (2025). Exploring the Effectiveness of Using Erroneous Examples to Simplify Algebraic Expressions: Embracing Misconceptions as Learning Opportunities. *International Journal of Science, Mathematics & Technology Learning*, *32*(2), 123. https://doi.org/10.18848/2327-7971/CGP/V32I02/123-147

Miles, M. B., Huberman, A. M., & Saldana, J. (2014). *Qualitative Data Analysis: A Methods Sourcebook* (Ed ke-8). United State: SAGE Publication, Inc.

Moru, E. K., & Mathunya, M. (2022). A Constructivist Analysis of Grade 8 Learners' Errors and Misconceptions in Simplifying Mathematical Algebraic Expressions. *Journal of Research and Advances in Mathematics Education*, *7*(3), 130–144. https://doi.org/10.23917/jramathedu.v7i3.16784

Mufit, F., Festiyed, Fauzan, A., & Lufri. (2023). The Effect of Cognitive Conflict-Based Learning (CCBL) Model on Remediation of Misconceptions. *Journal of Turkish Science Education*, *20*(1), 26–49. https://doi.org/10.36681/tused.2023.003

Naderifar, M., Goli, H., & Ghaljaie, F. (2017). Snowball Sampling: A Purposeful Method of Sampling in Qualitative Research. *Strides in Development of Medical Education*, *14*(3), 67670. https://doi.org/10.5812/SDME.67670

Nurpadila, N., Meridina, R., Sinaga, V. R., & Simanullang, M. C. (2025). Analisis Kemampuan Penalaran Mahasiswa dalam Memahami Konsep Limit Fungsi. *JURNAL PENDIDIKAN MIPA*, *15*(1), 339–348. https://doi.org/10.37630/JPM.V15I1.2606

Papadouris, J. P., Komis, V., & Lavidas, K. (2024). Errors and misconceptions of secondary school students in absolute values: a systematic literature review. *Mathematics Education Research Journal 2024 37:3*, *37*(3), 507–528. https://doi.org/10.1007/S13394-024-00499-9

Rahmiati, K., & Roesdiana, L. (2021). Analisis Miskonsepsi Matematis Kelas IX SMPN 2 Teluk Jambe Barat Materi Kubus dan Balok. *Union: Jurnal Ilmiah Pendidikan Matematika*, *9*(3), 243–256. https://doi.org/10.30738/UNION.V9I3.9468

Rakes, C. R., & Ronau, R. N. (2019). Rethinking Mathematics Misconceptions: Using Knowledge Structures to Explain Systematic Errors within and across Content Domains. *International Journal of Research in Education and Science*, *5*(1), 1–21. www.ijres.net

Rehman, N., Zhang, W., Mahmood, A., Fareed, M. Z., & Batool, S. (2023). Fostering twenty-first century skills among primary school students through math project-based learning. *Humanities and Social Sciences Communications 2023 10:1*, *10*(1), 424-. https://doi.org/10.1057/s41599-023-01914-5

Rijali, A. (2019). Analisis Data Kualitatif. *Alhadharah: Jurnal Ilmu Dakwah*, *17*(33), 81. https://doi.org/10.18592/ALHADHARAH.V17I33.2374

Rizal, F. (2023). Analisis Kesulitan Mempelajari Materi Limit Fungsi Siswa Kelas Xi Ipa Sman 1 Tambangan 2022/2023. *Cognoscere: Jurnal Komunikasi Dan Media Pendidikan*, *1*(1), 51–58. https://doi.org/10.61292/COGNOSCERE.147

Rohman, K., Turmudi, T., Budimansyah, D., & Syaodih, E. (2023). Misapprehension of mathematics among teachers, parents, and elementary school students. *Journal of Education and Learning (EduLearn)*, *17*(4), 598–603. https://doi.org/10.11591/EDULEARN.V17I4.20632

Sakdiah, S., & Siregar, R. N. (2025). Analysis of Students' Errors in Solving Algebraic Function Limit Problems based on Bloom's Taxonomy. *(JIML) JOURNAL OF INNOVATIVE MATHEMATICS LEARNING*, *8*(1), 160–172. https://doi.org/10.22460/JIML.V8I1.27152

Schroeder, N. L., Nesbit, J. C., Anguiano, C. J., & Adesope, O. O. (2018). Studying and Constructing Concept Maps: a Meta-Analysis. *Educational Psychology Review*, *30*(2), 431–455. https://doi.org/10.1007/S10648-017-9403-9/METRICS

Sreelohor, T., Jakpeng, S., & Chaijaroen, S. (2025). Constructivist Learning Environment Model for Rectifying Secondary Students' Misconceptions in Learning Science: Design Development and Validation Phases. *Journal of Education and Learning*, *14*(6), 418–434. https://doi.org/10.5539/jel.v14n6p418

Tong, D. H., Uyen, B. P., & Quoc, N. V. A. (2021). The improvement of 10th students' mathematical communication skills through learning ellipse topics. *Heliyon*, *7*(11), e08282. https://doi.org/10.1016/j.heliyon.2021.e08282

Wakhata, R., Balimuttajjo, S., & Mutarutinya, V. (2023). Building on Students' Prior Mathematical Thinking: Exploring Students' Reasoning Interpretation of Preconceptions in Learning Mathematics. *Mathematics Teaching Research Journal*, *15*(1), 127–151.