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Investigating student's misconception in solving mathematics problems using *four-tier diagnostic test*

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Abstract
Misconceptions are a significant challenge in mathematics learning, indicated by students' misconceptions that do not align with scientific concepts. This mismatch often occurs in the One Variable Linear Inequality (PtLSV) material. This study aims to diagnose and analyze in depth the types of misconceptions (theoretical, classificational, and correlational) experienced by seventh-grade students of MTsN Kota Batu when solving PtLSV problems. This study uses a qualitative approach with a case study type. The main instruments used are a four-tier diagnostic test to select subjects and in-depth task-based interviews to explore the reasons behind the answers. A total of 61 students were tested, and 32 students (approximately 52.5%) were identified as having misconceptions. After further analysis of the 32 students who had misconceptions, 14 students (43.75%) had theoretical misconceptions, 10 students (31.25%) had classificational misconceptions, and 8 students (25%) had correlational misconceptions. Then, six students (two for each type of misconception) were selected as interview subjects. The results showed that students with theoretical misconceptions misinterpreted definitions or symbols, students with classificatory misconceptions categorized and modeled variables incorrectly, while students with correlational misconceptions made errors in algebraic conceptual relationships.

Keywords:
Misconceptions; Four Tier Diagnostic Test; Linear Inequality Problems

A. INTRODUCTION

Misconceptions defined as a situation in which a person's understanding of a concept does not align with the scientific understanding recognized by experts (Suparno, 2013). In mathematics, misconception is part of students' inaccurate mathematical thinking, resulting in the answers students give to problems being less than accurate (Holmes dkk., 2013). Misconceptions occur because of incorrect understandings that students bring into the classroom, which then hinder the assimilation of new knowledge. Therefore, in-depth identification of misconceptions is an important component because they can hinder the learning process of students in understanding subsequent concepts (Satuti, 2025).

There are many types of misconceptions according to experts, for example Amien (in Fardah & Palupi, 2023), misconceptions are classified into three types: theoretical misconceptions (errors in understanding facts/concepts), classificational misconceptions (errors in grouping facts into categories), and correlational misconceptions (errors in understanding the relationship between events or incorrect assumptions). Several studies discussing misconceptions in mathematics learning, including those by Asbar (2017), Latifah dkk (2020), Arianta dkk (2023), Manfaluthy & Yuhana (2024), dan Maulida (2025) tend to be dominated by quantitative approaches using diagnostic tests to identify misconceptions. Therefore, this study was reformulated to identify and classify misconceptions in depth qualitatively through task-based interviews after subject selection

using the four tier diagnostic test. This qualitative focus aims to reveal the cognitive structures and specific reasons behind the formation of various types of misconceptions among students.

Misconceptions often arise in mathematics learning, especially in the topic of Linear Inequalities in One Variable (PtLSV). This topic is considered difficult, so misconceptions often occur in various forms, including: theoretical misconceptions (incorrect representation of concepts in symbols), classification misconceptions (incorrect determination of solution sets), and correlational misconceptions (incorrect application of PtLSV with other materials) (Cahyaningrum, 2023). In other research, it was found that theoretical misconceptions were that students did not understand how to create mathematical models related to linear inequalities with one variable, in classification misconceptions students did not understand the differences between variables, coefficients and constants, and in correlational misconceptions it was found that students performed algebraic operations, namely adding variables with constants (Lestari dkk., 2022). The importance of mastering PtLSV is reinforced by PISA 2022 data which shows a decline in math ability scores, in which this material is included (Kemendikbudristek, 2023). PtLSV is a foundational subject involving an understanding of algebra and number operations (Restuningsih & Khabibah, 2021). Therefore, mastering PtLSV material is crucial as a foundation for learning subsequent material.

Student misconceptions can be analyzed using various diagnostic tests, such as interviews, open-ended tests, or multiple-choice tests consisting of two, three, or four tiers (Gurel dkk., 2015). Each test has advantages and disadvantages. In identifying misconceptions, the four-tier diagnostic test is considered superior to the three-tier diagnostic test. Its advantage lies in the separation of questions regarding confidence in the answer and confidence in the reason, resulting in clearer and more specific data (Nurulwati & Rahmadani, 2020). As a development of diagnostic tests, the four-tier diagnostic test functions to diagnose students' level of understanding through four levels: (1) questions; (2) confidence in the answer; (3) reasons for the answer; and (4) confidence in the reason (Zulfikar dkk., 2017). This test accurately assesses misconceptions that are free from errors or ignorance, although the testing process requires a longer time. Due to its advantages, the four-tier diagnostic test was chosen as a diagnostic instrument to select subjects which in this context will discuss the forms of misconceptions that occur in grade 7 students of MTsN Kota Batu in solving linear inequality problems with one variable.

B. METHODS

This research uses a qualitative approach, specifically a case study type of research with the research subjects of grade VII students of MTs N Kota Batu who have studied the material of linear inequalities with one variable. A total of 61 students (N=61) will be tested and 6 students (n=6) will be selected for in-depth interviews. The instruments used in this study were four tier diagnostic test sheets and interview guidelines. Before being given to students, the instrument was validated by expert validators, namely lecturers in mathematics education at Maulana Malik Ibrahim State Islamic University who had at least two years of teaching experience. The aspects validated included the suitability of the material to the seventh grade curriculum, the construction of questions (including the relationship between tiers in the diagnostic test), and the clarity of language. Based on the validator's suggestions, the instrument has been revised and declared valid for use in research.

The data collected were the results of the four-tier diagnostic test for grade VII students to identify students with misconceptions and the results of further interviews regarding the reasons for their answers. The results of the four tier diagnostic test can be classified into several categories: misconceptions, not understanding the concept, errors, and understanding the concept (Gurel, et all, 2015) which are presented in Table 1.

Table 1. Four Tier Diagnostic Test Answer Combinations

No.	Category	Answer Combination			
		Answer	Confidence of Answer	Reason	Confidence of Reason
1	Misconception	True	Sure	False	Sure
2		True	Not Sure	False	Sure

3		False	Sure	False	Sure
4		False	Not Sure	False	Sure
5	Don't Understand the Concept	True	Sure	True	Not Sure
6		True	Sure	False	Not Sure
7		True	Not Sure	True	Sure
8		True	Not Sure	True	Not Sure
9		True	Not Sure	False	Not Sure
10		False	Sure	True	Not Sure
11		False	Sure	False	Not Sure
12		False	Not Sure	True	Not Sure
13		False	Not Sure	False	Not Sure
14	*Error*	False	Sure	True	Sure
15		False	Not Sure	True	Sure
16	Understand the Concept	True	Sure	True	Sure

Source: Gurel et all, 2015

This study began with the administration of a four-tier diagnostic test to seventh-grade students. The test used in this study was a four-level diagnostic test containing mathematical story problems on PtLSV material. The questions consisted of two types of answers, namely essays and multiple-choice questions at level four. The test results of the multiple-choice test were analyzed to classify students based on their conceptual understanding (understand the concept, misconceptions, errors, and do not understand the concept). Students identified with misconceptions were further analyzed on their essay answers to classify them into misconception types (theoretical, classificatory, or correlational). Two students from each misconception type were then selected as research subjects and interviewed in depth to explore the misconceptions they experienced when solving linear inequality problems with one variable.

C. RESULT & DISCUSSION

This study began with the administration of a four-tier diagnostic test to 7th-grade students of MTsN Kota Batu who had studied the material of linear inequality with one variable, namely class 7E and class 7J, totaling 61 students. Based on the results of the first four-tier diagnostic test that had been conducted on the two classes, the results of students' answers were categorized into four categories of understanding levels, namely misconceptions, do not understand the concept, errors and understand the concept.

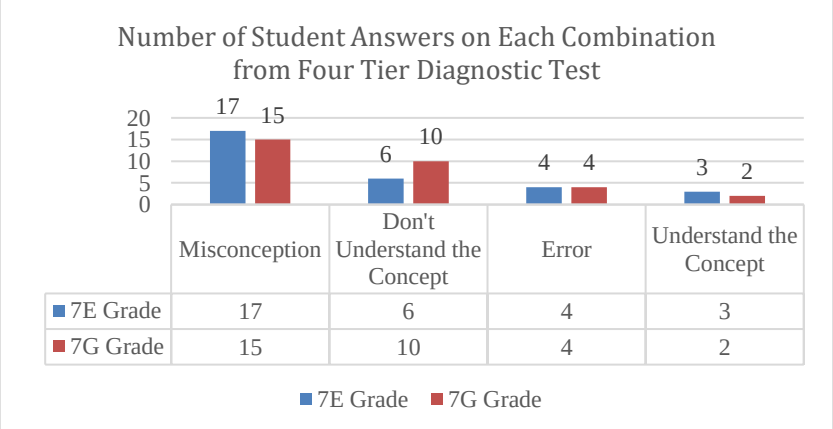


Figure 1. Number of Students Answers on Each Combination from Four Tier Diagnostic Test

Figure 1 shows the number of answer combination categories from 30 students in class 7E and 31 students in class 7G. The number of students experiencing misconceptions in the two classes was 32. Sixteen students did not understand the concept. Eight students made errors in answering the questions, and five students understood the concept. Based on the results of these answer categories, the answers of students experiencing misconceptions were recategorized into three

categories: theoretical misconceptions, classification misconceptions, and correlational misconceptions.

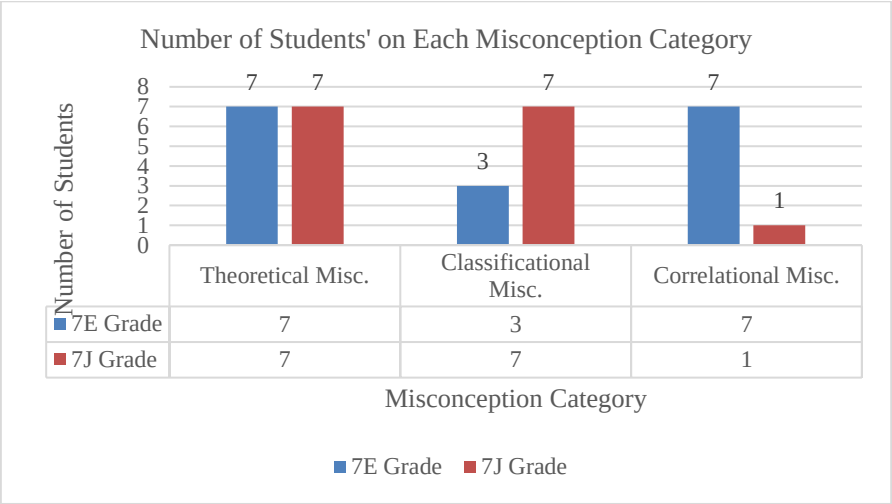


Figure 2. Number of Students' on Each Misconception Category

Based on Figure 2, it can be seen that 14 students (43,75%) experienced theoretical misconceptions, 10 students (31,25%) experienced classification misconceptions, and 8 students (25%) experienced correlational misconceptions. From this classification, 2 students were selected each representing each type of misconception, namely 2 students with theoretical misconceptions (student A and student B), 2 students with classification misconceptions (student C and student D) and 2 students with correlational misconceptions (student E and student F) to be interviewed in more depth regarding the misconceptions they experienced. The following is an explanation regarding each type of misconception in solving linear inequality problems with one variable:

1. Theoretical Misconceptions in Solving One-Variable Linear Inequalities

The first theoretical misconception in student A, namely experiencing a misconception with the correct answer, is shown by the results of the four tier diagnostic test in Figure 3 below:

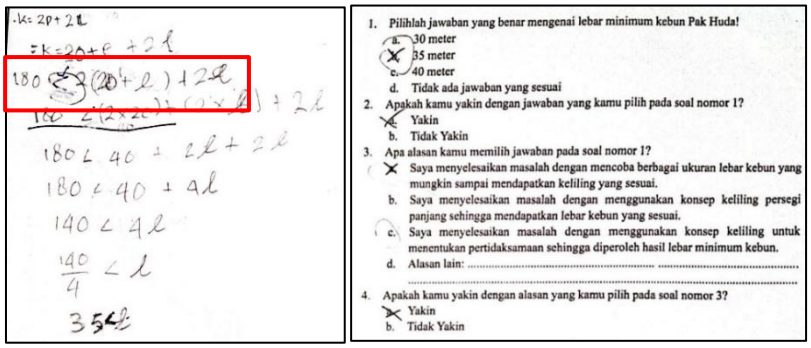


Figure 3. Student A's Four Tier Diagnostic Test Results

Based on Figure 3, student A wrote the circumference of not less than 180 as ">" and the final result was that the minimum width of the garden was 35 meters. In addition, the combination of answers in the four tier diagnostic test at the first level was correct, at the second level was sure, but at the third level the reason given was wrong and at the fourth level the belief in the reason was sure. This shows that the answer is correct but there is an error in the process of working so that it meets the criteria for theoretical misconceptions. This is also supported by the results of the interview with student A in the JW-SA-W01 section, student A also interpreted the symbol not more than as "<" and in the JW-SA-W02 section student A interpreted the symbol not less as ">" as shown by the following interview results:

PW-SA-W01 : *"Try writing 3 not more than 4 here!"*
JW-SA-W01 : *(student writes* $3 < 4$*)*
PW-SA-W02 : *"Try writing the circumference not less than 180. The circumference is symbolized by K not less than 180!"*
JW-SA-W02 : *(student writes* $K > 180$*)*

Furthermore, the second theoretical misconception in student B, namely experiencing misconception with the correct answer, is shown by the results of the four tier diagnostic test in Figure 4 below:

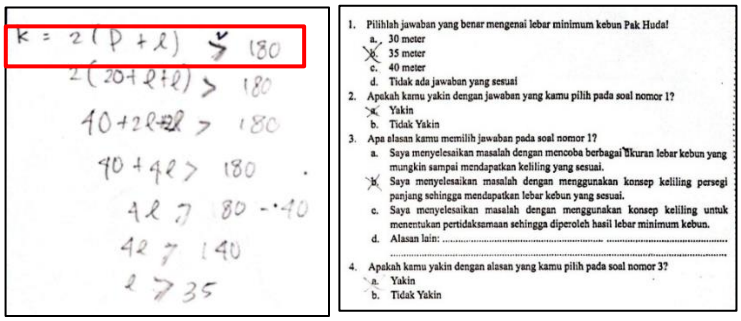


Figure 4. Student B's First Four Tier Diagnostic Test Results

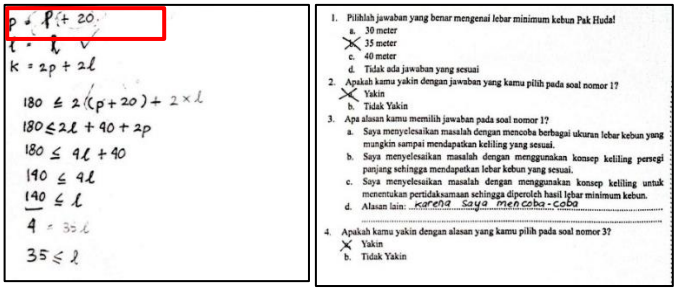
Based on Figure 4, student B wrote the circumference of not less than 180 as ">" and the final result was that the minimum width of the garden was 35 meters. In addition, the combination of answers in the four tier diagnostic test at the first level was correct, at the second level was sure, but at the third level the reason given was wrong and at the fourth level the belief in the reason was sure. This shows that the answer is correct but there is an error in the process of working so that it meets the criteria for theoretical misconceptions. This is also supported by the results of the interview with student B in the JW-SB-W02 section, student B interpreted the symbol not less as more than and in the JW-SB-W03 section, student B also interpreted the symbol not more than as "<" as shown by the following interview results:

PW-SB-W01 : *"Look at this one* $(K = 2(p + l) > 180)$*! Why did you write it like this?"*
JW-SB-W01 : *"Hey, no less is more."*
PW-SB-W02 : *"No less is more?"*
JW-SB-W02 : *"Yes."*
PW-SB-W03 : *"Try writing 3 not more than 4."*
JW-SB-W03 : *(student writes* $3 < 4$*)*

Based on the test and interview results, it can be said that students with theoretical misconceptions experience errors in understanding the concept of inequality. This is evident from students' incorrect interpretation of the term "not less than," in this case students assume that not less than is "more than." Students ignore other information that should also be considered, namely the concept of equality. In this case, not less than means more than or equal to. The theoretical misconceptions experienced by students are caused by incomplete information (misinformation) obtained by students. In addition, theoretical misconceptions are also shown from errors in writing mathematical notation, namely "<" which indicates not less than.

2. Classification Misconceptions in Solving One-Variable Linear Inequality Problems

The first classification misconception in student C, namely experiencing a misconception with the correct answer, is shown by the results of the four tier diagnostic test in Figure 5 below:



Based on Fig **Figure 5.** Student C's Four Tier Diagnostic Test Results e than the width as "$p + 20$" and the width of the garden as "l" and the final result was that the minimum width of the garden was 35 meters. In addition, the combination of answers in the four tier diagnostic test at the first level of the answer was correct, at the second level it was confident, but at the third level the reason given was wrong and at the fourth level the belief in the reason was confident. This shows that the answer is correct but there is an error in the process of working so that it meets the criteria for a classification misconception. This is also supported by the results of the interview with student C in the JW-SC-W03 section, student C believes that if the length of the garden is 20 meters more than the width it can be expressed as "$p + 20$". which is shown by the following interview results:

PW-SC-W01 : *"Why did you answer this* $2(p + 20) + 2l$*?"*
JW-SC-W01 : *"Because the length is 20 meters more than the width."*
PW-SC-W02 : *"Since the length is 20 meters more than the width, so the length is increased by 20?"*
JW-SC-W02 : *"Yes."*
PW-SC-W03 : *"Are you sure about your analogy?"*
JW-SC-W03 : *"Yes."*

Furthermore, the second classification misconception in student D, namely experiencing misconceptions with wrong answers, is shown by the results of the four tier diagnostic test in Figure 6 below:

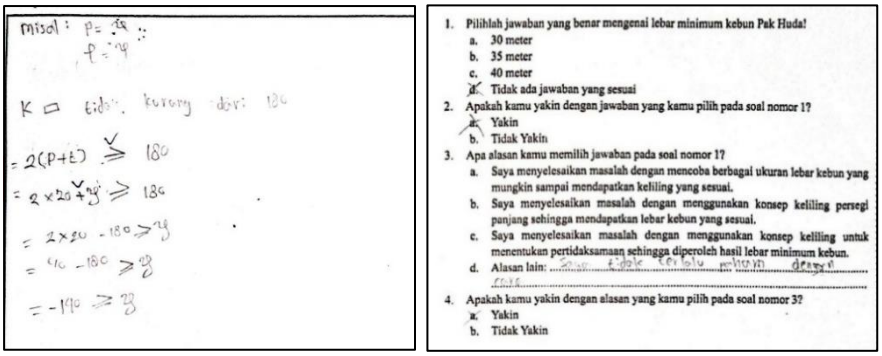


Figure 6. Student D's Four Tier Diagnostic Test Results

Based on Figure 6, student D initially wrote the length of the garden as x and the width of the garden as y. In the process of working, student D changed the length of the garden to 20, the final result of the minimum width of the garden was -140 meters. In addition, the combination of answers in the four tier diagnostic test at the first level of the answer was wrong, at the second level it was sure, with the reason given at the third level being wrong and at the fourth level the belief in the reason was sure. This shows that the answer is wrong and there is an error in the process of working, but the student is sure of the answer and reason so that it meets the criteria for a classification misconception. This is also supported by the results of the interview with student D in the JW-SD-W01 section. Initially, student D made an example of the length of the garden with the variable "x" and the width of the garden with the variable "y" because the values were not yet known. In the process section shown in JW-SD-W04, student D stated the length of the garden as "20" because in the question it was known that the length of the garden was 20 meters more than the width indicated by the following interview results:

PW-SD-W01 : *"Why did you answer this way in the example?"*
JW-SD-W01 : *"Because the length of the garden is 20 meters longer than the width. Since the length is unknown, it's assumed to be a variable."*
PW-SD-W02 : *"Are both variables?"*
JW-SD-W02 : *"Yes."*

PW-SD-W03 : *"Okay, so why is the length suddenly 20? Originally, it was assumed to be the variable x?"*
JW-SD-W03 : *"It makes it easier to find the width."*
PW-SD-W04 : *"Why did you choose 20?"*
JW-SD-W04 : *"Because the problem states that the length of the garden is 20 meters longer than the width."*

Based on the test and interview results, it can be said that students with classification misconceptions experience failure in carrying out the algebraic process. This failure occurs when creating mathematical models based on the given problem, this is caused by the students' inability to identify information in the given problem, especially related to determining variables and several things related to variables. Students textually interpret unknown elements in the problem with variables such as "x" or "y", while in other information, the two variables may be related to each other so that the simplification process can be carried out and a more relevant mathematical model can be obtained.

3. Correlational Misconceptions in Solving One-Variable Linear Inequality Problems

The first correlational misconception in student E, namely experiencing a misconception with a wrong answer, is shown by the results of the four tier diagnostic test in Figure 7 below:

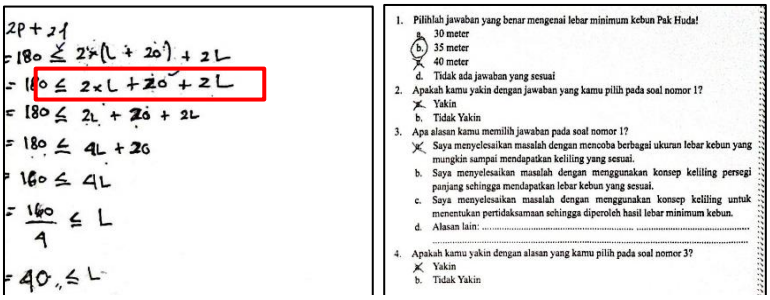


Figure 7. Student E's Four Tier Diagnostic Test Results

Based on Figure 7, student E performs the algebraic operation "$2(l + 20) + 2l$" to become "$2l + 20 + 2l$" and the final result is that the minimum width of the garden is 40 meters. In addition, the combination of answers in the four tier diagnostic test at the first level is wrong, at the second level it is sure, but at the third level the reason given is wrong and at the fourth level the belief in the reason is sure. This shows that the answer is wrong and there is an error in the work process but the student is sure of the answer and the reason given so that it meets the criteria for correlational misconceptions. This is also supported by the results of the interview with student E in the JW-SE-W01 section, student E stated that "$2l + 20 + 2l$" is obtained from the multiplication result "$(2(l + 20) + 2l)$" 2 times l then added to 20 then added to $2l$. In JW-SE-W02, student E understands that the concept used is an algebraic concept. To ensure his understanding, student E was asked to operate "$2(x + 5)$" given the result of JW-SE-W03 was "$2x + 5$". However, student E stated that he already understood the meaning of multiplication in JW-SE-W04 as shown by the following interview results:

PW-SE-W01 : *"Okay, now look at this answer. Why did you answer it that way?"*
JW-SE-W01 : *"Because this is 2, then multiply it by this* (l), *then add this* (20), *then add this* ($2l$)*."*
PW-SE-W02 : *"What concept is being used?"*
JW-SE-W02 : *"Algebra"*
PW-SE-W03 : *"Now, how can you operate on* 2 (x + 5)*?"*
JW-SE-W03 : *"So it becomes* $2x$ + 5*."*
PW-SE-W04 : *"Do you understand the meaning of multiplication?"*
JW-SE-W04 : *"Understood."*

Furthermore, the second correlational misconception in student F, namely experiencing misconceptions with the correct answer, is shown by the results of the four tier diagnostic test in Figure 8 below:

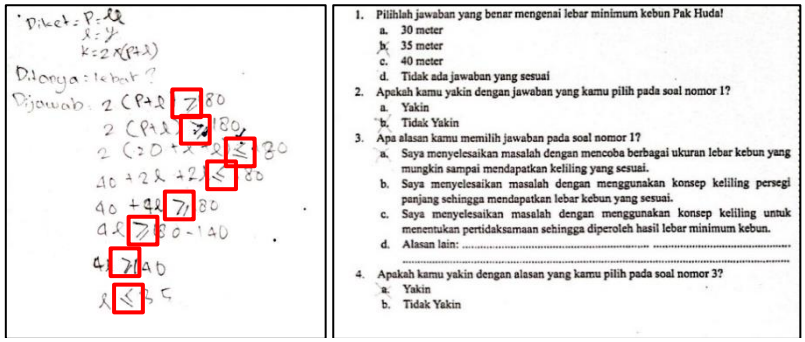


Figure 8. Four Tier Diagnostic Test Results for Student F

Based on Figure 8, student F performed algebraic operations by changing the "≥" sign to "≤" several times and then changing it again at each work process and obtained the final result of the minimum garden width of 35 meters. In addition, the combination of answers in the four tier diagnostic test at the first level of the answer is correct, at the second level is not sure, but at the third level the reason given is wrong and at the fourth level the belief in the reason is sure. This shows that the answer is correct but there is an error in the work process so that it meets the criteria for correlational misconceptions. This is also supported by the results of the interview with student F in the JW-SF-W01 section S6 stated that if the answer changes, the inequality sign also changes. In JW-SF-W03 and JW-SF-W04, S6 confirmed that he had studied the algebra material and had understood it as shown by the following interview results:

PW-SF-W01 : *"First, I wanted to ask, why did you answer like this? At first it was ≥, then it became ≤, then this one was ≥, then the sign changed again. Why?"*
JW-SF-W01 : *"Because the answer keeps changing."*
PW-SF-W02 : *"Oh, so if the answer keeps changing, you have to change the sign?"*
JW-SF-W02 : *"Yes."*

Based on test and interview results, students with correlational misconceptions failed to perform algebraic operations to solve linear inequalities. This was evident in several algebraic operations that did not conform to the rules or properties of algebraic operations and the concept of inequality. Students with classificational misconceptions tended to use their own methods to solve these algebraic operations.

Based on the results of the presentation and data analysis from two subjects on each type of misconception, it was found that the theoretical misconceptions of the four-tier diagnostic test and interviews showed that students experienced misconceptions related to the interpretation of the sentence "not less than" in the problem to become ">". This is in line with the indicators of theoretical misconceptions, namely errors in explaining the definition of the concept of the material being studied (Prawira, 2017). Although students may have good math grades and demonstrate proficiency in answering textbook questions and exam questions, their understanding of the basic principles of linear inequality is often still uncertain (Biney dkk, 2023).

The classification misconceptions from the results of the four-tier diagnostic test and interviews indicate that students experience misconceptions in categorizing or writing the variable length of the garden. It is known that in the question the length of the garden is 20 meters more than the width, the student wrote it as "$p + 20$" and other students also wrote it as "20". This is in line with the indicators of classification misconceptions, namely students incorrectly categorize the elements contained in the material of linear inequalities of one variable (Ainiyah, 2016).

Classification misconceptions experienced by students include errors in writing variables in the material of linear equations of one variable (Fitriyah, 2024). In line with Biney (2023) who stated that one of the weaknesses of students in linear inequalities of one variable is interpreting it.

In correlational misconceptions, there are two types of misconceptions, the first is an error in algebraic operations related to the distribution operation $2(l + 20) + 2l$ becomes $2l + 20 + 2l$ so that the final result of the minimum width is 40 meters. This is in line with Musabik's (2021) research, where the subject provided an incorrect explanation in simplifying algebraic forms and the subject provided an incorrect explanation in the final result, so the subject experienced correlational misconceptions both in simplifying distributive algebraic operations and the final result. Second, students experienced errors related to changes in inequality signs during algebraic operations, namely if the answer changes, the direction of the inequality sign is changed. This is in line with Mestika's (2021) research that students experienced misconceptions in the arithmetic operation "moving segments" students tend to think that if the segment is moved, the sign changes. This proves that in line with Bicer's (2014) opinion that correlational misconceptions in the material of linear inequalities in one variable require students to understand other mathematical concepts such as algebra, trigonometry, and analytical geometry.

D. CONCLUSION

Based on the results of data analysis and discussion, it can be concluded that this study successfully identified three types of misconceptions according to Amien experienced by students in solving One Variable Linear Inequality (PtLSV) problems, which were verified through the Four-Tier Diagnostic Test and in-depth interviews:

1. Theoretical misconceptions are demonstrated by students' characteristics in interpreting the concept of inequality. Inaccurate student interpretations of the concept of inequality indicate a misinterpretation. Students tend to ignore other related information, focusing solely on their own, inaccurate understanding.
2. Classification misconceptions are demonstrated by students' failure to create a mathematical model relevant to the problem. This failure is caused by the students' inability to identify the essential elements contained in the problem and to make connections between these essential elements and other elements that may be related.
3. Correlational misconceptions are demonstrated by students' errors in performing algebraic operations to solve linear inequalities. These errors occur because students ignore the properties and rules of algebraic operations or the concept of inequality, and tend to use their own methods in solving the problem.

Overall, students' misconceptions occur comprehensively, starting from the stage of understanding the language of the problem (theoretical), modeling the problem (classificational), to carrying out algebraic manipulation (correlational), indicating the need for learning interventions that focus on strengthening basic concepts, interpreting mathematical sentences, and applying algebraic operation rules.

In addition, the misconceptions hidden behind the correct answers are an important finding of this study, demonstrating the success of the Four-Tier Diagnostic Test and interviews in uncovering the misconceptions hidden behind the correct final answers. In some subjects, students provided numerically correct PtLSV solution answers, but analysis at the level of confidence and reasoning, as well as interviews, showed that their conceptual understanding was inaccurate (e.g., correct results were obtained from mutually canceling errors or incorrect reasoning). These misconceptions included fundamental hidden misunderstandings, even among students with correct answer scores, indicating the need for learning interventions focused on strengthening basic concepts, interpreting mathematical sentences, and applying algebraic operation rules.

REFERENCES

Ainiyah, L. A. (2016). Identifikasi Miskonsepsi Siswa dalam Materi Geometri pada Pembelajaran Matematika Siswa Kelas VII SMP Negeri 1 Punggelan. *Jurnal Pendidikan Matematika*, *5*(1), 1–10.

Arianta, Y., Kartini, K., Yuanita, P., & Maimunah, M. (2023). Analisis Miskonsepsi Matematika Siswa pada Materi Aljabar Berdasarkan Tes Diagnostik Three Tier Multiple Choice. *Prisma*, *12*(2), 458. https://doi.org/10.35194/jp.v12i2.3169

Asbar. (2017). Analisis Miskonsepsi Siswa pada Persamaan dan Pertidaksamaan Linear Satu Variabel dengan Menggunakan Three Tier Diagnostic Test. *Occupational Medicine*, *53*(4), 130.

Bicer, A, Capraro, R. M., & Capraro, M. M. (2014). Pre-service Teachers' Linear and Quadratic Inequalities Understandings. *Retrieved from Www.Cimt.Org.Uk*.

Biney, S. K., Ali, C. A., & Adzifome, N. S. (2023). Errors and misconceptions in solving linear inequalities in one variable. *Journal of Advanced Sciences and Mathematics Education*, *3*(1). https://doi.org/10.58524/jasme.v3i1.195

Cahyaningrum, I. Y. (2023). *Miskonsepsi Matematika Siswa Ditinjau dari Tipe Kepribadian Dominance, Influence, Steady, Compliance (Disc) pada Materi Pertidaksamaan Linear Satu Variabel*.

Fardah, D. K., & Palupi, E. L. W. (2023). Misconceptions of Prospective Mathematics Teacher in Linear Equations System. *Prima: Jurnal Pendidikan Matematika*, *7*(1), 100. https://doi.org/10.31000/prima.v7i1.7379

Fitriyah, D. E. N. (2024). *Miskonsepsi Siawa pada Materi Persamaan Linear Satu Variabel Menggunakan Asesmen Diagnostik*.

Gurel, D. K., Eryilmaz, A., & McDermott, L. C. (2015). A Review and Comparison of Diagnostic Instruments to Identify Students' Misconceptions in Science. *Eurasia Journal of Mathematics, Science and Technology Education*, *11*(5), 989–1008. https://doi.org/10.12973/eurasia.2015.1369a

Holmes, V.-L., Miedema, C., Nieuwkoop, L., & Haugen, N. (2013). Data-Driven Intervention: Correcting Mathematics Students' Misconceptions, not Mistakes. *The Mathematics Educator*, *23*(1), 24–44.

Iqdam Musabik, A., Maf, S., Suryowati, E., & Tinggi Keguruan dan Ilmu Pendidikan PGRI Jombang Jl, S. (2021). Analisis Miskonsepsi Siswa MTS Dalam Menyelesaikan Soal Aljabar. *Third Conference On Research And Community Service* , *September*, 187–194.

Kemendikbudristek. (2023). PISA 2022 dan Pemulihan Pembelajaran di Indonesia. *Laporan Pisa Kemendikbudristek*, 1–25.

Latifah, U. L. N., Wakhyudin, H., & Cahyadi, F. (2020). Miskonsepsi penyelesaian soal cerita matematika materi FPB dan KPK sekolah dasar. *Jurnal Riset Pendidikan Dasar*, *3*(2), 181–195.

Lestari, S., Hidayat, E., & Nurhayati, E. (2022). Analisis Miskonsepsi Peserta Didik pada Materi Pertidaksamaan Linear Satu Variabel Melalui Two Tier Test. *Jurnal Kongruen*, *1*(4), 367–371.

Manfaluthy, M. H., & Yuhana, Y. (2024). Analisis Miskonsepsi Siswa Pada Materi Persamaan Garis Lurus Menggunakan Three Tier-Test Ditinjau Dari Kemampuan Awal Siswa. *Pedagogy: Jurnal Pendidikan Matematika*, *9*(1), 293–302. https://doi.org/10.30605/pedagogy.v9i1.3814

Maulida, A. (2025). *Miskonsepsi peserta didik dalam penyelesaian masalah matematika pada materi pertidaksamaan kuadrat kelas x di madrasah aliyah hasan jufri*. *20*(15), 1–14.

Mestika, Y. (2021). *Penurunan Miskonsepsi dalam Memahami Konsep Matematika Melalui Strategi Scaffolding.* https://repository.ar-raniry.ac.id/id/eprint/19918/%0Ahttps://repository.ar-raniry.ac.id/id/eprint/19918/1/Yana Mestika%2C 150205078%2C FTK%2C PMA%2C 082276522086.pdf

Nurulwati, N., & Rahmadani, A. (2020). Perbandingan Hasil Diagnostik Miskonsepsi Menggunakan Threetier dan Four Tier Diagnostic Test pada Materi Gerak Lurus. *Jurnal Pendidikan Sains Indonesia*, *7*(2), 101–110. https://doi.org/10.24815/jpsi.v7i2.14436

Prawira, P. A. (2017). *Miskonsepsi Peserta Didik dalam Pemahaman Konsep Segiempat Berdasarkan Kemampuan Matematika*.

Restuningsih, & Khabibah, S. (2021). Analisis Kesalahan Siswa dalam Pemecahan Soal Cerita Materi Persamaan dan Pertidaksamaan Linier Satu Variabel. *Jurnal Cartesian (Jurnal Pendidikan Matematika)*, *1*(1), 32–41. https://doi.org/10.33752/cartesian.v1i1.2078

Satuti, R. I. R. W. A. (2025). 16_Mengatasi+Miskonsepsi+Dalam+Pembelajaran+Ipa+Tantangan+Dan+Strategi+Untuk. *Elementary School*, *12*(1), 150–161.

Suparno, P. (2013). *Miskonsepsi & Perubahan Konsep dalam Pendidikan Fisika*. PT Grasindo.

Zulfikar, A., Samsudin, A., & Saepuzaman, D. (2017). Pengembangan Terbatas Tes Diagnostik Force

Concept Inventory Berformat Four-Tier Test. *WaPFi (Wahana Pendidikan Fisika)*, *2*(1), 43–49. https://doi.org/10.17509/wapfi.v2i1.4903