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Revealing Mathematics Learning Difficulties Among Students with Numerical Dyscalculia: An Analysis of Conceptual Understanding in Mathematics

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ABSTRACT

This study employs qualitative descriptive case studies to examine mathematics learning difficulties in class VII students with dyscalculia, focusing on the use of mathematical concepts. Dyscalculia can be interpreted as a learning difficulty in calculating, although calculating skills are an essential foundation for solving mathematical problems and a primary means of mastering other fields of study. This study aims to analyse how students with dyscalculia experience difficulties in using mathematical concepts. This attitude focuses on three indicators of learning difficulties: (1) difficulty understanding concepts, (2) difficulties in calculations, and (3) difficulty in solving problems. This study was conducted at SMP Negeri 6 Jambi City, Jambi, Indonesia, in April 2025. Technical data collection, including written tests and interviews. This discovery indicates that students struggle to understand and apply mathematical concepts in algebraic operations. The observed errors include difficulties in conducting calculation operations, errors in writing positive and negative signs, and final answers that do not address the problem. In addition, according to the interview results, students acknowledge difficulties in completing additional operations, such as subtraction and multiplication, and have limited knowledge of algebraic concepts, including variables, coefficients, and constants. The findings offer a concrete illustration of these difficulties, particularly in algebraic operations.

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1. INTRODUCTION

Mathematics is essential for students' intellectual and cognitive development; however, many students experience learning difficulties, particularly those with disorders such as dyscalculia [1]. This learning difficulty is not only common but also profoundly affects

students' academic performance across various subjects. Difficulty learning mathematics is influenced by internal factors (such as health, intelligence, and motivation) and external factors (such as parental attention and the environment [2]. In addition, the learning difficulties experienced by students, as noted by Yulita and Ain [3], include difficulties in using concepts, applying principles, and solving verbal problems. Such challenges often persist despite repeated instructional efforts, indicating a need for a deeper understanding of the diagnostic process. Andri et al. [4] mentioned three main difficulties for students in learning mathematics:

- Difficulty in Understanding Concepts: Students often struggle to grasp fundamental principles, frequently relying on formulas and misinterpreting questions.
- Difficulty in Calculation: Mistakes in reading symbols and operating numbers cause inaccurate calculations.
- Difficulty in Solving Problems: Students struggle to apply concepts to solve story problems and often become stuck when faced with challenging problems.

Dyscalculia is a learning difficulty in mathematics that significantly affects students' understanding and use of mathematical concepts appropriately [5]. Meanwhile, according to Ashcroft [6], dyscalculia is a disorder affecting the ability to understand mathematics, including concepts of numbers, number operations, and their applications. In addition, students who experience dyscalculia also face difficulties in distinguishing between geometric shapes, symbols, and number concepts, as well as challenges in performing mathematical operations such as addition, subtraction, multiplication, and division. These obstacles are often persistent and not easily overcome with conventional teaching strategies. Based on research by Pramesti et al. [7] conducted at one of the State Special Needs Schools (SLBN) in Jambi City, several students experience difficulties in reading, arithmetic, and combining both skills. Initial observation data showed that two sixth-grade students at the SLBN were identified as having dyscalculia. They have difficulties in calculating and applying basic mathematical formulas. This reflects the need for more targeted instructional approaches for students with such conditions.

Dyscalculia can also be defined as difficulty in counting. Types of dyscalculia include quantitative, qualitative, intermediate, verbal, prognostic, lexical, graphic, indiagnostic, and operational [8]. Students with dyscalculia often struggle to understand concepts, calculate, and solve problems [2]. Mathematical concepts are abstract ideas used to classify objects and solve problems [9]. The abstract nature of these concepts demands not only memory but also a high level of logical reasoning and pattern recognition. Understanding this concept is an important task for teachers [10]. Hence, recognising the characteristics of dyscalculia early is vital to prevent prolonged learning delays.

Observations in Class VII D of SMPN 6 Kota Jambi revealed that many students struggled with algebraic operations, including errors in writing mathematical signs and obtaining incorrect final results. These issues suggest that students may not only struggle with procedural fluency but also with conceptual understanding. This study aims to analyse the learning difficulties of students with dyscalculia in using mathematical concepts, especially within the scope of algebraic operations. The benefits of this study are divided into two main aspects:

- Practical: Providing helpful input for teachers, researchers, readers, and students to improve the quality of learning and understanding of mathematics learning difficulties in students with dyscalculia.
- Theoretical: Being a source of reference and important information related to the causes and levels of mathematics learning difficulties in dyscalculia students, especially at SMPN 6 Jambi City. This research is expected to contribute to the development of inclusive mathematics education strategies in Indonesian schools.

2. METHOD

This research was conducted at SMPN 6 Kota Jambi, located at Jln. H. Kamil RT.21, Jambi Selatan District, Pasir Putih Village, Jambi City, during the odd semester of the 2024/2025 academic year. The school was selected based on initial observations indicating the presence of students who exhibited symptoms of mathematical learning difficulties.

Research Approach and Type

This research uses a qualitative method with a descriptive approach. Qualitative research aims to understand a phenomenon in depth, collecting data in the form of accurate and complete primary and secondary sources. This method emphasises the description and understanding of the observed social symptoms [11]. According to Sugiyono [12], qualitative research is conducted in natural object conditions, with researchers as key instruments, triangulation data collection techniques, inductive data analysis, and emphasises meaning rather than generalisation. In this study, qualitative methodology is particularly suited to explore the individual learning experiences of students with dyscalculia in understanding mathematical concepts, especially in algebra. The research produces detailed descriptions of the results of interviews, observations, and other documents related to the analysis of mathematics learning difficulties in dyscalculic students, particularly in their use of mathematical concepts, including algebraic material.

Data and Data Sources

- Data
  The data collected were descriptive, not numerical, comprising results from semi-structured interviews and mathematics diagnostic tests. These data aimed to reveal the types and patterns of learning difficulties experienced by students with dyscalculia.

- Data Sources
  The primary data source in this study was the researcher, who was the key instrument. Additional supporting data were obtained from student test responses and transcripts of interviews, ensuring multiple perspectives in the data interpretation process.

Research Subjects

The research subjects were selected using a purposive sampling technique. This technique involved identifying students who exhibited qualitative dyscalculia characteristics, based on diagnostic test outcomes in algebraic material. A total of three

students from grade VII were selected, each showing consistent signs of learning difficulties aligned with dyscalculia indicators.

Data Collection Techniques

- Observation:
  A direct classroom observation was conducted in Class VII C at SMPN 6 Kota Jambi to examine the learning process, teacher instruction methods, and students' visible difficulties. This allowed the researcher to record behavioural patterns and classroom interactions that were relevant to students' mathematical performance.
- Test:
  A diagnostic test, consisting of open-ended mathematical essay questions, was administered to identify students' difficulties in performing algebraic operations. The results served both as a diagnostic tool and a basis for interview probing.
- Interview:
  Semi-structured interviews were used to explore students' self-reported experiences regarding their learning difficulties. This method facilitated deeper insight into students' cognitive processes, emotional responses, and learning backgrounds.
- Documentation:
  Photographic and written documentation was compiled throughout the research process to support the authenticity and traceability of data collection [12]. These materials include test answer sheets, interview recordings, and photographs of classroom activities.

Data Validity Test

The credibility of the data was ensured through triangulation of techniques (tests, interviews, observations, and documentation) and triangulation of sources [12]. The researcher also conducted persistent observation and member checking, along with repeated validation of the collected data, including voice recordings, interview transcripts, and students' written test responses, to confirm consistency and trustworthiness.

Data Analysis Techniques

- Data Reduction:
  Information was grouped, summarised, and filtered to retain only the most relevant and significant data. This step helped to focus the analysis on meaningful patterns related to dyscalculia.
- Data Presentation:
  The reduced data were organised into a systematic narrative form to facilitate a clear and coherent understanding. Narrative descriptions were structured around key themes derived from the research questions.
- Conclusion Drawing:
  Conclusions were drawn based on patterns and findings identified through the analysis of tests, interviews, and observations. These conclusions reflect the central tendencies of students' learning difficulties and provide grounded interpretations.

Research Procedure

Pre-Field Stage

- Consultation with the supervisor
- Preparation of research plan
- Administration of a permit letter
- Initial observation at the research location
- Preparation of research instruments
- Proposal seminar

Field Work Stage

- Instrument validation by experts
- Diagnostic test on mathematics learning difficulties for dyscalculia students (algebraic operations material)
- Semi-structured interviews with selected subjects
- Documentation of each stage of data collection

Post-Field Stage

- Data processing and analysis until the data is saturated
- Drawing conclusions based on the data that has been collected

3. RESULTS AND DISCUSSION

3.1 Result

3.1.1 Location / Object Description Study

This research was conducted at SMP Negeri 6 Kota Jambi in the even semester of the 2024/2025 academic year. The research focused on analysing mathematics learning difficulties in class 7D dyscalculia students, particularly in the application of mathematical concepts in algebraic material. The subjects of the study were three students who were identified as having qualitative dyscalculia based on the results of observations and discussions with mathematics teachers. The implementation time for this research is as follows:

Table 1. Implementation Schedule Study

No	Activity	Execution time
1	Application permission study for a party school	March 14, 2025
2	Implementation difficulty test questions Study	April 11, 2025
3	Implementation interview student	April 21, 2025

This research was conducted on student dyscalculia among three people in class 7D in the even semester through observation, test difficulty, and a study of mathematics in students with dyscalculia using draft mathematics and interviews. The materials used are about algebra. Based on observations, three students with dyscalculia experience difficulty studying mathematics using the materials provided, such as algebraic materials.

3.1.2 Validation Result Data Description Instrument Study

The research instrument, in the form of a mathematics learning difficulty test and interview guidelines, has been validated by two mathematics education lecturers. Validation encompasses aspects such as the substance of the questions, clarity of instructions, language use, and the suitability of learning difficulty indicators. The validation results state that the instrument is suitable for use with minor revisions.

3.1.3 Description of Determination Result Data Subject

Subject determination was done through observation and discussion with the class teacher. Three 7D-grade students who met the criteria for qualitative dyscalculia were selected as research subjects. Qualitative dyscalculia students generally have difficulty understanding basic mathematical operations (multiplication, addition, subtraction, division) as well as story problems that require conceptual understanding.

Table 2. Result Data Subject

No	Criteria Subject Study	S1	S2
1	Students who experience dyscalculia qualitatively	√	√
2	Grade 7	√	√

Information:
S1: Subject 1
S2: Subject 2
S3: Subject 3

According to the third data result, the subject already fulfils the criteria for experiencing dyscalculia and is in class 7. The types of dyscalculia that researchers use are qualitative dyscalculia. Students who experience dyscalculia qualitatively experience difficulty in understanding operations such as multiplication, addition, subtraction, and division, as well as difficulty in understanding story problems or questions that require understanding of concepts.

3.1.4 Research Results Data Presentation

This research was conducted on Monday, April 11, 2025, at 10.00 WIB in the room class 7d. Before the test, researchers also prepared test questions on sheets, guidelines for interviews, and devices for documentation during the ongoing study. Researchers also conducted extension time research on April 21, 2025, to interview students. The following are the exposure data results from subjects S1, S2, and S3.

3.1.5 Subject Data Exposure First (S1)

The researcher gave S1 a test question sheet and read the instructions on how to complete the questions. After S1 solves the problem, researchers also conduct interviews to gather related information that S1 has found difficult to obtain. Study mathematics with the

use of draft mathematics. The following is the result of S1 problem-solving in the questions shown in Figure 1 below:

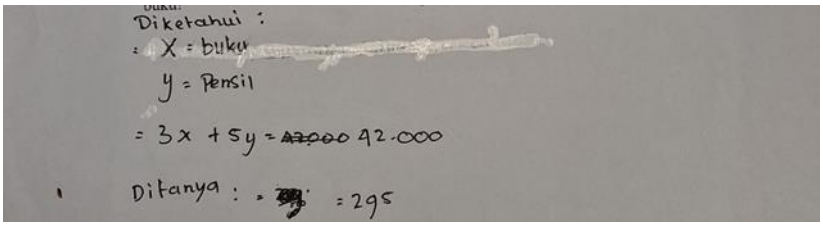

Figure 1. S1 Answer Results

The results from S1 work show that S1 wrote what is known and asked, providing only just written information, which was not complete enough on request, and only mentioned 295. So, here is the interview against S1:

P : *You try it, read it, and repeat this question. What information can you get from the question?*
S1 : *It is known that x is the book and y is the pencil.*
P : *Then what? Are there more?*
S1 : *(Silence)*
P : *Then this is 3x + 5y = 42,000 for you. Where can you go from?*
S1 : *From the question,*
P : *Then what was asked? Where did you get 295 from?*
S1 : *From the question*
P : *What? Do you know what a variable, coefficient, and constant are?*
S1 : *The variables are 3 and 5*
P : *Can the coefficient and constant be given, for example?*
S1 : *I do not know*
P : *However, hasn't this been taught in the classroom?*
S1 : *Yes, sis.*

The results of the interview show that S1, at the time the researcher asked about draft S1 algebra, answered the question with hesitant doubt, and the answer was incorrect. Therefore, S1 experiences difficulty in understanding the draft. Next, S1 wrote the results answers, such as in Figure 2 below:

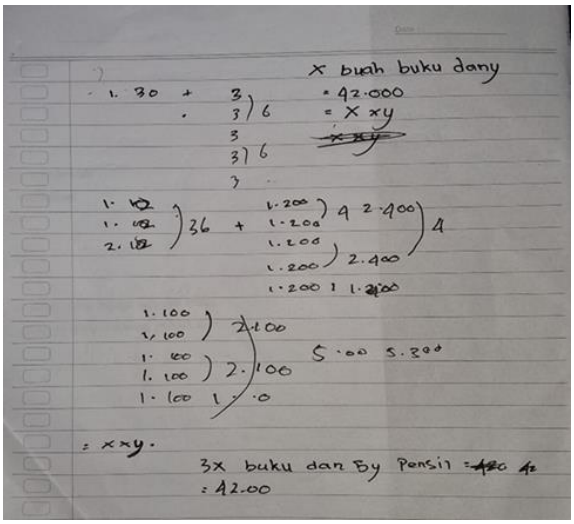

Figure 2. S1 Answer Results

Based on the results, the answer written by S1 can be answered from the question, but the results are not accurate. Regarding the results of this S1, consider conducting an interview. Here are the results of the interview with S1:

P : *Is it? Could you explain the answer you wrote in response to the results?*
S1 : *Can't*
P : *Then you can make the method. How is it like that?*
S1 : *I remember the sir's explanation about material algebra.*
P : *However, why are there 1,200 of them? There were two times, and the result was 2.4000; that is what it means. What does that mean?*
S1 : *Oh, I do not know*
P : *So you cannot solve the problem in the question?*
S1 : *No, about the problem. Such a form of writing*
P : *So it is about the shape. Can an operation be algebraically normal without such a question?*
S1 : *Yes, sis, but you have to see a friend.*
P : *If you do it alone, can't you?*
S1 : *Can not. I have difficulty with calculation problems.*
P : *Oh yeah, I finished homeschooling. What are you studying at home again?*
S1 : *No, sis.*
P : *There is one. Is it a tutoring course?*
S1 : *Not really, sis.*
P : *What? What is taught to parents?*
S1 : *That is not true either.*

S1 responds to exam questions about the outcomes and procedures based on the interview results. No, it is incorrect. However, the students still recall the content that was previously taught because S1 acknowledged that they had trouble understanding how to answer the question, and also struggled with counting. What happens when a maths difficulty arises?

3.1.6 Second Subject Data Exposure (S2)

S2 is given the test question sheet by the researcher, who also reads the instructions and works on the questions. Following S2's resolution of the issue, researchers conduct interviews to obtain relevant information in a challenging manner. Use draft mathematics to study mathematics. The outcomes of S2 problem solving on the questions are displayed. The following are the results of S2 problem-solving on the questions shown in Figure 3 below:

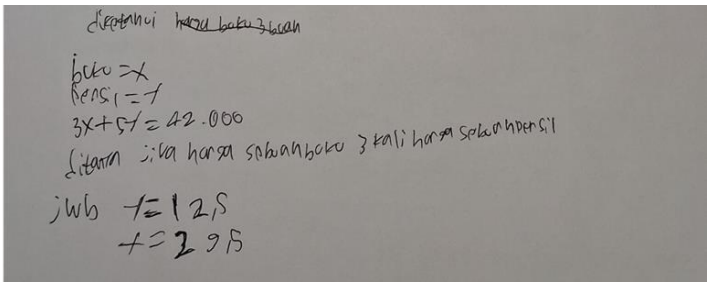

Figure 3. S2 Answer Results

Based on the results from the S2 work, it appears that S2 wrote what is known and requested, and the information is already complete. There is known and asked for information. Following is the interview against S2:

P : *Try it, read, and repeat this question: What information can you gather from the question?*
S2 : *If we know y = pencil and x = book , then 3x+5y = 42,000*
P : *Furthermore, is there anything else?*
S2 : *Asked the price of A book 3 times as the price of a pencil*
P : *Then what else?*
S2 : *None*
P : *What do you know about variables, coefficients, and constants?*
S2 : *I do not know, sis.*
P : *Nevertheless, you have explained it before, right? In the classroom?*
S2 : *Yes, sis.*
P : *Then what? Can you explain where the results of the answer you wrote come from?*
S2 : *x = 29.5 and y = 12.5*
P : *Can you explain where the results come from the x and y values?*
S2 : *No sis*
P : *Then how is that possible? Can the x and y values, if not, be used with the method of workmanship?*
S2 : *I do not know*
P : *Means you do not count. Does the same work with concept algebra?*
S2 : *Yes*
P : *Nevertheless, can you not do operations with algebra?*
S2 : *Yes, if it is not about that. There are positive and negative.*
P : *Means. Of course, it can be in the form of story questions.*
S2 : *Especially regarding the story, that is hard.*

P : *Okay, for example, about surgery. Count algebra, but nothing sign positive negative can do it?*
S2 : *Yes.*
P : *Really? Can?*
S2 : *When it comes to the tens form, I struggle with it.*
P : *What about surgery? His only multiplication and division is just?*
S2 : *Yes, the original multiplication of 1 to 5 only*
P : *Is there? Take lessons like that, or are you studying something you do at home after school again?*
S2 : *Nothing, Sis, I never study either*
P : *If taught with parents?*
S2 : *Sometimes taught me a difficult task.*

The results of the test questions and interview indicate that S2 is capable of writing answers; nonetheless, there is draft handiwork. The researcher then enquires about the draft algebra. S2 has taught it in class, but they do not know the answers. As a result, kids have trouble understanding the topic. It is also evident that S2 is unable to resolve issues with the narrative. Furthermore, according to the interview results, S2 only answered the No Correct test questions with the numbers in mind because he also had trouble counting while using the positive and negative signs.

3.1.7 Subject Data Exposure Third (S3)

S3 is given the test question sheet by the researcher, who also reads the instructions and works on the questions. Following S3's resolution of the issue, researchers conduct interviews to obtain relevant information in a challenging manner. Use draft mathematics to study mathematics. The findings of S3 problem-solving for the questions with the accompanying picture beneath are as follows:

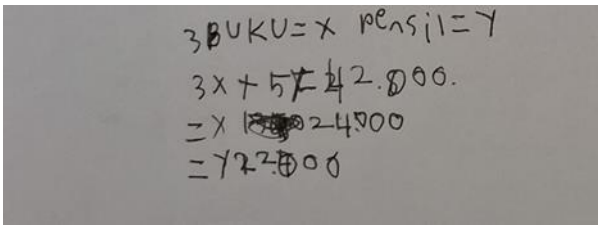

Figure 4. Student answer results S3

The results from the S3 work show that S3 wrote what is known and asked. Written information is not complete because there are no known or asked questions. So, here is the interview:

P : *You try it, read, and repeat this question: What do you gain from the question?*
S3 : *3 books = x and pencils = y and 3x+5y = 42,000*
P : *Where are you from? get 3x+5y = 42,000*
S3 : *From your question*
P : *That is what you write. Is it known or asked?*

S3 : *Known*
P : *Is it? Do you know what variables, coefficients, and constants are?*
S3 : *No*
P : *Nevertheless, you have taught me before, right? Material algebra in the classroom?*
S3 : *Yes.*
P : *Is it? Can you explain the results of the answer that you wrote?*
S3 : *x = 24,000 and y = 22,000*
P : *What? Could you explain where the x and y values were obtained?*
S3 : *No*
P : *Then why? Can the results of x and y?*
S3 : *I made a mistake*
P : *Does this mean you cannot use draft operation count algebra that has been studied?*
S3 : *Can't*
P : *However, can you do operations with algebra?*
S3 : *Addition and subtraction can be done as long as he marks his steps in dozens.*
P : *If multiplication is involved, can the same distribution be applied?*
S3 : *No sis*
P : *Why?*
S3 : *Because it is difficult, sis, I must add earlier times.*
P : *But memorised multiplication?*
S3 : *No*
P : *Do you take lessons, or do you study with your parents?*
S3 : *No, but I taught you the same aunt. I am the teacher.*
P : *Then it runs out of fuel, can it?*
S3 : *No, because math is hard*

When the interview findings indicated that S3 could write, the researcher asked about their algebra work. Although S3 had learned the material in class, they were unable to provide correct answers, indicating difficulty in understanding the content. Based on the results, S3 can formulate responses to questions, but these answers are often incorrect or false. S3 also struggles with calculations; for example, when performing operations, they tend to add or multiply unnecessarily. Additionally, S3 faces challenges in solving problems effectively.

3.2 Discussion

3.2.1 Difficulty Understanding Concepts

Based on the study's results, all subjects (S1, S2, S3) had difficulty understanding algebraic concepts, particularly in recognising positive and negative signs, variables, coefficients, and constants. Students were unable to explain or distinguish the basic elements of algebra and had not mastered the fundamental principles of integer operations essential in algebra. This difficulty aligns with the findings of Meilani et al. [13] and Sundari and Wulantina [14], which indicate that students often struggle to understand the fundamental

concepts of algebra, including distinguishing between like and unlike terms and applying the principles of adding and subtracting positive and negative numbers. Maulana et al. [15] added that a lack of understanding of coefficients, ignorance that coefficients can be one, and not yet mastering integer operations are the main causes. Sugiarti [16] also emphasised that students do not understand the definition of variables and constants. Juniawan's research [17] emphasises the need to improve students' understanding, accuracy, and precision in applying mathematical concepts. Nasywatu et al. [18] stated that dyscalculic students have difficulty recognising variables and coefficients, including the fact that coefficients can be one, and distinguishing between similar and dissimilar concepts.

3.2.2 Difficulty in Calculating

The test results showed that S1, S2, and S3 had difficulty calculating, both in terms of the method of working and the results obtained. Students tend to focus only on solving problems without accuracy and understanding, and often fail to memorise basic multiplication and division [17]. Salsabila et al. [19] stated that many students do not understand the concept of calculating well and need to improve their understanding and be cautious. Furthermore, Mudrikah et al. [20] stated that low motivation and interest in learning mathematics lead students to perceive mathematics as complicated. Hardianti [21] noted that students often experience confusion in determining the correct arithmetic operations, frequently making mistakes due to a lack of understanding and carelessness. Furthermore, Cahirati et al. [22] and Tyas [23] emphasised that difficulties in arithmetic are caused by errors in reading symbols and operating numbers. From interviews, students admitted that they had difficulty with arithmetic and were unable to perform arithmetic operations on story problems.

3.2.3 Difficulty Solving Problems

The three subjects were unable to work on the problems with the correct steps and were unable to solve the problems based on the available information. Ayu et al. [2] found that students were unable to follow the steps to solve the problems and did not understand the information in the problems. Rohim and Prayogi [24] stated that students' motivation and interest in learning mathematics were low, their understanding of algebra problems was lacking, and their accuracy in reading mathematical symbols was still low. Dewi et al. [25] noted that students struggled to transform story problems into mathematical models and were unfamiliar with the steps required to solve them. Kusumawati and Sutriyono [26] stated that students' motivation to pay attention to algebra learning tends to be low. In line with Rohati's research [27], there are difficulties in solving mathematical problems, especially those related to the demands of reasonable accuracy in their operation and understanding, which require a good grasp of concepts, as well as the numerous formulas that can be challenging to remember. If there is an error in understanding the problem and the steps to solve it, the results obtained will not be accurate, and students must repeat the process to identify the location of the error.

4. CONCLUSION

The study conducted in Class VII D at SMPN 6 Jambi City involved three subjects classified as having qualitative dyscalculia. The analysis revealed that all three students faced difficulties in learning mathematics due to their limited understanding of mathematical concepts. Among them, S1 retained some knowledge of algebraic operations but was unable to explain the concepts clearly. During interviews about algebraic terms such as variables, coefficients, and constants, the students only recognised variables, and even then, their answers were incorrect. Additionally, they struggled to apply positive and negative signs correctly. In solving problems, S1 attempted to work through questions but did not use proper arithmetic operations, while S2 and S3 only provided final answers without showing their work. The students also admitted to their inability to solve arithmetic problems presented in story form, as they could not understand the meaning of the problem and translate it into mathematical concepts. Overall, these three students with qualitative dyscalculia experienced difficulties in understanding concepts, performing calculations, and solving problems. The causes of these learning challenges stem from personal factors, family background, and the environment. For example, students who perceive mathematics as difficult tend not to study after school, often lacking sufficient support or guidance from their parents.

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