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Learning difficulties in solving mathematical story problem length measurement based on newman's error analysis

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ABSTRACT

Fourth-grade students at SD Negeri Samir made mistakes in solving story problems because the students had difficulty learning mathematics. This research aims to describe learning difficulties in solving mathematics story problems on length measurement material based on Newman's Error Analysis in the study of fourth-grade students at SD Negeri Samir. The type and approach of this research is a qualitative case study. The research location is Samir Elementary School, Tulungagung. The subjects of this research were six fourth-grade students at SD Negeri Samir. Data collection methods are observation, interviews, and documentation. The instruments used were an observation guide, an interview guide, and a document in the form of a long story question measuring four items. The results of this research are as follows: (1). Students have difficulty reading words (AS, RPP) and reading length measurement units (AS, MRA, RPP, RAIH, JSR, MZF); (2). Students experience verbal difficulties, namely determining story problem information based on numbers, punctuation marks, and words rather than understanding the story problem (AS, RPP); (3). Students experience verbal difficulties, namely being unable to determine and write the correct solution formula according to the request for the story problem (AS); (4). Students have difficulty applying the principles, namely difficulty converting length units (AS, MRA, RPP, RAIH, JSR, MZF); (5). Students have difficulty understanding the correct use of symbols (RAIH). The research results conclude that AS, MRA, RPP, RAIH, JSR, and MZF students experience difficulty learning language and reading, solving verbal problems, understanding symbols, and applying principles.

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INTRODUCTION

Students often encounter difficulties studying mathematics when solving word problems on length measurement material. Story problems connect a concept with everyday life and can be solved through computation and symbols (Heni & Nitta, 2022; Nurhidayah, 2014). Length measurement is

the number of units of length of an object sequentially and continuously from one end to the other (Salam et al., 2016). Length measurement story questions are descriptive questions that include length measurement calculation skills.

The inability to correctly complete the teacher's work is known as learning difficulties (Ningsih et al., 2022). Helping to learn is a situation where the skills achieved do not meet predetermined criteria, such as difficulties in listening, speaking, reading, and mathematics or arithmetic (Parnawi, 2019; Urbayatun et al., 2019). Helps learning experienced by students in the process of solving word problems in length measurement material.

Based on initial observations, it was found that six fourth-grade students at SD Negeri Samir experienced difficulties and made mistakes in solving story problems. AS and RPP students had trouble reading and made mistakes in comprehending story questions. MRA students experience issues and make mistakes in comprehending the meaning of story questions. RAIH and JSR students experienced difficulties and made mistakes in transforming story questions. MZF students experienced difficulties and made errors in arithmetic operations, resulting in the wrong answer being written.

Learning difficulties in solving story problems are very important to examine for fourth-grade students. The importance of researching this is because story problems can never be separated from mathematics related to everyday life. Story problems require the ability or skills to solve them. Students must understand the story's context, identify significant knowledge, and apply mathematical operations accurately when solving story problems. Based on this, it is important to look for difficulties experienced to help them overcome challenges when learning mathematics through teachers. Learning is student-centred, so knowing the learning difficulties in solving math story problems on length measurement material is important. This is to provide solutions to students so that students are not hampered in their learning process.

Learning difficulties in certain mathematical materials must be analyzed to provide solutions (Vitaloka et al., 2020). Learning difficulties are analyzed based on mistakes made by students. Analyzing errors using Newman's Error Analysis , namely analyzing how to solve story problems through five types of errors: reading, comprehension, transformation, process skills, and encoding (Rizqiani & Setiani, 2022).

This research is supported by previous relevant research, which states that students make mistakes in comprehending, transforming, and processing skills in solving story problems (Hadi, 2021; Rizqiani & Setiani, 2022). Students have difficulty reading and comprehending story questions (Zalfa & Mutianingsih, 2023)

This research aims to describe learning difficulties in solving mathematics story problems on length measurement material based on Newman's error analysis for fourth-grade students at SD Negeri Samir. Based on initial observations supported by previous research as well as case findings that occurred with fourth-grade students in the field, the researcher took the initiative to research several fourth-grade students at Samir State Elementary School with the title "Learning Difficulties in Solving Mathematical Story Problems Length Measurement Based on Newman's Error Analysis".

RESEARCH METHODOLOGY

The research method used in this research is qualitative case study research. Qualitative research is a method used to examine the conditions of natural objects, where the researcher is the critical instrument (Sugiyono, 2021). Using the case study method, researchers explore programs, events, processes, and activities with one or more people (Sugiyono, 2016). The research procedure is divided into three stages, namely the pre-field stage, fieldwork stage, and data analysis stage (Moleong, 2014). Each student was observed while solving story problems with the help of a

document in the form of a story question measuring four items in length. Interviews confirmed observations made on students. Observations and interviews were carried out for each story problem at different times. The data collection process was observing the process of solving length measurement story questions; after that, interviews were based on student's answers and the results of observations of solving length measurement story questions.

The location of this research is Samir Elementary School, Ngunut District, Tulungagung Regency. The criteria or considerations for determining research subjects are as follows: 1). Research subjects or informants made errors in solving math story problems on length measurement material; 2). Research subjects or informants experienced difficulty in solving mathematical story problems on length measurement material. The subjects of this research were six fourth-grade students at Samir State Elementary School, namely AS, MRA, RPP, RAIH, JSR, and MZF. Data collection techniques include observation, interviews, and documentation. The research instruments used were observation guidelines, interview guidelines, and documentation in the form of long measurement story questions. Checking the validity of the data uses triangulation techniques.

RESULTS AND DISCUSSION

Newman's Error Analysis has indicators adapted to long measurement story questions. The indicators of Newman's Error Analysis in solving length measurement word problems are as follows.

Table 1. Indicators of newman's error analysis in solving mathematical story problems in length measurement

Newman's Error Analysis Indicators	Sub Indicators for Newman's Error Analysis in Solving Mathematical Story Problems in Length Measurement
Reading: Students can read story questions	(1). Errors in reading words and units of length.
Comprehension: Students can determine and write down information	(1). Errors in determining and writing information (known, asked, and answered) on the answer sheet; (2). Error in writing the unit of length measurement symbol from the information.
Transformation: Students have a plan to solve relevant story problems	(1). Errors in changing the content of length measurement story questions into mathematical form; (2). Errors in determining the formula or solution steps; (3). Errors in writing mathematical calculation operations (+; - and =).
Process Skills: Students can solve story problems according to the solution plan	(1). Error in converting length units; (2). Errors in the application of equalizing length units; (3). Errors in calculating arithmetic operations; (4). Error in writing the length unit symbol in arithmetic operations.
Encoding: Students can provide a final answer	(1). Errors in writing the final answer based on arithmetic operations; (2). Error in writing the length unit symbol for the final result.

The error analysis results are further deepened to diagnose learning difficulties experienced by students. Students experience learning difficulties more often when solving problems in the form of stories compared to questions in the form of mathematical sentences. This is because questions with mathematical sentences are simpler than questions in the form of stories (Dwidarti et al., 2019). Several indicators of difficulty learning mathematics or numeracy are used in this (1). Language and reading difficulties; (2). Difficulty understanding symbols; (3). Difficulty solving verbal problems; (4). Difficulty applying principles (Cooney, Fauzi & Arisetyawan, 2020; Lerner, as mentioned in (Maryani et al., 2018).

The first indicators of learning difficulties are language and reading difficulties. Students who experience difficulties in the reading phase do not pay proper attention to the punctuation and symbols in the questions. Hence, they cannot find the correct information from the questions asked in the story (Bere, 2020). The second indicator of learning difficulties is difficulty solving verbal problems. Difficulties in solving verbal problems often arise due to students' inability to use

mathematical concepts and principles (Abrar, 2018). The third indicator of learning difficulties is difficulty understanding symbols. One of the characteristics of children who have difficulty learning mathematics is difficulty recognizing and understanding symbols (Runtukahu & Kandou (2014) as mentioned by Amaliyah et al., 2021). The fourth indicator is difficulty in applying the principles. Students who experience principle difficulties have the characteristic that they cannot use the principles (Cooney as mentioned by Pramesti & Prasetya, 2021). Students experience principle difficulties because they cannot express the meaning and apply principles that have a meaning until they use something they find (Nurhamsiah et al., 2016).

Difficulties experienced by students can lead to errors in solving story problems (Fitriatien, 2019). This shows that the learning difficulties encountered can be identified from the stage at which students make mistakes in solving story problems. The correspondence between indicators of learning difficulties in mathematics or numeracy with Newman's Error Analysis is presented in Figure 1.

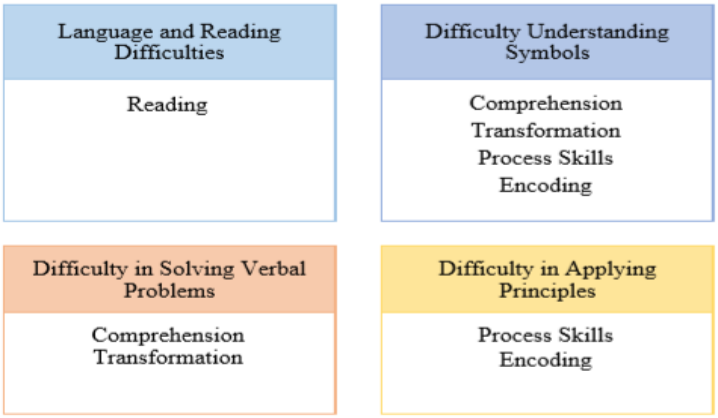


Figure 1. Suitability of indicators explaining mathematics or numeracy learning using newman's error analysis

Learning difficulties experienced by students are indicated by the relationship between indicators of learning difficulties in mathematics or arithmetic and errors made by students when solving story problems. The relationship between indicators of learning difficulties in mathematics or numeracy is based on the suitability of indicators of problems in learning mathematics or numeracy with the Newman's Error Analysis in solving mathematics story problems on length measurement material.

Table 2. The relationship between indicators of difficulty learning mathematics or counting with newman's error analysis in solving mathematical story problems on length measurement material

Indicators of Difficulty Learning Mathematics or Counting	Newman's Error Analysis Solving Mathematical Story Problems Measuring Length
Language and reading difficulties	(1). Students make mistakes in reading words and units of length in story questions about length measurement material.
Difficulty in solving verbal problems	(1). Students make mistakes in determining and writing down information obtained from length measurement story questions (known, asked, and answered) on the answer sheet; (2). Students make mistakes in changing the content of length measurement story questions into mathematical form; (3). Students make mistakes in determining the formula or steps for solving length measurement word problems.
Difficulty understanding symbols	(1). Students make mistakes in writing the length measurement unit symbols from the information in the length measurement story problems; (2). Students make mistakes in writing mathematical calculation operations (+; - and =); (3). Students make mistakes in

Indicators of Difficulty Learning Mathematics or Counting	Newman's Error Analysis Solving Mathematical Story Problems Measuring Length
	writing length unit symbols in mathematical calculation operations; (4). Students make mistakes in writing the length unit symbol for the final answer.
Difficulty in applying principles	(1). Students make mistakes in converting between units of length (for example, from centimeters to millimeters); (2). Students make mistakes in applying concepts in solving length measurement word problems (equating length units); (3). Students make mistakes in calculating arithmetic operations; (4). Students make mistakes in writing the final answers to solve story problems based on arithmetic operations.

Indicators of difficulty learning mathematics or numeracy based on Table 3 are described as follows: (1). Language and reading difficulties are related to reading long unit words and symbols in story problems; (2). Difficulty in solving verbal problems is related to difficulty writing down information, transforming word problems into mathematical sentences, and determining formulas (3). Difficulty understanding symbols is related to difficulties in writing and using length unit symbols; and (4). Difficulty in applying the principle refers to difficulty in converting units of length, difficulty applying the concept of completion, difficulty in carrying out arithmetic operations, and difficulty in writing down the final answer.

Based on the research results, several specific findings include; (1). AS and RPP students who cannot read fluently (spelling), (2). students have difficulty reading the long units hm, dam, and dm; (3). students determine story problem information based on numbers and punctuation; (4). students determine the solution formula based on words; (5). The learning difficulties most often experienced by students are learning difficulties in applying principles, namely difficulties converting length units, and (6). Lack of understanding of the meaning of length unit symbols and the calculation operations used.

Students who experience reading and language difficulties are diagnosed based on (1). Students are not able to read fluently, as indicated by students reading words by spelling one word. For example, in lesson plans, students in the word "long", students spell it with "pan-ja-ng," or for the word "whole", students spell it with "ke-se-lu-ru-han." The accuracy of AS and RPP students in reading words is not entirely correct. Some words that AS students misread were cutting (pronounced: memoto), purple (pronounced: ungu), and field (pronounced: lapaga); (2). Not being able to read according to the correct sound markings is shown by AS and RPP students not paying attention to the periods (.) or commas (,); (3). Lack of conceptual understanding of the words read is shown by AS and RPP students reading the words but not fully understanding the meaning of the words in the sentences read; and (4). AS and RPP students read each sentence with flat intonation or do not notice punctuation intonation. For example, if there is a question mark, you should use intonation with a slightly raised tone, but students use intonation with a flat tone.

This was confirmed by Vernon in Hargrove and Poteet (1984), who identified several characteristics of children who have difficulty learning to read, including: (1). unable to understand sound symbols; (2). difficulty in ordering words and letters; (3). reading word for word with incorrect pronunciation and intonation; and (4). lack conceptual thinking abilities (De Gomes, 2017).

Students experiencing difficulties in reading and language are diagnosed based on students not being able to read long units such as hm, dam, and dm. This refers to the characteristics of children who have difficulty learning to read, as stated by Vernon in Hargrove and Poteet (1984), namely lacking conceptual thinking abilities (De Gomes, 2017). All students could not read the length units hm (hectometer) and dam (decameter), as indicated by the students not reading these units in the story questions. AS, RPP and MZF students cannot read the length unit dm (decimeter). MRA students read the units of length dm (decimeter) as dam (decameter).

Difficulty in solving verbal problems can be diagnosed by understanding story problems, which are characterized by correctly determining, writing down, and understanding the information that is known and asked. Story problems can be understood when students understand the meaning and concept of the questions presented (Wulandari et al., 2023). If students experience difficulties, namely, being unable to recognize crucial words, symbols, or variables comprehensively, they will experience errors in interpreting story questions (Sari & Rejeki, 2021). Soegino confirms this in Paridjo (2008), who states that difficulties in completing verbal statements are difficulties using data, interpreting language, and drawing conclusions (Dewi et al., 2020).

Based on the research results, AS and RPP students experienced difficulty solving verbal problems, namely determining story problem information based on several things: (1). Students determine known information based on numbers, namely when writing information. Determining information from story questions based on numbers indicated by writing is known from sentences containing numbers and the length units that follow them. Students assume that sentences containing numbers and units of length are unknown. For example, in story problem 1, in the sentence "The length of the table measured by Rani is 3 meters plus 15dm", students determine the information based on the numbers "3" and "15" followed by the units of length "meters" and "dm" not from the length of the table measured by Rani. This unknown determination is not in accordance with the correct determination of the information asked in the story question; (2). Students determine information based on punctuation, namely when writing the information requested. Determining information from story questions based on punctuation is shown by writing questions from story questions based on sentences containing question marks (?) and dots (...). Students assume that a sentence containing a question mark (?) and dots (...) is the information being asked.

Difficulty in solving verbal problems can also be diagnosed from the inability to determine the correct solution formula. This is confirmed by Abrar (2018) who states that the difficulty in solving verbal problems is the students' inability to understand the context of the questions presented, in understanding story problems, students still have difficulty determining formulas and understanding theorems. The solution formula students determine is not based on understanding the meaning of the story problem but on certain words. An inaccurate solution formula will affect subsequent calculation operations. Arithmetic operation errors occur when students fail to correctly determine the formula and solution concept (Murtiyasa & Wulandari, 2020).

This is shown by AS students who determine the formula for solving story problems based on words such as: (1). The word "more" refers to the solution formula using the addition arithmetic operation, "more" is changed to a plus sign (+); (2). The word "remaining" refers to the solution formula using the subtraction arithmetic operation. AS students determine the subtraction arithmetic operation without properly understanding the meaning and question request. Students choose the formula for solving story problems with the word "remaining" always subtracting; and (3). The word "whole" refers to the solution formula using the addition arithmetic operation. AS students determine the arithmetic operation of addition based on the word "whole" rather than based on the correct meaning and request of the story problem.

Difficulty in applying the principle is diagnosed based on the difficulty in converting length units. This was reinforced by Cooney, who stated that students who had difficulty applying principles could indeed state a principle. Still, they could not examine the principle in its entirety, resulting in them being unable to use the principle (Fauzi & Arisetyawan, 2020). Difficulty in converting length units is the most frequently experienced difficulty.

Students' difficulties in converting length units consist of: (1). AS and RPP students do not know how to convert and the correct sequence of length units. US students converted length units

but the results were the same (m=cm; dm=cm) as 'did not convert'. RPP students do not know what is meant by converting or equating units of length; (2). Students have misunderstandings about how to convert, including: (a). MRA students' misunderstanding of length unit conversion is that the length unit in front of "more" is converted following the length unit behind "more". For example, if behind "more" the length unit used is dm, then the length unit in front of more is converted the same as the length unit dm; and (b). The misunderstanding of JSR students in length unit conversion is that there is no difference between going up or down stairs once and going up or down stairs several times, every time you go down the stairs is still multiplied, and every time you go up the stairs is still divided by 10; and (3). MRA, RAIH, JSR, and MZF students do not know the correct order of the ladder of units of length. Each student understands the order of different length units, presented through the ladder of length units in the image below.

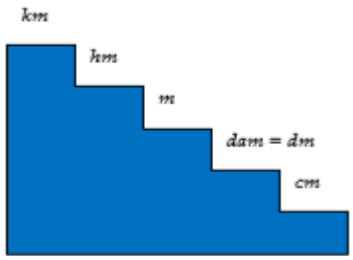


Figure 2. Sequence of unit length stairs according to mra students

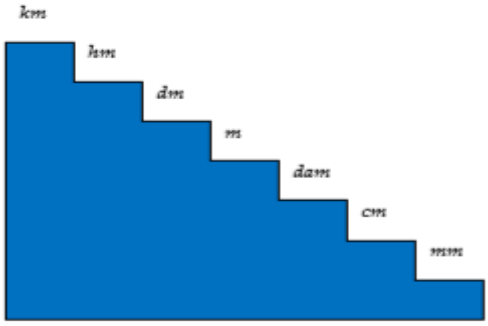
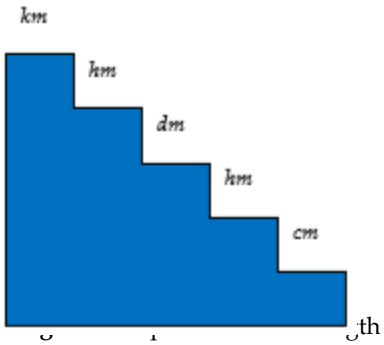


Figure 3. Sequence of unit length stairs according to RAIH students



According to MZF students

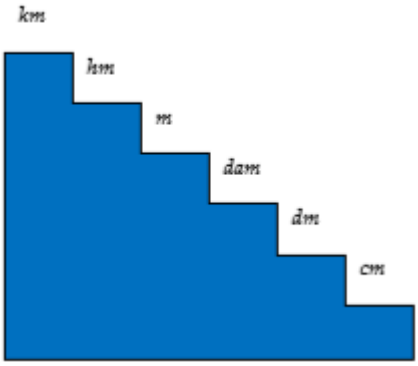


Figure 4. Sequence of Unit Length Stairs According to JSR students

Based on the pictures above, each student understands the sequence of ladder units of length differently. Students' understanding of the order of length units includes: (a). The order of length units according to MRA students is km, hm, m, dam=dm, cm; (b). The sequence of length units according to RAIH students is km, hm, dm, m, dam, cm, mm; (c). The order of length units according to MZF students is km, m, dm, hm, cm; (d). According to JSR, the sequence of length units is km, hm, m, dam, dm, cm.

Difficulty understanding symbols is diagnosed based on students knowing the unit of length symbols and arithmetic operation symbols but not correctly understanding the use of these symbols in length measurement story problems. Lerner confirms this by explaining that difficulty understanding symbols is difficulty understanding the use of symbols. These symbols are like +, -, =, ?, km, m, hm and so on (Maryani et al., 2018).

Based on the research results, it was found that several students misunderstood the use of length unit symbols and arithmetic operation symbols. The research results show that most students make errors in writing arithmetic operation symbols for several reasons: (1). The calculation operation symbol is used in the wrong formula to affect the following process; (2). The operation symbols used do not match the formula. The research results found that RAIH students did not understand the use of arithmetic operation symbols, namely, writing the plus symbol (+) to become times (x) and the minus symbol (-) to become a slash (/).

CONCLUSION

The results of this research can conclude that AS, MRA, RPP, RAIH, JSR, and MZF students experience difficulty learning language and reading, solving verbal problems, understanding symbols, and applying principles. Difficulty reading and understanding language are closely related to difficulty solving mathematics problems. Students who experience difficulties at the reading stage are unable to read fluently, do not understand the concept of the sentences they read, and do not pay proper attention to punctuation and symbols in the questions, making them unable to find the right information from the story questions being asked. Students who experience difficulties in one stage, such as reading, will have problems in subsequent phases. Each student has difficulty learning mathematics or calculating and solving length measurement math story problems. The learning difficulties most often experienced by students are (1). Language and reading difficulties; (2). Difficulty in applying principles.

It is hoped that this research can be used as a reference or consideration for teachers looking for learning strategies to overcome difficulties in learning mathematics or numeracy experienced by AS, MRA, RPP, RAIH, JSR, and MZF students specifically. These difficulties include language and reading difficulties, difficulties in solving verbal problems, difficulties in understanding symbols, and difficulties in applying principles.

This research can be further deepened to find new things, such as factors that cause learning difficulties, types of learning difficulties experienced by students, and problem-solving strategies for difficulties learning mathematics or numeracy.

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