ANALYSIS OF STUDENTS' CONCEPTUAL UNDERSTANDING IN SOLVING STORY PROBLEMS AMONG MIDDLE SCHOOL STUDENTS

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Abstrak

Salah satu kemampuan yang harus dimiliki oleh siswa adalah kemampuan pemahaman konsep namun fakta dilapangan menunjukkan bahwa kemampuan pemahaman konsep siswa dalam kategori rendah. Adapun tujuan pada penelitian ini adalah untuk mengetahui kemampuan pemahaman konsep siswa dalam menyelesaikan soal cerita matematika. Metode penelitian yang digunakan adalah pendekatan kualitatif dengan metode deskriptif. Subjek dalam penelitian adalah kelas VIII SMPN 1 Ingin Jaya yang terdiri dari enam siswa yaitu dua siswa dengan kemampuan pemahaman konsep dalam kategori tinggi, dua siswa dengan kategori sedang, dan dua siswa dengan kategori rendah. Instrumen dalam penelitian ini adalah peneliti sendiri, lembar tes kemampuan pemahaman konsep yaitu LTKPKS-1 dan LTKPKS-2, pedoman wawancara serta alat perekam. Pengumpulan data dilakukan dengan tes dan wawancara. Analisis data menggunakan triangulasi waktu. Hasil penelitian adalah (1) Subjek kategori tinggi memenuhi semua indikator kemampuan pemahaman konsep. (2) Subjek dengan kategori sedang memenuhi empat indikator pemahaman konsep yaitu menyatakan ulang sebuah konsep, memberi contoh dan bukan contoh dari suatu konsep, menyajikan konsep dalam berbagai bentuk representasi matematis, mengembangkan syarat perlu dan syarat cukup dari suatu konsep, namun masih melakukan banyak kesalahan pada indikator menggunakan dan memanfaatkan serta memilih prosedur atau operasi tertentu dan mengaplikasikan konsep atau algoritma pada pemecahan masalah serta belum memenuhi pada indikator memenuhi pada indikator mengklasifikasikan objek menurut sifat-sifat tertentu sesuai dengan konsepnya. (3) Subjek dengan kategori rendah hanya memenuhi empat indikator kemampuan pemahaman konsep yaitu indikator menyatakan ulang sebuah konsep, memberi contoh dan bukan contoh dari suatu konsep, menyajikan konsep dalam berbagai bentuk representasi matematis, mengembangkan syarat perlu dan syarat cukup dari suatu konsep, namun belum mampu mengklasifikasikan objek menurut sifat-sifat tertentu sesuai dengan konsepnya, menggunakan dan memanfaatkan serta memilih prosedur atau operasi tertentu serta mengaplikasikan konsep atau algoritma pada pemecahan masalah.

Kata kunci: Analisis, Kemampuan Pemahaman Konsep Matematika, Soal Cerita, SPLDV

Abstract

One of the abilities that must be possessed by students is the ability to understand concepts but the facts in the field show that students' ability to understand concepts is in the low category. The purpose of this study was to determine students' conceptual understanding skills in solving math word problems. The research method used is a qualitative approach with descriptive methods. The subjects in this study were class VIII SMPN 1 Want Jaya which consisted of six students, namely two students with the ability to understand concepts in the high category, two students in the medium category, and two students in the low category. The instruments in this study were the researchers themselves, concept comprehension test sheets, namely LTKPKS-1 and LTKPKS-2, interview guides and recording devices. Data collection is done by tests and interviews. Data analysis using time triangulation. The results of the study were (1) Subjects in the high category fulfilled all indicators of conceptual understanding ability. (2) Subjects in the moderate category meet the four indicators of understanding the concept, namely restating a concept, giving examples and non-examples of a concept, presenting concepts in various forms of mathematical representation, developing necessary and sufficient terms of a concept, but still making many mistakes on indicators of using and utilizing and selecting certain procedures or operations and applying concepts or algorithms to problem solving and not fulfilling on indicators fulfilling on indicators of classifying objects according to certain properties according to the concept. (3) Subjects in the low category only meet the four indicators of ability to understand concepts, namely indicators restating a concept, giving examples and non-examples of a concept, presenting concepts in various forms of mathematical representation, developing necessary and sufficient requirements of a concept, but not yet able to classify objects according to certain characteristics according to the concept, use and utilize and select certain procedures or operations and apply concepts or algorithms to problem solving.

Keywords*: Analysis, Ability to understand Mathematical Concepts, Contextual Problem, System of Linear Equation of Two Variables*

INTRODUCTION

One of the goals of mathematics education according to the NCTM is to understand concepts. Students are expected to discover the concepts from the material they study, enabling them to better understand and retain previously learned concepts (Fahrudin, 2018), as the success of students in learning mathematics is determined by their conceptual understanding of the subject.

Conceptual understanding is the mastery of various learning materials; students should not just recognize and know, but also be able to express concepts in more understandable forms and apply them (Rosmawati, 2008). According to

Duffin & Simpson, conceptual understanding is the ability of students to explain concepts, use concepts in different situations, and develop several consequences from a concept (Duffin, 2000). From Duffin & Simpson's views, it can be concluded that conceptual understanding is the ability to comprehend definitions, understand what is being communicated, provide explanations or detailed descriptions in their own words, restate a concept, and apply concepts in problem-solving.

Thus, the mathematical conceptual understanding referred to in this study is the ability demonstrated by students in solving problems based on the stages of indicators of mathematical conceptual understanding. The indicators used in this research are based on the National Department of Education and include: a. Restating a concept: the ability of students to express what has been communicated to them. b. Classifying objects according to specific properties aligned with the concept: the ability to classify objects based on whether they meet the criteria that form the concept or the ability to group objects by type based on their properties. c. Providing examples and non-examples of a concept: the ability of students to distinguish between examples and non-examples of a material. d. Presenting concepts in various mathematical representations: the ability of students to sequentially present concepts in a mathematical manner. e. Developing necessary or sufficient conditions for a concept: the ability of students to examine which conditions are necessary and which are sufficient in relation to a material concept. f. Using and applying specific procedures or operations: the ability of students to solve problems correctly according to procedures. g. Applying concepts or algorithms in problem-solving: the ability of students to apply a concept in problem-solving using correct steps (Departemen Pendidikan Nasional, 2019).

Conceptual understanding is a crucial element in learning mathematics. Mastery of many concepts allows individuals to solve problems more effectively since solving problems requires rules based on the concepts they possess. A concept is an abstract idea that enables a person to categorize objects or events and explain whether an object or event is an example of that idea.

The low level of students' conceptual understanding can be seen from the results of the national mathematics examination (UN) in 2019. Aceh ranked 33rd out of 34 provinces in Indonesia with an average score of 38.79. Additionally, the average score of middle school students in the Aceh Besar region was 37.19, while the average score of students at SMPN 1 Ingin Jaya was 34.84. This performance is still below the national average of 45.52 (Kemdikbud, 2019). This indicates that students in Aceh have not been able to optimally solve UN questions because they lack precise conceptual understanding, preventing them from answering nationally standardized questions. The UN questions include conceptual understanding, application, reasoning, and many questions are focused on conceptual understanding. This shows that students in Aceh have a low level of conceptual understanding.

A survey conducted by PISA (Programme for International Student Assessment) in 2018 ranked Indonesia 73rd out of 79 countries with an average score of 379, a decline from the previous period (Putri, 2019). According to Haji, cited by Haji et al., the weaknesses of Indonesian students in solving PISA questions are caused by various internal and external factors. One internal factor is students' weakness in understanding mathematical concepts (Haji, 2018). Thus, it is evident that one reason for the low PISA results is that students lack understanding of the concepts in the given questions. Many students memorize material without truly understanding it, which results in their inability to answer questions that differ from the examples they memorized.

Based on the results of PISA and UN, it is clear that the conceptual understanding of Indonesian students, particularly in Aceh, remains low. This is because the questions tested in PISA and UN assess students' mathematical abilities, including conceptual understanding (Aminah, 2020). Consequently, students struggle to answer questions that require conceptual understanding to solve them.

Furthermore, based on a preliminary study conducted on June 15, 2022, in class VIII-B at SMPN 1 Ingin Jaya, a test of conceptual understanding was

administered to 22 students. The results showed that 4 students were in the high category of mathematical reasoning ability, 7 students were in the medium category, and 11 students were in the low category. This indicates that 50 percent of students have low conceptual understanding.

Previous studies indicate that students' conceptual understanding is still low. This is supported by research conducted by Suraji, Maimunah, and Sehatta Saragih, which shows that the ability to understand concepts remains low. This is influenced by several factors, such as students lacking ideas in solving problems, insufficient understanding of the problems presented, and a lack of comprehension of the formulas used to solve problems and apply them in everyday life (Suraji, 2018).

This is supported by interviews conducted by the researcher with a mathematics teacher at SMPN 1 Ingin Jaya, who reported that many students still lack understanding of mathematical concepts. This is evidenced by students being able only to solve problems similar to those provided by the teacher. However, when given different problems, students struggle to solve them. This behavior indicates that students' mathematical conceptual understanding is still low.

One type of question contributing to low conceptual understanding among students is story problems, as solving story problems requires students to understand concepts well. Story problems are presented in both verbal and written forms, illustrating everyday activities (Karnasih, 2015). To solve mathematics story problems, several steps must be considered: understanding the facts, including determining what is known and what is being asked, creating a model, solving the mathematical model, and concluding the answer to the mathematics story problem (Indra, 2018).

In general, students can solve story problems that are similar to examples in the guidance book; however, they face difficulties when encountering story problems that differ in model from the examples. One reason is the inability of students to choose the appropriate steps to solve them or even the unawareness of alternative approaches available for solving story problems, compounded by

insufficient understanding of mathematical concepts (Ningrum, 2015). Therefore, an analysis of students' conceptual understanding is needed to help researchers and teachers determine whether students can optimally grasp concepts.

Based on the background above, the researcher intends to conduct a study titled "Analysis of Students' Conceptual Understanding in Solving Story Problems Among Middle School Students." Through this research, the author hopes to enhance students' mathematical conceptual understanding effectively.

RESEARCH METHODOLOGY
Type of Research

The approach used in this study is qualitative. Arikunto defines qualitative research as a form of research approach where the researcher does not use numbers in collecting data or in interpreting the results (Arikunto, 2006). Qualitative research aims to understand phenomena about what the research subjects experience holistically, through descriptions in the form of words and language within a specific natural context, utilizing various natural methods (Moleong, 2009). Based on this opinion, the researcher aims to describe a specific phenomenon regarding the conceptual understanding of middle school students in solving linear equation systems in two variables through descriptive scientific procedures.

The type of research employed is descriptive research. Descriptive research is a method that attempts to describe the subjects being studied as they are, aiming to systematically describe the facts and characteristics of the objects being studied accurately (Darmadi, 2011). This research analyzes student responses based on test results and interviews. The researcher will describe the students' conceptual understanding in solving mathematical problems related to story problems involving linear equation systems in two variables.

Time, Place, and Subjects of the Research

The research was conducted during the administration of the Student Conceptual Understanding Ability Test Sheet (LTKPKS) from June 13 to June 18, 2022, at SMP Negeri 1 Ingin Jaya, involving 6 students from class VIII-B. These included 2 students with high conceptual understanding, 2 with medium understanding, and 2 with low understanding.

Procedure

On June 15, 2022, the researcher administered LTKPKS 1 to the 22 students of class VIII-B at SMP 1 Ingin Jaya for the 2021/2022 academic year, consisting of 12 female and 10 male students. Based on the results of the conceptual understanding test, 6 subjects were selected for the interviews: 2 students with high conceptual understanding, 2 with medium understanding, and 2 with low understanding. To ensure no information was overlooked, on June 16, 2022, the researcher conducted interviews with these 6 subjects, asking for their opinions and ideas about the problem-solving processes they employed in LTKPKS 1. After obtaining data from the subjects in solving LTKPKS 1, triangulation was performed to verify the validity of the data collected. This triangulation process was conducted on June 18 and June 20, 2022, by administering LTKPKS 2 and interviewing the 6 subjects.

Data Sources, Instruments, and Data Collection Techniques

The instruments used in this research include: 1) the researcher, 2) the Student Conceptual Understanding Ability Test Sheet (LTKPKS), and 3) a semi-structured interview instrument. The data collection techniques employed include written tests using LTKPKS and interviews to delve into the thought processes used by subjects in answering the given test questions. To ensure the validity of the data, triangulation was necessary. The type of triangulation used in this study was time triangulation.

Data Analysis Techniques

Data in this research were analyzed descriptively using the concepts of Miles and Huberman, which include the stages of data reduction, data presentation, and drawing conclusions or verification.

RESEARCH RESULTS AND DISCUSSION

Research Results

Based on the analysis of the mathematical conceptual understanding ability of students in the high, medium, and low categories, the results can be categorized as presented in the following table.

Table of Categorization of Students' Conceptual Understanding Ability: High, Medium, and Low Categories

No	Indikator Kemampuan Spasial Matematis	Subjek Kategori Tinggi		Subjek Kategori Sedang		Subjek Kategori Rendah	
		STp	STk	SSp	SSk	SRp	SRk
1	Menyatakan ulang sebuah konsep	Mampu	Mampu	Mampu	Mampu	Mampu	Mampu
2	mengklasifikasi objek menurut sifat-sifat tertentu sesuai dengan konsepnya	Mampu	Mampu	Belum Mampu	Belum Mampu	Belum Mampu	Belum Mampu
3	Memberi contoh dan bukan contoh dari suatu konsep	Mampu	Mampu	Mampu	Mampu	Mampu	Mampu
4	Menyajikan konsep dalam berbagai bentuk representasi matematis	Mampu	Mampu	Mampu	Mampu	Mampu	Mampu
5	Mengembangkan syarat perlu atau syarat cukup dari suatu konsep	Mampu	Mampu	Mampu	Mampu	Mampu	Mampu

6	Menggunakan dan memanfaatkan serta memilih prosedur atau operasi tertentu	Mampu	Mampu	Belum Mampu	Belum Mampu	Belum Mampu	Belum Mampu
7	Mengaplikasikan konsep atau algoritma pada pemecahan masalah	Mampu	Mampu	Belum Mampu	Belum Mampu	Belum Mampu	Belum Mampu

Discussion

1. **Mathematical Concept Understanding Ability of High-Category Students**

Based on the results of tests and interviews conducted with subjects categorized as having high conceptual understanding ability, students in this category achieve all indicators of mathematical conceptual understanding very well. There is a similarity between subjects STp and STk in understanding and solving test problems; both can correctly explain the concept of SPLDV (Simultaneous Linear Equations of Two Variables) using their own language, thereby fulfilling the indicator of restating a concept. This aligns with Puspitasari et al.'s opinion that "high-category students are able to restate a concept correctly and accurately" (Puspita, 2019).

Furthermore, subjects STp and STk are able to categorize the given equations based on their types very well and can explain the reasons for their classifications fluently, correctly, and precisely. This is in line with research conducted by Aisyah and Dani, which states that subjects with high conceptual understanding can classify objects based on mathematical concepts very well (Aisyah, 2021).

Subjects STp and STk can also accurately provide examples and non-examples, as well as explain their reasoning fluently. This does not align with Aisyah and Dani's research, which indicates that students still struggle to determine examples and non-examples of the concepts they have studied (Aisyah, 2021). Both subjects are also capable of presenting mathematical concepts in various forms of mathematical representation, where both can transform word

problems into mathematical models. This is consistent with Fajar et al.'s statement that high-category students can present a concept in the form of a mathematical representation correctly and completely (Fajar, 2018).

Both subjects excel in developing necessary or sufficient conditions of a concept. They are also able to select and use procedures or steps for solving problems in a detailed and meticulous manner, resulting in correct and precise answers. This aligns with Fajar's research, which states that subjects with high ability have met the indicators for using, utilizing, and selecting specific procedures or operations (Fajar, 2018). Both subjects can also apply the concepts they have learned to solve the given problems. This supports Ana's research, which states that students with high ability can determine how to solve word problems by applying what is known and asked, providing correct explanations for the solutions, and performing mathematical calculations accurately (Ningrum, 2016).

Based on the above description, it can be concluded that subjects with high conceptual understanding abilities meet 7 indicators of conceptual understanding, which include: restating a concept, classifying objects according to certain properties based on their concepts, providing examples and non-examples of a concept, presenting concepts in various forms of mathematical representation, developing necessary and sufficient conditions of a concept, using, utilizing, and selecting specific procedures or operations, and applying concepts or algorithms in problem-solving.

2. **Mathematical Concept Understanding Ability of Medium-Category Students**

There is a similarity between subjects SSp and SSk in fulfilling the indicator of restating a concept; both subjects can explain the SPLDV concept correctly using their own language. This is consistent with research conducted by Diani et al., which states that medium-category students can accurately restate a mathematical concept (Diani, 2019). Next, both subjects have not been able to categorize the presented equations by type correctly. This is in line with research

by Aisyah and Dani, which shows that subjects with medium conceptual understanding still face difficulties in grouping or classifying objects based on mathematical concepts (Aisyah, 2021).

Subjects STp and STk can distinguish between examples and non-examples and can explain their reasoning fluently and correctly. This contradicts Aisyah and Dani's findings that students still struggle to determine examples and non-examples of the concepts learned (Aisyah, 2021). Subjects SSp and SSk can also present mathematical concepts in various forms of mathematical representation, where both can transform word problems into mathematical models. This aligns with Ruhama et al.'s research, which states that medium-category students can present a concept in the form of mathematical representation correctly, but not completely (Ruhama, 2021).

Both subjects are capable of developing necessary or sufficient conditions of a concept. They can select and use procedures or steps for problem-solving, but they are less thorough in completing problems and make mistakes in calculations, leading to incorrect solutions. This is inconsistent with research by Puspitasari and Ratu, which states that medium-category students are unable to use or apply formulas according to procedures in solving problems (Fajar, 2018). Both subjects also still make mistakes in applying concepts or algorithms in problem-solving. This supports Ana's findings that students with medium ability can determine how to solve word problems by applying what is known and asked, but still not accurately, and they can explain the solutions but are less precise in their explanations and make calculation errors (Ningrum, 2016).

Based on the description above, it can be concluded that subjects with medium conceptual understanding abilities meet 4 indicators, which include: restating a concept, providing examples and non-examples of a concept, presenting concepts in various forms of mathematical representation, and developing necessary and sufficient conditions of a concept. However, they still make many mistakes in the indicators for using and utilizing specific procedures or operations and applying concepts or algorithms in problem-solving, and have

not met the indicator for classifying objects according to certain properties based on their concepts.

3. **Mathematical Concept Understanding Ability of Low-Category Students**

Subjects SRp and SRk have met the indicator of restating a concept; both subjects can explain the SPLDV concept using their own language accurately. This is in line with Mustafa et al.'s opinion that subjects with low mathematical conceptual understanding can restate a concept accurately (Diani, 2019). Next, subjects SRp and SRk have not been able to categorize the presented equations by type correctly. This is consistent with research conducted by Aisyah and Dani, which indicates that subjects with low conceptual understanding are unable to classify objects based on mathematical concepts (Aisyah, 2021).

Subjects SRp and SRk can differentiate between examples and non-examples and can provide reasons for their given answers. This does not align with Aisyah and Dani's research, which states that students have not been able to determine examples and non-examples of the concepts they have studied (Aisyah, 2021). Subjects SRp and SRk can also present mathematical concepts in various forms of mathematical representation, where both can transform word problems into mathematical models. This is inconsistent with Ruhama et al.'s findings that low-category students do not respond to the indicator of presenting a concept in the form of mathematical representation (Ruhama, 2021).

Regarding the indicator of developing necessary or sufficient conditions of a concept, both subjects are capable of this. However, they have not been able to select and use procedures or steps for solving problems, and they still make many calculation errors, resulting in incorrect solutions. Both subjects also make mistakes in applying concepts or algorithms in problem-solving. This aligns with Ruhama's research, which states that subjects with low conceptual understanding are unable to respond to the indicator of applying concepts or algorithms in problem-solving. Students cannot solve the given problems because they do not know the formulas or the steps or procedures that should be used (Ruhama, 2021).

Based on the description above, it can be concluded that subjects with low conceptual understanding abilities meet 4 indicators of conceptual understanding, which include: restating a concept, providing examples and non-examples of a concept, presenting concepts in various forms of mathematical representation, and developing necessary and sufficient conditions of a concept. However, they have not been able to classify objects according to certain properties based on their concepts, use and utilize specific procedures or operations, or apply concepts or algorithms in problem-solving.

CONCLUSSION

Based on the research conducted regarding the students' conceptual understanding abilities in solving word problems among eighth-grade students at SMPN 1 Ingin Jaya, the researcher draws several conclusions about students' mathematical reasoning abilities in problem-based situations as follows:

1. **Students with High Conceptual Understanding Ability** meet 7 indicators of conceptual understanding, which include: restating a concept, classifying objects according to certain properties based on their concepts, providing examples and non-examples of a concept, presenting concepts in various forms of mathematical representation, developing necessary and sufficient conditions of a concept, using, utilizing, and selecting specific procedures or operations, and applying concepts or algorithms in problem-solving.

2. **Students with Medium Conceptual Understanding Ability** meet 4 indicators, which include: restating a concept, providing examples and non-examples of a concept, presenting concepts in various forms of mathematical representation, and developing necessary and sufficient conditions of a concept. However, they still make many mistakes in using, utilizing, and selecting specific procedures or operations and applying concepts or algorithms in problem-solving, and they have not met the indicator for classifying objects according to certain properties based on their concepts.

3. **Students with Low Conceptual Understanding Ability** meet 4 indicators of conceptual understanding, which include: restating a concept, providing examples and non-examples of a concept, presenting concepts in various forms of mathematical representation, and developing necessary and sufficient conditions of a concept. However, they have not been able to classify objects according to certain properties based on their concepts, use and utilize specific procedures or operations, or apply concepts or algorithms in problem-solving.

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