

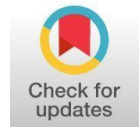
Students' Mathematical Conceptual Knowledge

Nurfad¹, Indriana², Frans Julian³

^{1,2,3} Universitas Tadulako

Jalan Soekarno Hatta Km. 9 Palu

¹fhadbagenda@gmail.com, ²indriana160403@gmail.com, ³fransjulian0724@gmail.com



Abstract

Conceptual knowledge is basic knowledge that connects pieces of information such as facts, skills, concepts, or principles. Knowledge can be understood deeply if someone masters a comprehensive understanding of the concept. This study aims to analyze the importance of mathematical conceptual understanding in mathematics learning. This study was conducted using the literature review method, namely by conducting a systematic review of relevant literature sources in scientific journals, books and academic articles about the importance of conceptual knowledge on students' mathematics learning outcomes. The indicators of students' mathematical conceptual understanding are: students verbally restate the concepts that have been learned, students classify objects based on whether or not the requirements to form the concept are met, students apply concepts algorithmically, students present concepts in various forms of mathematical representation, and students relate various concepts (internal and external mathematics). Based on the research conducted, it was found that conceptual knowledge plays an important role in the teaching and learning process and is the basis for achieving the final results. The reason why mathematical conceptual understanding is important for students is as a basis for knowledge that is the goal of early mathematics learning. If the basic concept received by students is wrong, it is difficult to correct it, especially if it has been applied in solving mathematics problems.

Keyword: Conceptual knowledge, Indikator of understanding mathematical concepts, Students'

INTRODUCTION

Conceptual knowledge in mathematics refers to an individual's capacity to understand and master mathematical ideas in a comprehensive, integrated, and functional manner (Kilpatrick et al., 2001). Individuals who have strong conceptual knowledge are able to represent mathematical situations through various approaches and understand the function of each representation in different contexts (Kilpatrick et al., 2001). This is in line with that conveyed by the Ministry of National Education (2006) in the Content Standards for elementary and secondary education units, it is stated that the objectives of mathematics learning at the junior high school/MTs level are formulated through the Competency Standards and Basic Competencies that have been set by the government, namely:

1. Understand mathematical concepts, explain the relationship between concepts and apply concepts or algorithms, flexibly, accurately, efficiently, and appropriately in solving problems.
2. Make generalizations, compile evidence, or explain mathematical ideas and statements.
3. Solve problems that include the ability to understand problems, design mathematical models, solve models and interpret the solutions obtained.
4. Communicate ideas with symbols, tables, diagrams, or other media to clarify situations or problems.
5. Have an attitude of appreciating the usefulness of mathematics in life, namely having curiosity, attention, and interest in studying mathematics, as well as a persistent and confident attitude in solving problems.

One of the principles in learning mathematics is that students must learn mathematics with

understanding, and actively build new knowledge based on previously owned knowledge and experience (Mulyono and Hapizah, 2018). Based on its characteristics, mathematics is a regularity of organized structures, mathematical concepts are arranged hierarchically and systematically, starting from simple concepts to the most complex concepts (Hasratuddin, 2015). This statement illustrates that understanding concepts plays an important role in learning mathematics. If the basic concept received by students is wrong, it is difficult to correct it again, especially if it has been applied in solving mathematical problems (Hutagulung, R. 2017).

Conceptual is a science that is demonstrated using the ability to connect between constituent elements as a result of building a concept. People who are said to be able to sort out a concept using another concept if they have achieved generalizing the components of knowledge that make up the previous concept (Bintang, et al. 2020). Mastery of concepts is very important for students because it is an indicator that students have succeeded in understanding what has been taught (Sitepu, et al. 2019).

Kilpatrick, et al. (2001) stated that conceptual knowledge is the ability to understand and master mathematical ideas in a functional and integrated manner (Badjeber & Mailili. 2019). Hiebert & Wearne (1993) stated that conceptual knowledge in mathematics is basic knowledge that connects pieces of information in the form of facts, skills, concepts or principles.

Conceptual knowledge is included in group knowledge, classification and relationships between more complex and organized sciences. Conceptual knowledge includes implicit and explicit schemes, examples or theories in asynchronous cognitive examples. These schemes, examples and theories represent the knowledge that a person has about structured teaching materials, then how asynchronous parts or information work together and are interrelated in a more systematic way, and these parts function together (Yudianto, 2014). Conceptual knowledge includes 3 elements, namely group & category knowledge, principle and generalization knowledge, theoretical knowledge, examples & structures (Tanjung, et al. 2020).

METHOD

The research method used is the library research method or literature review. This method is a process of collecting data or information carried out through literature studies or library materials such as books, journal articles, papers, or other sources of information that are relevant to the research topic to be carried out. In the library research method, the author analyzes and synthesizes the information obtained from the library materials to gain a better understanding of the research topic. The literature collection process is carried out systematically through searches on electronic databases such as Google Scholar and ResearchGate, using keywords such as conceptual knowledge, mathematical understanding, and mathematics education an also from book. The selected literature is selected based on the criteria of recency, topic relevance, and publication quality.

RESULTS AND DISCUSSION

Someone who masters the ability to understand mathematical concepts will certainly have characteristics that distinguish them from others. The following are indicators for assessing students' mathematical concept understanding abilities:

1. Re-expressing ideas that have been studied in writing.
2. Categorizing topics based on whether or not a condition that forms the concept is met.
3. Providing examples and non-examples of a concept that has been studied.
4. Expressing concepts in various forms of mathematical representation (graphs, tables, pictures, diagrams, mathematical models, sketches, etc.).
5. Applying concepts in solving meaningful problems related to the concepts studied. (Ministry of Education and Culture, 2014).

Anderson and Krathwohl (2015) stated that the dimensions of knowledge consist of 4 types, namely factual knowledge, conceptual knowledge, procedural knowledge, & metacognitive knowledge. Knowledge can be understood deeply if you master conceptual and procedural understanding. If one is not available, then the understanding will not be deep. This means that conceptual & procedural understanding are expected & interrelated with each other in achieving maximum learning output (Gunawan, et al. 2019). Conceptual knowledge plays an important role in the teaching and learning process and is the basis for achieving final results (Adhani & Rupa 2020).

Soedjadi (Utomo, 2010) stated that in the terminology of mathematics learning, a concept is defined as an abstract idea that allows people to show which are examples and which are not examples of the concept. One of the keys to success in learning mathematics is mastery of concepts. The reason understanding mathematical concepts is important for students is the basic knowledge that is the goal of early mathematics learning (Mulligan & Mitchelmore, 2009). (Kilpatrick, et al 2001) stated that understanding mathematical concepts as the ability to understand concepts, operations and relations in mathematics with indicators: (1) Verbally restating concepts that have been learned; (2) Classifying objects based on whether or not the requirements to form the concept are met; (3) Applying concepts algorithmically; (4) Presenting concepts in various forms of mathematical representation; and (5) Relating various concepts (internal and external mathematics) (Hutagulung, R. 2017).

Based on its characteristics, mathematics is a regularity of organized structures, mathematical concepts are arranged hierarchically and systematically, starting from the simplest concepts to the most complex concepts (Hasratuddin, 2015). Hutagulung, R (2017) stated that understanding concepts plays an important role in learning mathematics. If the basic concepts received by students are wrong, it is difficult to correct them, especially if they have been applied in solving mathematical problems.

One example of students' mathematical knowledge is an understanding of the concept of fractions. A strong understanding of fractions is important in mathematics because it provides a solid foundation for understanding many more advanced mathematical concepts and applications. Here are some reasons why understanding the concept of fractions is so important:

1. Part of a whole representation: Fractions are used to represent parts of a whole. Understanding the concept of fractions allows students to recognize and model smaller parts of a larger entity. This is important in many real-life situations, such as dividing food, measuring, and dividing resources.
2. Mathematical operations; Fractions are involved in various mathematical operations, including addition, subtraction, multiplication, and division of fractions. Understanding the concept of fractions allows students to master these operations correctly and understand the properties and rules associated with fraction operations.
3. Decimal representation: Fractions are also closely related to decimal representation. A good understanding of the concept of fractions helps students understand the relationship between fractions and decimals, and master the changes between the two. This is important in calculating and solving problems in various mathematical contexts.
4. Comparisons and propositions: Fractions are used in comparisons and propositions. Understanding the concept of fractions allows students to compare and evaluate the comparison of fractions and understand the concept of propositions in mathematics in everyday life.
5. Percentages and ratios: Fractions are also related to percentages and ratios. Understanding the concept of fractions helps students understand the conversion between fractions, percentages, and ratios. This is important in various contexts such as sales, discounts, and statistics.

A solid understanding of the concept of fractions provides a solid foundation in understanding and applying mathematics in everyday life as well as in more advanced subjects such as algebra, geometry, and statistics. This understanding also helps students in solving mathematical problems carefully and confidently. Therefore, it is important for students to learn and understand the concept of fractions in depth.

Conceptual knowledge is defined as a skill in learning and mastering mathematical sciences in a functional and integrated manner (Ismail, et al. 2019). Someone who has conceptual knowledge is able to explain concepts, understand the relationships between concepts, and how to find concepts (Sapitri, R. et al. 2018). Van de Walle (2002) states that conceptual knowledge contains relationships (between mathematical concepts) and the relationship between these relationships with other mathematical concepts.

Information stored in conceptual knowledge is part of a whole. Students are required to actively think to recognize, understand and use the relationships between mathematical objects, and make justifications to accommodate new knowledge to occupy a more complete mental structure. Students who have good conceptual knowledge will understand that objects in mathematics are interrelated. In addition, students who have conceptual knowledge are also able to organize their knowledge into a whole so that they can link newly learned mathematical ideas with mathematical ideas they already have (Badjeber & Mailili 2019).

Students can be said to understand mathematical concepts when they are able to restate concepts, categorize topics based on certain properties according to the concept, provide examples and non-examples of concepts, state concepts in various forms of mathematical representation, elaborate on the necessary or sufficient conditions of a concept, choose certain procedures, use and utilize them, and apply concepts or algorithms to solve a problem (Sengkey, et al. 2023).

CONCLUSION

Knowledge can be understood deeply if you master conceptual and procedural understanding. Conceptual knowledge plays an important role in the teaching and learning process and is the basis for achieving final results. One of the keys to success in learning mathematics is mastery of concepts. The reason understanding mathematical concepts is important for students is as a basis for knowledge that is the goal of early mathematics learning. If the basic concepts received by students are wrong, it is difficult to correct them, especially if they have been applied in solving mathematical problems.

REFERENCE

- Adhani, Aidil & Darius Rupa. 2020. "Biologi Pada Matakuliah Fisiologi Tumbuhan." *Quantum: Jurnal Inovasi Pendidikan Sains* 11(1): 18-26.
- Anderson, Lorin, W. & Krathwohl, R, David. (Eds.). (2015). *Kerangka Landasan untuk Pembelajaran, Pengajaran, dan asesmen*. Yogyakarta: Pustaka Pelajar.
- Badjeber, Rafiq & Wahyuni H. Mailili. 2019. "Profil Pengetahuan Konseptual Matematis Siswa SMP Ditinjau Dari Gaya Kognitif." *Jurnal Ilmiah Pendidikan Matematika* 2(1).
- Bintang, H. et al. 2020. "Analisis Pengetahuan Konseptual, Prosedural, Dan Metakognitif Siswa Melalui Pembelajaran Integrasi Flipped Classroom Dan PBL." *Physich Education Research Journal* 2(2): 105-22.
- Depdikbud. 2014. *Peraturan Menteri Pendidikan dan Kebudayaan Republik Indonesia Nomor 58 Tahun 2014 Tentang Kurikulum 2013 Sekolah Menengah Pertama dan Madrasah Tsanawiyah*. Jakarta: Menteri Pendidikan dan Kebudayaan Republik Indonesia.
- Gunawan, et al. 2019. "The Improvement of Conceptual and Procedural Understanding by Scaffolding with Responsiveness." *Internasional Journal of Innovation, Creativity and Change* (October).
- Hiebert, J., & Wearne, D. (1993). Instructional tasks, classroom discourse, and students' learning in second-grade arithmetic. *American Educational Research Journal*, 30(2), 393–425.

- Hutagulung, Ruminda. 2017. "Peningkatan Kemampuan Pemahaman Konsep Matematis Siswa Melalui Pembelajaran Guided Discovery Berbasis Budaya Toba Di SMP Negeri 1 Tukka." *Journal of Mathematics Education and Science* 2(2).
- Ismail, A. *et al.* 2019. "Enhancing Students' Conceptual Understanding of Electricity Using Learning Media-Based Augmented Reality." *Internasional Conference on Mathematics and Science Education*.
- Findell, B., Swafford, J., & Kilpatrick, J. (Eds.). (2001). Adding it up: Helping children learn mathematics. National Academies Press.
- Mulyono, Budi & Hapizah. 2018. "Pemahaman Konsep dalam Pembelajaran Matematika" *KALAMATIKA Jurnal Pendidikan Matematika* 3 (2): 103-122.
- Sapitri, R. *et al.* 2018. "Pengetahuan Konseptual Peserta Didik." *Prosiding Seminar Nasional Pendidikan Biologi* (2018).
- Sengkey, Dwi Jeanita *et al.* 2023. "Kemampuan Pemahaman Konsep Matematis : Sebuah Kajian Literatur." 3:67–74.
- Sitepu, *et al.* 2019. "Analysis of Vocational School Student' Ability in Conceptual Understanding." *JIPF (Jurnal Pendidikan Fisika)* 4(1): 28-32.
- Tanjung, *et al.* 2020. *Kajian Pengetahuan Konseptual Teori & Soal*. Bandung: CV Media Sains Indonesia.
- Van de Walle, John A. (2002). *Geometric Thinking and Geometric Concept, In Elementary and Middle School Mathematics: Teaching developmentally*. 4th ed. Boston: Allyn and Bacon.
- Yudianto, Erfan. 2014. "Profil Pengetahuan Konseptual Dan Pengetahuan Prosedural Siswa Dalam Mengidentifikasi Masalah Pecahan." *AdMathEdu* (June 2013).