The mathematical connection ability of junior high school students on fraction

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Abstract
The method used in this research is descriptive-qualitative. Through descriptive research. Through descriptive research, researchers only intend to describe or explain symptoms. The subjects used in this study were 3 junior high school students in the village of Sukawangi, Tarogong Kaler district, Garut district. The test used to be researched in this study is the mathematical connection ability test, The mathematical connection indicator used in this study consists of the relationship between mathematical concepts and mathematical concepts, the relationship between mathematical concepts and other fields of science, and the relationship between mathematics and everyday life. The instruments used in this study were written tests, interviews, The objects that were used as sources for the interview were 3 students who also completed the test questions. The test instrument contains five questions in accordance with the mathematical connection ability indicator. In analyzing the data, the technique was carried out by assessing students' answers based on written tests.
Keywords: Mathematical Connection Ability; Fractions; descriptive-qualitative

Abstrak
Metode yang digunakan pada penelitian ini adalah deskriptif-kualitatif. Melalui penelitian deskriptif. Melalui penelitian deskriptif peneliti hanya bermaksud mendeskripsikan atau menjelaskan gejala. Subjek yang digunakan pada penelitian ini yaitu 3 orang siswa SMP di desa Sukawangi kecamatan Tarogong Kaler kabupaten Garut. Tes yang digunakan untuk diteliti pada penelitian ini yaitu tes kemampuan koneksi matematis, indikator koneksi matematis yang digunakan pada penelitian ini yaitu terdiri dari keterkaitan antara konsep matematika dengan konsep matematika, keterkaitan konsep matematika dengan bidang ilmu lain, dan keterkaitan antara matematika dengan kehidupan sehari-hari. Instrumen yang digunakan pada penelitian ini adalah tes tertulis, wawancara, objek yang di jadikan narasumber untuk wawancara adalah 3 orang siswa yang juga menyelasaikan soal tes. Instrumen tes yaitu memuat lima soal yang sesuai dengan indikator kemampuan koneksi matematis. Dalam menganalisis data teknik yang dilakukan yaitu dengan menilai jawaban siswa berdasarkan tes tertulis.
Kata Kunci: Kemampuan Koneksi Matematis; Pecahan; kualitatif deskriptif

Introduction

In education, of course we want progress and improvement in terms of both understanding and skills. Education is often a benchmark for the progress of a country. Therefore, education is considered very important in creating a young generation of successors to the nation who are qualified and potential. This is reinforced by Mundiri's opinion (2016), that education can advance culture and raise the nation's status in the eyes of the international world. Education is an important and inseparable part of human life, because with education humans will try to develop themselves to face every change that occurs due to the development of scientific and technological progress.

In Indonesia, the importance of education is stated in the National Education System Law Number 20 of 2003 General Provisions Article 1 paragraph 1, namely Education is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential to have spiritual religious strength, self-control, personality, intelligence, noble morals, and skills needed by themselves, society, nation and state. This law is the basis for the establishment of the education process in Indonesia. In order to improve the quality of education, especially to improve the mastery of science and technology that will affect the success of building an advanced and independent society. Development in the field of science and technology must be supported by the ability to utilize, develop and master technology, applied science and basic science in a balanced manner. One effort to improve the ability to master science and technology is to improve their ability in mathematics.

Mathematics is the queen of sciences, because mathematics is closely related to other sciences and other fields. Mathematics is a structured science and also a subject that must be studied by students at every level of education from elementary school to college, but mathematics is less popular with some students because they cannot see the relationship between mathematics and their daily lives (Mukhtari et al., 2019; Adni et al., 2018; Apipah & Kartono, 2017). This condition requires students to have the ability to understand the relationship between mathematical concepts, the relationship between mathematical concepts and various fields of science and the relationship between mathematical concepts and everyday problems. The ability to connect these things is a characteristic of mathematical connection ability. If students want to master mathematics well, mathematical connection ability is one of the abilities that students must have (Mukhtari et al., 2019).

According to (NCTM, 2000), there are five basic mathematical skills that are standards, namely problem solving, reasoning and proof, communication, connections, and representation. Mathematical connections are two words derived from Mathematical Connection which were popularized by NCTM and used as the standard curriculum for

elementary and secondary school mathematics learning (Sumarmo, 2006). Referring to the five NCTM ability standards above, the objectives of mathematics learning set in the 2006 Curriculum essentially include (1) connections between concepts in mathematics and their use in solving problems, (2) reasoning, (3) problem solving, (4) communication and representation, and (5) affective factors. In the 2013 curriculum, it is stated that the activities emphasized in the implementation of this learning are that students are trained to learn to connect the material that has been learned in school by applying it in everyday life (Mulyasa, 2013). Students' ability to relate mathematical material to subsequent material and mathematical material to everyday life is a mathematical connection ability.

According to NCTM (2000), it is stated that if students are able to connect mathematical ideas, then students will be able to see the relationship between mathematical topics and mathematics itself, mathematics with other fields of science, and also mathematics with everyday life, and will also make students' understanding of mathematics deeper and more lasting. Therefore, students are required to be able to connect one topic to another. One of the important abilities that every student must have is the ability to make mathematical connections.

Mathematical connection ability is a student's ability and knowledge in linking, understanding, and developing relationships between concepts and procedures, both between mathematics and mathematics itself, and with other fields or in everyday life (Mayasari & Afriansyah, 2016; Nursaniah et al., 2018; Anandita, 2015). According to NCTM (2000), mathematical connection ability is important because it will help mastery of conceptual understanding and help solve problems. Without mathematical connections, students have to learn and remember too many separate mathematical concepts and procedures, therefore students need to have connection ability.

Through mathematical connections, previously completed mathematical materials and concepts will not be left as separate concepts, but will be applied as basic knowledge to master other new concepts that are still related. Mathematical connection ability is the ability of students to connect several issues related to mathematics. Connections include internal mathematics and between mathematics and fields outside mathematics (Mukhtari et al., 2019).

There are three indicators of mathematical connection ability, namely understanding the equivalent representation between mathematical topics and the mathematical topics themselves, the relationship between mathematical topics and other fields of science, and the relationship between mathematical topics and everyday life in mathematical models (Fitriah & Aripin, 2019; Widiyawati et al., 2020; Ni'mah et al., 2017).

Based on several studies, it is stated that students' mathematical connection abilities still need to be improved. Students still experience problems in solving mathematical connection problems. (Warih et al., 2016), and (Sudirman et al., 2018) each revealed that

students' abilities in making mathematical connections are still relatively low and moderate. Based on the explanation of mathematical connection abilities, it shows that mathematical connection abilities are important abilities to be developed in high school students. So, the author wants to study students' mathematical connection abilities in more depth.

According to (Damayanti & Mayangsari, 2017), it is stated that in learning mathematics, students still have difficulties with fraction material. The difficulty stems from the lack of mastery of the concept of fraction material as a whole. Understanding the concept is the first step taken to move on to the next stage, namely application in mathematical calculations. Understanding the concept of fractions in the learning process is not easy to do.

This study aims to determine the mathematical connection ability and analyze students' errors in solving mathematical connection test questions on fraction material. Based on the background that has been described, the researcher is interested in conducting a study entitled Analysis of Students' Mathematical Connection Ability on Fraction Material.

Method

The method used in this study is descriptive-qualitative. Through descriptive research. Through descriptive research, researchers only intend to describe or explain symptoms (Arikunto, 2019). The subjects used in this study were 3 junior high school students in Sukawangi village, Tarogong Kaler district, Garut regency. The test used for research in this study was a mathematical connection ability test, the mathematical connection indicators used in this study consisted of the relationship between mathematical concepts and mathematical concepts, the relationship between mathematical concepts and other fields of science, and the relationship between mathematics and everyday life. The instruments used in this study were written tests, interviews, the objects used as sources for interviews were 3 students who also completed the test questions. The test instrument contains five questions that are in accordance with the indicators of mathematical connection ability. In analyzing the data, the technique used is to assess students' answers based on written tests. From the results of the written exam, the percentage score for each stage of each question is then calculated with the following formula:

$$\mathrm{P} = \frac{T}{s \,\mathrm{x}\, n} \mathrm{x}100\%$$

Description:

P: Percentage of scores for each stage of each question

T: Total score for each indicator for each question item for all subjects

S: Maximum score for each indicator for each question item

N: Number of subjects

In this study, there are several aspects that are studied which can be seen in the following Table 1:

Table 1. Rubric for Assessment Scale of Students' Response Mathematical Connection Ability Level.

Student Response	Score
Correct answer, knowing mathematical concepts, understanding the relationship between concepts and their use.	4
The answer is correct, it is the same as the criteria but there is something wrong with the answer.	3
The answer is correct but does not match most of the criteria.	2
The answer exists but does not match the specified criteria.	1
The answer is no.	0

Result

Based on the written test results of 3 students of grade VIII on fraction material using a mathematical connection test instrument. The assessment instrument is in the form of a mathematical connection ability test of 5 descriptive questions. The results obtained from this study are in the form of an analysis of student answers based on the reference guidelines for scoring mathematical connections in Table 1. The results of scoring mathematical connections on fraction material can be seen in Table 2 below:

Table 2. Scoring mathematical connections on fraction material.

No.	Student Initials	Code
1	SE	R1
2	ST	R2
3	NJ	R3

Respondent 1 in solving the problem of understanding between mathematical topics is shown in the answers in Figure 1 and Figure 2.

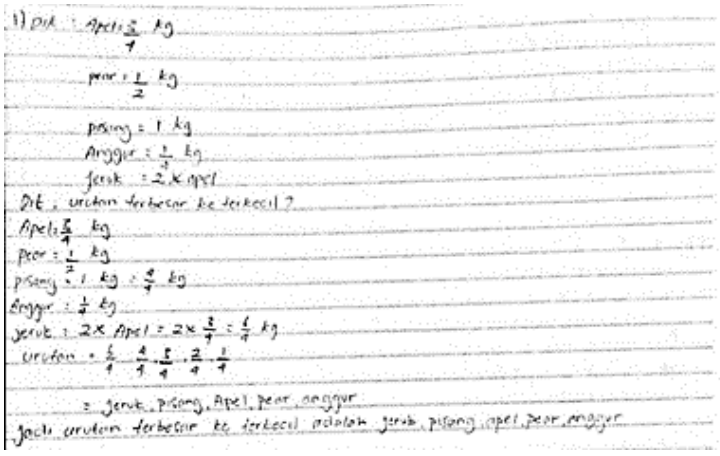

Figure 1. Written answer R1 on test number 1

Based on Figure 1 above, R1 has shown an understanding of the material and R1 is able to solve the problems in the test. In working on the test questions given by the researcher in question number 1, R1 was able to answer correctly and R1 was able to answer according to the indicators that must be achieved, R1 wrote the answer according to the answer key, wrote what was known, then changed it into a simpler fraction.

To find more accurate information regarding the answers that have been presented, the researcher conducted an interview with R1 with the following results:

P: Do you find it difficult to find the information given in the question?

R1: No ma'am, the question is quite clear.

P: Do you find it difficult to calculate the results of the fractions?

R1: No ma'am.

P: Do you find it difficult to order the fractions?

R1: No ma'am, God willing I can order the fractions

P: Are you sure you have done the fractions problem correctly?

R1: God willing I am sure ma'am.

The interview results showed that R1 did not have difficulty in working on written test question number 1, as seen from the student's complete answers in working on the test questions. Based on the results of the answer sheet and interview, it is known that R1 has been able to work on the questions well and correctly, so it can be concluded that R1 has been able to solve problems in understanding between mathematical topics.

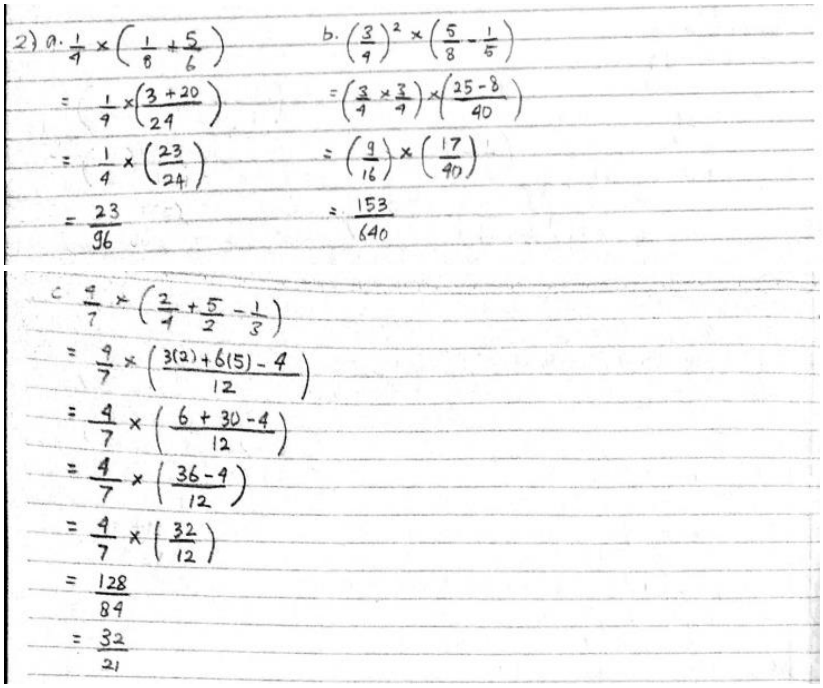

Figure 2. Written answer R1 on test number 2

Based on Figure 2 above, R1 has not shown an understanding of the material being studied, R1 is also able to complete the intended concept, in working on the test questions given by the researcher in question number 2, R1 was unable to answer the question correctly. In this answer, the researcher saw that R1 did not use the concept requested by the researcher in question number 2 and R1 completed the question using another concept.

The interview results for the answer to question number 2 are as follows:

P: Do you find it difficult to calculate the fractional number operations?

R1: Yes ma'am, I forgot about working on the properties of the operations.

P: Do you find it difficult to calculate with the properties of the fractional number operations?

R1: Yes ma'am, so I work with the concept that I remember.

P: Are you sure you have solved the problem correctly?

R1: No ma'am, but God willing if the content is the same.

The interview results showed that R1 had a little difficulty in working on written test question number 2, as seen from the answers of students who worked on the test questions with different concepts, but the final results were the same, but not in accordance with what was asked in the test questions.

Based on the results of the answer sheet and interviews, it is known that R1 has not been able to work on the questions properly and correctly and in accordance with what was asked in the test, so it can be concluded that R1 in this test question has not been able to solve problems in understanding between mathematical topics.

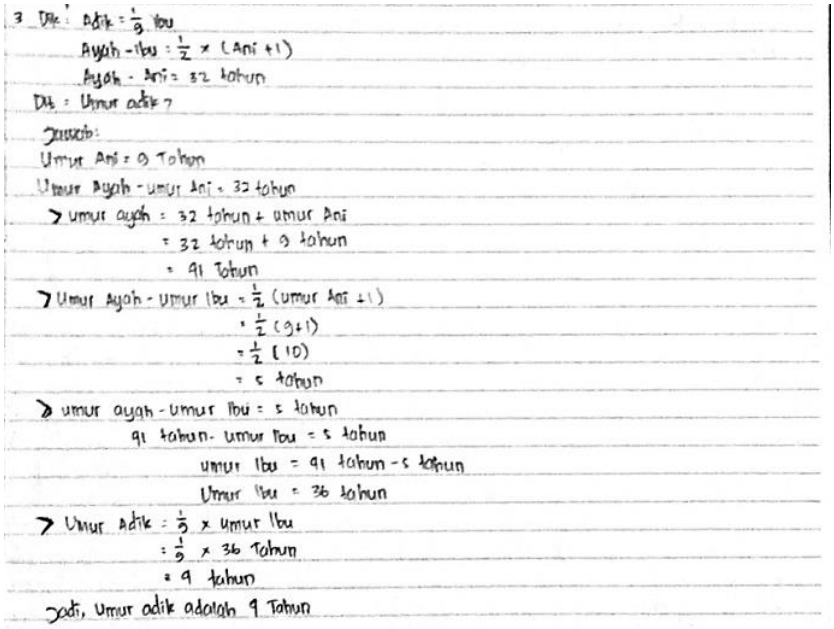

Figure 3. Written answer R3 on test number 3

Based on Figure 3 above, R3 has shown an understanding of the material and R1 is able to solve the problems in the test. In working on the test questions given by the researcher on question number 3, R3 was able to answer correctly and R3 was able to answer according to the indicators that must be achieved.

To find more accurate information regarding the answers that have been presented, the researcher conducted an interview with R1 with the following results:

P: Do you find it difficult to find the information given in the problem?

R3: No ma'am.

P: Do you find it difficult to choose a solution plan in solving the fraction problem?

R3: No ma'am.

P: Do you find it difficult to solve the fraction problem?

R3: No ma'am, God willing I did it correctly.

P: Are you sure you have done the fraction problem correctly?

R3: God willing I am sure ma'am.

The interview results showed that R3 did not have difficulty in working on written test question number 3, as seen from the student's complete answers in working on the test questions.

Based on the results of the answer sheet and interview, it is known that R3 has been able to work on the questions well and correctly, so it can be concluded that R3 has been able to solve problems in understanding and being able to use mathematics in other fields of science.

The 2nd respondent in solving problems in understanding and being able to use mathematics in other sciences is shown in the answers in Figure 4.

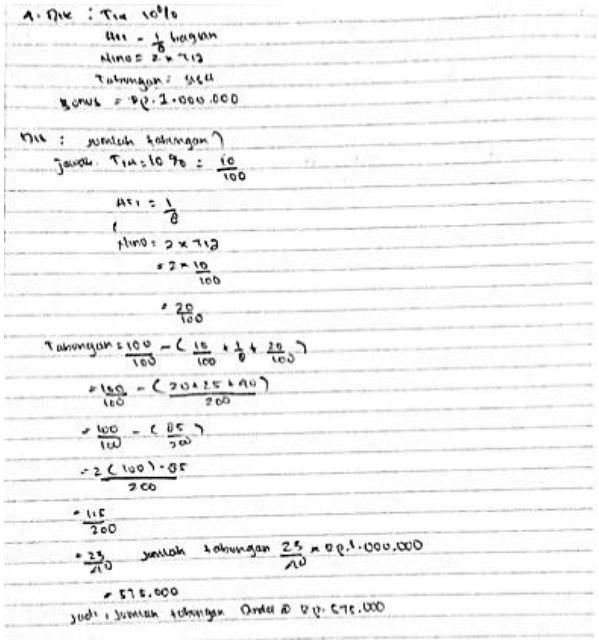

Figure 4. Written answer R2 on test number 4

Based on the Figure 4, R2 has shown an understanding of the material and R1 is able to solve the problems in the test. In working on the test questions given by the researcher on question number 4, R2 was able to answer correctly and R1 was able to answer according to the indicators that must be achieved.

To find more accurate information regarding the answers that have been presented, the researcher conducted an interview with R2 with the following results:

P: Do you find it difficult to find the information given in the question?

R2: No ma'am.

P: Do you find it difficult to choose a solution plan in solving the fractional number problem?

R2: No ma'am.

P: Do you find it difficult to solve the fractional number problem?

R2: God willing ma'am, there is no difficulty for question number 4.

P: Are you sure you have done the fractional problem correctly?

R2: Sure ma'am, God willing.

The interview results showed that R2 did not have difficulty in working on written test question number 4, as seen from the student's complete answers in working on the test questions.

Based on the results of the answer sheet and interview, it is known that R2 has been able to work on the questions well and correctly, so it can be concluded that R2 has been able to solve problems in understanding and being able to use mathematics in other fields of science.

The 3rd respondent in solving problems in understanding and being able to use mathematics in everyday life is shown in the answer in Figure 5.

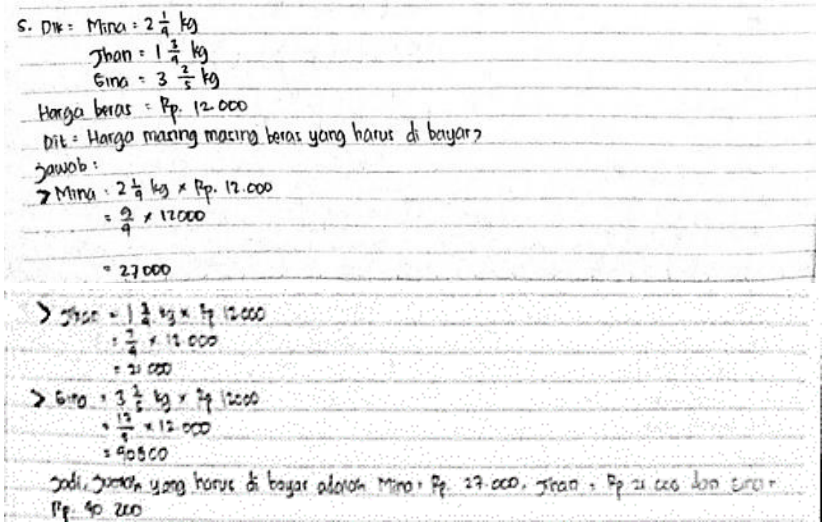

Figure 5. Written answer R3 on test number 5

Based on Figure 5, R3 has shown an understanding of the material and R3 is able to solve problems in the test. In working on the test questions given by the researcher on question number 5, R3 was able to answer correctly and R3 was able to answer according to the indicators that must be achieved.

To find more accurate information regarding the answers that have been presented, the researcher conducted an interview with R3 with the following results:

P: Do you find it difficult to write/change the mixed fractions into ordinary fractions?

R3: No ma'am.

P: Do you find it difficult to solve the fractions problem?

R3: No ma'am.

P: Are you sure you have done the problem correctly?

R3: Sure ma'am, God willing.

The interview results showed that R3 did not have difficulty in working on written test question number 5, as seen from the student's complete answers in working on the test question. Based on the results of the answer sheet and interview, it is known that R3 has been able to work on the question well and correctly, so it can be concluded that R1 has been able to solve problems in understanding and being able to use mathematics in everyday life.

Discussion

During the research, respondent 1 after being given the question sheet/written test sheet, he immediately read the question then immediately wrote or filled in question number 1 on the answer sheet, first of all what R1 wrote was what was known from the question, and wrote down what was asked in the question, then next filled in the question with confidence that he could do the question correctly and completely, while occasionally erasing the writing or wrongly written answers and replacing them with the answers that he thought were correct, after finishing question number 1 then R1 took the question sheet and read the next question which was question number 2, and when he wanted to do number 2, R1 was a little confused then finally continued by writing the answer with the way he knew how to do it, until finishing number 2, after working on question number 2 R1 then took and reread the question on the test sheet then the student worked on question number 3 with confidence that he understood and could do the question well and correctly, and continued on to question number 5 also with confidence that R1 could do it, until finally he worked on question number 4 with a little confusion and doubt, also anxious about the answer written.

During the research, respondent 2 after being given the question sheet/written test sheet, he immediately read the question then immediately wrote or filled in question

number 1 on the answer sheet, first of all what R1 wrote was what was known from the question, and wrote down what was asked in the question, then next filled in the question with confidence that he could do the question correctly and completely, but R2 was not like R1 who did it with confidence but still relaxed, while R2 was a bit hasty, after finishing question number 1 then R2 took the question sheet and read the next question, which was question number 2, and when he wanted to do number 2, R1 was a bit confused then finally continued by writing the answer by working according to the instructions in the question, R2 worked on question number 2 with full confidence that he could do it, until finishing number 2, after working on question number 2 R2 then took and reread the question on the test sheet then the student worked on question number 4 with a bit of uncertainty that he understood and could do the question well and correctly, so he took a long time to work on the question, and continued on to question number 3 R2 was confused and began to feel restless, and not sure that he could not do the problem until the time to work on the problem ran out.

During the research, respondent 3 after being given the question sheet/written test sheet, he immediately read the question then immediately wrote or filled in question number 1 on the answer sheet, first of all what R3 wrote was what was known from the question, and wrote down what was asked in the question, then next filled in the question with confidence that he could do the question correctly and completely, after finishing question number 1 then R3 took the question sheet and read the next question which was question number 2, and when he wanted to do number 2, R3 did not experience any difficulty and anxiety on this question, R3 worked on the question a little hastily and R3 was sure that the answer was correct and complete, then R3 continued to fill in questions number 4, 5 with confidence that the answer was correct and complete, while for question number 3 R3 experienced a little confusion but was able to complete the question confidently and on time.

Conclusion

Based on the results of the research that has been done, it can be concluded that the level of mathematical connection ability of several students in Sukawangi Village, Tarogong Kaler District is grouped into three categories. The data grouping is based on the results of students' scores on the mathematical connection ability test. There is one student who is included in the high category, one student who is included in the medium category and one other student is included in the low category.

Conflict of Interest

The authors declare that no conflict of interest regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies have been completely by the authors.

Reference

Adni, D. N., Nurfauziah, P., & Rohaeti, E. E. (2018). Analisis Kemampuan Koneksi Matematis Siswa SMP ditinjau dari Self Efficacy Siswa. *JPMI*, *1*(5), 957–964.

Apipah, S., & Kartono. (2017). Analisis Kemampuan Koneksi Matematis Berdasarkan Gaya Belajar Siswa pada Model Pembelajaran Vak dengan Self-Assessment. *UJMER*, *6*(2), 148–156.

Arikunto, S. (2019). *Prosedur Penelitian*. Rineka Cipta.

Damayanti, N. W., & Mayangsari, S. N. (2017). Analisis kesalahan siswa dalam pemahaman konsep operasi hitung pada pecahan. *Jurnal Ilmiah Edutic*, *4*(1), 1–7.

Mukhtari, Z., Yuliani, A., & Hendriana, H. (2019). Analisis Pengaruh Self Efficacy Terhadap Kemampuan Koneksi Matematik Siswa SMP Pada Materi Bangun Ruang Sisi Datar. *Jurnal Pembelajaran Matematika Inovatif*, *2*(5), 337–346.

Mulyasa, E. (2013). *Pengembangan dan implementasi kurikulum 2013*. PT Remaja Rosdakarya.

Mundiri, A. (2016). Strategi Lembaga Pendidikan Islam Dalam Membangun Branding Image. *Pedagogik; Jurnal Pendidikan*, *3*(2), 58–72.

NCTM. (2000). *Principles and standards for school mathematics. Reston, VA: NCTM*. NCTM.

Sudirman, Cahyono, E., & Kadir. (2018). Analisis Kemampuan Koneksi Matematis Siswa SMP Pesisir Ditinjau Dari Perbedaan Gender. *Jurnal Pembelajaran Berpikir Matematika*, *3*(2), 11–22.

Sumarmo, U. (2006). *Pembelajaran Keterampilan Membaca Matematika pada Siswa Sekolah Menengah*. Bandung: FMIPA Universitas Pendidikan Indonesia.

UU Sistem Pendidikan Nasional Nomor 20 Tahun. (2003). *No Title*. *1*.

Warih, P. D., Parta, I. N., & Rahardjo, S. (2016). Analisis Kemampuan Koneksi Matematis Siswa Kelas VIII pada Materi Teorema Phytagoras. *Konferensi Nasional Penelitian Matematika Dan Pembelajarannya (KNPMP I)*, *Knpmp I*, 377–384.