International Journal of Technology and Education Research

https://e-journal.citakonsultindo.or.id/index.php/IJETER

E-ISSN: 2986-0733

# Preliminary Study of In-Action Learning: An Analysis of Mathematical Connection Abilities of Junior High School Students

**Nurmala R[1], Alfian Mucti[2], Achmad Zultan Mansur [3], Eka Widyawati[4], Jusmawati[5]**

[1,2,3,4] Universitas Borneo Tarakan, Tarakan, Indonesia
[5] Universitas Megarezky, Makassar, Indonesia

Corresponding Author: nurmala.r@borneo.ac.id

**Abstract**

*This article examines mathematical connection ability, an essential competency emphasized in the National Council of Teachers of Mathematics (NCTM) recommended mathematics learning objectives. Specifically, this research aims to describe students' mastery of mathematical connection ability in the topic of Quadrilaterals and Triangles. Employing a descriptive qualitative methodology, the research instrument consisted of three essay-type test questions on mathematical connection ability, which were implemented to collect data. Data analysis revealed that the average percentage of students' achievement in mathematical connection ability was 30%. These findings indicate that middle school students' mastery of the mathematical connection ability in the topics of quadrilaterals and triangles remains relatively low. The results of this study provide educators with a foundation for designing more effective learning experiences to enhance students' mathematical connection ability. The importance of developing this ability lies not only in fostering a deep conceptual understanding but also in applying mathematics in broader contexts, both within and outside the field of mathematics.*

**Keyword: Mathematical Connection Skills, Essay Test, Junior high school**

## INTRODUCTION

Mathematics, as the universal language of science and technology, is a fundamental discipline that is integrated into the educational curriculum at all levels, from primary education to higher education, given its crucial role in the development of logical, analytical, and problem-solving skills that are essential for daily life and various professional fields. Learning mathematics



Copyright to the author of some rights reserved This work is licensed under aCreative Commons Attribution-ShareAlike 4.0 International License.

in school is very important because it is a valuable subject in both education and daily life. In addition, mathematics is a discipline that relies on thought processes. Mathematics plays a very important role in living things, which can be used in daily life (Akbar et al., 2018; Bernard et al., 2018; Rudyanto et al., 2019; Zuyyina et al., 2018)

Mathematics is studied to develop students' reasoning, connection, problem-solving, communication, and representation skills (NCTM, 2000). The evaluation of the Programme for International Student Assessment (PISA) in 2018 revealed that Indonesian students' mathematics competence still needs significant improvement. Data show that Indonesia ranks 73rd with an average score of 379, far behind the average mathematics achievement score in OECD countries, which reaches 489 (Lanya et al., 2021; OECD, 2019). Although the 2022 PISA results show that math skills have increased by 5 positions compared to 2018, Indonesia's score has dropped by 13 points. One of the important factors that students must master in improving their math skills is the ability to make mathematical connections (Prihandhika, 2017; Sumiati et al., 2019)

Mathematical connections as an essential element in the mathematics learning process (Ayunani et al., 2020; Bingölbali & Oşkun, 2016; Depdikbud, 2014; Jaelani & Hidayati, 2021) play a crucial role in facilitating students' conceptual understanding. By building bridges between abstract mathematical concepts and real-world applications (Ariyani et al., 2020; Ayunani et al., 2020), mathematical connections enable students to construct meaningful and relevant knowledge. National Council of Teachers of Mathematics, as quoted by Nugraha (Nugraha, 2018) emphasizing that mathematical connections are an essential cognitive competency, not only limited to the ability to understand and relate concepts within the realm of mathematics itself, but that mathematical connections also include the ability to bridge these concepts with other fields of study, as well as apply them in real-life contexts. Thus, mathematical connections not only enrich understanding of mathematics itself but also demonstrate its relevance and usefulness across various aspects of life and learning. So, mathematical connections are closely related to the ability to connect or associate one thing with another. In this case, the student's ability to relate various rules in mathematics, relate mathematics to other subjects, and relate mathematics to everyday life is all part of mathematical connection ability.

Mousley emphasized the importance of "making connections" in math learning to build deep, long-lasting understanding (Mousley, 2004). When students succeed in establishing connections between mathematical ideas, they not only understand mathematics as a collection of separate formulas but also see the interconnectedness between the various topics within it; they can relate mathematics to other disciplines and find its application in everyday situations (NCTM, 2000; Siagian, 2016; Siregar & Siagian, 2019). Students' mathematical comprehension will



Copyright to the author of some rights reserved This work is licensed under aCreative Commons Attribution-ShareAlike 4.0 International License.

improve if they can relate existing knowledge to new knowledge. The most beneficial connection occurs when students connect relevant mathematical concepts appropriately (Kilpatrick et al., 2001). Thus, the ability to make mathematical connections is essential to creating meaningful learning.

Given the importance of mathematical connection skills in the learning process, as previously elaborated, this study aims to explore and describe the mathematical connection abilities of junior high school students, particularly with square and triangular materials. Thus, this research is expected to provide an empirical picture of the extent to which students can relate the mathematical concepts in the material. With this research, it is hoped that teachers can involve students in developing their mathematical connection skills in the next lesson. One way to do this is to get students used to practising problems that develop mathematical connection skills.

## METHOD

This study adopts a qualitative, descriptive approach, which aligns with its goal of providing a comprehensive picture of students' mathematical connection abilities based on results from working on triangle and quadrilateral materials.

This research was conducted at a junior high school in Makassar City, with grade VIII students as the main participants. To measure students' mathematical connection skills, a research instrument was used in the form of a description test consisting of three questions. These questions are carefully arranged based on relevant indicators of mathematical connection ability. Data collection was carried out by giving the description test to students after they studied the square and triangle material. Furthermore, the data obtained from the test were analyzed in depth using Miles and Huberman'sHuberman's data analysis techniques, which included the stages of data reduction, data presentation, and conclusion drawing (Scott, 2014). Through this approach, it is hoped that a more comprehensive understanding of students' mathematical connection abilities in the context of quadrilateral and triangular materials can be obtained, along with their implications for improving the mathematics learning process.

At the data reduction stage, the first step is to assess the results of students' work on the mathematical connection ability test using the assessment rubric developed (Nursaniah et al., 2018)

**Table 1. Mathematical Connection Ability Assessment Rubric**

| Score | Remarks |
|---|---|
| 4 | The student's answers are correct, show a good understanding of the relationships between mathematical concepts and can apply them correctly. |



Copyright to the author of some rights reserved This work is licensed under aCreative Commons Attribution-ShareAlike 4.0 International License.

International Journal of Technology and Education Research

https://e-journal.citakonsultindo.or.id/index.php/IJETER

E-ISSN: 2986-0733

| | |
|---|---|
| 3 | The students' answers are mostly correct and meet the criteria, but some parts are not precise or need correction. |
| 2 | The students' answers are correct, but some of the criteria do not match. |
| 1 | There is an answer, but it does not meet the criteria that have been determined. |
| 0 | No student answer |

Furthermore, to classify students' level of mathematical connection ability, this study adopted validated grouping criteria (Maryanasari & Zanthy, 2019). This criterion allows for a quantitative analysis of the percentage of achievement in students' mathematical connection skills, thus providing a clearer picture of the distribution of these ability levels in the study.

**Table 2. The percentage achievement of mathematical connection ability**

| Achievements | Category |
|---|---|
| 75% - 100% | Height |
| 50% - 75% | Medium |
| 0 – 50% | Low |

## RESULTS DISCUSSION

Based on the results of the written test of 32 students on the material of the quadrangle and triangle using a mathematical connection test instrument consisting of 3 description questions, and each question represents an indicator of mathematical connection ability, results were obtained in the form of an analysis of students' answers based on the mathematical connection scoring guidelines in Table 1. The results of scoring mathematical connections in the Quadrilateral and Triangle materials are shown in Table 2 below. The scoring of students' mathematical connections in understanding the Quadrilateral and Triangle material is shown in Table 3.

**Table 3. Percentage of Achievement of Mathematical Connection Ability**

| Question No. | Indicator | Presentase | Category |
|---|---|---|---|
| 1 | Can connect the topics in mathematics | 42% | Low |
| 2 | Be able to connect mathematics with disciplines outside of mathematics | 27% | Low |
| 3 | Can connect mathematics with everyday life | 21% | Low |
| **Average Presentation** | | 30% | Low |

Based on Table 3, the percentage of mathematical connection ability grouping criteria for



Copyright to the author of some rights reserved This work is licensed under aCreative Commons Attribution-ShareAlike 4.0 International License.

International Journal of Technology and Education Research

https://e-journal.citakonsultindo.or.id/index.php/IJETER

E-ISSN: 2986-0733

32 students who have taken the instrument test. The measurement results indicate that students' abilities across the three indicators remain relatively low. In detail, the table shows that students' ability to connect mathematical topics falls in the low category, with an achievement rate of 42%. Connecting mathematics with disciplines outside mathematics is also relatively low, at only 27%. Connecting mathematics with daily life has the lowest achievement percentage, at 21%, which is also in the low category. Overall, the average percentage of students' achievement in mathematical connection ability is 30%, indicating a low level. This data indicates the need to improve students' ability to connect mathematical concepts within and across mathematics topics, with other fields of study, and with daily life.

This research focuses on evaluating students' mathematical connection skills at one school in Makassar. To achieve this goal, a mathematical connection ability test in the form of a description consisting of three questions was used. These questions were specifically developed to measure students' ability to connect mathematical concepts, with each question based on relevant indicators of mathematical connection ability. The materials tested in this test are Quadratic and Triangle, which were chosen because they were considered representative of students' mathematical connection abilities at the Junior High School level.

Question item number 1 on the mathematical connection ability test measures students' ability to connect different subjects in mathematics. The question asks: A rectangle has a length of (3x + 2) cm and a width of (x - 1) cm. If the circumference of the rectangle is 26 cm, specify the x-value and the area of the rectangle! The following is an example of the answers given by students:

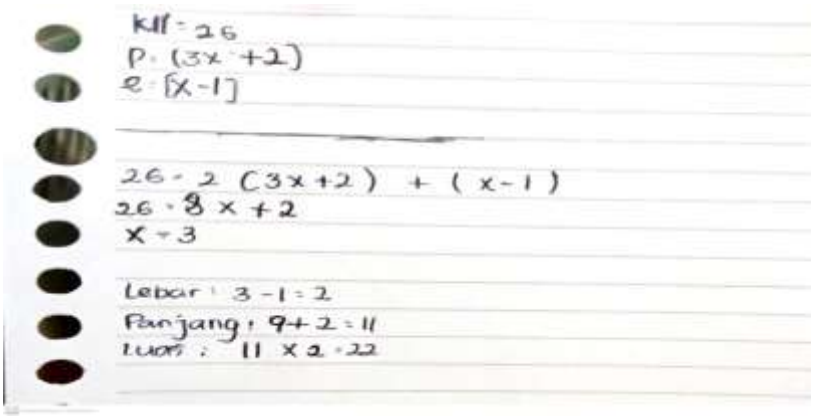



Figure 1. Results of student work on question number 1



Copyright to the author of some rights reserved This work is licensed under aCreative Commons Attribution-ShareAlike 4.0 International License.

International Journal of Technology and Education Research

https://e-journal.citakonsultindo.or.id/index.php/IJETER

E-ISSN: 2986-0733

Figure 1 shows that the students have reached the correct final answer, but their writing of mathematical ideas is incomplete, so they only get a score of 2. When determining the value x to use for length and width, students do not explain its origin. Ideally, when solving the description problem, students should demonstrate how to obtain an x-value using the concept of rectangular circumference in the context of a single-variable linear equation. These findings indicate a tendency among students to fail to relate mathematical ideas from previous material to the material being studied (Laili & Puspasari, 2018). Based on the results of work on question item 1, students still have difficulty understanding the relationship between the material being studied and the previous material. The 42% achievement rate in indicator 1 indicates that students' mathematical connection ability for this indicator is in the low category.

The next indicator, measured by question 2, is students' ability to connect mathematics with other disciplines. The question is: a farmer owns a plot of land in the shape of a right triangle with sides measuring 60 meters and 80 meters on the right. The farmer wanted to build a fence around the land. If the cost of the fence is Rp 50,000 per meter, what is the total cost for the farmer to make a fence?

In question item 2, there is an indicator: being able to connect mathematics with other subjects, namely, Social Science subjects. The relationship that occurs concerns the circumference of a triangle and the Pythagorean theorem in the subject of Social Sciences. Below is the work on question 2, which is the result of one of the students' works:

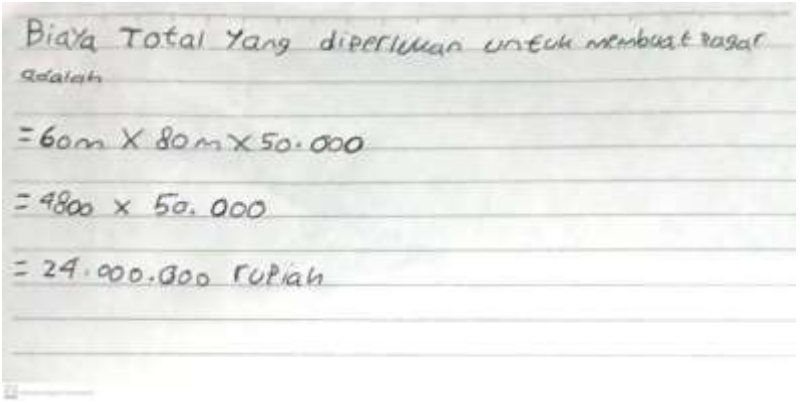



Figure 2. Results of student work in question number 2

The picture shows the students' efforts in solving the problem, even though there are errors in the process and in the final result, which results in a low score of 1. This error is caused by a lack of explanation of the rules used, especially in determining the concept of calculating



Copyright to the author of some rights reserved This work is licensed under aCreative Commons Attribution-ShareAlike 4.0 International License.

International Journal of Technology and Education Research

https://e-journal.citakonsultindo.or.id/index.php/IJETER

E-ISSN: 2986-0733

total costs. Students should first calculate the length of the triangle's oblique side using the Pythagorean Theorem. Then, complete the circumference of the triangle before finally multiplying the circumference by the cost of the fence per meter. Previous research has shown that students often have difficulty relating math material to other subjects, indicating an inability to apply mathematical concepts to solve problems outside of the math context (Laili & Puspasari, 2018). The results of working on question 2 show that students have not been able to master the relationship between mathematical material and other subjects. The achievement percentage in indicator 2, at 27%, confirms that students' mathematical connection ability for this indicator is in the low category.

Furthermore, question 3, with its indicators, connects mathematics to daily life. The question is: what is the area of the floor of a rectangular room measuring 5 meters by 7 meters, installed with square tiles measuring 50 cm on a side? How many tiles does it take to cover an entire floor?

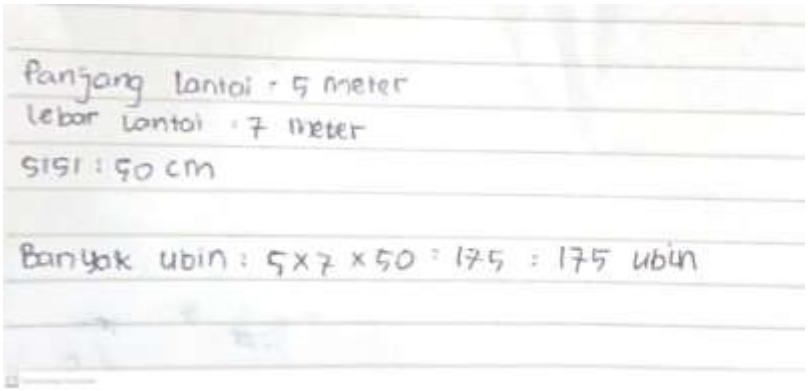



Figure 3. Remaining work results in number 3

The results of the students' work indicate that the student has started by recording the known information and asking questions, indicating an effort to solve the problem. However, errors in the process resulted in a low score of 1. Students do not write down mathematical ideas in full, especially when linking the concept of rectangular breadth to real-life contexts, leading to errors in the final result. This aligns with research (Nugraha, 2018), which found that students often did not elaborate on their mathematical ideas or connect the material to real-world problems. As a result, mathematical concepts are only understood in the abstract and are not connected to everyday activities (Laili & Puspasari, 2018)

Analysis of results from working on problem 3 indicates that students are not fully able to integrate mathematical concepts into real-world activities. The achievement percentage in



Copyright to the author of some rights reserved This work is licensed under aCreative Commons Attribution-ShareAlike 4.0 International License.

indicator 3, at only 38%, is relatively low, reinforcing this finding and indicating that the mathematical connection ability of junior high school students remains significantly underdeveloped.

## CONCLUSION

The results of the data analysis showed that the average percentage of achievement in theirstudents' mathematical connection ability when solving three test questions was 30%, indicating that this ability is still in the low category. The difficulty students have in expressing mathematical ideas fully, understanding the relationships between mathematical concepts, connecting them with other disciplines, and applying them in real situations is clear evidence of weak mathematical connections. These difficulties directly contribute to the student's mistakes in solving the given math problem.

These findings underscore the urgency of innovating the mathematics learning process at the Junior High School level. The innovation should focus on developing students' mathematical connection skills, so that they are not only able to understand mathematical concepts separately but also to see their connections within mathematics itself, with other disciplines, and with daily life. Thus, it is hoped that students will be more successful in solving math problems and in applying their knowledge across various contexts.

## REFERENCE

Akbar, P., Hamid, A., Bernard, M., & Sugandi, A. I. (2018). Analisis kemampuan pemecahan masalah dan disposisi matematik siswa kelas xi sma putra juang dalam materi peluang. Jurnal Cendekia: Jurnal Pendidikan Matematika, 2(1).

Ariyani, Pitoi, Yusiasih, Maulana, & Koesmawati. (2020). The optimization of pyrethroid simultaneous analysis in tropical soil of Indonesian tea plantation: Preliminary study. The 4th International Symposium on Green Technology for Value Chains 2019. DOI 10.1088/1755-1315/483/1/012037

Ayunani, D. S., Mardiyana, & Indriati, D. (2020). Analyzing mathematical connection skill in solving a contextual problem. Journal of Physics: Conference Series. DOI 10.1088/1742-6596/1511/1/012095

Bernard, M., Nurmala, N., Mariam, S., & Rustyani, N. (2018). Analisis Kemampuan Pemecahan Masalah Matematis Siswa SMP Kelas IX Pada Materi Bangun Datar. SJME (Supremum Journal of Mathematics Education), 2(2), 77–83.

Bingölbali, E., & Oşkun, M. (2016). A Proposed Conceptual Framework For Enhancing The Use Of



Copyright to the author of some rights reserved This work is licensed under aCreative Commons Attribution-ShareAlike 4.0 International License.

MakingConnections Skill In Mathematics Teaching. Education and Science 2016, Vol 41, No 183, 233-249.

Depdikbud. (2014). Kurikulum 2013 Sekolah Menengah Pertama/Madrasah Tsanawiyah. Jakarta :

Jaelani, & Hidayati. (2021). Analisis Kemampuan Koneksi Matematis Siswa SMP Negeri 2 Majalaya pada Materi Pola Bilangan. MAJU : Jurnal Ilmiah Pendidikan Matematika Vol 8, No 1 (2021).

Kilpatrick, Jeremy, Swafford, J., & Findell, B. (2001). Adding it up: Helping children learn mathematics. Adding It up: Helping Children Learn Mathematics. Mathematics Learning Study Committee, National Research Council.

Laili, J., & Puspasari, R. (2018). Analisis Kesulitan Belajar Matematika Siswa Ditinjau dari Kemampuan Koneksi Matematika. JP2M (Jurnal Pendidikan Dan Pembelajaran Matematika), 4(2), 1–10. doi: https://doi.org/10.29100/jp2m.v4i2.951

Lanya, H., Zayyadi, M., Sulfiah, S. K., & Roziq, A. (2021). Students' mathematical literacy on the performance of PISA questions: What is gender correlation? Jurnal Didaktik Matematika, 8(2), 222–234. doi:10.24815/jdm.v8i2.20570

Maryanasari, R., & Zanthy, L. S. (2019). Analisis Kemampuan Koneksi Matematis Siswa Smp Dengan Pendekatan Model- Elicitng Activities. Jurnal on Education, 1(2), 54–60. https://doi.org/10.31004/joe.v1i2.22

Mousley. (2004). Mathematical understanding as situated cognition. Doctoral Thesis, LaTrobe University, Australia.

NCTM. (2000). Principals and Standards for School Mathematics. United States of America: The National Council of Teachers of Mathematics, Inc.

Nugraha, A. A. (2018). nalisis Kemampuan Koneksi Matematis Siswa Pada Materi Sistem Persamaan Linear Dua Variabel (SPLDV). Suska Journal of Mathematics Education, 4(1). doi:10.24014/sjme.v4i1.4579

Nursaniah, L., Nurhaqiqi, & Yuspriyati, D. N. (2018). Analisis Kemampuan Koneksi Matematik Siswa SMP Pada Materi Bangun Ruang Sisi Datar. JPMI (Jurnal Pembelajaran Matematika Inovatif), 1(5), 857–862. https://doi.org/10.22460/jpmi.v1i5.p857-862

OECD. (2019). PISA 2018 Results (Volume I): What Students Know and Can Do. OECD Publish.

Prihandhika, A. (2017). Perbedaan kemampuan koneksi matematis melalui model pembelajaran react dengan model pembelajaran learning cycle 5e siswa SMKN 39 Jakarta. JNPM (Jurn.

Rudyanto, H., Ghufron, A., & Hartono, H. (2019). Use of Integrated Mobile Application With Realistic Mathematics Education: A Study to Develop Elementary Students' Creative Thinking Ability. International Association of Online Engineering.



Copyright to the author of some rights reserved This work is licensed under aCreative Commons Attribution-ShareAlike 4.0 International License.

Siagian, M. D. (2016). Kemampuan Koneksi Matematik Dalam Pembelajaran Matematika. MES: Journal of Mathematics Education and Science, 6(2).

Siregar, & Siagian, M. . (2019). Mathematical connection ability: teacher's perception and experience in learning. Journal of Physics Conference Series 1315(1):012041. doi:012041. 0.1088/1742-6596/1315/1/012041

Sugiyono. (2014). Metode Penelitian Pendidikan Pendekatan Kualitatif, Kuantitatif, dan R&D. Alfabeta.

Sumiati, Asfar, A. M. I. T., Serly, & Hasnawati. (2019). Peningkatan kemampuan koneksi matematis siswa melalui pengaplikasian model pembelajaran PMC (project matching a card). Seminar Na.

Zuyyina, H., Wijaya, T. T., & Senjawati, E. (2018). Kemampuan koneksi matematis siswa SMP pada materi lingkaran. Sosiohumaniora: Jurnal Ilmiah Ilmu Sosial Dan Humaniora, 4(2), 79-90.



Copyright to the author of some rights reserved This work is licensed under aCreative Commons Attribution-ShareAlike 4.0 International License.