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How to Enhance Mathematical Connection Ability of Junior High School Students in Indonesia

Ayu Agustianingsih[1], Shelly Morin[2], Veni Saputri[3]
[1,2,3]Universitas Media Nusantara Citra, Indonesia

[1]ayu.agustianingsih@mncu.ac.id

Abstract

Quality education is part of the Sustainable Development Goals (SDGs) and is important for developing critical thinking and problem solving skills in students. Mathematics as a basic discipline, plays an important role at all levels of education, including junior high school. Students' mathematical connection ability in linking mathematical concepts with various other fields and daily life, needs to be developed. However, research shows that students' mathematical connection ability are still low. This study aims to analyze and synthesize empirical findings related to students' mathematical connection ability to provide a deeper understanding. The method used in this research is systematic literature review (SLR) with three stages (planning, conducting, reporting). Data collection was obtained from data based Google Schoolar using the Publish or Perish application. The results showed that innovative learning models, such as RME, CORE, and PBL with multimedia, proved effective in enhancing students' mathematical connection ability.
Keywords: *Mathematical Connection Ability, Junior High School*

Introduction

The Sustainable Development Goals (SDGs) are a global agenda adopted by United Nations member states in 2015, consisting of 17 goals designed to address issues of poverty, inequality, climate change, and to enhance health and education by 2030. The SDGs aim to promote prosperity while protecting the environment, targeting inclusive and sustainable development for all (Filho et al., 2019). Quality education strives to ensure inclusive and equitable education and to promote lifelong learning opportunities for everyone. This goal underscores the critical role of education in driving sustainable development.

Quality education is one of the Sustainable Development Goals (SDGs). Quality education not only acts as an agent for change in the younger generation, who will eventually assume leadership roles in the country, but must also function a driving force capable of generation genuine transformation (Safitri et al., 2022). In the context of mathematics, quality education is not only on mastering basic concepts, but also on developing critical thinking and problem-solving skills that allow students to apply mathematics in various real situations. Mathematics is an important subject at every level of education and plays a role in the development of education (Agustyaningrum & Pradanti, 2022). As a pure science, mathematics continues to develop and almost all fields of science and technology require mathematics as a basic science. In fact, even daily activities are very dependent on mathematics.

Given the important role of mathematics, the subject is integrated in every type and level of education, such as junior high school. This aims to ensure that students have a strong foundation in mathematical thinking. According to the National Council of Teachers of Mathematics NCTM (2000) there are five mathematical thinking abilities, namely mathematical problem solving ability, mathematical reasoning ability, mathematical communication ability, mathematical connection ability and mathematical representation ability. Among these abilities,

mathematical connection ability plays an important role in helping students link the mathematical concepts they learn with various other fields of study, as well as with everyday life. (Alfiyah et al., 2019). By developing mathematical connection ability, students not only understand mathematics as an isolated discipline, but also as a tool that can be applied to solve problems in various contexts. Therefore, the integration of mathematics lessons in the curriculum at various levels of education aims to strengthen these connection ability, to help students understand the importance and practical benefits of learning mathematics in their daily lives.

In line with this, mathematical connection ability is one of the abilities that must be possessed by students. According to Permana & Sumarmo (2007), mathematical connection is a thought process that requires effort to expand understanding of a particular mathematical concept, connect it to other topics, and use the concept in everyday life or in other fields. While NCTM (2000) states that mathematical connection ability is the ability of students to identify the relationship between representations of a concept and procedure, grasp the connections between different mathematical topics, link mathematical concepts together, and use these ideas in various contexts or in daily life. According to NCTM (2000) in measuring mathematical connection ability, there are several indicators, namely (1) Connecting mathematical concepts between one topic and another, (2) Linking mathematics with disciplines outside of mathematics, and (3) Applying mathematics in everyday life situations. In addition, Sumarmo (2012) suggested that the indicators of connection ability are as follows: (1) Equivalent representations of a mathematical concept, process, or procedure, (2) Finding relationships between various representations of mathematical concepts, processes, or procedures, (3) Understanding the relationship between mathematical topics, (4) Applying mathematics in other fields or in everyday life, (5) Finding the relationship between one procedure and another in an equivalent representation, and (6) Applying relationships between mathematics topics and between mathematics topics and topics of other disciplines.

Based on multiple studies related to mathematical connection ability, it is said that students' mathematical connection ability are still relatively low, for example, it can be seen from the results of research by Sudirman et al. (2019), regarding "Analysis of Mathematical Connection ability of Coastal Junior High School Students in View of Gender Differences" with the results showing that the average achievement of students' mathematical connection ability reached 36%, which shows that the mathematical connection ability of these students are still relatively low. Mathematical connection ability in male students reached 29%, while in female students reached 40%. This shows that the mathematical connection ability of female students is higher than that of male students. The main factor that causes the low mathematical connection ability in coastal junior high school students is the lack of students' understanding of mathematical concepts. Furthermore, a study by Andriani & Aripin (2019) regarding "Analysis of Mathematical Connection Ability and Self-Confidence of Junior High School Students" with the results of his research shows that the mathematical connection ability of junior high school students in the Bandung area is still quite low based on written description tests. This is because students have difficulty in solving math problems that are related to real life or other sciences.

According to Retnawati et al. (2020) in their research, based on the discussion, it can be concluded that students still have difficulty in making mathematical connections when solving math problems. In general, the indicators of mathematical connection difficulties experienced by students are as follows. First, lack of familiarity in solving mathematical connection problems characterized by difficulty in recognizing mathematical patterns, linking mathematical concepts, and performing mathematical manipulations. Second, the lack of understanding of concepts is characterized by difficulties in understanding some mathematical terms, understanding the whole problem, identifying important points of the problem, applying mathematical formulas.

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In a global context, connection ability are among the ability that are still the focus of study in various countries, including Iran. Iran is a country that discusses students' mathematical connection ability, this is evidenced by one of the researches Rafiepour (2023), who examined the "Investigation of the mathematical connection's ability of 9th grade students" and the findings of his research indicated that students' proficiency in the indicators of connecting mathematical concepts was fairly good (69%), on the indicators of the connection between mathematics and other sciences were also quite good (66%), and on the indicators of the connection between mathematics and everyday life were not enough (42%). In addition, the results of the Spearman correlation coefficient show that there is a significant relationship between the two indicators of mathematical connection ability. Thus, the connection between mathematics and students' daily lives must be improved. Here is a visualization image that explains the mathematical connection ability.

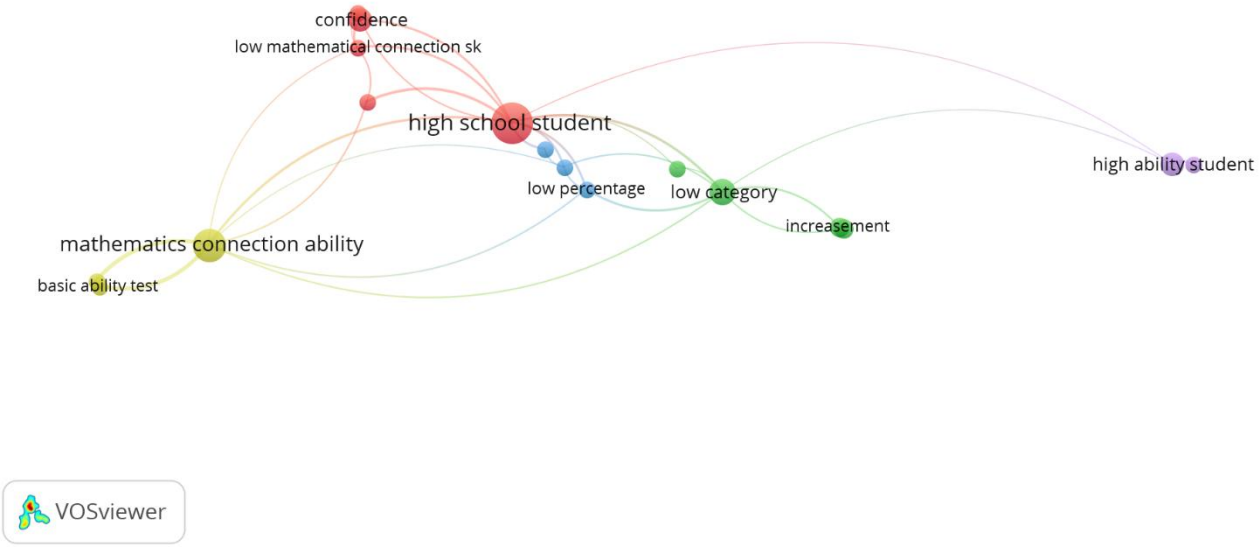


Figure 1. Visualization of VOSviewer

Based on the visualization of the VOSviewer results, it shows that the relationship between mathematics connection ability and various factors in secondary school students. The main center is mathematics connection ability which is closely related to confidence, basic ability test, and low mathematical connection ability, indicating that improving mathematics connection ability can increase students' confidence. High school students were the main focus, indicating the study population. Students with low mathematical connection ability had a low percentage and category of assessment. There was also a focus on high ability students, showing significant differences in ability. The word increment indicates improvement in math connection ability. Overall, this visualization underscores the importance of mathematical connection ability in influencing students' confidence and academic performance.

Based on the description above, this study aims to analyze and synthesize findings from existing empirical research to provide a more in-depth explanation of mathematical connection ability based on various literature that has been found. The novelty of this research lies in its comprehensive synthesis of empirical studies on students' mathematical connection abilities, particularly in junior high schools, using a systematic literature review. This approach provides a deeper understanding of how various factors, such as innovative learning models and multimedia, enhance mathematical connections across different contexts.

Method

This research uses the Systemtic Literature Review (SLR) method. Systematic Literature Review is a method used to search, review, and combine several studies that are in accordance with the topic to be discussed so as to provide answers to these research questions. The stages in the SLR method are planning, conducting, and reporting (Snyder, 2019).

The planning stage identified the need for the review and developed literature review guidelines. A search strategy was developed to find studies relevant to the review questions and objectives. At this stage, inclusion and exclusion criteria were determined, including keywords, databases, time periods and search fields. Therefore, the review guidelines for this paper are presented in the following table (Farrukh et al., 2022).

Table 1. Review protocol

Category	Description
Unit of analysis	Peer-reviewed journal articles in Indonesian were selected
Search limitations	The search was limited to journal articles on math connection ability in junior high school.
Type of analysis	Qualitative, Quantitative, Research & Development, and Mix Methods
Analysis time period	2019-2023
Search field (Vosviewer)	Title and Abstract
Database	Keywords were searched in various combinations from the popular database Google Scholar
Keywords used	Math connection ability, junior high school

The table details the process of searching and analyzing journal articles on math connection ability in junior high school. The unit of analysis selected was journal articles that had gone through the peer review process and were written in Indonesian. The search limitations focused on articles that discussed mathematical connection ability at the junior high school level, so that the research had a specific and relevant focus. The types of analysis used included qualitative, quantitative, research and development, and mixed methods. The time period of analysis covered 2019 to 2023, ensuring that the data collected was current and relevant within the last five years. Search fields using Vosviewer focused on article titles and abstracts. The database used was Google Scholar, which was chosen for its wide coverage and good accessibility. The keywords used in the search were "math connection ability" and "junior high school", which were specific to finding articles relevant to the research topic.

At the conducting stage, researchers collected articles with the keywords mathematical connection ability, junior high school data obtained from Google Scholar using Publish or Perish. The article search was 200 articles in each year, then the articles were selected based on the title and keywords. Researchers identified 45 articles, which included 10 articles in 2019, 2020 obtained 7 articles, 2021 obtained 11 articles, 2022 obtained 9 articles, and 2023 there were 8 articles. Then the researcher re-selected articles based on abstracts and content, 33 articles were found. After that, from 33 articles on mathematical connection ability, researchers categorized based on the results of research that stated that students' mathematical connection ability were low, medium, and methods to enhance students mathematical connection ability.

For the final stage, namely reporting, the researcher summarizes the articles that have been selected by discussing descriptively. The data collected using secondary data comes from Google Scholar with the help of the Publish or Perish application then stored in Zotero and excel tables containing title, author, year, methodology, main findings, and limitation

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Results

After completing the three stages (planning, conducting, and reporting), 33 articles were obtained using three research approaches, namely, quantitative, qualitative, and research & development. The following number of articles obtained in each year can be seen in the figure below:

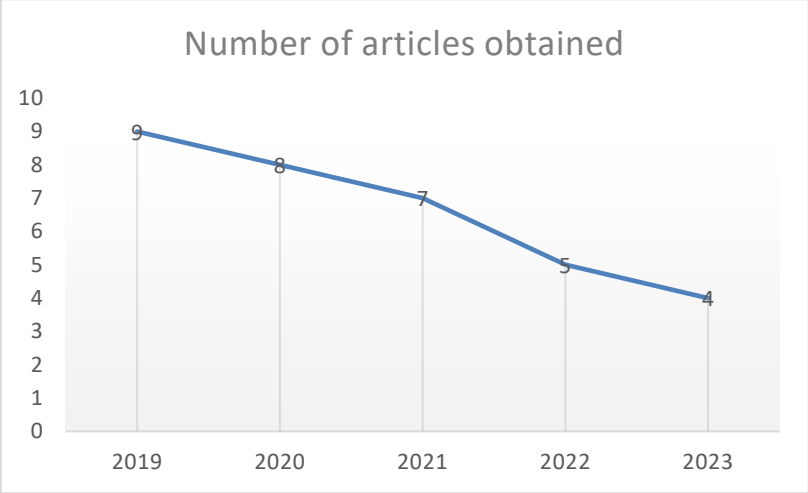


Figure 2: Number of articles obtained each year

The figure above shows the number of articles obtained each year from 2019 to 2023. In 2019, the number of articles obtained reached 9 articles. However, this number decreased slightly in 2020 to 8 articles. The decline in the number of articles continued in 2021, with only 7 articles obtained. A more significant decline occurred between 2021 and 2022, where the number of articles obtained decreased from 7 to 5 articles. In 2023, the number of articles obtained again decreased to 4 articles. Overall, the graph shows a decrease in the number of articles obtained from 2019 to 2023. This decline is seen consistently every year. The most significant decrease occurred between 2021 and 2022. This graphically indicates a decrease in the number of articles obtained over the five-year period.

Table 2 presents some relevant search result articles, with a total of 20 articles. These articles are related to the research title and then synthesized, these articles have the same findings, namely seen in the results of research which state that the mathematical connection ability of junior high school students in various regions are low. The following are articles related to mathematical connection ability with research results stating that students' mathematical connection ability are low.

Table 2: Connection ability articles classified as low

No.	Title (Author, Year)	Methods	Findings	Limitations
1.	Analisis Kemampuan Koneksi Matematis Siswa SMP Pesisir Ditinjau Dari Perbedaan Gender (Sudirman et al., 2019)	Qualitative research with descriptive method	The overall mathematical connection ability of coastal junior high school students is low, with a percentage of general ability achievement of only 36%. This shows that students have significant difficulties in connecting mathematical concepts with objects, daily life, and other disciplines.	As this study was limited to one junior secondary school in a particular coastal area, the results may not be easily generalizable to other coastal areas or to the wider educational context.
2.	Mathematics Connection Ability	Qualitative research	There are variations in students' mathematical connection ability,	The study was conducted in only one

	for Junior High School Students Based on Learning Independence Level (Samudro & Shodikin, 2022)	with descriptive method	students who have high mathematical connection ability despite their low learning independence, students with moderate mathematical connection ability who demonstrate a high degree of learning independence, and students with limited mathematical connection ability who also demonstrate low learnng outcomes independence. Students showed difficulty in developing mathematical connections, which was reflected in their low level of ability to connect mathematical concepts in everyday problem solving.	junior secondary school in Lamongan district, East Java, which may limit the generalizability of the findings. Regional variability in education may mean that the findings cannot be widely applied to all junior secondary school contexts, especially outside Indonesia.
3.	Analysis Of Mathematical Connections Ability On Junior High School Students (Kleden et al., 2021)	Qualitative research with descriptive method	Students' mathematical connection ability varied in different categories, with Indicator 2 categorized as sufficient, Indicator 1 as very low, and Indicator 3 as very low. Errors were identified in the completion of some questions, indicating weaknesses in students' mathematical connection ability.	There are difficulties found in students' mathematical connection ability, especially in recognizing and using relationships between mathematical ideas as well as in contexts outside mathematics, which results in errors in solving some questions and shows weaknesses in students' mathematical connection ability.
4.	Students' Mathematical Connection Ability in Solving Real-world Problems (Putri & Wutsqa, 2019)	Qualitative research with descriptive method	Eighth grade students' mathematical connection ability are still in the low category. This can be seen from their difficulty in understanding the problem and connecting it with relevant mathematical concepts to find a solution.	This study only involved students from one private junior high school in Bantul, Yogyakarta. The results may not be widely generalizable to all students at the same level or in other regions due to different demographic and institutional factors.
5.	Analysis of The Difficulty of VIIIth Grade Junior High School Students in Circle Material Reviewed from The Mathematics Connection Ability (Wijayanti & Abadi, 2019)	Qualitative research with descriptive method	The mathematical connection ability of VIII grade junior high school students in circle material is low. Although students are able to model real-world problems into mathematical problems, students' mathematical connection ability in applying mathematical concepts in solving real-world problems is better than connections between mathematical topics. However, the errors that are often made by students in this study are the wrong selection of formulas and calculation errors in number operations.	The low mathematical connection ability of VIII grade junior high school students in circle material, especially in connecting mathematical concepts with the real world. This can be seen from the low percentage of students who gave correct answers, as well as errors made by students in choosing the right formula and performing correct

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				calculations in number operations.
6.	Analysis of the ability of mathematical connections of middle school students in the field of algebra (D. N. O. Sari, 2020)	Qualitative research with descriptive method	The main finding of this study shows that the mathematical connection ability of junior high school students in algebra is still at a low level. This is reflected in the results of the analysis of students' mathematical connection ability which show a low percentage in various connection indicators measured.	The shortcoming in this study is that students' mathematical connection ability are still low, reaching only 37%.
7.	Analisis Kemampuan Koneksi Matematis Siswa pada Materi Segiempat Ditinjau dari Self-Regulated Learning (Fadilah et al., 2021)	Qualitative research with descriptive method	Students with high SRL showed better mathematical connection ability, in the good category. These students were able to fulfill three of the five indicators of mathematical connection ability set out in the study. These students showed variation in their mathematical connection ability, generally being in the fair category. Students with moderate SRL tended to fulfill fewer indicators of mathematical connection ability than students with high SRL.	The study involved only six students, all from the same school.
8.	Kemampuan Koneksi Matematis Berdasarkan Minat Belajar Siswa (Hamdani & Nurdin, 2020)	Qualitative research with grounded theory design	There is a significant positive relationship between students' learning interest and their mathematical connection ability. Students who have high learning interest show better mathematical connection ability compared to students who have low learning interest. However, the results showed that the average students' mathematical connection ability was still low.	By using only nine students as a sample, the study results may not be generalizable to a larger population or different contexts.
9.	Analisis Kemampuan Koneksi Matematis Pada Materi Segiempat (Elisahaya & Imami, 2020)	Qualitative research with descriptive method	The mathematical connection ability of VIII grade students at SMP Negeri 1 West Karawang on quadrilateral material is still relatively low. This shows that students have difficulty in linking various mathematical concepts and applying them in the context of real life.	The study only involved 6 students, which may not be representative enough to make broader generalizations.
10.	Analisis Kemampuan Koneksi Matematis Siswa Dalam Menyelesaikan Soal Cerita (Rena et al., 2020)	Qualitative research with descriptive method	This study found that students' mathematical connection ability in solving story problems was high in several indicators, such as finding relationships between various representations of concepts and procedures, understanding relationships between mathematics topics, understanding equivalent representations of a concept, and finding relationships between equivalent procedures. However, students' mathematical connection ability are low in applying mathematics to other fields of study or daily life, as well as in	The instruments used in the form of story problems and interviews may not cover all aspects of students' mathematical connection ability thoroughly.

			applying the relationship between mathematics topics and topics outside of mathematics.	
11.	Evaluasi Pembelajaran: Kemampuan Koneksi Matematis Siswa SMPN 1 Dan SMPN 2 Kepenuhan (Deswita & Ario, 2020)	Qualitative research with descriptive method	This study shows that the mathematical connection ability of students of SMPN 1 and SMPN 2 Kepenuhan is very low. The average mathematical connection ability of students in SMPN 1 was 40.52%, while in SMPN 2 it was only 7.41%. The most difficult mathematical connection indicator for students of SMPN 1 is connecting mathematics with daily life, while for students of SMPN 2 is connecting various concepts in mathematics.	This approach provides an overview of current conditions but falls short in providing an in-depth understanding of the causes of low mathematical connection ability.
12.	Analisis Kemampuan Koneksi Matematis Siswa Ditinjau Dari Gaya Belajar (Hidayati & Jahring, 2021)	Qualitative research with descriptive method	This study found that the mathematical connection ability of ninth-grade students at SMP Negeri 1 Tanggetada was categorized as poor. According to the test results, the students' average mathematical connection ability was 59.59%.	The results showed that the mathematical connection ability of ninth grade students of SMP Negeri 1 Tanggetada were in the deficient category. However, the study did not explain how these results could be generalized to other schools or contexts.
13.	Deskripsi Kemampuan Koneksi Matematis Siswa Pada Materi Teorema Pythagoras (Yusuf et al., 2022)	Qualitative research with descriptive method	This study shows that the mathematical connection ability of grade VIII students at SMP Negeri 1 Bolaang Uki on the Pythagorean theorem material is still relatively low. The results showed that students' mathematical connection ability in recognizing and using connections between mathematical ideas was 45.14%, understanding how mathematical ideas are connected and build a coherent whole by 29.63%, and recognizing and applying mathematics in everyday life by 23.61%.	The description test used may not cover all aspects of students' mathematical connection ability thoroughly, so the results may not fully describe students' mathematical connection ability.
14.	Analisis Kemampuan Koneksi Matematis Siswa Kelas IX SMP Pada Materi Bangun Ruang Sisi Datar (Syahputri & Hidayati, 2022)	Qualitative research with descriptive method	This study found that the mathematical connection ability of students in grade IX of junior high school on flat-sided space building material is still low. The test results showed that only 4 out of 23 students were in the high category, 6 students in the medium category, and 13 students in the low category. Overall, the average percentage of students' mathematical connection ability is 52%. Students with high ability were able to fulfill all indicators, while students with medium and low ability were unable to fulfill some indicators, especially in connecting mathematics with real life problems.	The conclusion shows that students' mathematical connection ability are still low, but does not provide specific and operational recommendations for improving learning methods or interventions that can be done by teachers.

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15.	Analisis Kemampuan Koneksi Matematis Siswa Kelas Viii Smp Negeri 24 Poleang (Nasruddin et al., 2022)	Qualitative research with descriptive method	This study found that the mathematical connection ability of class VIII students at SMP Negeri 24 Poleang was in the very poor category. From the test results, only one student had mathematical connection ability in the excellent category, one student in the good category, one student in the sufficient category, one student in the deficient category, and 26 students in the very deficient category.	The instruments used in this study were only tests and interviews which may not cover all aspects of students' mathematical connection ability thoroughly.
16	Analisis Kemampuan Koneksi Matematis Siswa SMP Pada Materi Segiempat (Meilani & Hidayati, 2023)	Qualitative research with descriptive method	Based on the results of descriptive analysis, it can be concluded that the mathematical connection ability of students in grade VIII of junior high school on the subject of quadrilaterals are still low.	The mathematical connection ability of students in grade VIII of junior high school on the subject of quadrilaterals is still low, with most students unable to fulfill all indicators tested. The disadvantage of this article is that it does not provide details about the learning methods used in overcoming students' low mathematical connection ability.
17	Analisis Kemampuan Koneksi Matematik dan Kepercayaan diri siswa SMP (Andriani & Aripin, 2019)	Qualitative research with descriptive method	This study found that the mathematical connection ability of junior high school students in Bandung Regency is still relatively low. Based on the test results, only 37.84% of students were able to understand the relationship between mathematical topics well, and 16.22% of students were able to use mathematics in everyday life. However, 83.78% of students had difficulty in applying math concepts to real situations. Nevertheless, students' confidence in learning mathematics is quite good, with more than 50% of students showing positive confidence in their own abilities.	This research was conducted in the context of a particular school in Bandung Regency, so the results may not be directly applicable to other schools or regions with different contexts.
18	Analisis Kemampuan Koneksi Matematik Dan Self Confidence Siswa SMP Melalui Model Pembelajaran Think Pair Share (Alfiyah et al., 2019)	Qualitative research with descriptive method	This study found that the mathematical connection ability of junior high school students who used the Think Pair Share (TPS) learning model was still relatively low. Based on the written test, only a small percentage of students were able to connect mathematical concepts with everyday life and other disciplines, with a percentage of around 35.5% to 47.3%.	The use of qualitative descriptive methods, while providing in-depth insights, limits the ability to generalize findings and conduct more extensive statistical analysis.
19	Analisis Kemampuan Koneksi Matematik Ditinjau Dari Kemampuan Awal Matematika Siswa	Qualitative research with descriptive method	This study found that the mathematical connection ability of junior high school students are still relatively low. The test results showed that students with higher initial mathematical ability (KAM)	The research was conducted in one school with specific materials (straight line equation), so the results may not be directly applicable to

	SMP Pada Materi Persamaan Garis Lurus (P. C. Sari et al., 2019)		had better mathematical connection ability.	other contexts and materials.
20	Analisis Kemampuan Koneksi Matematika Dan Self Efficacy Matematis Siswa Kelas Vii Smp Negri 7 Naringgul Cianjur (Lindawati, 2019)	Qualitative research with descriptive method	This study found that the mathematical connection ability of seventh grade students at SMP Negeri 7 Naringgul were still relatively low. The majority of students have difficulty in connecting mathematical concepts with other subjects and in using mathematical concepts to solve everyday problems.	The study only involved 20 students, which may not be representative enough to make broader generalizations.

In table 3 are some relevant search result articles, with a total of 3 articles. This article discusses the mathematical connection ability of junior high school students classified as moderate. The following are articles related to mathematical connection ability with research results stating that students' mathematical connection ability are moderate.

Table 3. Connection ability article classified as medium

No.	Title (Author, Year)	Methods	Findings	Limitations
1.	Investigation of the mathematical connection's ability of 9th grade students (Rafiepour, 2023)	Quantitative approach	Students' qualifications in two indicators of mathematical connection ability, namely the connection between mathematical concepts and the connection between mathematics and other sciences, are quite good, but lacking in the connection indicator between mathematics and daily life.	There was a lack of explanation on how the student sample was selected and whether the sample was representative of the Grade 9 student population as a whole. The study also did not provide enough detailed information about the data collection process and the data analysis conducted.
2.	Analisis Kemampuan Koneksi Matematis Siswa SMP Kelas IX (Angelina & Effendi, 2021)	Qualitative approach with descriptive method	The mathematical connection ability of students in class IX 5 in the SMP studied in solving SPLDV problems is in the medium category, with 2 students in the high category, 22 students in the medium category, and 5 students in the low category.	The sample taken in the study was relatively small, involving only 29 students in the mathematical connection ability test. This limited sample size may not fully represent the entire student population in terms of mathematical connection ability.
3.	Analisis Kemampuan Koneksi Matematis Peserta Didik Dalam Menyelesaikan Soal Berbasis Hots (Panjaitan et al., 2023)	Qualitative research with descriptive method	The level of difficulty of VIII grade students of SMP Swata Hosana in mathematical mathematical connection ability on the material of the system of linear equations of two variables has moderate criteria.	This study has a shortcoming in terms of excessive repetition of information, where some parts of the text are repeated without providing significant additional information. This can make the reader lose focus and make it difficult to understand the material presented.

In table 4 are some relevant search result articles, with a total of 10 articles. These articles are related to the research title and then will be synthesized, this article is there are some strategies to enhance mathematical connection ability. Furthermore, there are articles stating that the mathematical connection ability of junior high school students are high. The following are articles related to strategies in improving students' mathematical connection ability.

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Table 4. Strategies for improving mathematical connection ability

No.	Title (Author, Year)	Methods	Findings	Limitations
1.	Peningkatan Kemampuan Koneksi Matematis Siswa dengan Penerapan Pendekatan RME (Mufidah & Machromah, 2023)	Mix Methods	The Sign Test results obtained 0.004 <0.05, which means that the RME approach has an effect in improving students' mathematical connection ability.	This study was conducted in one school with one specific material (SPLDV), so the results may not be directly applicable to other contexts and materials.
2.	Increasement Of Mathematical Connection Ability And Self-Efficacy Of Students Through Problem-Based Learning Approach With Multimedia (Hindun et al., 2019)	Quantitative with pretest-posttest control group design	There is a difference in the improvement of KKM between students in both classes in the medium category, where the improvement of KKM of students who learn through the PBL approach with multimedia (PBLM) is better than students who use the PBL approach alone. There is no difference in the SE of students in both classes and is in the low category. There is a positive relationship between SE and student performance in the medium category.	Using a pretest-posttest control group design without randomization may limit the power of the study to establish a strong cause-and-effect relationship. Without randomization, there is a risk of selection bias that might affect comparability between experimental and control groups.
3.	Kemampuan Koneksi Matematis Pada Model Pembelajaran Connecting, Organizing, Reflecting, Extending dan Numbered Head Together (Jahring, 2020)	Quantitative with posttest only control group design.	The CORE learning model has a positive influence on improving students' mathematical connection ability. The results showed that students' mathematical connection ability improved after implementing the CORE learning model. the CORE learning model assists students in connecting, reflecting, organizing, and expanding their mathematical knowledge.	The absence of in-depth qualitative data such as interviews or classroom observations can create a lack of understanding of how and why one model is more effective than another.
4.	Kemampuan Koneksi Matematis ditinjau dari Self Efficacy Siswa SMP pada Materi Pola Bilangan (Indriani & Sritresna, 2022)	Qualitative research with descriptive method	students with low selfefficacy have high mathematical connection ability, students with moderate selfefficacy have very high mathematical connection ability, and students with high selfefficacy have very high mathematical connection ability. Thus, mathematical connection ability is generally classified as good when viewed from selfefficacy.	Samples taken were only 3 people from different schools in Garut
5.	Analisis Kemampuan Koneksi Matematis Siswa Smp pada	Qualitative research with	Students in grade VIII at Asyifa 44 Junior High School have good mathematical	Does not provide information on the limitations of the research

	Materi SPLDV (Amelia et al., 2021)	descriptive method	connection ability in solving problems in SPLDV material.	conducted, such as the population used, data collection techniques, or more in-depth data analysis.
6.	Pengaruh Pendekatan Matematika Realistik Indonesia (PMR) terhadap Kemampuan Koneksi Matematis Siswa pada Materi Bilangan (Rahmadan, 2020)	Quantitative research	The results showed that there was a significant effect of PMRI on students' mathematical connection ability, with a t_count value greater than t_table at a significance level of 0.05, indicating a significant increase in mathematical connection ability.	The sample was limited to one location, reducing the ability to generalize the results to a broader context.
7.	Pengembangan LKS Berbasis STEM dengan Model ProblemBasedLearning terhadap Kemampuan Koneksi Matematis Siswa (Styasih et al., 2021)	Development (Research and Development).	The development of the LKS was successful and well received based on high validation regarding feasibility, readability, and positive responses from students. The LKS is effective for improving students' mathematical connection ability with the integration of STEM and Problem Based Learning approaches.	The use of Student Worksheets (LKS) that have not optimized student participation, lack of student understanding of mathematical concepts, and conventional LKS that do not provide learning experiences for students.
8.	Analisis Kemampuan Koneksi Matematis Siswa SMP pada Materi Bangun Ruang (Daiyan et al., 2020)	Qualitative research with descriptive method	The mathematical connection ability of students of class IX-A SMP Negeri 1 Kota Ternate in learning the material of building space with an average of 74.46 in the high category.	Only 4 students as subject representatives based on the category of mathematical connection ability (Very high, high, medium, and low) were interviewed as a form of triangulation.
9.	Kemampuan Koneksi Matematis Siswa Ditinjau Dari Kecemassan Belajar Pada Siswa Smp Pada Materi Lingkaran (Fani & Effendi, 2021)	Qualitative approach with descriptive method	There is a negative relationship between students' learning anxiety and mathematical connection ability of junior high school students in solving problems related to circle material. Students with low learning anxiety are able to achieve all indicators of mathematical connection, while students with moderate and high learning anxiety cannot achieve all indicators of mathematical connection ability.	The lack of variation in data collection methods, which only uses a learning anxiety questionnaire and a description test of students' mathematical connection ability. The use of other methods such as direct observation or interviews with students can provide more in-depth additional information about the relationship between learning anxiety and students' mathematical connection ability.
10.	Analisis Kemampuan Koneksi Matematis Siswa SMP dalam Menyelesaikan Soal Persamaan dan Pertidaksamaan Linear	Descriptive qualitative with a class action research model (PTK).	The mathematical connection ability of seventh grade students at junior high schools in Cimahi demonstrade improvement after utilizing the learning methode, as evidenced by	The pretest and posttest tests may not cover all aspects of students' mathematical connection ability, especially in a broader and more diverse context.

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Satu Variabel (Nuryatin & Zanthy, 2019)	pretest and posttest analysis. Overall, their mathematical connection ability showed significant enhancement compared to their ability prior to the instruction.

Discussion

Based on the analysis of articles in table 2, and table 3, and table 4. shows that there are several previous researchers who conducted research on students' mathematical connection ability, especially at the junior high school level.

Mathematical connection ability is one of the important abilities that students need to master in learning mathematics. Through mathematical connection ability, students are expected to be able to connect mathematical concepts with other mathematical concepts, as well as relate them to everyday life and other sciences. Some of these articles analyze the mathematical connection ability of junior high school students based on the results of various studies using literature review.

Based on table 2 analyzed, almost all studies show that the mathematical connection ability of junior high school students in general are still relatively low For example, the research of Sudirman et al. (2019) which states that the overall mathematical connection ability of coastal junior high school students is low, with a percentage of general ability achievement of only 36%. This finding was reinforced by another study, Putri & Wutsqa (2019), where eighth grade students had difficulty in connecting real-world problems with relevant mathematical concepts. In general, the results of this study indicate that many junior high school students still have difficulty in linking various mathematical concepts and applying them in real-life contexts. Then some research shows that there are variations in mathematical connection abilities based on the material studied and variations in student learning styles. Wijayanti & Abadi (2019) stated that VIII grade students have difficulty in circle material, especially in connecting mathematical concepts in everyday life. Meanwhile, Fadilah et al. (2021) showed that students with high self-regulated learning (SRL) have better mathematical connection ability, in the good category. These students were able to fulfill three of the five indicators of mathematical connection ability set out in the study. These students showed variation in their mathematical connection ability, generally being in the fair category. Students with moderate SRL tended to fulfill fewer indicators of mathematical connection ability than students with high SRL. Hidayati & Jahring (2021) also found that learning style affected students' mathematical connection ability, with variations in ability seen in each of the mathematical connection indicators.

Research by Kleden et al. (2021) identified errors that often occur in problem solving, this can indicate significant weaknesses in mathematical connection ability. Common errors include improper formula selection and calculation errors in number operations. Sari (2020), also found that student errors were located in integer operations, algebra, and linear equations of one variable. Then there are several factors that affect students' mathematical connection ability. Samudro & Shodikin (2022) identified that there are variations in students' mathematical connection ability, students who have high mathematical connection ability despite their low learning independence, students with moderate mathematical connection ability who have high learning independence, and students with low mathematical connection ability who also exhibit low levels of learning independence. Hamdani & Nurdin (2020), stated that there is a significant positive relationship between students' learning interest and their mathematical connection ability. Students who have high learning interest show better mathematical connection ability

compared to students who have low learning interest. In addition, self-confidence is also an important factor, where in Andriani & Aripin's (2019) research, it shows that students with good self-confidence tend to have higher mathematical connection ability even though many still have difficulties in applying mathematical concepts to everyday life.

Certain learning models also affect students' mathematical connection ability. Alfiyah et al. (2019), stated that although the Think Pair Share (TPS) learning model increased student confidence, students' ability to make mathematical connections remained weak. This indicates that an effective learning model should focus more on improving mathematical connection ability specifically.

Table 3 shows the focus of research on students' mathematical connection ability at the secondary education level. Rafiepour's research (2023), states that students are quite well qualified in connections between mathematical concepts and connections with other sciences, but lack in connections with everyday life. Angelina and Effendi (2021) also found that the mathematical connection ability of grade IX students was mostly in the medium category, and out of 29 students, only 2 students were in the high category in terms of mathematical connection ability, while the majority were in the medium and low categories. This shows that there are individual differences in mathematical ability that can be influenced by various learning styles.

Some error analysis is also an important part of this research. For example, Panjaitan et al. (2023), showed that the level of difficulty in mathematical connection ability in SPLDV (System of Linear Equations of Two Variables) material was in the medium category. It is important to understand where students have difficulties and how educational interventions can be made. Furthermore, some factors that affect mathematical connection ability include learning methods, research sample size, and sample representation. The learning method applied also plays a role in students' mathematical connection ability. In Rafiepour's study (2023) there was a lack of explanation about the sample selection and data collection process. In addition, Angelina and Effendi (2021) also showed that a small sample size could not fully represent the student population. Other factors that can be influential include student motivation, support from the learning environment and the use of technology in learning. Thus, based on table 3, it can be concluded that students' mathematical connection ability are generally in the moderate category. Then, qualitative research with descriptive methods such as those conducted by Panjaitan et al. (2023) and Angelina & Effendi (2021) showed that in-depth analysis of learning methods can provide insight into ways to enhance students' mathematical connection ability.

Based on table 4, students' mathematical connection ability is one of the abilities that can be improved through various approaches and learning methods. Research by Mufidah & Machromah (2023) showed that the application of the Realistic Mathematics Education (RME) approach can significantly enhance students' mathematical connection ability. In addition, Jahring's research (2020) also shows that the Connecting, Organizing, Reflecting, Extending (CORE) learning model has a positive influence on improving students' mathematical connection ability. Then variations in learning materials and student learning styles also affect mathematical connection ability. For example, research by Hindun et al. (2019), found that the Problem Based Learning approach with multimedia (PBLM) was more effective than regular PBL in improving students' mathematical connection ability, although there was no significant difference in students' self-efficacy. On the other hand, research by Indriani & Sritresna (2022) stated that students' self-efficacy is positively correlated with mathematical connection ability, where students with higher self-efficacy have better mathematical connection ability.

Various learning approaches and methods have been proven effective in improving mathematical connection ability, but it is also important to consider analyzing the errors students

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make in solving mathematical problems. Amelia et al. (2021) emphasized the importance of analyzing the mathematical connection ability of grade VIII students in solving SPLDV problems, which showed good results even though the study did not provide sufficient limitation details. Research by Daiyan et al. (2020) emphasized the importance of analyzing mathematical connection ability on the material of building space to understand the difficulties faced by students with the results of his research stating that the mathematical connection ability of students in class IX-A SMP Negeri 1 Kota Ternate in learning the material of building space with an average of 74.46 in the high category. Then, several factors that affect students' mathematical connection ability include self-efficacy, learning anxiety, and the use of learning media. Fani & Effendi (2021) found a negative relationship between learning anxiety and students' mathematical connection ability, where students with low anxiety were better able to achieve mathematical connection indicators than students with high anxiety. Another case is Rahmadan's research (2020) which states that the Indonesian Realistic Mathematics Approach (PMRI) has a substantial impact on enhancing students' mathematical connection ability.

Other learning models have been proven effective in improving students' mathematical connection ability. Like Styasih et al. (2021) who have succeeded in developing a STEM-based Student Worksheet (LKS) with a Problem Based Learning (PBL) model that is effective in improving students' mathematical connection ability. Nuryatin & Zanthy (2019), also showed that the classroom action learning method (PTK) was effective in improving students' mathematical connection ability. Thus, based on Table 4, it can be concluded that students' mathematical connection ability can be improved through the application of various innovative and interactive learning approaches.

Conclusion

Based on the results and discussion that have been presented, This systematic literature review highlights the ongoing challenges in the mathematical connection abilities of junior high school students, with some showing moderate abilities while a significant proportion struggle to effectively integrate mathematical concepts with real-world applications. The research emphasizes the importance of innovative educational strategies such as RME, CORE, and Problem-Based Learning (PBL) supplemented with multimedia, in enhancing students' mathematical connection abilities. Effective implementation of these models has proven to significantly improve students' capacity to relate mathematics to other disciplines and everyday life, supporting the development of critical thinking and problem-solving skills. These findings not only enrich existing knowledge but also advocate for the systematic incorporation of these methods into educational curricula to address gaps in mathematical understanding, aligning with our research goals to deepen understanding of the factors affecting students' mathematical connection abilities and providing direction for future educational practices and research.

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