International Journal of Multicultural and Multireligious Understanding

http://ijmmu.com
editor@ijmmu.com
ISSN 2364-5369
Volume 12, Issue 5
April, 2025
Pages: 145-155

The Effectiveness of Scientific Learning Is Reviewed from the Ability of Mathematical Connections Junior High School Students

Natasyalika Dhiya Ma'rufah; Agus Maman Abadi

Yogyakarta State University, Indonesia

http://dx.doi.org/10.18415/ijmmu.v12i5.6709

Abstract

This study aims to describe the effectiveness of scientific learning from the mathematical connection ability and self-efficacy of junior high school students. This study is a quasi experiment using a non-equivalent (pre-test and post-test) control-group design. The population in this study is grade VIII students of SMP Negeri 4 in Yogyakarta City, namely class VIII A was selected based on the recommendation of the teacher. Data collection was carried out with a mathematical connection ability test instrument (valid and reliable). Learning is said to be effective if: (1) the average value of students' mathematical connection ability exceeds the Minimum Criteria Completeness (MCC) limit, which is 76; (2) The average posttest score of the mathematical connection is higher than the average pretest score. The results of the study using a significance level of α=5% showed that effective scientific learning was reviewed from the mathematical connection ability and self-efficacy of junior high school students.

Keywords: *Effectiveness; Scientific; Mathematical Connection Ability*

Introduction

Education has an important role in advancing a country judging from the quality of human resources it has. The progress of a country is supported by the availability of human resources, namely qualified students. Education is the main focus in every country so that countries will strive to improve the quality of education in their country because education is very important for society to face challenges in an increasingly developing era (Biemans et al., 2016). Indonesia is one of the countries that is trying its best to continue to improve its education.

Education in Indonesia is required to be able to produce students who have good knowledge and skills. This is in line with the provisions in the Preamble to the 1945 Constitution which states that improving intellectuality is one of the main goals of the state which reads to educate the life of the nation. Education is one of the determining factors in improving a country's human resources (Sanga & Wangdra, 2023). Education is realized through learning in schools through various subjects, one of which is mathematics.

Mathematics is one of the important foundations needed in life, especially to face global challenges, especially education. This is supported by Sari et al. (2019) stating that mathematics is one of the subjects that affects various fields of life. The role of mathematics is very important and can be used to solve everyday problems such as economic, technological, astronomical, scientific, social, health, and others, as well as to develop research tools in other disciplines.

Various efforts are made to facilitate the construction process of mathematics such as material packaging strategies, material delivery, class management, and assessments that are summarized in a curriculum. This is in accordance with the opinion of Neagley & Evans (1967) the curriculum will help schools in designing everything to achieve good student learning outcomes. In the Independent Curriculum of the Decree of the Head of BSKAP No. 033 of 2022, there are six mathematics learning objectives that are provided to students, one of which is to relate mathematics learning materials in the form of facts, concepts, principles, operations, and mathematical relationships in a field of study, across fields of study, across fields of science, and with life (mathematical connections).

The purpose of mathematics learning in the Independent Curriculum and the mathematics learning process standards that contain the ability to make mathematical connections in it show the importance of these abilities for a person to have in supporting good mathematics learning outcomes. Marshman (2014) stated that learning will be meaningful if students are able to connect and find patterns that are associated with the knowledge that students already have. This is the main point for students to be able to have mathematical connection skills.

Seeing the importance of mathematical connections in mathematics learning, it is appropriate that the achievement of this ability be the concern of teachers. However, in the fact that in the study of Saputra et al. (2023), students' mathematical connection ability was also strengthened by the results of interviews and student answers on the initial test in junior high school. Students are not yet able to meet all three indicators of mathematical connection ability. There are still junior high school students who have not met the indicators of mathematical connection ability, so they still need to be improved (Purwati et al., 2022). Based on facts in the field, the mathematical connection ability of junior high school students is categorized as low because most students still have difficulty relating between mathematical concepts (Qondiyana et al., 2021).

Bernard & Senjayawati (2019) argue that mathematics is needed by everyone without any age limit. The supporting fact is mathematics learning in formal education from elementary school to college. Schools are required to graduate human resources who are creative, innovative, have good technological literacy, and multitasking makes these skills an additional competency that must be achieved in the mathematics learning process (Freiman & Tassell, 2018). One of the approaches to mathematics learning that is still often used is scientific learning.

A scientific approach is a learning process designed so that students actively construct concepts, laws, or principles through observing activities, formulating problems, proposing/formulating hypotheses, collecting data with various techniques, analyzing data, drawing conclusions, and communicating (Hosnan, 2014). The scientific approach is intended to provide understanding to students in getting to know and understand various materials using a scientific approach. The scientific approach is a learning model that provides space for students to explore and elaborate on the material learned (Rusman, 2015). In addition, this educational model also provides opportunities for students to hone their skills through learning activities that have been designed by teachers.

Learning with a scientific approach according to Daryanto (2014) is a learning process that is designed in such a way that students actively construct concepts, laws or principles through the stages of observation (to identify and find problems), formulate problems, propose or formulate hypotheses, collect

data with various techniques, analyze data, draw conclusions and communicate concepts, laws or principles that are "discovered".

The Scientific Approach is an approach to learning that applies scientific (scientific) methods which involve observing or observing, questioning, trying, processing, presenting, reasoning, and creating (Majid & Rochman, 2014). The scientific approach is a learning model that borrows research concepts to be applied in learning (Abidin, 2014). The scientific approach is learning that uses scientific principles. Scientific approaches or scientific methods generally contain a series of activities, collecting data through observation, questioning, experimenting, processing information or data, and then communicating (Izzuddin, 2021). Explaining the five syntypes of the scientific approach can be detailed in various activities consisting of observing, questioning, collecting information/trying, associating/processing information and communicating (Marsigit, 2015).

A study by Ain and Huda shows that learning carried out through a scientific approach is very helpful for students in finding concepts systematically, which of course supports the improvement of their critical and creative thinking skills (Ain & Huda, 2018). Scientific learning is not only about understanding concepts, but also increasing students' motivation to learn (Kamil, 2023). Research in the context of mathematics education confirms that students who are able to build connections both between mathematics topics and between mathematics and other disciplines show a deeper and more sustainable understanding of the material (Santoso et al., 2020).

Based on the description above to optimize mathematics learning activities, the researcher will carry out research related to "The Effectiveness of Scientific Learning Reviewed from the Mathematical Connection Ability of Junior High School Students". The researcher hopes that this research can be a reference in effective learning to develop students' mathematical connection skills.

Method

The research was conducted using a quantitative approach with a pseudo-experimental type of research. Experimental research is a test of a treatment on a selected individual to see if the treatment has a different impact (Creswell, 2012). The population in this study is grade VIII students of SMP Negeri 4 in Yogyakarta City in the even semester of the 2024/2025 school year with a sample class, namely class VIII A based on the recommendation of the teacher who has the same and heterogeneous mathematical abilities. Sampling is carried out using the purposive sampling technique which is a sampling technique from the population by determining the characteristics of the sample and then looking for samples that have these characteristics (Johnson & Christensen, 2014). So in this study, class VIII A was used as an experimental class that was given scientific learning treatment totaling 32 students.

Experimental classes apply scientific learning. Data collection was carried out with a mathematical connection ability test instrument (valid and reliable).

Table 1. Mathematical Connection Ability Test Instrument Grid

Aspects	Mathematical Connection Ability Indicator	Question Indicator	Question No.
Connections between math topics	Students can make connections between concepts in mathematics that support the solution of everyday problems	Students can relate average concepts to algebraic concepts that support the resolution of everyday problems	1
Mathematical	Students can relate the math	Students can connect the concept	2

connections with other fields of study	concepts being studied with other areas of study that support the resolution of everyday problems	of average with the concept of speed that supports the resolution of everyday problems	
Mathematical connection to everyday life	Students can relate mathematics in solving everyday problems	Students can connect modes in solving everyday problems	3
		Students can connect the median in solving everyday problems	4

The validity of the content in this research instrument was provided by two expert validators from Lecturers of Mathematics Education, Yogyakarta State University. After obtaining the validity of the content and revised according to the advice of experts, the instrument was tested on students. Based on the reliability values that have been obtained, it shows that the instruments that have been compiled in this study are reliable so that the data obtained will be consistent. The results of the reliability test of the mathematical connection ability pretest instrument using the R program were obtained at 0.7 and the posttest of mathematical connection ability was 0.76 so that it can be concluded that the level of reliability of the mathematical connection ability test instrument is in the high category.

The formulation of the research problem that has been determined is answered by conducting an inferential analysis. Assumption tests (pretest and posttest data) are carried out before answering the problem formulation and testing the hypothesis. The assumption test is a condition that must be met before the data obtained can be analyzed. The assumption test was carried out with the aim of proving that the data obtained came from a normally distributed and homogeneous population. Learning is said to be effective if: (1) the average score of students' mathematical connection ability exceeds the limit of the Learning Goal Achievement Criteria (KKTP), which is 76; (2) The average posttest score of the mathematical connection is higher than the average pretest score. Data analysis used one sample t-test and paired t-test.

Results and Discussion

Results

Scientific Learning was carried out from July 19, 2024 to July 30, 2024 in class VIII A. During the learning process, there were observers in charge of observing the results of scientific learning observations as presented in table 2 below.

Table 1. Implementation of Scientific Classes

Meeting	Date	Teaching Materials	Implementation of Learning Activities
1	Friday, 19 July 2024	Collect and differentiate data types	100%
2	Tuesday, July 23, 2024	Presenting bar chart data and pie chart data	95%
3	Friday, July 26, 2024	Mode and median of a data	95%
4	Tuesday, July 30, 2024	Average of a data	90%
		Average	95%

Based on table 2 above, it can be seen that the average percentage of learning implementation assessed by observers in the control class has an average of 95%. Based on the predetermined learning implementation criteria, the average score is included in the "Very Good" category and the implementation at each meeting successfully exceeds 75% as per the learning implementation criteria that have been determined. These results show that the learning steps contained in the teaching module are implemented very well.

The results of the mathematical connection ability test obtained from both classes are in the following table.

Table 2. Description of Mathematical Connection Ability Data

Description	Scientific Class	
	Pretest	Posttest
Average	46,48	79,10
Theoretical maximum value	100	100
Theoretical minimum values	0	0
Maximum student score	62,5	100
Student minimum score	31,25	62,5
Standard deviation/Standard deviation	8,83	10,83

Table 3. Results of the Scientific Class MCA Grouping

Score Interval	Criterion	Pretest		Posttest	
		F	%	F	%
$92 \leq x \leq 100$	Very High	0	0%	5	16%
$84 \leq x < 92$	Tall	0	0%	5	16%
$76 \leq x < 84$	Keep	0	0%	7	22%
$68 \leq x < 76$	Low	0	0%	11	34%
$0 \leq x < 68$	Very Low	32	100%	4	12%
Total		32	100%	32	100%

From table 4 above, it is observed that the ability of the pretest and posttest mathematical connections of students in the control class to be several criteria. The results of the pretest of students with the very low category were 100% while the results of the posttest of students with the very low category were 12%, the low category was 34%, the medium category was 22%, the high category was 16%, and the very high category was 16%.

Table 54. Results of Mathematical Connection Ability

Indicators/Aspects of Mathematical Connection Ability	Scientific Class	
	Pretest	Posttest
Connections between math topics	(1.96)	(3.43)
	49.21%	85.93%
Mathematical connections with other fields of study	(1.78)	(3,12)
	44.53%	78.12%
Mathematical connection to everyday life	(3.68)	(6.09)
	46.09%	76.17%
Total average	(2.47)	(4,21)
	46.61%	81.41%

In table 5, the average indicator of connection between mathematics topics in the pretest data was (1.96) 49.21% and the posttest data was (3.43) 85.93% so that it increased. The average indicator of mathematical connection with other fields of study in the pretest data was (1.78) 44.53% and the posttest data was (3.12) 78.12% so that it increased. The average indicator of mathematical connection with daily life in the pretest data was (3.68) 46.09% and the posttest data was (6.09) 76.17% so that it increased. Based on this, it is clear that the achievement of the indicator of mathematical connection ability has increased significantly from the total average before and after learning.

Data Analysis Technique

Testing of data normality in univariate pretest and posttest results using the Shapiro Wilk test with the help of Program R. Normally-distributed data distribution provisions if the p-value > 0.05 (5%), H_0 is accepted and the data is declared to be distributed normally. The following are the results of the calculation of the univariate normality assumption test using pre-test and post-test data.

Table 6. Univariate Normaliness Test Results

Class	Variable	*Shapiro Wilk*	P-value	Information
Pretest				
Scientific	Mathematical Connection Capabilities	0,940	0,076	Normal
Posttest				
Scientific	Mathematical Connection Capabilities	0,948	0,126	Normal

Based on table 6, it can be seen that the pretest and posttest data on mathematical connection ability in scientific learning are normally distributed because the p-value of the mathematical connection ability data is 0.076 > 0.05 and 0.126 > 0.05.

a) The average score of students' mathematical connection ability exceeds the limit of Minimum Criteria Completeness (KKM), which is 76.

b) The average posttest score of mathematical connections is higher than the average of pretest scores.

The following is an average scientific learning result reviewed from the ability of mathematical connections.

Table 7. Average Mathematical Connection Ability Score

Data	Mathematical Connection Capabilities
Pretest/Prescale	46,48
Posttest/Postscale	79,10

The data in table 7 are used to test the effectiveness criteria as established. The test results of the effectiveness criteria were on the ability of mathematical connections.

The scientific learning effectiveness test was reviewed from the mathematical connection ability using *the one sample t-test* with the H_0 decision criterion rejected if the p-value < 0.05 and the

effectiveness criterion where the average value of the student's mathematical connection ability exceeded the Minimum Criteria Completeness (MCC) limit, which was 76. The following are the results of testing assisted by the R program.

Table 8. One Sample T-Test Test Results

Variable	t	Df	p-value	Decision
MCA	2,140	31	0,020	H_0 rejected

Based on the results in table 8, it can be concluded that H0 is rejected because the p-value of mathematical connection ability is 0.020 < 0.05 so that the average posttest score of mathematical connection ability of students in scientific learning classes is more than 75.99.

The scientific learning effectiveness test was reviewed from the ability of mathematical connections using a paired t-test where the H_0 decision was rejected if the p-value < 0.05. The following are the results of testing assisted by the R program.

Table 9. Results of the Paired T-Test for Mathematical Connection Ability

Variable	t	Df	p-value	Decision
MCA	-26,853	31	0,000	H_0 rejected

Based on the results in table 9, it can be concluded that H_0 is rejected because the p-value of mathematical connection ability is 0.000 < 0.05 so that the average posttest value of mathematical connection ability is more than the average pretest value of mathematical connection ability in scientific learning.

Discussion

The learning outcomes of students' mathematical connection skills in the classroom provided scientific learning have increased. This can be concluded from the average pretest, which is 46.48 before being given scientific learning, and the average posttest, which is 79.10 after being given scientific learning. The results of the pretest of students with the very low category were 100% while the results of the posttest of students with the very low category were 12%, the low category was 34%, the medium category was 22%, the high category was 16%, and the very high category was 16%.

Univariately, it was concluded that H0 was rejected because the p-value of mathematical connection ability was 0.020 < 0.05 so that the average posttest score of mathematical connection ability of students in scientific learning classes was more than 75.99. Based on the results of the hypothesis test, it was concluded univariately that H0 was rejected because the p-value of mathematical connection ability was 0.000 < 0.05 so that the average posttest value of mathematical connection ability was more than the average pretest value of mathematical connection ability in scientific learning.

After being given scientific learning, the average indicator of connections between mathematics topics increased from (1.96) 49.21% to (3.43) 85.93%. In the indicator of mathematical connection with other fields of study, there has been an increase from the initial ability of (1.78) 44.53% to (3.12) 78.12%. In the indicator of mathematical connection with other fields of study, there has been an increase from the initial ability of (3.68) 46.09% to (6.09) 76.17%.

Research by Sugianto & Qohar (2020) highlights the importance of mathematical connections in learning, where students who have good connection skills can connect mathematical concepts with other sciences and daily life. This research shows that structured learning with a scientific approach can significantly improve students' mathematical connection skills.

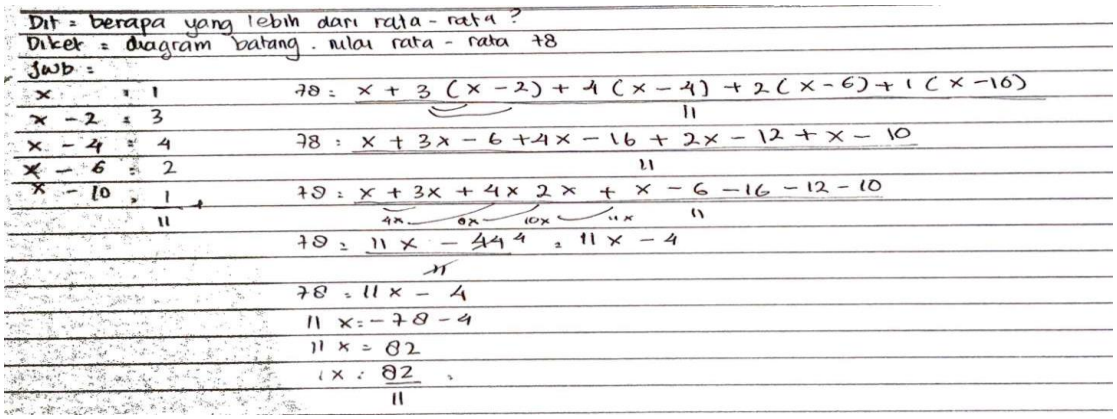


Figure 1. Snippets of Student Answers Indicators of Connections Between Math Topics

In the picture, it can be seen that students can understand and write down the information provided from the question because students can write down what is known and asked about the question. The answer shows a connection between mathematical concepts but is not precise and incomplete because students are trying to solve problems using algebraic concepts but students cannot solve problems completely and precisely.

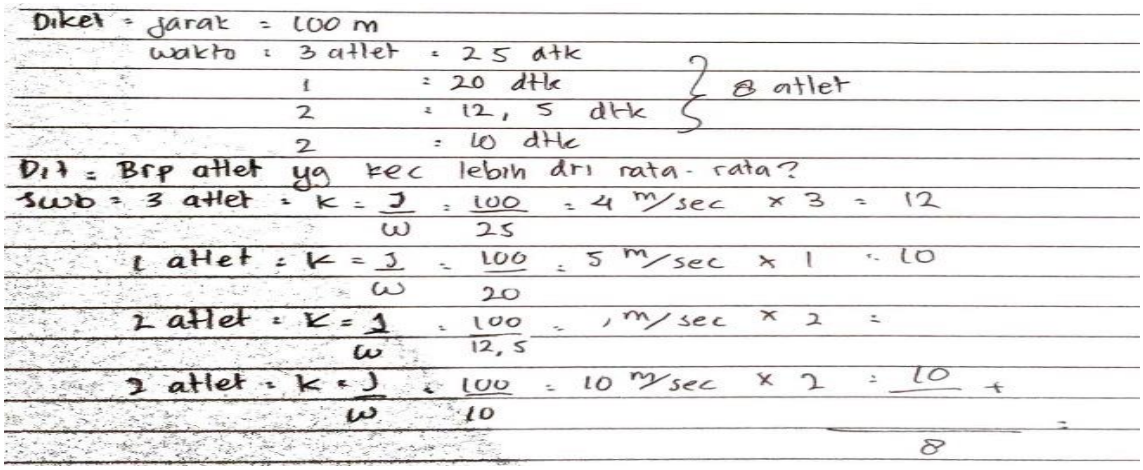


Figure 2. Snippets of Student Answers Indicators of Mathematics Connection with Other Fields of Study

In the picture, it can be seen that students can understand and write down the information provided from the question because students can write down what is known and asked about the question. The answer shows a mathematical connection with the concept of speed but is not precise and incomplete because students try to solve problems using the concept of speed but students cannot solve the problem completely and precisely.

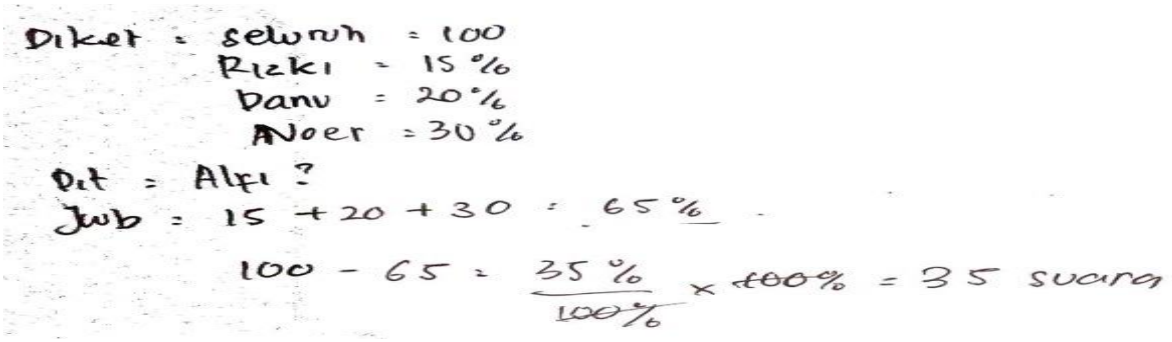
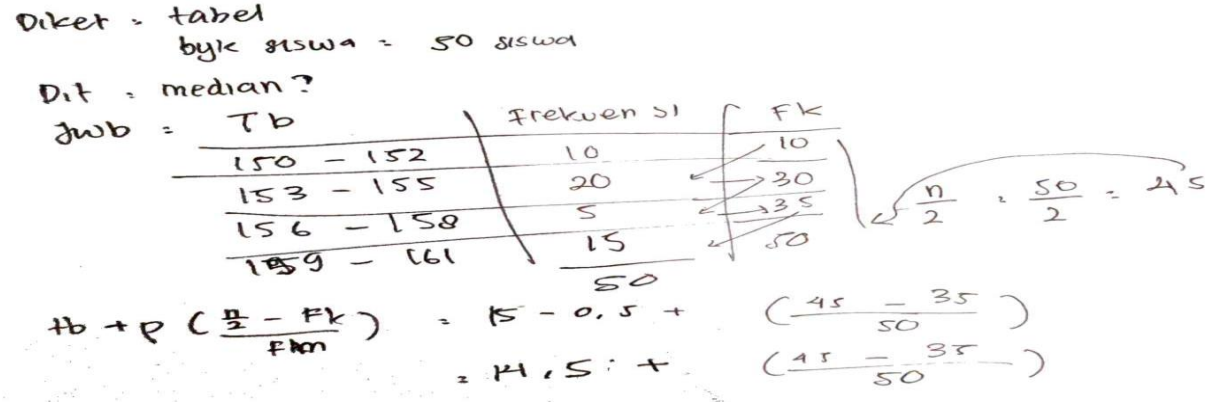


Figure 3. Student Answer Snippets Indicators of Mathematics Connection With Daily Life

In the picture, it can be seen that students can understand the information given from the question but it is not complete because students do not specifically write down what is known and asked about the question. The students' answers show the right final result because the students can solve the problem of the connection of mathematics with daily life but the steps and conclusions written are incomplete.



Picture 4. Snippets of Student Answers Indicators of Mathematics Connection with Daily Life

In the picture, it can be seen that students can understand and write down the information provided from the question but it is not complete because students are not specific in writing down what is asked from the question. Student answers show students are unable to solve problems using mathematical connections to everyday life and incomplete steps.

Conclusion

Effective scientific learning is reviewed from the mathematical connection ability of junior high school students to statistical materials. This is supported by descriptive data analysis and statistics of students' mathematical connection ability showing that the data on these variables have met the learning effectiveness criteria that have been set. Scientific learning is also effective in improving mathematical connection skills even though not all indicators are met. The average posttest of mathematical connections increased from 46.48 to 79.10. The implementation of learning reached 95%. Statistical tests showed a p-value < 0.05, which proved its effectiveness. The average mathematical connection ability on all indicators also increased significantly, although the average was in the very low to high category.

References

Abidin, Y. (2014). *Learning System Design in the Context of the 2013 Curriculum*. Bandung: PT Refika Aditama.

Ain, N. and Huda, C. (2018). Scientific approach in primary school. *Momentum Physics Education Journal*, 2(1), 1. https://doi.org/10.21067/mpej.v1i1.2368.

Bernard, M., & Senjayawati, E. 2019. Developing the Students' Ability in Understanding Mathematics and Self-confidence with VBA for Excel. JRAMathEdu (*Journal of Research and Advances in Mathematics Education*), 4(1), 45–56. Available on https://doi.org/10.23917/jramathedu.v4i1.6349.

Biemans, H., Mariën, H., Fleur, E., Tobi, H., Nieuwenhuis, L., & Runhaar, P. (2016). Students' learning performance and transitions in different learning pathways to higher vocational education. *Vocations and Learning*, 9(3), 315–332. https://doi.org/10.1007/s12186-016-9155-6.

Creswell, John W. (2012). *Educational Research : Planning, Conducting, And Evaluating Quantitative And Qualitative Research Fouth Edition*. Boston: Pearson Education, Inc.

Daryanto. (2014). *Scientific Learning Approach to the 2013 Curriculum*. Yogyakarta: Gava Media.

Freiman, V., & Tassell, J. L. (2018). *Creativity and technology in mathematics education*. Switzerland: Springer.

Hosnan. 2014. *Scientific and Contextual Approaches in 21st Century Learning*. Bogor: Ghalia Indonesia.

Izzuddin, A. (2021). Implementation of scientific approaches to online learning during the covid-19 pandemic in primary education institutions. *Journal of Early Childhood Islamic Education*, 3(1), 45–63.

Johnson, R. Bruke, & Larry Christensen. (2014). *Educational Research: Quantitative, Qualitative, and Mixed Approaches*. USA: SAGE Publications, Inc.

Kamil, F. (2023). Improving students' motivation and learning outcomes with scientific learning approach. *Journal of Physical Medicine*, 21(2), 1-18. https://doi.org/10.20414/jtq.v21i2.6201.

Majid, Abdul & Rochman, Chaerul. (2014). *Scientific Approach in the Implementation of the 2013 Curriculum*. Bandung: PT. Teenager Rosdakarya.

Marshman, M. (2014). Using concept maps to show "connections" in measurement: An example from the Australian Curriculum. *Australian Mathematics Teacher*, 70(4), 11-20.

Marsigit. (2015). *Scientific Approach and Its Implementation in the 2013 Curriculum. Paper, Workshop on the Implementation of Scientific Approach in the Implementation of the 2013 Curriculum.* Yogyakarta: LPPMP UNY.

Neagley, R. L & Evans, N. D. (1967). *Handbook for Effective Curriculum Development*. Prentice-Hall.

Purwati, Afifasani, I., & Firmansyah. (2022). Mathematical Connection Ability of Grade VIII Students in the Material of the Two-Variable Linear Equation System. *AXIOM: Journal of the Mathematics Education Study Program*. 11(4), 3237-3248. https://doi.org/10.24127/ajpm.v11i4.5906.

Qondiyana, D., Riyadi, & Siswanto. (2021). Mathematical Connection Ability Based On Reflective Cognitive Styles. *AXIOM: Journal of the Mathematics Education Study Program*. 10(1), 318-327. https://doi.org/10.24127/ajpm.v10i1.3439.

Rusman. (2015). *Integrated Thematic Learning: Theory, Practice, and Assessment*. Jakarta: PT Raja Grafindo Persada.

Sanga, L. D., & Wangdra, Y. (2023). Education is a determining factor for the competitiveness of the nation. *Proceedings of the National Seminar on Social Sciences and Technology (SNISTEK)*, 5, 84–90. https://doi.org/10.33884/psnistek.v5i.8067.

Santoso, K., Kusaeri, K., & Kurniawan, A. (2020). Increased motivation and mathematical connection of junior high school students through pictorial riddles. *Journal of Mathematics Education (Jpm)*, 7(1), 1. https://doi.org/10.33474/jpm.v7i1.4898 .

Saputra, E., Maison, & Huda, N. (2023). The analysis of the ability of mathematical connections in solving mathematical problems is reviewed from the learning styles of junior high school students. *AXIOM: Journal of the Mathematics Education Study Program*. 12(2), 739-747. https://doi.org/10.24127/ajpm.v12i1.6427.

Sari, G., Gistituati, N., & Syarifuddin, H. (2019). The Effect of Guided Discovery Learning Method Toward Students' Ability in Understanding Math Concept. *International Journal of Educational Dynamics*, 1(2), 54 60. Taken from http://ijeds.ppj.unp.ac.id/index.php/IJEDS.

Sugianto, I. and Qohar, A. (2020). Mathematical connections in the learning of mathematics of logarithmic material for grade x students. *Square Journal of Mathematics and Mathematics Education*, 2(1), 82. https://doi.org/10.21580/square.2020.2.1.5323.

Copyrights