IMPLEMENTATION OF COOPERATIVE MODEL'S JIGSAW WITH REACT STRATEGIES TO IMPROVE CONNECTION MATHEMATIC ABILITY OF STUDENTS

Nuril Huda[1], Muda Sakti Raja Sihite[2], Irham Habibi Harahap[3],
Anisa Agustanti[4], Novi Andriati[5]
[1] UIN Maulana Malik Ibrahim Malang, [2]Universitas HKBP Nommensen Medan,
[3]Universitas Muslim Nusantara Al Washliyah, [4] STIT Ihsanul Fikri, [5]IKIP PGRI Pontianak
nurilhuda26@uin-malang.ac.id, mudasaktisihite79@gmail.com*,
irhamharahap3@gmail.com, anisaagustanti@gmail.com)
novieandriaty@yahoo.co.id
*Corresponding Author

ABSTRACT

The problem of this research is the low ability of mathematical connections due to the low ability of students to understand mathematical concepts. This research is a Classroom Action Research conducted at Husni Thamrin High School Medan. In the implementation of this research tools and research instruments have been developed.. The results in cycle I show that: (1) the average test score of students' mathematical connection ability is 68.0 or there are 73% of the number of students who take the test have a level sis mathematical connection ability, (2) the level of active activity of students has not met the set ideal percentage of time, . In cycle II the results were obtained: (1) the average score of students' mathematical connection ability test was 73.0 or there were 86.6% of the number of students who took the test had a minimum level of students' mathematical connection ability in the sufficient category and 13.4% had a level students' mathematical connections are under the sufficient category, (2) the level of active activity of students fulfills the ideal percentage of time. In cycles I and II, concluded that implementation of jigsaw cooperative learning with the react strategy can improve students' mathematical connection ability.

Key words: Cooperative Model' Jigsaw Learning, REACT Strategies, Connection Mathematic Ability, Student Activity

A. Introduction

School is a place for fostering human resources in accordance with the development of science and technology. Education is a process of cultivating character or the crystallization of the values of human life. Because until now the world of education is seen as an effective tool in trying to preserve and pass on the values of life. Appropriate curriculum, approaches, methods, strategies and models, adequate facilities and professional human resources are aspects that are interrelated to achieve the planned learning objectives. Education is the only solution to create reliable human

resources, smart, and also have high morality that supposed to be able to apply his/her knowledge for human welfare. For that reason human beings must get appropriate education in order to be his/her asset for his/her future.

Forming a reliable nation requires a way, one way the most effective way is through the educational process. Education is an integral part of development. The educational process cannot be separated from the development process itself, when the quality of our education is low then we can say that Indonesia's development will be hampered. A teacher has responsibilities and tasks that must be carried out in accordance with the demands of the teaching profession and the most important thing is to advance and guiding students in the learning process (Lorensius et al., 2022). Of course, all teaching and learning processes carried out must be well designed, but also not rigid.

Varied innovative and interesting learning methods make the learning process Mathematics in class entertains and delights students. method has implications for student

motivation in learning. Hence, the election the method must be appropriate and not monotonous so that students do not feel bored in receiving math material from the teacher. The role of the teacher in learning mathematics is very important with the methods used in teaching students. High and low results student learning one of which depends on the teacher. Low learning outcomes students in learning mathematics caused by many factors. One of Among them is the factor of teachers who are less able to create a conducive learning climate fun for students. A teacher in mathematics is required to be able to create an active, creative and fun learning atmosphere for students (Syafril et al., 2021). With the creation of such an atmosphere then can grow and even increase students' interest in mathematics.

The REACT learning model is one of the learning models that can be used by teachers in instilling understanding of concepts student math. Learning REACT applies generative learning (constructivism) namely linking experience with knowledge and instill the meaningfulness of learning that is built in students so that makes it easier to

learn mathematics, especially in forming concept (Dewi et al., 2021). According to Cord REACT, it is contextual learning consists of five strategies that must be visible, namely: (1) Relating, is learning in the context of real-life experience or knowledge previously (2) Experiencing , is a learning strategy by learning through exploration, discovery and creation. Various classroom experience can include the use of manipulatives, activities problem solving and laboratory. (3) Applying , is learning by putting concepts to use, by giving realistic and relevant exercises. (4) Cooperating, (working together) is learning in the context of sharing, responding and communicating with other students (5) Transferring is learning using knowledge in new contexts.

Table 1.1. React Model's Syntax

Stages	Activity
Related	The teacher begins the lesson by presenting contextual problems that contain new content that is linked to existing concepts
Experiencing	Student conducts experimental activities or hands on activities to find concepts to be studied, and the teacher helps and directs students to carry out their activities.
Applying	Students using the concepts they learn or the knowledge they learn in solving everyday problems or mathematical problems
Cooperating	Students study or work in small groups, brainstorm with each other, conduct group discussions to solve problems and develop the ability to work together with friends.
Transferring	Students apply the knowledge they gain during learning into new situations or contexts.

The advantage of this model is that it has a clear understanding strategy gradually, from the basic

understanding that is expected to appear in stages 'Applying' and a deep understanding of the 'Transferring' stage. understanding which gradually can help streamline students' thinking skills(Sari & Muchlis, 2022). REACT is able to improve understanding and problem solving mathematics for SMP and (Ulandari et al., 2019) SMA students (Siagian et al., 2019). Furthermore, REACT has influence which is quite significant to the science process skills of SMP students (Simamora et al., 2018) . Thus, the REACT model is one of the learning models that can improve students' understanding of concepts.

Mathematical connection ability is needed by students in studying interrelated mathematical topics. According to (Hasibuan et al., 2018), if a topic is given separately, learning will lose a moment in an effort to improve student achievement in mathematics in general. Without mathematical connection skills, students will have difficulty learning mathematics.

One of important skills to have every student is connection ability mathematical. Namely students must be able use mathematics in the field other sciences, able to relate

mathematics with other mathematical concepts and with other fields of science and mathematics with everyday life. Through abilities mathematical connections, students are able solve math problems and apply it in everyday life. This is in accordance with reality mathematics, that mathematics is a science closely related to life students everyday. According to (Tambunan, 2019) there are several indicator of mathematical connection ability, in including indicators of ability mathematical connection between them, (1) using inter-topic connections mathematics and intertopic mathematics with another topic; and (2) use mathematics in other fields of study and or in everyday life. Thus, learning who can develop skills students' mathematical connections, making students understand what is studied, and not only just know during the lesson. However, it is very contrary to what's going on in field. Learning activities are while this is happening is activity incapable of learning help and can't facilitate students to develop mathematical connection ability. Where learning activities are still conventional (traditional), ie learning in the form of explanations and

students listen without understanding. Matter this is in line with (Verschaffel et al., 2020)that "Learning that done in elementary school less develop connection skills mathematical and less interesting and the attention of students so not small students think that the lesson math is a difficult thing and boring".

(Cai & Hwang, 2020)states that mathematical connection is an activity that includes: (1) looking for relationships between various representations of concepts and procedures, (2) understanding relationships between mathematical topics, (3) using mathematics in other fields of study or everyday life, (4) look for connections or other procedures in equivalent representations, and (5) using connections between mathematical topics and between topics with other topics.

(Fajriah et al., 2019)argues that the ability of mathematical connections is the ability to relate externally mathematical concepts, namely mathematics with other fields of study as well as with everyday life. Mathematics is a field of study whose topics are integrated with each other. If students have good mathematical connection skills, they are able to see a broad interaction between mathematical topics, so that students learn mathematics more meaningfully (Maass et al., 2019).

Relevant research using the REACT learning model by (Rodríguez-Martínez et al., 2020) shows that the REACT learning model is proven to be effective in improving student learning outcomes. In addition, based on (Rodríguez-Martínez et al., 2020)the REACT learning model provides experience to students, so as to improve student physics learning outcomes. Because of this model, students are really actively involved in learning, not just listening to the teacher. In each phase students are actively involved so they are not easily bored in the learning process. Students are also trained to associate the material studied with applications in everyday life, with everyday problems so that students are able to analyze and relate it to learning, and are able to apply it in everyday life.

An emphasis on mathematical connections helps students understand how different mathematical ideas are related.

Through this mathematical connection students learn to make predictions and develop their minds using insights in a certain context to test a conjecture in another context (Brezovszky et al., 2019). (Hwang & Tu, 2021)explained indicators of mathematical relationships, including: (1) Finding relationships from various representations of mathematical concepts and procedures. (2) Understanding the relationship between topics in mathematics. (3) Able to use mathematics in solving problems in everyday life. (4) Understand the equivalent representation of concepts (5) Find the relationship between one procedure and another which is equivalent. (6) Using the connections between mathematics and mathematics itself and with other sciences.

So to connect, students must understand the information they get, so they can see, explore, problems, try to find solutions by using mathematical ideas to solve problems, whether related to mathematics, other disciplines, or with everyday life. In connecting, students must understand the newly acquired information to be directed to information that was previously received (Md, 2019)

Based on the results of observations made by researchers in senior high school schools, it appears that students' ability to connect inter-mathematical ideas are still lacking, one of them on fractional material, more specifically on the material addition and subtracting a fraction with a denominator is not The same. Often students experience difficulties in equalizing the denominator even more fatal again many students are doing adding and subtracting fractions the denominators are not direct add up the two denominators and the numerator. In addition, in the material students feel less benefit what is obtained so inclined rote only. This has an impact the attitude of students who tend to be more passive, very low learning motivation, nonexistent self-confidence, and others expected to know the relationship between the subject matter that is built and understood in school with real life daily for further application in solving internal problems public.

B. Method

The research is conducted at SMA Husni Thamrin Medan. The research is conducted in the second semester of 2022/2023.

The population of this research is all the students of 11st grade of SMA Husni Thamrin Medan. The sample of the research is 35 the students of the 11st grade from A class of SMS Husni Thamrin Medan.

Based on the problem to be studied, the research is using classroom action research in order to improve the process and the result of learning in classroom by applying cooperative learning's model.

In order to collect data the researcher in this research is taking the data from a direct observation.

As instruments of collecting data the researcher is using :

A. Connection Mathematic Test

This test is used to measure level of understanding and the ability achieved by students in several knowledge. The scoring is using the method applied by (Li & Schoenfeld, 2019)

B. Sheets of Students' Activity Observation

These sheets cover the activity of the students from the beginning of the learning process until the teacher closed the learning process. The data is taken through the observation of the students' activity during the learning process whether it is personally or in group.

C. Sheets of Learning Organization Observation

This instrument is measuring the teacher's ability in organizing the problem based learning. This sheet includes five steps of learning; organized students to learn leading personal or group investigation, developing and presenting the finding, analyzing and evaluating process of finishing the problem in which all the problem are described as indicators.

Data analysis techniques in this study include:

A. Data analysis of Connection mathematic ability. Based on questions number one and two in the formulation of the problem, the pre-test and post-test data will be analyzed with ANAKOVA inferential statistics. This analysis is used to test the hypothesis in this study

B. Analysis of active student activity data

Data from observations of student activities during learning activities were analyzed using

percentages. The percentage of observations of student activity is the average frequency of each aspect of observation divided by the number of average frequencies of all aspects of observation multiplied by 100% with a tolerance limit of 5%.

36 5,12	5	25	15

Control			
Ideal Score S	X min	X max	x
36 5,12	3	20	13

C. Results and Discussion

Data on Connection Mathematic Ability Test Results. After being given learning in the experimental class with the Jigsaw cooperative learning type with the REACT approach and the control class with conventional learning (ordinary), students are given the opportunity to answer the final test questions (posttest). Post-test data is CMA (Connection Mathematic Ability) . After processing the post-test data in the experimental and control classes, the lowest score (Xmin), highest score (X max), average score (X average) and standard deviation (s) are obtained as shown in Table 2.

Table 2.Posttest Data Recapitulation of Experiment Class and Control Class

Eksperimen			
Ideal Score S	X min	X max	x

Table 2. above shows that there is a sizable difference between the experimental class and the control class. In the aspect of CMA (Connection Mathematic Ability) in the experimental class the achievement score was 44.72% of the ideal score, greater than the score of the control group with an achievement of 38.05% of the ideal score.

Student Activity Data During Learning

Data on student activity during the Jigsaw type cooperative learning with the REACT strategy took place, obtained through two observers (namely researchers and 1 math teacher at SMA Husni Thamrin Medan) at each meeting/face to face with observation sheets. Furthermore, at the time of learning, observations were made and then an assessment was carried out with three categories

of assessment, namely, Good (B), Enough (C), and Poor (K). Data from observations were analyzed by converting the Good category (B) to Score 3, Enough Category (C) to score 2 and Poor Category (K) to score 1. Then look for the average value and percentage of student activity. The results of the analysis are presented in Table 3.2.

Table 3. Student Activity during Learning in the Experiment class

No	Observed aspect	Average Student Activity Score				Category
		1	2nd	3rd	Average	
1	2	3	4	5	6	10
1	each member in group activities	2.8	2.7	2.9	2.83	Good
		93 %	90%	97%	93%	
2	Work on LKS	2.7	2.6	2.65	2.7	Good
		90%	86 %	86%	91.7%	
3	Discussion between students and teachers	2.6	2.5	2.6	2.56	Good
		87%	83.3%	86.7%	85.3%	
4	Discuss among fellow students	2.8	2.7	2.7	2.78	Good
		92%	90%	90%	91%	
5	Pay attention to friends' explanations	2.5	2.6	2.65	2.66	Good
		84%	85%	83.3%	88%	
6	note things that are relevant to learning	2.45	2.6	2.65	2.66	Good
		81.7%	86.7%	88.3%	88.7%	
7	pay attention to the teacher's explanation	2.5	2.5	2.7	2.66	Good
		83.3%	83.3%	90%	88.7%	
8	behavior that is irrelevant to KBM	0	0	0	0.04	Good
		0%	0%	0%	1.33%	

The existence of differences between connection mathematic abilities of experimental class students and control class students can be explained theoretically and empirically operationally. In terms of theoretical foundation, the Jigsaw type cooperative learning model with the REACT strategy is a learning model that emphasizes student activities to find the concepts they learn, students work in small groups, apply these concepts in everyday life and transfer these concepts in new conditions (Süren & Kandemir, 2020). which contains five activities, namely: a) Relating, which shows that the content to be learned is related to the knowledge students already have; b) Experiencing, that is, students are actively involved in the process of discovering the concepts they are learning; c) Applying, namely the activity of applying the concepts he finds in solving everyday problems or problems in mathematics; d) cooperative, which depicts students working and studying in small groups,

brainstorming with other friends; e) Transferring, namely students transfer the knowledge gained during learning into everyday life or other situations (Niss & Højgaard, 2019).

The form of the questions given can be in the form of pictures, stories, or other information that must be related to the subject matter being taught (Engelbrecht et al., 2020). While the conventional learning method is more prioritizing rote memorization than understanding, placing more emphasis on numeracy skills or abilities, prioritizing results rather than the process that occurs, emphasizing more on theoretical content than the motivation given and the intention behind the content or material content, and learning is more centered to the teacher (Namkung et al., 2019).

In terms of operational empirical basis in the presentation of learning, students who study using the Jigsaw type cooperative learning model with the REACT approach are equipped with student worksheets (LKPD). In each learning process with the Jigsaw cooperative learning model with the REACT approach, learning

activities emphasize students more on several things, namely the ability of students to formulate questions and solve them which can develop mathematical thinking abilities or use students' mathematical thinking patterns (Dwijayani, 2019). Thus the students' ability to solve problems is also getting better because when students raise questions/problems that are given by the teacher, they indirectly think about the answers(Chevallard & Bosch, 2020; Laursen & Rasmussen, 2019)Thus, students become more trained to think actively, creative and productive. So that learning can be more meaningful and also students become easier in solving every math problem or problem in their daily lives.

D. Conclusion

Based on the results and discussion, it can be concluded that learning using the Jigsaw cooperative learning model using the REACT strategy is as follows:

(1) students' physics learning activities while using the Jigsaw cooperative learning model using the REACT strategy (Relating, Experiencing, Applying, Cooperating, Transferring) at SMA Husni Thamrin

Medan is included in the active category, with the highest percentage of indicators in the Experiencing stage and the lowest percentage indicators being oral activity in the relating, applying and cooperating stages.

(2) the Jigsaw type cooperative learning model using the REACT strategy (Relating, Experiencing, Applying, Cooperating, Transferring) has a significant effect on students' mathematics learning outcomes in the cnnection domain at SMA Husni Thamrin Medan. The suggestions from this study include: (a) For other researchers, it is hoped that the Jigsaw type cooperative learning model using the REACT strategy (Relating, Experiencing, Applying, Cooperating, Transferring) can be a reference for further research with different material and with different school populations, activities at the transferring stage in the form of practice questions should be multiplied, so students will get used to working on questions during the post test; (b) The characteristics of students, time allocation and adequate experimental tools should be considered by teachers in planning learning devices so that learning objectives can be achieved optimally.

it is hoped that the Jigsaw type cooperative learning model using the REACT strategy (Relating, Experiencing, Applying, Cooperating, Transferring) can be a reference for further research with different material and with different school populations, activities at the transferring stage in the form of exercises questions should be reproduced, so that students will get used to working on questions during the post test;

References

Brezovszky, B., McMullen, J., Veermans, K., Hannula-Sormunen, M. M., Rodríguez-Aflecht, G., Pongsakdi, N., Laakkonen, E., & Lehtinen, E. (2019). Effects of a mathematics game-based learning environment on primary school students' adaptive number knowledge. *Computers & Education*, *128*, 63–74. https://doi.org/10.1016/j.compedu.2018.09.011

Cai, J., & Hwang, S. (2020). Learning to teach through mathematical problem posing: Theoretical considerations, methodology, and directions for future research. *International Journal of Educational Research*, *102*, 101391. https://doi.org/10.1016/j.ijer.2019.01.001

Chevallard, Y., & Bosch, M. (2020). Didactic Transposition in Mathematics Education. In *Encyclopedia of Mathematics Education* (pp. 214–218).

Springer International Publishing. https://doi.org/10.1007/978-3-030-15789-0_48

Dewi, I. L. K., Zaenuri, Dwijanto, Mulyono, Waluya, S. B., & Rochmad. (2021). Conceptual understanding and productive disposition in trigonometry through generative learning. *Journal of Physics: Conference Series*, *1918*(4), 042050. https://doi.org/10.1088/1742-6596/1918/4/042050

Dwijayani, N. M. (2019). Development of circle learning media to improve student learning outcomes. *Journal of Physics: Conference Series*, *1321*(2), 022099. https://doi.org/10.1088/1742-6596/1321/2/022099

Engelbrecht, J., Llinares, S., & Borba, M. C. (2020). Transformation of the mathematics classroom with the internet. *ZDM*, *52*(5), 825–841. https://doi.org/10.1007/s11858-020-01176-4

Fajriah, F., Salasi, R., Suryawati, S., & Fatimah, S. (2019). Analysis of problem solving ability in social arithmetics. *Journal of Physics: Conference Series*, *1157*, 042102. https://doi.org/10.1088/1742-6596/1157/4/042102

Hasibuan, A. M., Saragih, S., & Amry, Z. (2018). Development of Learning Materials Based on Realistic Mathematics Education to Improve Problem Solving Ability and Student Learning Independence. *International Electronic Journal of Mathematics Education*, *14*(1).

https://doi.org/10.29333/iejme/4000

Hwang, G.-J., & Tu, Y.-F. (2021). Roles and Research Trends of Artificial Intelligence in Mathematics Education: A Bibliometric Mapping Analysis and Systematic Review. *Mathematics*, *9*(6), 584. https://doi.org/10.3390/math9060584

Laursen, S. L., & Rasmussen, C. (2019). I on the Prize: Inquiry Approaches in Undergraduate Mathematics. *International Journal of Research in Undergraduate Mathematics Education*, *5*(1), 129–146. https://doi.org/10.1007/s40753-019-00085-6

Li, Y., & Schoenfeld, A. H. (2019). Problematizing teaching and learning mathematics as "given" in STEM education. *International Journal of STEM Education*, *6*(1), 44. https://doi.org/10.1186/s40594-019-0197-9

Lorensius, L., Anggal, N., & Lugan, S. (2022). Academic Supervision in the Improvement of Teachers' Professional Competencies: Effective Practices on the Emergence. *EduLine: Journal of Education and Learning Innovation*, *2*(2), 99–107. https://doi.org/10.35877/454RI.eduline805

Maass, K., Geiger, V., Ariza, M. R., & Goos, M. (2019). The Role of Mathematics in interdisciplinary STEM education. *ZDM*, *51*(6), 869–884. https://doi.org/10.1007/s11858-019-01100-5

Md, M. R. (2019). 21st Century Skill "Problem Solving": Defining the Concept. *Asian Journal of*

Interdisciplinary Research, 64–74. https://doi.org/10.34256/ajir1917

Namkung, J. M., Peng, P., & Lin, X. (2019). The Relation Between Mathematics Anxiety and Mathematics Performance Among School-Aged Students: A Meta-Analysis. *Review of Educational Research*, *89*(3), 459–496. https://doi.org/10.3102/00346543 19843494

Niss, M., & Højgaard, T. (2019). Mathematical competencies revisited. *Educational Studies in Mathematics*, *102*(1), 9–28. https://doi.org/10.1007/s10649-019-09903-9

Rodríguez-Martínez, J. A., González-Calero, J. A., & Sáez-López, J. M. (2020). Computational thinking and mathematics using Scratch: an experiment with sixth-grade students. *Interactive Learning Environments*, *28*(3), 316–327. https://doi.org/10.1080/10494820 .2019.1612448

Sari, M. M., & Muchlis, M. (2022). Improving critical thinking skills of high school students through guided inquiry implementation for learning reaction rate concept in chemistry. *Jurnal Pijar Mipa*, *17*(2), 169–174. https://doi.org/10.29303/jpm.v17i 2.3278

Siagian, M. V., Saragih, S., & Sinaga, B. (2019). Development of Learning Materials Oriented on Problem-Based Learning Model to Improve Students' Mathematical Problem Solving Ability and Metacognition Ability. *International Electronic Journal of Mathematics Education*, *14*(2).

https://doi.org/10.29333/iejme/57 17

Simamora, R. E., Saragih, S., & Hasratuddin, H. (2018). Improving Students' Mathematical Problem Solving Ability and Self-Efficacy through Guided Discovery Learning in Local Culture Context. *International Electronic Journal of Mathematics Education*, *14*(1). https://doi.org/10.12973/iejme/39 66

Süren, N., & Kandemir, M. A. (2020). The Effects of Mathematics Anxiety and Motivation on Students' Mathematics Achievement. *International Journal of Education in Mathematics, Science and Technology*, *8*(3), 190. https://doi.org/10.46328/ijemst.v8 i3.926

Syafril, S., Asril, Z., Engkizar, E., Zafirah, A., Agusti, F. A., & Sugiharta, I. (2021). Designing prototype model of virtual geometry in mathematics learning using augmented reality. *Journal of Physics: Conference Series*, *1796*(1), 012035. https://doi.org/10.1088/1742-6596/1796/1/012035

Tambunan, H. (2019). The Effectiveness of the Problem Solving Strategy and the Scientific Approach to Students' Mathematical Capabilities in High Order Thinking Skills. *International Electronic Journal of Mathematics Education*, *14*(2). https://doi.org/10.29333/iejme/57 15

Ulandari, L., Amry, Z., & Saragih, S. (2019). Development of Learning Materials Based on Realistic Mathematics Education Approach

to Improve Students' Mathematical Problem Solving Ability and Self-Efficacy. *International Electronic Journal of Mathematics Education*, *14*(2). https://doi.org/10.29333/iejme/5721

Verschaffel, L., Schukajlow, S., Star, J., & Van Dooren, W. (2020). Word problems in mathematics education: a survey. *ZDM*, *52*(1), 1–16. https://doi.org/10.1007/s11858-020-01130-4