International Journal of Multicultural and Multireligious Understanding

http://ijmmu.com
editor@ijmmu.com
ISSN 2364-5369
Volume 7, Issue 5
June, 2020
Pages: 275-284

The Effect of the Treffinger Learning Model on Mathematical Connection Ability Students Viewed from Mathematical Resilience

Syahrur Rohmah; Tri Atmojo Kusmayadi; Laila Fitriana

Sebelas Maret University, Indonesia

http://dx.doi.org/10.18415/ijmmu.v7i5.1621

Abstract

Treffinger learning model is one of the learning models that can help students to think creatively and connect ideas between thoughts and provide opportunities for students to be able to show their abilities, such as mathematical connection abilities. Besides the learning model, there are internal factors that become factors to improve the students' mathematical connection ability, one of which is mathematical resilience. Students with good resilience are students who tend not to give up easily and are certain or confident in solving problems in the questions. The research type a quasi-experimental research. The data analysis technique used was the two-way ANOVA with unbalanced cells and post hoc tests using the Scheffe method. The population in this study was 8th grade students of SMP in Karanganyar district. Based on the statistical analysis, (1) There is no difference in the effects between the learning models used on the mathematical connection ability; (2) There are differences in the effects between the mathematical resilience used on the mathematical connection ability; (3) There is no interaction between learning models and mathematical resilience to the mathematical connection ability.

Keywords: *Mathematical Connection Ability; Mathematical Resilince; Treffinger Learning Model*

Introduction

Education is one of the secondary needs of every individual to meet the needs of life and as a tool to achieve goals in the future, and also with education people can develop the potential possessed by each individual. The National Council of Teachers of Mathematics (NCTM, 2000) formulates mathematical learning abilities called mathematical power, including: problem-solving, reasoning and evidence, communication, connecting ideas, and representatives. The standard process is the basic skills and understanding that students need in learning Mathematics. Mathematics learning assists students to be able to analyze and have reasoning and ability of problem-solving process, communication and mathematical connections, so that when students solve a problem in Mathematics learning, it is not solely aimed at getting the right answers, but how students can construct all knowledges and all forms of solutions in a rational way.

Based on the results of the observations of the initial ability made by the researcher, the students' ability to recognize and use relationships between mathematical ideas is 35.94%, the students' ability in understanding the relevance of mathematical ideas is 39.71%, and the students' ability in recognizing and applying one mathematical content into other mathematical content or in everyday life is 37.5%. Students have not been able to recognize and use the relationship between concepts in solving mathematical problems in word problems, students have not been able to identify the elements that are known, asked, and the adequacy of the elements needed before carrying out calculation operations. It means that students find it difficult to transform mathematical models on word problems, so students do not understand what the problem is. Lack of students practicing working on word problems requires in order and correct steps in solving problems. Mathematical connection abilities are important to master by students in helping to solve problems through the interrelationships of mathematical concepts, between mathematical concepts and other fields of science and between mathematical concepts and everyday life. Students who are able to connect mathematical ideas have a deep mathematical understanding and it will last a long time with their ability to connect mathematical ideas, interrelationships between mathematical topics and experiences of daily life. In connecting concepts, students must understand the newly acquired information to be directed at information that has been received previously (Siregar & Surya, 2017).

Mathematical connection ability is students' understanding of connecting mathematical ideas that facilitate the ability to formulate and verify deductive conjectures between topics. Mathematical concepts and procedures obtained can be used to solve problems in Mathematics and other fields of science (Rohendi, 2012). Students who have the mathematical connection ability can understand the relationship between mathematical topics, the ability to understand the relationship between Mathematics and other sciences, and the ability to understand the relationship between Mathematics and real-life (Maulina, 2018). Mathematical connection ability is needed for junior high school students to understand mathematical concepts (Nabilah, 2019). When a student is able to build, develop, and manage the mathematical connection abilities they have, they can make connections between sensory experiences and existing schemes. The connection is one of the most important processes of learning and teaching which is emphasized in the curriculum in Mathematics education. When connections occur in the brain, learning related to relevant concepts also occurs. Mathematical connection indicators used in this study include: (1) recognizing and using relationships between mathematical ideas; (2) understanding the interrelationships between mathematical ideas and forming new mathematical ideas to produce a comprehensive interrelationship; (3) recognizing and applying another mathematical content and to the environment outside Mathematics.

One of the teacher's plans in the learning process is to use learning models that are in accordance with the material and characteristics of students so that learning objectives are achieved. The learning model used is expected to be implemented interactively, inspiring, fun, challenging, motivating, so that students can participate actively and provide sufficient space for innovation, creativity and independence following their talents and interests (Cankoy, 2010). One learning model used to improve students' mathematical connection skills is the Treffinger learning model. Treffinger proposed a practical model to describe three different levels of learning, by considering the dimensions of cognitive and affective at each level. These three levels are divergent functions, complex thinking and feeling processes, and involvement in real challenges. In each stage of the activity, the Treffinger learning model has concrete purposes to improve the expected cognitive and affective abilities (Treffinger, Isaksen, & Firestien, 1982). The steps in the Treffinger learning model (Treffinger, Isaksen, & Firestien, 1982) are: (1) Understanding Challenge; (2) Generating Ideas; (3) Preparing for Action, able to apply new ideas and see as many ways as possible in solving problems and students have creative ideas that involve thinking processes and feelings to solve the problem. By frequently applying new ideas, it can be seen the basic development of creative functions and abilities, both cognitive and affective. Treffinger learning model can help students to think creatively in solving problems, help students master the concepts of the material being taught, help students find ideas, connect ideas between thoughts and provide opportunities for students to be able to show their abilities, such as mathematical connection abilities.

Students' mathematical connection ability is not only influenced by intelligence and learning models, but there are also other factors that influence it, as seen from a positive attitude towards Mathematics and learning Mathematics. Students must have non-intellectual aspects when solving the problems encountered (NCTM, 2000), including affective skills, such as persistence, never giving up, being curious and confident, and understanding the role of Mathematics in real life. One of the positive attitudes that must be fostered in learning Mathematics is mathematical resilience. Mathematical resilience has five aspects: (1) have a developing mindset that is demonstrated through behaviors, such as learning from mistakes; (2) have meta-cognition that is demonstrated through a desire to reflect answers and problem-solving processes; (3) adaptability that is demonstrated through a willingness to try a new strategy or start over; (4) between individuals have aspects of learning, such as when asking questions, it is not a smart thing and not an acknowledgment of lack of knowledge; and (5) students' desire to find meaning in learning (Thornton, Statton , & Mountzouris, 2012).

Mathematical resilience is essential in learning Mathematics because with high mathematical resilience, students can interact and work together in groups, thus building social relationships with others, can learn in groups, and discuss things to build their knowledge independently while learning in class (Hafiz, Darhim, & Dahlan, 2017). Students with good resilience are students who tend not to give up easily and are certain or confident in solving problems in the questions. This is caused by the formation of students' disciplinary behavior and positive character. They will assume that Mathematics is not an obstacle, even when the students themselves experience difficulties, they will maintain their confidence. The better the mathematical resilience, the better the mathematical ability and students with good mathematical resilience will quickly develop compared to students with poor mathematical resilience (Ariyanto, Herman, Sumarno, & Suryadi, 2017).

A study conducted by Alhaddad et al. (2015) examines the achievement and improvement of mathematical communication ability that is reviewed based on students' initial mathematical abilities (high, medium and low) using the Treffinger learning model and conventional learning. The results show that overall, the achievement and improvement of mathematical communication ability of students who receive the Treffinger learning model is higher than those who receive the conventional learning model, because the Treffinger learning model in Mathematics learning invites students to be able to think creatively in solving the problems. A study conducted by Rusmini and Surya (2017) states that there is a significant effect of contextual learning on students' mathematical connection abilities and self-confidence. The previous study used the Treffinger learning model to improve the mathematical communication ability and apply contextual learning model to see an increase in the students' mathematical connection ability, thus the researcher wants to see the effect of Treffinger learning model on students' mathematical connection ability in terms of mathematical resilience of junior high school students in Karanganyar Regency.

Methodology

Based on the problem analyzed, the research type was quasi-experimental research. The population in this study were all eighth-grade students of State Junior High Schools in Karanganyar Regency in the academic year of 2019/2020. The sample in this study was obtained by taking 2 classes from 3 state junior high schools in Karanganyar Regency. The research sample consisted of 2 groups, consisting of one experimental group and one control group. The experimental group implemented the Treffinger learning model and the control group implemented the conventional learning model. Sampling was done by stratified cluster random sampling.

The population of the junior high schools in Karanganyar Regency was divided into three categories, consisting of high, moderate and low school categories. Once each school was categorized into high, moderate and low, then the three groups of junior high schools were chosen randomly, one junior high school from the high group, one junior high school from the moderate group, and one junior high school from the low group. Furthermore, from each of the selected junior high schools, two classes were randomly chosen. The subjects of this study were 163 students who were divided into the experimental class of 89 students and the control class of 74 students.

The instrument used in this study was a descriptive test to assess the students' mathematical connection ability and a mathematical resilience questionnaire. The mathematical resilience questionnaire consisted of 40 statement items. Before the test and questionnaire were given to the research subjects, each test and questionnaire were validated and tested first. After obtaining the results of the validation of the mathematical connection ability test and the mathematical resilience questionnaire, it was be tested on 64 students who were excluded from the study sample. The data that had been collected for the mathematical connection ability test were analyzed using the reliability test, the level of difficulty, and distinguishing strength for each item, while the mathematical resilience questionnaire was analyzed using the internal consistency test and reliability test with the Cronbach's Alpha technique.

In this study, the mathematical resilience questionnaire that had been validated by experts and had been tested with a total of 40 statement items was provided to students in the three school categories, in order to obtain data on the category of numbers of students who have high, moderate and low resilience in each school. The data summary for level grouping of the students' mathematical resilience categories in each learning model used can be seen in Table 1.

Table 1 Description of the Mathematical Resilience Level in Each Learning Model

Category Mathematical Resilience	Group		Total
	Experiment	Control	
High	34	11	45
Moderate	24	33	57
Low	31	30	61
Total	89	74	163

Table 1 shows the number of each sample at the level of mathematical resilience. The number of samples of students who have a high level of mathematical resilience is 45 students, who have a moderate level of mathematical resilience are 57 students, and who have a low level of mathematical resilience are 61 students.

The data collection techniques in this study used a description test of mathematical connection ability and a mathematical resilience questionnaire. The data analysis technique of this study used a two-way ANOVA statistical test with unbalanced cells and based on the mathematical connection ability test score and the mathematical resilience questionnaire which was then categorized based on the mathematical resilience category of student scores. In this study, students' mathematical resilience was divided into three categories, including high, moderate, and low. Before conducting the test, a balance test on the mathematical connection ability of the students is needed to carry out to determine whether the average initial ability of students in the experimental group and the control group is the same or not. The initial ability data were obtained from the description test results of pre-experimental mathematical connection ability. After the balance test was conducted and the initial conditions were fulfilled, the Treffinger learning model experiment was implemented and the other model was implemented for three months in the study sample. Before conducting the two-way ANOVA, the prerequisite test was conducted, which was the normality test and data homogeneity test.

Results and Discussion

Based on the pre-test data results of students' mathematical connection ability, the results of student balance test can be seen in Table 2.

Table 2 The Balance Test Results

		Equal Variances Assumed	Equal Variances not Assumed
Levene's Test of Equality of Variances	F	2.561	
	Sig	0.111	

Based on Table 2, Levene's Test for Equality of Variances value on mathematical connection ability variabel $Sig > 0.05$, therefore, H_0 is not rejected which means because the probability value (significance) mathematical connection ability with equal variance assumed is 0.111 greater than 0.05, so it can be concluded that the ability beginning of the same student.

The univariate normality test in this study was conducted using the Lilliefors method. This univariate normality test was also carried out on each group consisting of Treffinger and conventional learning model groups, students with high, medium and low mathematical resilience. Summary of univariate normality test results of research data in this study can be seen in Table 3.

Table 3 Univariate Normality Test Results

Data	Group	L_{obs}	$L_{(0.05;n)}$	Test Decision	Conclusion
Mathematical Connection Ability	*Treffinger*	0.093	0.094	H_0 is not rejected	Normal
	Conventional	0.062	0.103	H_0 is not rejected	Normal
	High Mathematical Resilience	0.101	0.108	H_0 is not rejected	Normal
	Moderate Mathematical Resilience	0.078	0.088	H_0 is not rejected	Normal
	Low Mathematical Resilience	0.089	0.097	H_0 is not rejected	Normal

Based on the results of the univariate normality test presented in Table 3, it appears that for each group of students the mathematical connection ability data obtained that $L_{obs} < L_{(0{,}05;n)}$ with $DK=\{L|\ L > L_{(0{,}05;n)}\}$ then the L_{obs} value for each group is outside the critical area ($L_{obs} \notin DK$). This results in H_0 being accepted which means the sample is taken from a univariate normally distributed population.

Homogeneity test of variance in this study using the Barlett test. Homogeneity test in this study was conducted to determine whether the data variances of students' mathematical connection abilities in the group learning model with the same category of mathematical resilience or not. A summary of the results of the variance homogeneity test is presented in Table 4.

Table 4 Homogeneity Test Results

Data	Group	χ^2_{obs}	$\chi^2_{(0{,}05;k-1)}$	Test Decision	Conclusion
Mathematical Connection Ability	Learning model	1.98	3.841	H_0 is not rejected	Homogen
	Mathematical Resilience	5.51	5.991	H_0 is not rejected	Homogen

Table 4 shows that the value of $\chi^2_{obs} < \chi^2_{(0{,}05;k-1)}$ both for data mathematical problem solving ability and mathematical connection ability of students in each group , where $DK = \{\chi^2 \mid \chi^2 > \chi^2_{(0{,}05;k-1)}\}$ so that $\chi^2_{obs} \notin DK$ resulting in H_0 is accepted. This means that the sample comes from populations that have the same variances.

Hypothesis testing in this study was conducted using a two-way variance analysis test. This test is carried out because there are two independent variables namely the learning model and mathematical resilience, and the dependent variable is the mathematical connection ability. The results of variance analysis test can be seen in Table 5.

Table 5 Results of Variance Analysis

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	10449.305	5	2089.861	7.399	0.000
Intercept	306534.260	1	306534.260	1085.331	0.000
Learning_Models	24180	1	24.180	0.086	0.770
Mathematical_Resilience	7348.862	2	3674.431	13.010	0.000
Learning_Models * Mathematical_Resilience	185.085	2	92.543	0.328	0.721

The results of the variance analysis test presented in Table 5 show that:

1) Test results on the effect of the learning model factor show that the value of *Sig* = 0.770, because *Sig* > 0.05 results in H_0 is not rejected. This means that there are no differences in the effects between the learning models used on mathematical connection abilities.

2) Test results on the effect of mathematical resilience factors indicate that the value of *Sig* = 0,000, because *Sig* <0.05 results in H_0 is rejected. This means that there are differences in the effects between the mathematical resilience used on the mathematical connection ability.
3) Test results on the interaction between learning models and mathematical resilience obtained values from *Sig* = 0.721, because *Sig* > 0.05 resulted in H_0 is not rejected. This means there is no interaction between learning models and mathematical resilience to the ability of mathematical connections.

Based on the results of variance analysis tests on mathematical resilience, it is rejected, so an inter-column average comparison test is required. The inter-column average comparison in this study used the inter-column pairwise comparison test with the Scheffe method to determine which level of mathematical resilience gives better mathematical connection ability. The results of the inter-column pairwise comparison test in this study can be seen in Table 6.

Table 6 Multiple Comparison Test Results

(I) Mathematical_Resilience	(J) Mathematical_Resilience	Mean Difference (I-J)	Std. Error	Sig.
High	Moderate	14.61*	3.351	0.000
	Low	19.49*	3.302	0.000
Moderate	High	-14.61*	3.351	0.000
	Low	4.87	3.096	0.293
Low	High	-19.49*	3.302	0.000
	Moderate	-4.87	3.096	0.293

Based on Table 6, it can be concluded that:

1) The test results on the mathematical resilience of the high and moderate categories show that the value of $Sig = 0.000$, because $Sig < 0.05$, H_0 is not accepted. This means that there are differences in the mathematical connection ability between students with high and moderate mathematical resilience. The results of the average difference obtained 14.61, indicating that the mathematical connection ability of students with high mathematical resilience is more effective than students with moderate mathematical resilience.
2) The test results on the mathematical resilience of the high and low categories show that the value of $Sig = 0.000$, because $Sig < 0.05$, H_0 is not accepted. This means that there are differences in mathematical connection ability between students with high and low mathematical resilience. The results of the average difference obtained 19.49, indicating that the mathematical connection ability of students with high mathematical resilience is more effective than students with low mathematical resilience.
3) The test results on the mathematical resilience of the moderate and low categories show that the value of $Sig = 0.293$, because $Sig > 0.05$, H_0 is accepted. This means that there is no difference in the mathematical connection ability between students with moderate and low mathematical resilience.

Based on the analysis of the ANOVA test, there is no difference in the effects of the learning models on the problem-solving ability and mathematical connection ability. Based on a study conducted by Handayani, et al. (2018), it states that learning instruments that use the Treffinger learning model can trigger students' creative thinking ability that involves cognitive and affective abilities, because the Treffinger learning model encourages creative learning which consists of three stages of regulation, ranging from basic elements and move up to more complex thinking functions. The steps in the Treffinger learning model can apply new ideas and see as many ways as possible in solving problems and students have creative ideas that involve thinking processes and feelings to solve the problem.

In this study, the factors that cause students' difficulties in learning are not due to learning model factors, but due to internal factors that affect students, which is mathematical resilience. This is also in line with the opinion of Chung (2000) which states that learning is not only controlled by external aspects, but also is controlled by internal aspects. Based on the results of the study, students with high mathematical resilience have a better mathematical connection ability than students with moderate and low mathematical resilience. Students with moderate mathematical resilience have the same mathematical connection ability as students who have low mathematical resilience. A study conducted by Kooken, et al. (2015) reveals that indicators in assessing mathematical resilience use three correlated factors, consisting of values, struggle and growth. Hutauruk and Priatna (2017) explains that resilience with the students' affective ability can face and can overcome obstacles and negative situations in the learning process, changing negative situations into situations that support them. Strong students are able to obtain better learning outcomes than they expect. Based on this study, it is shown the correlation and influence of indicators on students' mathematical resilience, both separately and simultaneously.

The results of mathematical resilience show students' participation and persistence in learning Mathematics. Some studies have identified mathematical resilience among students (Lee & Wilder, 2008), stating that students with good mathematical resilience have the will to develop mathematical abilities, are reflective and always think hard, make every effort when learning Mathematics. Thinking hard, discussing with others, able to develop mathematical ideas, and not desperate to make progress with ideas that seem difficult and problematic. Students with good mathematical resilience have confidence that their abilities will continue to develop; They assume that when they have difficulty learning Mathematics, they remain confident that they will be able to solve the difficulties and succeed; They are aware of the resources that can help them and are confident in their existence and benefits; They maintain confidence in their ability to solve mathematical obstacles; Develop new abilities if needed and work together with others if needed (Goodall & Wilder, 2015).

Mathematical resilience has a significant relationship with the mathematical connection ability because students will always have a positive attitude in dealing with various existing difficulties in learning Mathematics. Students with high mathematical resilience have a positive and optimistic attitude in following Mathematics learning so that they will be confident of being able to solve if they find a difficult problem. Students with moderate mathematical resilience will consider the problem as a burden but do not give up and try to solve the mathematical problem as much as they can. Students with low mathematical resilience will experience anxiety and experience disappointment when dealing with mathematical problems and cannot solve the given problem.

Conclusion

The results of the study show that: (1) There is no difference in the effects between the learning models used on the mathematical connection ability; (2) There are differences in the effects between the mathematical resilience used on the mathematical connection ability. Mathematical connection skills of students with high mathematical resilience are more effective than students with moderate mathematical resilience, mathematical connection abilities of students with high mathematical resilience are more effective than students with low mathematical resilience, there is no difference in mathematical connection abilities between students with moderate and low mathematical resilience; (3) There is no interaction between learning models and mathematical resilience to the mathematical connection ability. Mathematical resilience has a significant relationship with the mathematical connection ability because students will always have a positive attitude in dealing with various existing difficulties in learning Mathematics. Students with high mathematical resilience have a positive and optimistic attitude in following Mathematics learning so that they will be confident of being able to solve if they find a difficult problem. Students with moderate mathematical resilience will consider the problem as a burden but do not give up and try to solve the mathematical problem as much as they can. Students with low mathematical resilience will experience anxiety and experience disappointment when dealing with mathematical problems and cannot solve the given problem.

References

Ariyanto, L., Herman, T., Sumarno, U., & Suryadi, D. (2017). Developing Mathematical Resilience of Prospective Math Teachers. *International Conference on Mathematics and Science Education*, 1-5.

Cankoy, O. (2010). Effect of a Problem Posing Based Problem Solving Instruction. *Journal of Education, 38*, 11-24.

Chung, M.K. (2000). The development of self-regulated learning. *The Institute of Asia Pasific Education Development*, 1(1), 55-56.

Goodall, J., & Wilder, S. J. (2015). Overcoming Mathematical Helpness and Developing Mathematical Resilience in Parents: An Illustative Case Study. *Journal Creative Education, 6*(5), 526-535.

Hafiz, M., Darhim, & Dahlan, J. A. (2017). Comparison of Mathematical Resilience Among Studentswith Problem Based Learning and Guided Discovery Learning Model. *International Conference on Mathematics and Science Education*, 1-6.

Handayani, R., Hajidin, Duskri, M., & Maidiyah, E. (2018). Development of Learning Tools Using Treffinger Learning Model to Improve Cretive Thinking. *Journal of Physics* 1088 012090.

Hutauruk, A. J., & Priatna, N. (2017). Mathematical Resilience of Mathematics Education Students. *IOP Conf. Series: Journal of Physics: Conf. Ser. 895 012067*.

Kooken, J., Welsh, M. E., McCoach, D. B., Johnston-Wilder, S., & Lee, C. (2015). Developpment and Validation of The Mathematical Resilience Scale. *Measurement and Evaluation in Counseling and Development*, 1-26.

Lee, C., & Wilder, S. J. (2008). Does Articulation Matter When Learning Mathematics? *Proceedings of British Society for Research Into Learning Mathematics, 28*(3), 54-59.

Maulina, Ikhsan, M., and Subianto. (2018). Development of Learning Tool with Contextual Teaching and Learning (CTL) Approach to Improve Student Mathematical Connection Ability. *IOP Conf. Series: Journal of Physics: Conf. Ser.* **1088** 012012.

Nabilah, R. G., Suhendra, S., & Yulianti, K. (2019). The Efforts of Improving Mathematical Connection Ability of Senior High School Students with 7e Learning Cycle Model. *Journal of Physics*, Conf. Series **1157** 042096.

National Council of Teachers of Mathematics. (2000). *Principles and Standar For School Mathematics.* Reston: (VA: NCTM).

Rohendi, D. (2012). Developing E-Learning Based on Animation Content for Improving Mathematical Connection Abilities in High School Students. *International Journal of Computer Science, 9*(1), 1-5.

Rusmini, & Surya, E. (2017). The Effect of Contextual Learning Approach to Mathematical Connection Ability and Student Self-Confidence Grade VIII SMP Negeri 8 Medan. *International Journal of Sciences: Basic and Applied Research, 23*(2), 249-262.

Siregar, N. D., & Surya, E. (2017). Analysis of Students' Junior High School Mathematical Connection Ability. *International Journal of Science: Basic and Applied Research, 33*(2), 309-320.

Thornton, S., Statton , J., & Mountzouris, S. (2012). Developing Mathematical Resilience among Aboriginal Students. *Proceedings of the 35th annual conference of the Mathematics Education Research Group of Australasia, 1*(1), 730-737.

Treffinger, D. J., Isaksen, S. G., & Firestien, R. L. (1982). Theorical Perspective on Creative Learning and Possing Facilitation: An Overview. *The Journal of Creative Behavior, 17*(1), 9-17.