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Students' Mathematical Problem-Solving Abilities in Terms of Emotional Intelligence with TGT and TAI Models

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Abstract: This study aims to determine the differences in each learning model of emotional intelligence and the ability to solve mathematical problems of students as well as in the interaction between the two. This research is quasi-experimental research. The population of this study was all eighth-grade students of the State Junior High School in Karanganyar Regency in the academic year 2018/2019. The sample consists of eighth-grade students of State Junior High School 1 Matesih, 1 Jumantono and 3 Tasikmadu which are taken by *stratified cluster random sampling*. The instrument used to collect data is a test of mathematical problem-solving abilities and student emotional intelligence questionnaires. The technique of data analysis using MANOVA cell is not the same. The results showed that: (1) TGT model provide problem solving abilities better than TAI model on the material side room flat. (2) The TGT model provides students with emotional intelligence that is better than the TAI model in the material of building flat side spaces. (3) In each learning model, mathematical problem solving abilities of students with high emotional intelligence are better than students with moderate and low emotional intelligence, and students with moderate emotional intelligence are better than students with low intelligence. The results of research on eighth grade students with the TGT and TAI models are that students tend to be better at problem solving skills than students who are taught with the direct model. from the results of this study, it is expected that the TGT model is used to teach material to build flat side spaces in eighth grade students.

Keywords: *TGT, TAI, mathematical problem solving ability*

INTRODUCTION

The ability to solve mathematical problems is an important skill and must be mastered by students in the 21st industrial revolution because it can be used to determine alternative solutions to a problem. Students' mathematical problem solving skills can be seen as the basis for making students innovative and able to find alternatives to problems or challenges, both now and in the future. This ability is important especially for junior high school students as students begin to think adults and independently. The ability to solve students' mathematical problems is one of the important aspects needed in the field of work because creativity makes a person able to keep abreast of the times, create new things and be useful to face challenges. This ability can be developed through mathematics in schools with learning models that focus on the level of emotional intelligence of students in solving problems. The learning process requires planning and choosing the right strategy. Therefore, there is a need for junior high school students to have an understanding of students' mathematical problem solving abilities to determine mathematical learning strategies and methods appropriately.

The progress of a nation is determined by the development of education that exists in the nation's children. The society of a developed country will bring progress in various fields such as development, science, technology, economics, social, politicals and national civilization. Advanced, high and developing education requires a plan that relates to the national goals of

education of a nation. The National Education aim System Number 20 of 2003 states that the aim of national education is to create a generation of people who are faithful and devoted, virtuous, intelligent and creative.

The quality of education is related to the learning process that occurs in the classroom which involves students actively helping students to construct and construct mathematical ideas independently. Active learning includes students' ability to ask questions, discuss, express opinions, give advice, solve problems and will provide competencies, knowledge and a set of skills needed (Kaur, 2013). Problem solving ability starts from the ability to identify, analyze, make hypotheses and conclude even students can develop the problem given. Teacher-centered learning makes students passive in the learning process in the classroom. Students only receive knowledge delivered by the teacher and students are not allowed to construct mathematics based on the ideas that students have. What should be done by the world of education to achieve the set goals? This question is a separate task for teachers to be able to answer.

The national exam results based on PAMER data for children of Public Middle School in Karanganyar Regency in 2017/2018 are still very low, namely in category D with a value of 44.33 which is caused by students' problem-solving ability which is still low. The absorptive capacity of students, especially for geometry and measurement material is also still low, 42.80. The survey results from several schools in Karanganyar justify the use of learning models that are less varied learning models, making children less creative in solving problems that are being faced. Is there an appropriate learning model to solve all the problems currently faced by the world of education? Researchers try to provide an overview of the appropriate learning models to address the problem of education in this era.

The Group processing helps improve the effectiveness of the members in contributing to the share effort to achieve the groups goals via reflection on the learning process (Ballantine, 2007). The TAI cooperative learning model is one of the learning models that apply guidance between friends, where students are cleverly responsible to weak students by forming heterogeneous small groups with different ways of thinking to help each other. In this learning teacher order is no longer the center of activity in the classroom. The teacher only directs and motivates students to learn independently and fosters a sense of responsibility so that students can actively understand a problem and solve it in groups. Slavin (2005) says that the TAI learning model is a learning model that applies guidance between friends in a heterogeneous small group.

The TAI model has 8 components that must exist as follows:

1. Placement Test
   Giving tests to students to get grades to find out student weaknesses on certain material.
2. Teams
   Heterogeneous group formation.
3. Teaching Group
   The teacher gives material briefly to be used as a reference for completing group assignments.
4. Study Team
   Group learning activities with the help of friends and teachers provide individual guidance to students who have difficulty.
5. Student Creative
   Students can create an atmosphere that creates individual success as an influence of the group.

6. Facts Test
   Tests conducted by the teacher to measure the ability of students individually.
7. Team Score
   The teacher gives assess of the success of a group and rewards the group with the highest point.
8. Whole Class Units
   The teacher provides material at the end of learning as a conclusion with problem solving.

TGT learning model is classroom management where students are placed in heterogeneous ability teams to compete in a game. The TGT model can improve basic abilities, student learning achievement, positive interactive among students acceptance of diversity of classmates, and self-confidence. Allthough there is research which indicates that students from collectivistic working in groups and perform well in groups (Hofstede, 2005). In this learning model students become ready in trying to understand and master the material in the learning process and train students to work well together with group members in answering the assignments given by the teacher. The TGT model expects students to be more interested in the subject matter because the lessons are delivered in a more fun and interesting way. Wyk (2010) examines the effects of TGT on the achievement and knowledge retention of education students In TGT cooperative learning there are five components must exist, namely:

1. Class presentation
   At the beginning of learning the teacher delivers material usually indirect learning with lectures or discussions.
2. Team
   Groups usually consist of 3-5 students representing all parts of the class in terms of academic achievement, gender, race, and ethnicity.
3. Game
   The game consists of questions designed to test students' knowledge.
4. Match
   A match is a structure where the game takes place. In this tournament, three or four students are equal and represent different teams competing in answering questions.
5. Team Awards
   Teams that have managed to get an average score exceeding certain criteria are given an award, it needs to be emphasized that awards are given to groups, not individuals, so the group's success is determined by the success of each member.

The learning model can improve the learning process in the classroom as an external factor but also internal factors in students can also influence the success of the learning process. Learning situations are not cooperative if students are arranged into groups without positive interdependence (Johnson, 2009). The internal factor in question is the emotional intelligence of students. Goleman (Chamundeswari, 2013) states that emotional intelligence is a person's ability to regulate his emotional life with intelligence, maintain emotional harmony and disclosure through skills, self-awareness, self-control, self-motivation, empathy and social skills. In another book Goleman (2015) states that 80% of success is influenced by emotional intelligence (EQ), which is self-motivating ability, overcoming frustration, controlling heart pressure, regulating moods and ability to work together while the remaining 20% is contributed by intellectual intelligence.

Problems that can be identified that the low ability to solve mathematical problems causes students to be less active in the learning process that has been carried out in the classroom.

Therefore, it is necessary to examine whether the use of the new learning model can improve the ability of mathematical problem solving rather than the learning model that has been used so far (Buhrmester, 1998). Factors that cause students' low mathematical problem solving abilities may be due to the level of emotional intelligence of students. Research needs to be done for what purpose by knowing the level of emotional intelligence of different students the teacher can accommodate learning in the classroom to improve the ability of students to solve mathematics problems.

Basically, the ultimate goal of learning is to produce students who have the knowledge and skills in solving problems faced later in community life. The problem is to produce students who have competencies in problem solving so we need strategies and learning models to solve mathematical problems. Nur Hamiyah (Tarim, 2009) says that mathematical problem solving ability is a process or a way to find a way out of something that is not liked or creates difficulties for oneself and others by using abstract science based on of calculating, measuring and describing objects. Made Wena (Tarim, 2009) explains that mathematical problem solving ability is a process to find a combination of several some many rules according to stages systematically in to overcome a new better situation.

Polya (2014) explains that mathematical problem solving ability is a potential business to find a way out of a difficulty to achieve something as an end. Polya stated that there were 4 indicators of problem solving, namely understanding the problem, planning a solution, resolving the problem as planned, doing checking again on all the steps taken. Polya put forward 4 indicators of problem solving, namely as follows:

1. Understanding the problem without an understanding of a given problem, students may not be able to solve the problem correctly. Activities that can be carried out in this step are to write down what is known and what is asked about the question.
2. Planning a settlement after students understand the problem correctly, then they must be able to develop a problem solving plan. Activities that can be carried out in this step are trying to find or remember similar problems that have been resolved which have independence in the process of completion according to existing procedures.
3. Resolve problems as planned if the completion plan has been made in writing or not, then the problem is resolved according to the plan which is considered the most complete and the right answer. Activities that can be carried out in this step are to carry out the procedures that have been made in the previous step to get a solution answer.
4. Re-check all steps taken. Activities that can be carried out in this step are analyzing and evaluating whether the procedures applied and the results expected to be obtained are correct and effective. Checking activities are carried out from the first phase to the third phase.

Students check answers if they are by following the first phase and then compare answers with other possibilities to ensure the answers obtained are correct according to the problem. From some understanding of problem solving abilities that have been described, the authors conclude that mathematical problem solving ability is a potential that is owned by someone to be able to overcome the difficulties faced in mathematical problems systematically by following the expected goals.

Goleman (2015) states that emotional intelligence is the ability to know our feelings and the feelings of others, the ability to motivate yourself and the ability to manage emotions well ourselves and in relationships with others. Emotional intelligence (EQ) is the other side of the intelligence of human beings considered important in determining the level of his success in

life. This includes the success of students in their learning competencies. As stated by Goleman (2015) that emotions are the foundation of academic and cognitive abilities. Goleman (2015) states that emotional intelligence has five main elements, namely *self-awareness* (*self-awareness*), *self-* regulation (*self-regulation*), motivation (*motivation*), empathy (*empathy*), and social skills (*social-skills*). The five elements are namely:

1. Self-awareness
   Recognizing one's own emotions is an ability to recognize feelings as they occur. This ability is the basis of emotional intelligence, namely one's awareness of his own emotions.
2. Self-regulation
   Managing emotions is the ability of individuals to deal with feelings so that they can be expressed appropriately so that an equilibrium is reached within the individual. Keeping troubling emotions under control is the key to emotional well-being.
3. Motivation
   Achieving achievement must be passed by having motivation in the individual, which means having the perseverance to refrain from satisfaction and control impulse.
4. Empathy
   The ability to recognize other people's emotions is also called empathy. One's ability to recognize others or care shows one's empathy ability.
5. Social-skills
   The ability to build relationships is a skill that supports popularity, leadership, and success between people. Communication skills are the basic ability to successfully build relationships.

METHOD

This type of research is a quasi-experimental study commonly called *quasi experimental research* because it is impossible for researchers to control and manipulate all relevant variables. The population in this study were all eighth grade students of the State Middle School in Karanganyar Regency consisting of 51 schools. The sample was taken by *stratified cluster random sampling* which was then obtained by 85 students from 3 public junior high schools in Karanganyar Regency. The method of data collection in this study uses documentation, tests, and questionnaires. Documentation for retrieving initial data, namely the value of national examinations. The test is used to get the value of students' mathematical problem solving abilities. A Questionnaire is used to get the value of emotional intelligence. The data analysis technique used in this study is the *unequal Multivariate Analysis of Variance* (MANOVA) cells. The model used in this study uses the model proposed by (Budiyono, 2003) as follows:

$$\mathbf{X_{ijk}} = \mu + \alpha_{\mathbf{i}} + \beta_{\mathbf{j}} + (\alpha\beta)_{\mathbf{ij}} + \boldsymbol{\varepsilon_{ijk}}$$

Information:

X_{ijk} : k-observation data in row i-th column j
μ : average of all observed data
α_i : i-line effect on the dependent variable
β_j : j-column effect on the dependent variable
$(\alpha\beta)_{ij}$: interaction of the i-th row and j-th column
ε_{ijk} : Observational data deviations from the mean of normally from distributed populations with a mean of 0.

The use of multivariate variance analysis has the advantage of being able to analyze all the dependent variables simultaneously, so to minimize errors in making statistical test conclusions. The analysis is carried out through cells that are not the same because of the low probability of conditions in the field each school has many of the same students in each class. The analysis was carried out after the normality, homogeneity and balance prerequisite tests were carried out and the results met the requirements for the statistical test. This design was selected because it may help test the cause and the effect relationship between the independent variable and the dependent variables (Creswell, 2009).

RESULTS AND DISCUSSION

The results of the study obtained the average value of students for mathematical problem solving abilities and emotional intelligence using the TGT model and the TAI model. A homogeneity test is done to find out whether the data in the population has the same variant or not. This design was selected because it may help test the cause and effects relationship between the independent variable and the dependent variables (Razavieh, 2009)

Table 1. Data of Box-M Test

Box's Test of Equality of Covariance Matrices[a]	
Box's M	20,076
F	6,517
df1	3
df2	1263003,709
Sig.	0,075

Based on the table, it is obtained that the value of the mathematical problem solving ability variable has sig > 0.05, which means that H_0 is accepted and it is concluded that the two variables have the same or homogeneous variants.

A normality test as a prerequisite test is done to find out whether data comes from a population that is normally distributed or not.

Table 2. Test of Normality

One-Sample Kolmogorov-Smirnov Test				
		Problem solving ability	Emotional intelligence	method
N		85	85	85
Normal Parameters	Mean	59,8824	55,0941	1,51
	Std. Deviation	14,59730	3,51738	0,503
Most Extreme Differences	Absolute	0,140	0,084	0,343
	Positive	0,140	0,065	0,337
	Negative	-0,074	-0,084	-0,343
Test Statistic		0,140	0,084	0,343
Asymp. Sig. (2-tailed)		0,083	0,200	0,074

Based on the table obtained the value of sig > 0.05 then H_0 is accepted which can be assumed that population data is normally distributed. Prerequisite test has been fulfilled so that data analysis can be continued by the multivariate tests.

The balance test is carried out before the treatment is carried out to find out whether the population data on the initial ability possessed is balanced or not.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
problem solving	Equal variances assumed	13,271	,200	7,187	83	,000	17,97619	2,50125	13,00130	22,95109
	Equal variances not assumed			7,135	59,453	,000	17,97619	2,51949	12,93551	23,01687
emotional intelligence	Equal variances assumed	,884	,350	,371	83	,712	,28461	,76703	-1,24098	1,81019
	Equal variances not assumed			,372	82,214	,711	,28461	,76592	-1,23899	1,80821

Figure 1. Independent Sample Test

Based on the table from the figure obtained that the value of sig > 0.05 then H_0 is accepted which can be assumed that population data is balanced. Prerequisite test has been fulfilled so that data analysis can be continued by the multivariate tests.

Table 3. Test of Between Subjects Effects

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	problem solving	6865,847	1	6865,847	51,651	,000
	emotional intelligence	1,721	1	1,721	1,138	,012
Intercept	problem solving	305836,247	1	305836,247	2300,776	,000
	emotional intelligence	257985,721	1	257985,721	20638,340	,000
Method	problem solving	6865,847	1	6865,847	51,651	,000
	emotional intelligence	1,721	1	1,721	1,138	,012
Error	problem solving	11032,976	83	132,927		
	emotional intelligence	1037,526	83	12,500		
Total	problem solving	322700,000	85			
	emotional intelligence	259045,000	85			
Corrected Total	problem solving	17898,824	84			
	emotional intelligence	1039,247	84			

Based on the table, several of things are concluded, namely as follow: obtained the value F_{count} = 51,651 and p = 0,000 because $F_{count} > F_{table}$ and p < 0,05 this is assumed H_0 is rejected there are differences in effects between the TGT and TAI models with students' mathematical problem solving abilities. Obtained the value F_{count} = 1,138 and p = 0,012 because $F_{count} > F_{table}$ and p < 0,05 this is assumed H_0 is rejected there are differences in effects also occur in emotional intelligence with the TGT and TAI models. The value from F_{count} = 2300,776 and the value p = 0,000 because $F_{count} > F_{table}$ and p < 0,05 this is assumed H_0 is rejected there are any interaction between the TGT and TAI models with students' mathematical problem solving abilities. The value F_{count} = 20638,34 and p = 0,000 because $F_{count} > F_{table}$ and p < 0,05 this is

assumed H_0 is rejected there are any interaction also occur in emotional intelligence with the TGT and TAI models.

In this study the experiments were carried out only on two learning methods so that they could not use the post-manova follow-up test for the learning model. A good learning model can be determined by looking at the average results of the analysis of the dependent variable.

Table 4. Descriptive Statistic

Descriptive Statistic					
	Method	N	Mean	Std. Deviation	Std. Error Mean
problem solving	TGT	42	68,9762	14,68281	2,26561
	TAI	43	51,0000	7,22759	1,10220
Emotional intelligence	TGT	42	55,2381	3,31154	0,51098
	TAI	43	54,9535	3,74136	0,57055

According to the table above it can be concluded that the mathematical problem solving abilities of students with the TGT model is better than the TAI model while the level of emotional intelligence of students with the TAI model is better than the TGT model. Likewise, a study conducted by Muldoko (2015), which states that the TGT and TAI models provide equally good performance compared to the direct model. This is similar to the results of The Depari (2011) study, concluding that students subjected to the TGT model have better learning achievement. This is supported by Darmono (2016), finding that there is an influence of the TAI model on student learning outcomes. With the results of this research and related studies nested TGT models can be used effectively in the process of learning to build flat side space material to improve students' mathematical problem solving abilities. Good problem solving skills will be able to improve student learning achievement.

CONCLUSION

Learning models that are by following with the subject matter and character of students greatly influence the level of students' mathematical problem solving abilities. Students' character can be seen from the level of emotional intelligence possessed by students. The ability of students to solve mathematical problems greatly determines the level of student learning outcomes. TGT and TAI models are cooperative learning models that are suitable for improving students' mathematical problem solving abilities. There is the influence of the learning model used on students' mathematical problem solving abilities where the TGT model is better than the TAI model. The learning model also influences the level of emotional intelligence of students where the TGT model provides a higher level of emotional intelligence than the TAI model. Problem solving ability math problems students with high emotional intelligence is better than sis w A with emotional intelligence being and low and students with emotional intelligence are having problem-solving abilities better math than students with emotional intelligence is low on materi geometrical flat side. In each learning model, mathematical problem solving abilities of students with high emotional intelligence are better than students with moderate and low emotional intelligence, and students with moderate emotional intelligence have better problem solving skills than students with low intelligence.

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