USING THE JIGSAW AND TAI MODELS TO ANALYZE A MATH LEARNING EXPERIMENT, REVIEW THE STUDENTS' ADVERSITY QUOTIENT

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Abstract: The goal of this study was to identify: (1) Significant differences in mathematics learning results between the jigsaw learning model and TAI. (2) Significant variations in kids' AQ levels and mathematical learning results (3) There is a relationship between students' AQ scores and the outcomes of mathematics learning. A quasi-experimental research design is used in this quantitative study type. 98 students from SMP Muhammadiyah 5 Surakarta in the seventh grade made up the research population. The first class was sampled using the jigsaw model, the second class was sampled using the TAI model, and the third class was sampled using the conventional model. Cluster random sampling was employed as the sampling method. ways for gathering data via tests, surveys, and documentation. Two-way analysis of variance with uneven cells is the analytical method employed. Using the study's findings and a 5% level of significance, the following was discovered: (1) Jigsaw, TAI, and conventional learning models all produce the have different in terms of learning outcomes for mathematics, however Jigsaw performs better than TAI and conventional; (2) There are variations in kids' AQ levels in terms of mathematics learning results. While students with AQ campers are superior to students with AQ quitters, students with AQ climbers are superior to students with AQ campers and quitters; (3) There is a relationship between AQ levels (climbers, campers, quitters) and learning models (Jigsaw, TAI, and traditional) on the outcomes of mathematics learning. Students who are AQ climbers in the jigsaw learning paradigm learn mathematics more effectively than students who are AQ quitters.

Keywords: adversity quotient; jigsaw; math activity; team assisted individualized

Abstrak: *Penelitian ini bertujuan untuk mengidentifikasi: (1) Perbedaan hasil belajar matematika yang dihasilkan dari penerapan model pembelajaran jigsaw dan TAI; (2) perbedaan hasil belajar matematika siswa antar kategori AQ; (3) interaksi antara penerapan model pembelajaran (jigsaw dan TAI) dengan AQ siswa terhadap hasil belajar*

matematika. Desain quasi-experimental digunakan dalam penelitian kuantitatif ini. Populasi penelitian merupakan siswa kelas 7 SMP Muhammadiyah 5 Surakarta yang berjumlah 98 siswa. Cluster random sampling digunakan sebagai metode pengambilan sampel. Kelas pertama dijadikan sampel untuk penerapan model jigsaw, kelas kedua dijadikan sampel untuk penerapan model TAI, dan kelas ketiga dijadikan sampel untuk penerapan model konvensional. Data dikumpulkan melalui teknik tes, survei, dan dokumentasi. Analisis varians dua arah dengan sel tak sama adalah jenis formula statistik yang digunakan. Dengan menggunakan tingkat signifikansi 5%, ditemukan hal-hal berikut: (1) model pembelajaran jigsaw, TAI, dan konvensional semuanya menghasilkan hasil yang berbeda dalam hal hasil belajar matematika, jigsaw berkinerja lebih baik daripada TAI dan konvensional; (2) Terdapat perbedaan hasil belajar matematika ditinjau dari variasi tingkat AQ. Sementara siswa dengan AQ camper lebih unggul daripada siswa dengan AQ quitter, siswa dengan AQ climber lebih unggul dari siswa dengan AQ campers dan quitter; (3) Ada interaksi antara model pembelajaran (Jigsaw, TAI, dan traditional) dan tingkat AQ (climbers, campers, quitters) terhadap hasil belajar matematika. Siswa dengan AQ climber dan menggunakan model jigsaw memiliki hasil belajar matematika lebih baik daripada siswa dengan AQ quitters.

***Kata kunci**: adversity quotient; jigsaw; pembelajaran mathematika; team assisted individualized*

INTRODUCTION

Education is an intentional and planned endeavor to create a learning environment and learning process for students to actively develop their potential to have the moral character and abilities required by themselves, society, nation, and state.

They are either physical, mental, or spiritual in nature. "Education is an endeavor to develop the quality of human beings in all its aspects," asserts Mahmud (2011). Education is a planned activity with specific objectives involving several interrelated components that interact with one another to create a system that influences one another. The issue of the learning process weakness is one of the issues our educational system is currently dealing with (Agustin & Supriyanto, 2009). Interesting learning will keep students engaged in the process, ensuring that the learning outputs align with the desired educational aims.

The manifestation or development of a person's potential talents or capacities is referred to as learning outcomes or achievement (Care et al., 2018). Learning results in mathematics serve as a cognitive indicator of student intelligence. Learning outcomes are skills that students possess in the cognitive, emotional, and psychomotor domains

(Begam & Tholappan, 2018). Accordingly, the results of learning activities in mathematics take the form of continual changes in cognitive, affective, and psychomotor abilities about numbers, shapes, concepts, and logical links that may be measured or seen (Volk et al., 2017). One can determine whether their mathematics learning was effective or unsuccessful by looking at the mathematical values they have attained.

In Indonesia, pupils' math learning achievements frequently fall short of expectations. Indonesian students' mathematics skills were placed 63rd out of 69 nations in the 2015 Program for International Study Assessment (PISA) study conducted by the Organization for Economic Cooperation and Development (OECD) (OECD, 2019). According to UNESCO, Indonesia is ranked 34th out of the 38 nations studied for the quality of its mathematical education (Raymundo, 2015). Other information comes from the International Statistics Center for Education's (National Center for Education in Statistics') study results of 41 nations in math proficiency, with Indonesia coming in at number 39 behind Thailand and Uruguay.

According to R&D data from the Ministry of Education and Culture, the national average score for SMP/MTs for the 2016–2017 academic year dropped from 58.61 to 54.25, compared to the 2015–2016 academic year (Balitbang, 2022). The average grade in mathematics is still relatively poor. The average score for the 2017 Mathematics National Examination was only 50.31, significantly lower than the average scores for the Science and Indonesian Language sections of the exam, which were 64.32 and 52.19, respectively (Balitbang, 2022). With an average score of 36.22 on the National Mathematics Examination, SMP Muhammadiyah 5 Surakarta was rated 56 out of 84 public and private schools in Surakarta City (Balitbang, 2022).

Numerous internal and external elements, as well as internal factors, have an impact on poor mathematics learning outcomes. The internal factors originate from within each student and are responsible for the poor learning outcomes in mathematics. These elements significantly impact a person's achievement, one of which is the capacity for problem-solving, known as the adversity quotient (AQ). The research findings of Pambudi et al. (2016)indicated that AQ has a similar impact on students' learning achievement in mathematics. In line with this, Rukmana et al. (2016) research

indicates that AQ has a 43.1% influence on mathematics learning outcomes, with other variables having a 56.9% influence.

Another element is external to the students, such as a less appealing learning model, inadequate learning resources and facilities, and an unappealing learning environment. Because conventional learning models feel more realistic in planning to implementation and how learning is currently carried out in daily life, teachers prefer to employ them while instructing their students.

The Team Assisted Individualized (TAI) variety of cooperative learning approaches becomes another option. Siswanto and Palupi's (2013) study found that when the TAI learning model is used, students are more likely to participate in discussions and offer their opinions on the subject matter. Additionally, learning the TAI model is said to produce higher math learning accomplishments than learning it directly, according to research by (Pambudi et al., 2016).

Three hypotheses underlie this study: 1) There are differences in mathematics learning outcomes among class VII students at SMP Muhammadiyah 5 Surakarta using the Jigsaw, TAI, and conventional learning models; 2) There are differences in mathematics learning outcomes based on students' AQ levels; and 3) There is an interaction between the learning models (Jigsaw, TAI, and conventional) and students' AQ level on mathematics learning outcomes. The three goals of this study are to 1) compare the significant differences in mathematics learning outcomes between the Jigsaw and TAI learning models, 2) compare the significant differences in mathematics learning outcomes according to students' AQ levels, and 3) analyze the relationship between learning models and students' AQ levels in terms of mathematics learning outcomes.

METHODOLOGY

A quantitative methodology is used in this research. This study used a non-equivalent control group and a quasi-experimental design or a quasi-experimental design with a post-test alone. According to Sutama (2019), a true experiment is developed into a quasi-experimental design because doing a true experiment is practically challenging. Sugiyono (2017) defines a quasi-experiment as an experiment that includes experimental units and impact measurements but excludes random samples. Three classes —two experimental classes and one control class— were used

as samples in this study. Students in the first experimental class use the jigsaw learning model, those in the second experimental class use the TAI learning model, and those in the control class use the traditional learning model.

A validity test and a reliability test are used in the testing method for the instrument. Using the Product Moment Correlation calculation to assess the test's and the questionnaire's validity. The Cronbach's Alpha formula was used for the test, and the questionnaire's reliability test. This study's data analysis method involved the analysis of variance in two different cell pathways. The normality test and the homogeneity test, which are necessary tests for the analysis of variance, were completed before the analysis. The data normality test aims to ascertain whether or not the data derived from the study findings are regularly distributed. The Liliefors test was utilized in this study's normality test, which had a 5% significance level. The homogeneity test is used to assess whether or not the variances of several populations are similar. The Bartlett method is employed for the homogeneity test with a significance level of 5%.

RESULTS AND DISCUSSION

Before the third-class sample was given treatment, especially the formerly balance test, to ensure that class experiment and class control could have the same start or balanced, based on the calculation of anava test one path, it can be concluded that the experimental class and control class have the same initial ability before treatment.

This research was conducted in four meetings. At the end of the meeting, namely the fourth meeting, students were given an evaluation test for learning mathematics results. The mathematics learning outcomes test is used to obtain data on student learning outcomes. After the data was obtained, the students' mathematics learning outcomes were tested for normality and homogeneity as a condition for testing the hypothesis with a two-way analysis of variance. Test results show that the data are normally distributed and homogeneous.

After the data collected is declared normally distributed and homogeneous, hypothesis testing is carried out by testing variance analysis of two unequal cell paths. The calculation results can be summarized as follows:

Table 1 Results of Two-Way Analysis with Dissimilar Cells

Source	JK	DK	RK	F_{obs}	F_{table}	Decision
Models (A)	2407.55	2	1203.78	9.003	3.138	H_0 Rejected
AQ (B)	5446.26	2	2723.13	20.365	3.138	H_0 Rejected
Interaction (AB)	1694.98	4	423.74	3.169	2,513	H_0 Rejected
Error	8691.51	65	133.72	-	-	-
Total	18240.3	73	-	-	-	-

Based on Table 1, the researcher can interpret the results of the two-way analysis of variance with unequal cells as follows:

The test between rows (A) is obtained. The two-way analysis of variance with unequal cells shows that H_{0A} is rejected, indicating differences in mathematics learning outcomes in using different learning models. Test between column (B), the analysis of two-way variation with unequal cells results shows that H_{0B} is rejected, indicating differences in mathematics learning outcomes in terms of the level of student adversity quotient. The interaction test (AB) obtained the results of the analysis of two-way variation with unequal cells showing $H_{0\mathrm{AB}}$ was rejected, indicating an interaction between the learning model and the adversity quotient of students on mathematics learning outcomes.

Based on the test decision on the two-way analysis of variance with unequal cells, it was found that H_{0A} was rejected, H_{0B} was rejected, and $H_{0\mathrm{AB}}$ was rejected. It is necessary to do a multiple comparison test using Scheffe' method for comparison double determine formerly the mean of each cell and the marginal mean, which results in Table 2.

Table 2 Average Learning Outcomes

Learning model	Student Adversity Quotient			
	Climbers	Climbers	Climbers	Climbers
Jigsaw	77,500	56,727	39,636	57.955
TAI	51.167	49,800	43,833	48,267
Conventional	56,250	39,818	32,300	42,789
Marginal Average	61,639	48,782	38,590	

The first hypothesis shows that H_{0A} is rejected, then there are differences in the effects of the jigsaw, TAI, and conventional learning models on students' mathematics learning outcomes. A double comparison test was carried out between rows to determine the difference between these effects. After conducting comparative test calculation, double on average between lines.

From the multiple comparison test that was carried out, the results $H_0: \mu_1 = \mu_2$ were rejected, so there were differences in the results of learning mathematics in students who were given learning using the jigsaw learning model and the TAI learning model. By paying attention to the marginal mean of the jigsaw learning model of 57.955 and the TAI learning model of 48.267, it can be concluded that students who are taught using the jigsaw learning model have better mathematics learning outcomes than the TAI learning model. $H_0: \mu_2 = \mu_3$ accepted, then there is no difference in mathematics learning outcomes for students who are taught using the TAI learning model and the conventional learning model. $H_0: \mu_1 = \mu_3$ rejected, then there are differences in learning outcomes of mathematics in students who are given learning using the jigsaw learning model and the conventional learning model. By paying attention to the marginal mean of the jigsaw learning model of 57.955 and the conventional learning model of 42.789, it can be concluded that students who are given learning using the jigsaw learning model have better mathematics learning outcomes compared to conventional learning models.

These results are under the results of research from Pambudi, et al. (2016) entitled Experimentation of Jigsaw Type Cooperative Learning Models and Team Assisted Individualized (TAI) in Two Variable Linear Equation System (SPLDV) Materials because of Adversity Quotient (AQ) Class VIII State Junior High School Students throughout Karanganyar Regency for the 2015/2016 Academic Year. It concluded that the Jigsaw type cooperative learning model resulted in better mathematics learning achievement than mathematics learning using the TAI type cooperative learning model and direct learning model. Besides, the results are also relevant to the research of Mohammadi and Davarbina (2015), who concluded that the learning outcomes of students who applied the Numbered Head Together and Jigsaw learning models were more effective in improving learning outcomes compared to conventional instructions.

In line with the research of Wijayanti (2012) entitled Experimentation of Mathematics Learning with Jigsaw and TAI Strategies Judging from the Prerequisite Ability of Students of SMP Negeri 1 Tangen for the Academic Year of 2011/2012, which stated that the jigsaw learning strategy was better than the TAI learning strategy.

The conditions in the field support this. Based on exposure before, the results of this study are already under the hypothesis put forward by the researcher.

The second hypothesis stated that based on the results of the analysis of research data, it was concluded that there were differences in mathematics learning outcomes between students with the adversity quotient level of climbers, campers, and quitters. The results of this study are in accordance with the results of research from Pambudi, et al. (2016), which states that students with the AQ Climber category have better learning achievements than students with AQ Campers and Quitters, while students with AQ Campers have better learning achievements than students with AQ Campers. AQ Quitter. In line with Leonard's research (2014) entitled The Effect of Adversity Quotient (AQ) and Critical Thinking Ability on Mathematics Learning Achievement, which concluded that there was a significant positive effect of AQ on mathematics learning achievement.

Multiple comparison tests on mean between columns using the Scheffe method, the results $H_0: \mu_1 = \mu_2$ are rejected, so there are differences in mathematics learning outcomes for students who have AQ climbers and AQ campers. Considering the marginal mean of AQ climbers of 61,639 and AQ of campers of 48,782, it can be concluded that students who have AQ climbers have better mathematics learning outcomes than students who have AQ campers. $H_0: \mu_2 = \mu_3$ rejected, then there is a difference in mathematics learning outcomes for students who have AQ campers and AQ quitters. By paying attention to the marginal mean of AQ campers of 48.782 and AQ of quitters of 38.590, it can be concluded that students who have AQ campers have better mathematics learning outcomes than students who have AQ quitters. $H_0: \mu_1 = \mu_3$ rejected, then there are differences in learning outcomes of mathematics in students who have AQ climbers and AQ quitters. Considering the marginal mean of AQ climbers of 61,639 and AQ of quitters of 38,590, it can be concluded that students who have AQ climbers have better mathematics learning outcomes than students who have AQ quitters.

The third hypothesis, with a two-way analysis test with unequal cells, obtained 0 is rejected, then there is an interaction between the learning model and the level of student adversity quotient on students' mathematics learning outcomes. A double comparison test was carried out between cells in the same row and column to find out

the interaction. After conducting comparative test calculation double on average between cells in the same column and row, we get results analysis only there is one denial, that is, in the test between cells on the same row Among $\mu_{11} = \mu_{13}$. Then there are differences in mathematics learning outcomes for students with AQ climbers and AQ quitters who were given learning using the jigsaw learning model. By paying attention to the cell mean of the first row - the first column of 77,500 and the first row - third column of 39,636, it is concluded that the jigsaw learning model for students with AQ climbers' level has better mathematics learning outcomes than students with AQ quitters' level.

This result is in line with research conducted by Budiada (2011); Lubis et al. (2017); Pratama & Sani (2016), all of which concluded that there was an interaction between AQ and the learning model applied to improve student learning outcomes. The comparison test or further test on this third hypothesis results from the comparison test for the mean between cells in the same row and column.

CONCLUSION

Three conclusions were drawn after discussion and data analysis. The jigsaw, TAI, and traditional learning models have different implications for students' learning outcomes in mathematics. The outcomes of mathematics learning are affected differently by the teaching processes using Jigsaw, TAI, and traditional models. Math learning outcomes for students using the Jigsaw learning model are typically superior to those using TAI and traditional learning techniques. Second, there are differences in the learning results for mathematics among kids who are climbers, campers, and quitters when faced with difficulty. In other words, the outcomes of arithmetic learning are influenced by the various AQ levels of students. In terms of learning outcomes in mathematics, climbers' AQ levels are higher than campers' and quitters' AQ levels. The AQ level of students who stay in school is higher than that of students who drop out. In other words, the outcomes of pupils' mathematics learning are influenced by their AQ. Third, the learning model and the degree of students' adversity quotient affect students' learning results in mathematics.

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