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Elevating natural science learning achievement: Cooperative learning and learning interest

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ABSTRACT

Natural science learning achievement is an essential factor in learning outcomes. This research investigated an experimental study that aimed to improve concept science test result in online learning through Jigsaw cooperative learning model and learning style. The research involved the sample of 80 students from junior high school in South Jakarta, Indonesia divided into two groups: the experimental class and the class control. Raw data were statistically analyzed using the two-way variance technique at the .05 significance level. The findings revealed an effect between cooperative learning on natural science learning achievement, learning interest in natural science learning achievement, and interaction between cooperative learning and learning interest in natural science learning achievement. As a result, cooperative learning type Jigsaw shows a significant impact and had a good test result on natural science learning achievement. Therefore, the research suggests that Jigsaw cooperative learning is well suited to use as a learning model among junior high school students based on effect size test results.

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1. INTRODUCTION

In general, studying natural sciences at the junior level is insufficient due to a lack of understanding of scientific concepts. Poor learning design contributes to poor learning outcomes in the natural sciences [1]. Low performance in science learning is caused by two factors: internal factors in students such as health, interests, and intelligence, and external factors beyond the student's control such as home environment, community, teachers and learning models, and learning facilities [2]. The Pisa 2018 results of Indonesian science obtained a score of 396, while the average world score was 489, and China was ranked first with a score of 590 [3].

The data show that Indonesian students' mastery of concept science is unsatisfactory; thus, this research uses learning activities based on cooperative learning that interacts with learning interests. The availability of various learning models has improved students' cognitive and affective learning [4]. Students become bored due to a monotonous learning strategy, resulting in poor learning outcomes [5]. One of the results of a lack of learning interest is a low learning achievement [6]. The cooperative learning models provide students with learning experiences that can enable them to learn better [7]. The application of these models' trains students to express their opinions and collaborate in personal interactions in group processes [8]. Students have different learning styles [9]; motivation, engagement and learning interests in a subject varies as well [10].

Learning achievement correlated to the results of students' efforts in achieving maximal learning outcomes [11]. The effectiveness of learning is evaluated with continuous assessment or academic test, under the achievement of applicable success standards [12], [13]. Learning achievement is one of the important components of learning in an educational system [14]. High learning performance students generally correlate with high learning attitudes and desires [15], [16]. In other words, that learning achievement results from students' efforts in learning with an evaluation that achieves a certain passing grade.

A cooperative learning model is a learning strategy that divides students into groups to discuss and work together in understanding the subject matter guided by the teacher to achieve learning goals [17], [18]. Cooperative learning type Jigsaw is a learning model involving students thinking actively about abilities, emotions, and skills [8]. Jigsaw cooperative learning in the classroom can improve the understanding and discovery of the concept of the material studied [19]. In this collaborative method learning model each student is part of groups: the original and the expert group. In the expert group, each student has a material responsibility [20]. The expert group comes from members of the original group, who have the information to be explained to the original group [21].

One of the learning models for increasing student involvement in learning is problem-solving [22]. It is a learning model that focuses on problems that students must solve [23]. This is also a learning method that trains students to solve problems and provides students with the necessary metal schemes to use the concept of thinking at a higher level [24]. A problem-solving learning model is essentially a learning model that focuses on the material associated with the problem, which students must solve with cognitive abilities learned in advance.

Students show learning interest to comprehend the subject matter [25]. Students' learning interests manifest as positive learning habits [10]. Appropriate learning models are associated with increased student learning interest [26]. Students show learning interest by studying more diligently [27], [28]. Students who would like to learn will spend their free time studying natural science wherever they are [29]. Students show learning interest by studying hard, doing tasks, and always attempting to understand the subject matter delivered by the teachers in the classroom.

Interaction Jigsaw and learning interest is to find out the difference in the average value of two categories. There is a significant interactive influence of the Jigsaw learning model with learning interest [30]. If there is an interactive influence then continue the Tukey test. Tukey test in ANOVA is to determine the level of trust [31]. Concerning the background of the research above, the following research questions are formulated to determine the purpose of this research and show the importance of natural science learning achievement in learning outcomes: i) Is cooperative learning affecting students' performance in science learning achievement?; ii) Is there an effect of learning interest on students' natural science learning outcomes?; iii) Is there a relationship between the interaction influence of cooperative learning model and learning interest students' science on learning achievement?

The determination of the effect size of Jigsaw cooperative learning is a novel aspect of this study, which includes the research hypotheses: i) Cooperative learning has a significant impact on natural science learning outcomes (h_1); ii) Natural science learning achievement is significantly influenced by learning interest (h_2); iii) Cooperative learning and a learning interest interaction have a significant effect on natural science learning achievement (h_3).

2. RESEARCH METHOD

With a research sample of 80, this study was an experiment in which two study groups of students from class VIII junior high school in South Jakarta, Indonesia were given different types of treatment. The first group was the experimental group, which received natural science instruction via cooperative learning Jigsaw. The second group served as a control group for natural science learning using cooperative learning problem-solving. Because the research variable is treatment, a two-way ANOVA was used in the study. Each class was then divided into teams of two students based on their level of learning interest: high and low. Tests were given to both classes with the same instrument at the end of the treatment, and the results were analyzed and compared. Google Classroom has been used for learning activities, as well as the division of student groups, namely the initial group and experts. At each session, teachers can assist with group activities and provide directions as needed.

For learning interest, a Likert scale has been used as research instruments in questionnaires, and natural science learning achievement, an essay test with 20 questions about Household Chemistry; Uses and Side Effects of Chemicals; Natural and Artificial Chemicals. The study was carried out in the odd semesters of 2021/2022. Deployment of instrument learning was accomplished by using a Google Form and instrument essay tests and answers through a WhatsApp group. The research instruments are tested for validity and reliability, the factorial research designs 2 x 2 treatments by level, as shown in Table 1.

Table 1. Research design

Learning interest		Cooperative learning		Total
		Jigsaw (A1)	Problem solving (A2)	∑ B
High	(B1)	A1B1	A2B1	∑ B1
Low	(B2)	A1B2	A2B2	∑ B2
	∑ A	∑ A1	∑ A2	AxB

Note:
A1B1: Natural science learning achievement score high learning interest students with Jigsaw
A1B2: Natural science learning achievement score of low learning interest students with Jigsaw
A2B1: Natural science learning achievement score of high learning interest students with problem solving
A2B2: Natural science learning achievement score of low learning interest students with problem solving

3. RESULTS AND DISCUSSION

For the requirements for data analysis in research, the data must be normal and homogeneous. Data normality testing with the One-Sample Kolmogorov-Smirnov SPSS 24 test with n=80 in Normal Parameters at Asymp. Sig.2-tailed)>.05, the test conclusion distribution is normal. The variance test homogeneity result employs a Levene population with a significance level (=0.05), concluding homogeneous data with Sig.>.05, as shown in Table 2 while Table 3 shows the analysis results of testing with the ANOVA SPSS program showed that Sig.<.05 proved all hypotheses were significant.

Table 2. Test of homogeneity of variances

Dependent variables: Natural science achievement			
Levene Statistic	df1	df2	Sig.
2.047	3	76	.114

Tests the null hypothesis that the error variance of the dependent variable is equal across groups
a. Design: Intercept + A + B + A * B

Table 3. Tests of between-subjects effects

Dependent Variables: Natural science learning achievement					
Source	Type III Sum of squares	Df	Mean square	F	Sig.
Corrected model	81.737[a]	3	27.246	6.167	.001
Intercept	501019.513	1	501019.513	113410.225	.000
A	35.113	1	35.113	7.948	.006
B	27.613	1	27.613	6.250	.015
A * B	19.013	1	19.013	4.304	.041
Error	335.750	76	4.418		
Total	501437.000	80			
Corrected Total	417.487	79			

a. R Squared = .196 (Adjusted R Squared = .164)

The first findings from the research intended to answer the first research question: the influence of cooperative learning on students' performance in science education at Jakarta's 8th grade Junior High Schools. According to the results of the analysis of the table test effects between the subjects in Table 3, which state that the p-value for the cooperative training model was .006 (0.05), there was a significant difference in natural science learning achievement using the learning model cooperative Jigsaw and Problem-solving. The Jigsaw learning model performed better than the type problem-solving model, with a score of 79.80>79.48. The findings of this study are relevant, indicating that cooperative learning strategy has a positive influence on students' achievement at STIKON Surabaya [32]. Cooperative learning strategies positively affect student achievement in Aceh Besar senior high schools [33]. According to meta-analysis research, cooperative learning affects students' learning achievement [34].

The second results are to answer the second research question: The influence of learning interest on students' natural science learning outcomes, 8th grade Junior High schools in Jakarta. The analysis results on the table Test of Between-Subject Effects in Table 3 notes that the p-value for learning interest was .015 (0.05), there was a significant difference in natural science learning achievement using learning interest. The average score on the learning interest test (High and Low) was A1B1=79.90; A2B1=79.55 and A2B1=79.70; A2B2=77.40. Previous research has found that learning interest positively affects the chemistry of learning outcomes in Jogjakarta public high schools [26]. Learning interest has a positive effect on learning achievement in Pangkajene elementary schools [10].

The third results are used to answer the third research question: the interaction influence of cooperative learning model and learning interest students on learning achievement, 8th grade Junior High schools in Jakarta. Based on the analysis results on the table Test of Between-Subject Effects in Table 3, which notes that the p-value for learning interest was .000 (0.05), it means that interactive, cooperative learning and learning interest significantly influenced natural science learning achievement. Cooperative learning and learning interest had an interactive influence on students' learning achievement at Kebumen Central Java Junior High School [35]. Similarly, based on Table 3, it is possible to conclude that the use of cooperative learning and learning interest contributes 19.6 % to students' learning achievement at a junior high school in South Jakarta.

Based on the third result, the search for significance influence requires further tests then conducted in post-hoc or Tukey tests on variables. Then the results of Tukey test calculations with SPSS 24. Table 4 shows the Post-hoc or Tukey score tests in the natural sciences. Based on the Tukey test result, the pair has a meaningful difference at the .05 was: A1B1 and A2B2; A1B2 and A2B2; A2B1 and A2B2; A2B2 and A1B1; A2B2 and A1B2; A2B2 and A2B1 because they have sig values. <.05.

Table 4. Multiple comparisons

Dependent variables: Natural science achievement Tukey HSD						
(I) Post hoc	(J) Post hoc	Mean difference (I-J)	Std. error	Sig.	95% Confidence interval	
					Lower bound	Upper bound
A1B1	A1B2	.20	.665	.990	-1.55	1.95
	A2B1	.35	.665	.952	-1.40	2.10
	A2B2	2.50*	.665	.002	.75	4.25
A1B2	A1B1	-.20	.665	.990	-1.95	1.55
	A2B1	.15	.665	.996	-1.60	1.90
	A2B2	2.30*	.665	.005	.55	4.05
A2B1	A1B1	-.35	.665	.952	-2.10	1.40
	A1B2	-.15	.665	.996	-1.90	1.60
	A2B2	2.15*	.665	.010	.40	3.90
A2B2	A1B1	-2.50*	.665	.002	-4.25	-.75
	A1B2	-2.30*	.665	.005	-4.05	-.55
	A2B1	-2.15*	.665	.010	-3.90	-.40

Based on observed means.
The error term is Mean Square (Error) = 4.418
*. The mean difference is significant at the .05 level.

The following conclusions can show the additional test described above based on the test information in Table 4: First, there was Jigsaw and a high-interest learning group (A1B1) and a low-interest learning group (A1B2), and the Mean Difference is (.20)., Since the difference between the scores of (A1B1) and (A1B2) did not have a significant value .990>.05, this implies that there is no difference between (A1B1) and (A1B2). Students are not required to master specific cognitive abilities; the Jigsaw learning model prioritizes responsibility in learning so that students with high and low learning interests share the same responsibility. In this case, Jigsaw cooperative learning is a learning model in which students are responsible for the subject matter. Students must understand the learning material as simply as possible and be able to explain it to their friends [36].

Second, it shows that the mean Difference amounted to (2.30) in the problem solving cooperatively and high-interest learning group (A2B1) and the problem solving cooperative learning and low-interest learning group (A2B2), indicating that the difference between the scoring average of (A2B1) and (A2B2) was a significance value .010<0.05, implying that (A2B1) and (A2B2) differ significantly. Students who are disinterested in class lack the motivation to learn [37]. When compared to students who are enthusiastic about learning, this will result in lower learning achievement.

Third, in the Jigsaw and a high-interest learning group (A1B1) and a problem-solving learning group and high-interest learning (A2B1), the Mean Difference is (.35), indicating that the difference between the scores of (A1B1) and (A1B2) was not significant. A significance value .952>.05 can be interpreted (A1B1) and (A1B2) did not have a significant value. These findings can be explained by the fact that students who are enthusiastic about learning in any learning model will work hard to learn. Interest in learning has the ability to control one's desire to learn [37].

Fourth, it discovered that the mean Difference amounted to (2.30) in the Jigsaw cooperative learning and low-interest learning group (A1B2) and the problem-solving cooperative learning and low-interest learning group (A2B2), indicating that the difference between the scoring average of (A1B2) and (A2B2) was a significance value .005<0.05, implying that (A1B2) and (A2B2) differ significantly. This demonstrates

students who have a low interest in learning that Jigsaw method is superior to problem-solving, even though their interest in learning is also low.

To achieve the best learning outcomes, a teacher must consider the size effect of the method when selecting a learning model. Furthermore, to avoid misinterpretation, learning models should be used first to familiarize students with the new method. Based on experimental data collection, we will calculate the use of Jigsaw and problem-solving in learning activities in this research. The magnitude of the effect size, defined as the strength of the relationship in test results between the control and experiment classes [35]. Becker further said that effect size is defined as the difference in the average score of test results from the experimental and control classes divided by the combined standard deviation [36]. Becker went on to say that the effect size should be calculated using the formula Effect Size: D=$\frac{Xe-Xk}{Spooled\ D}$ with D=Effect Size Cohen; Xe=Mean Experimental group; Xk=Mean Group control; Spooled=Combined Standard Deviation. While the Spooled D value uses the formula=$\sqrt{\frac{(n1-1)sd_1^2+(n2-1)sd_2^2}{n1+n2}}$; the large classification of small effect size is: D<.15 (Negligible); .15<D≤.40 (small effect size); .40<D≤.75 (enough); .75<D≤1.10 (High enough); 1.10<D≤1.45 (high); D>1.45 (very high) [38].

From the data in Table 5, it shows a value of D=.6037 (.40<D≤.75: enough) with the conclusion that the Jigsaw cooperative learning model has enough effect size. Thus, Jigsaw cooperative learning can be used as a natural science learning model in junior high schools.

Table 5. Descriptive statistics

Dependent variables: Natural science achievement				
Cooperative learning	Learning interest	Mean	Std. Deviation	N
Jigsaw	High	79.90	2.654	20
	Low	79.70	1.949	20
	Total	79.80	2.301	40
Problem solving	High	79.55	1.820	20
	Low	77.40	1.875	20
	Total	78.48	2.124	40
Total	High	79.73	2.253	40
	Low	78.55	2.218	40
	Total	79.14	2.299	80

4. CONCLUSION

The use of Jigsaw learning models is an effort to increase understanding of a subject. Based on the theory, Jigsaw cooperative learning can increase students' learning activities in the classroom that emphasize the learning process, although there is an influence of learning interest in achieving learning outcomes. The study concluded that Jigsaw cooperative learning is the appropriate learning model to be implemented in junior high school compared to the method of learning problem solving. Jigsaw revealed better test results and a reasonably good effect size.

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