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The Effectiveness of the Two Stay Two Stray (TSTS) Cooperative Learning Model Compared to the Jigsaw Type on Students' Science Learning Outcomes

Siti Nur Faiqoh[1*], Sri Sami Asih[1]

[1]Primary Teacher Education, FIPP, Universitas Negeri Semarang, Semarang, Indonesia.

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Corresponding Author:
Siti Nur Faiqoh
nurfaiqoh9819@students.unnes.ac.id

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Abstract: The mismatch of models and objectives causes students' learning outcomes to vary. This study aims to determine the effectiveness of the Two Stay Two Stray (TSTS) cooperative learning model compared to the Jigsaw type in improving the learning outcomes of science students on the human digestive system material for class V SDIT Mutiara Hati Rembang. This study uses an experimental research type with a quasi-experimental research design in the form of Non-Equivalent Control Group Design. The sample in this study amounted to 54 students. The sampling technique used purposive sampling. Class VB as the control class and class VA as the experimental class. The data collection technique used a test technique in the form of pretest and posttest questions; non-test techniques in the form of interviews, observations, and documentation. The data analysis technique consists of initial data analysis in the form of normality tests and homogeneity tests and final data analysis in the form of t-tests and N-Gain tests. Based on the t-test, the sig. value is 0.013 (<0.05) meaning that Ho is rejected and Ha is accepted. So, there is a significant difference in the effectiveness of the application of the TSTS and Jigsaw learning models on the learning outcomes of science students for class V SDIT Mutiara Hati Rembang. Furthermore, based on the results of the N-Gain test, the control class was 0.46 and the experimental class was 0.56. In conclusion, the TSTS learning model is more effective than Jigsaw on social science learning outcomes.

Keywords: Effectiveness; Learning Outcomes; Social Science; Jigsaw; Two Stay Two Stray

Introduction

Education plays an important role in the life of the nation. Education is a way to share expertise, insights, and knowledge with someone (Zamiri & Esmaeili, 2024). Education also continues to innovate for effective and appropriate education systems, program structures, and learning models (Serdyukov, 2017). Education is a place for people to live their lives. The extent to which education is obtained will affect the course of human life in the future. Thus, education is a primary need for humans. This is in line with what is stated in the National Education System Law No. 20 of 2003 Chapter I Article 1 Paragraph 1, namely education is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential to have spiritual religious strength, self-control, personality, intelligence, noble morals, and skills needed by themselves, society, nation, and state. Schools as educational institutions hold the main priority in carrying out learning activities. The quality of learning is the main key to improving human resources (Sri, 2022). By implementing the learning process, it is expected to be able to create students who are independent, capable, pious towards God Almighty, able to build themselves, cultured, and contribute to society.

Elementary school is a basic educational institution that plays an important role in providing students with

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basic abilities such as skills, knowledge, and attitudes so that they can be used as guidelines when continuing higher education. In carrying out learning activities, it is expected to be in accordance with the environment, characteristics of students, and background. The teacher's ability to explain material to students determines the success of learning which includes the ability to prepare lesson materials competently and convey knowledge to students (Hollenstein & Brühwiler, 2024). In addition, teachers must be creative in delivering material to students so that pupils do not become bored rapidly and learning becomes fun.

Learning is a process of interaction between instructors and students equipped with learning resources in the environment where learning activities take place (Sejati et al., 2019). In carrying out learning activities, it cannot be separated from the curriculum. That education needs to be based on a curriculum so that education can be of good quality, in the learning process the curriculum plays a role as an important element and becomes the main foundation. Consistent with this viewpoint, (Sejati et al., 2019), argues that the curriculum needs to be evaluated in accordance with developments in the era by paying attention to dynamic, innovative, and continuous aspects. Currently, the curriculum has undergone several changes. In dealing with the transition of various stages of the curriculum, teachers usually utilize formal or theoretical knowledge and personal practical knowledge (Kwangmuang et al., 2021), Indonesia itself has implemented the Independent Curriculum in education. (Dasmo et al., 2023), are of the view that the Independent Curriculum is a varied intracurricular learning that provides students with optimal space to explore competencies and concepts. One of the impacts of the implementation of the Independent Curriculum is the combination of science and social studies subjects into Natural and Social Sciences (IPAS) with the hope that students will be able to understand the existence of the natural and social environment simultaneously (Otto & Pensini, 2017). Natural and Social Sciences are sciences that focus on the study of living things and inanimate objects in the universe and their interactions with their surroundings. In addition, this subject also studies human life as social beings who interact with their surroundings. In learning activities, science attempts to enhance students' curiosity in performing studies on occurrences in the surrounding environment and can play a role in maintaining, caring for, and preserving resources in the surrounding environment properly and optimally (Azzahra et al., 2023). Currently, classroom learning tends to be less encouraging for students' activeness, especially in science learning in elementary schools.

The role of students is only as recipients of material from the teacher, while the teacher dominates the learning activities in the classroom. This situation makes students easily bored and tired due to learning that does not encourage student interest due to the lack of innovation in learning models and teacher creativity. In addition, students tend to only memorize the subject matter presented by the teacher. This results in a lack of activeness in students in learning and lack of mastery of the material so that their learning outcomes are low. To overcome this problem, a teacher must be innovative in creating enjoyable learning. A smart learning environment can create chances for students to actively participate in learning (Adler et al., 2025). Teachers need to create active, interesting, and non-boring learning so that students are more interested in learning a subject matter. This shows the need for effective strategies to achieve learning objectives so that students might gain knowledge or science more optimally and meaningfully (Darling-Hammond et al., 2024).

The learning model is based on learning theory which is then implemented into a learning model. Thus, each learning model reflects a learning theory, which learning theory arises from the philosophy of learning. This is in line (Mahayanti et al., 2024). who argued that designing a learning model has several objectives including ways of thinking, teaching information concepts, and studies related to social values. By implementing the right learning model, it can improve student learning outcomes. Some forms of learning outcomes are intellectual abilities, verbal information, attitudes, motor skills, and cognitive strategies (Vong & Kaewurai, 2017). The results of learning science at SDIT Mutiara Hati Rembang in class V vary, such as some getting high scores and some getting low scores. Regarding the low results of learning science, this is in line with several problems encountered during learning science.

According to interviews with class V homeroom instructors, the cause of low grades in science topics among class V pupils was their passive learning attitudes. In class V science learning at SDIT Mutiara Hati, the class V homeroom teacher stated that he had carried out science learning in groups but only discussions and presentations. Group activities are also rarely done and when in groups, only a few students tend to actively discuss so that learning like this is less effective because it is likely that other students are passive and do not understand the material related to science and natural sciences. In addition, teachers use more lecture methods in explaining the material so that students do not master the subject matter. In addition, based on initial observations that researchers conducted on students, several problems were obtained related to science and natural sciences learning for grade V at SDIT

Mutiara Hati Rembang, including many students who are less interested in science and natural sciences learning, teachers use lecture methods more often than group activities so that students become passive, students are less active in asking and answering questions during science and natural sciences learning, students become bored and tired of the learning model used by the teacher, making the classroom environment unconducive. Students are less able to understand the science and natural sciences material taught by the teacher due to the learning model, which does not encourage students to participate.

With several problems that occur, of course, it will affect students' science and natural science learning outcomes, for this reason, a varied learning model is needed, such as a cooperative learning model. The cooperative learning model is a learning technique that is implemented by encouraging students to work together to attain learning objectives (W. Johnson & T. Johnson, 2019). The cooperative learning model has steps, namely conveying a learning goal and motivating students, providing information, organizing students in groups, providing guidance to student learning groups, carrying out the evaluation process, and giving awards. One of the keys to the cooperative learning model is the establishment of social interaction between students (Hortigüela Alcalá et al., 2019); (Sjølie et al., 2022). Students are invited to share ideas, communicate, and work together to solve problems. The cooperative learning model that will be implemented in this study is the Two Stay Two Stray (TSTS) and Jigsaw learning models.

The TSTS cooperative learning paradigm involves students establishing groups, then discussing and exchanging the outcomes of their conversations with other groups, after which each group is assigned the job of being the guest team and the presentation team. The TSTS learning model is able to encourage student activity during learning in class. This is because in learning activities, all students are actively involved (Une et al., 2023). Students will be more likely to do speaking and listening activities directly. With this Two Stay Two Stray learning approach, all students must endeavor to gain and absorb material since they will later be required to explain the information received to other group members, ensuring that all students participate in group activities. Student-centered learning can provide opportunities to gain more experience so that learning outcomes can improve (Sari & Indarini, 2021). This cooperative learning model also provides lessons for students to be able to work together and socialize with their friends.

Jigsaw type cooperative learning is a cooperative learning model that is implemented by students taking turns and answering questions in a group (Diza Jusriani & Ibrohim Muchlis, 2023); (Maielfi & Wahyuni, 2020). This learning strategy will help pupils understand and recall the subject content more quickly. Through this Jigsaw learning paradigm, success in learning is attained not only by the teacher, but also by other parties in learning, one of which is the student's peers. Thus, this study intends to adopt the TSTS and Jigsaw type cooperative learning models in the science topic of the human digestive system, with the objective of increasing student activeness in learning so that students may more readily retain the material in order to improve science learning results. The reason for choosing the human digestive system material is so that students are more active in understanding various concepts in the human digestive system. In addition, the use of the TSTS and Jigsaw learning models is expected to achieve meaningful learning and student-centered or constructivist learning.

The researcher will compare the level of effectiveness of the Two Stay Two Stray learning model compared to Jigsaw in improving the learning outcomes of science subjects on the human digestive system of class V SDIT Mutiara Hati Rembang. It is envisaged that the Two Stay Two Stray (TSTS) and Jigsaw learning models will be able to create a pleasant learning environment and boost knowledge of the material contained in a game. One element that is anticipated to enhance the learning results of class V students at SDIT Mutiara Hati Rembang is the application of the Two Stay Two Stray and Jigsaw learning models. One of the teacher's responsibilities is to carry out activities that aim to create learning opportunities for pupils; it is desired that students would actively participate in learning activities. In addition to choosing a learning model, teachers must be able to recognize and understand each student's qualities. Students can help to design and implement effective and engaging learning activities to maximize their learning results.

Based on the findings in the above description, the researcher is interested in conducting a study named "The Effectiveness of the Two Stay Two Stray (TSTS) Cooperative Learning Model Compared to the Jigsaw Type on Students' Science Learning Outcomes". Hopefully, this study will be able to evaluate the science learning outcomes of students who used the Two Stay Two Stray (TSTS) learning model to the Jigsaw learning model.

Method

This study was conducted as an experiment, with a quasi-experimental research design in the form of a Non-Equivalent Control Group. At the start of the learning process, the control and experimental classes

were given a pretest to determine their initial abilities before implementing learning activities in both courses. The control class was treated with the Jigsaw learning model, whereas the experimental class received therapy with the Two Stay Two Stray learning model. At the conclusion of the learning activity, a posttest was held to determine the difference in learning outcomes between before receiving treatment and after receiving treatment. The following is a quasi-experimental design that can be seen in Table 1.

Table 1. Research design

Group	Pretest	Treatment	Posttest
Experiment	O_1	X_1	O_2
Control	O_3	X_2	O_4

Information:
O1: pretest experimental class
O2: posttest experimental class
O3: pretest control class
O4: posttest control class
X1: treatment in the experimental class using the Two Stay Two Stray learning model
X2: treatment in the control class using the Jigsaw learning model

The treatment in this study was carried out when learning science on the human digestive system material with the following learning outcomes (CP): CP: Students carry out simulations using simple pictures/charts/tools/media about the human body organ system (respiratory/digestive/circulatory system) which are associated with how to properly maintain the health of their organs. The sample used in this study was all fifth grade students of SDIT Mutiara Hati Rembang as many as 54 students. Class VA as many as 28 students and class VB as many as 26 students. The sampling technique in this study was purposive sampling which was based on considerations after discussing with the fifth grade teacher. VB students as the control class with the Jigsaw type learning model, and VA students as the experimental class with the Two Stay Two Stray type learning model.

This study used two variables, namely, the first independent variable is the Two Stay Two Stray learning model (X1) and the second independent variable is the Jigsaw learning model (X2). While the dependent variable in this study is the results of learning science (Y). The hypothesis in this study is that there is no significant difference in the effectiveness of the application of the Two Stay Two Stray (TSTS) and Jigsaw learning models on the results of learning science of class V SDIT Mutiara Hati Rembang (H0); there is a significant difference in the effectiveness of the application of the Two Stay Two Stray (TSTS) and Jigsaw learning models on the results of learning science of class V SDIT Mutiara Hati Rembang (Ha). The data collection techniques in this study consisted of test and non-test techniques. The test technique involved providing pupils 25 pretest and posttest questions. Before the questions were given to the control class and the experimental class, the researcher conducted a trial of the questions first. The findings of the validity, reliability, difficulty level, and discrimination tests yielded 25 questions adequate for study implementation. Non-test procedures used in this study included interviews, observations, and documentation. In this study, data is analyzed initially using normality and homogeneity tests. Furthermore, final data analysis included the t-test and the N-Gain test.

Result and Discussion

Based on the results of the research that has been undertaken at SDIT Mutiara Hati Rembang, which comprises of class VB as a control class and VA as an experimental class, there are several things that will be discussed in the results and discussion, including: pretest and posttest used to assess students' scientific learning results; normality test of pretest and posttest data in the control and experimental classes; pretest and posttest data homogeneity test for the experimental and control groups; hypothesis test with independent samples t-test for the control and experimental classes; N-Gain test in the control and experimental classes. Student learning outcomes in this study were obtained from the pretest and posttest scores in the control and experimental classes. Table 2 shows student learning results based on pretest and posttest scores in the control and experimental classes.

Table 2. Learning Outcomes of Control Class and Experimental Class

Information	Pretest		Posttest	
	Experiment	Control	Experiment	Control
Number of Students	28	26	28	26
Average	50	48	79.86	74.62
Maximum Score	76	72	96	88
Minimum Score	20	20	68	64
Students Who Completed	2	1	24	19
Learning Success	7%	4%	86%	73%

Table 2 indicates that students in the experimental class, which received treatment using the Two Stay Two Stray (TSTS) learning model, had higher average learning outcomes based on pretest and posttest scores than the control class, which received treatment using the Jigsaw learning model. The researcher employed the SPSS version 25 application to perform the normality test. Before the control class and the experimental class were given treatment, both classes were given pretest questions first. After being given treatment, the control class and the experimental class were given posttest questions. A normality test was used to determine whether or not the learning outcomes of SDIT Mutiara Hati Rembang's class V pupils were normally distributed. Table 3 shows the results of the pretest and posttest normality tests.

Table 3. Results of Pretest and Posttest Normality Tests

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Class	Statistics	df	Sig.	Statistics	df	Sig.
Learning outcomes	Pretest Experiment	0.092	28	0.200	0.975	28	0.718
	Control Pretest	0.160	26	0.084	0.946	26	0.182
	Experimental Posttest	0.144	28	0.142	0.940	28	0.110
	Control Posttest	0.156	26	0.101	0.934	26	0.098

The normality test findings in Table 3 show that the significant value of the control class pretest with the Kolmogorov-Smirnov technique is 0.084 and the experimental class is 0.200. Using the Shapiro-Wilk method, the significance value of the control class pretest data is 0.182, while the experimental class has a significance value of 0.718. Furthermore, the significant value for the control class posttest data using the Kolmogorov-Smirnov method is 0.101, while the experimental class is 0.142. Using the Shapiro-Wilk method, the significant value of the control class posttest is 0.098, while the experimental class is 0.110. In conclusion, the significant value of the pretest and posttest data in the control and experimental classes is more than 0.05 in both the Kolmogorov-Smirnov and Shapiro-Wilk methods. Thus, the pretest and posttest data are normally distributed. After that, in this study, a homogeneity test was conducted using the SPSS version 25 application. The homogeneity test was applied to the students' pretest and posttest findings to determine whether or not the data variance was homogeneous. Table 4 shows the following homogeneity test results.

Table 4. Results of the Pretest and Posttest Homogeneity Test

Learning outcomes		Levene Statistic	df1	df2	Sig.
Based on Mean	Pretest	0.744	1	52	0.392
	Posttest	1.441	1	52	0.235

According to the above-mentioned homogeneity test results, the pretest's significance value in the control and experimental classes was 0.392, while the posttest's significance value in the control and experimental classes was 0.235. Thus, if the significant value of the pretest and posttest data of the control and experimental classes is more than 0.05, H0 is accepted, indicating that the data is homogeneous and there is no variation in data variance between the control and experimental classes. The findings of the precondition test show that the data in this investigation are normally distributed and homogeneou. This means that to test the hypothesis, an independent sample t-test can be used. In testing the hypothesis, this study uses student learning outcomes in the form of posttest scores to determine the difference in the effectiveness of the Two Stay Two Stray learning model compared to the Jigsaw type on the learning outcomes of class V science. To test the hypothesis, this study uses a hypothesis test in the form of an independent sample t-test and N-Gain. The following are the results of the independent sample t-test with the SPSS version 25 application which can be seen in Table 5.

The independent sample t-test results in Table 5 show a significant (2-tailed) value of 0.013, which is less than 0.05 (0.013 <0.05). So, we can conclude that H0 is rejected and Ha is accepted. This suggests that the control and experimental classes had significantly different average scientific learning outcomes. The study concludes that the effectiveness of using the Two Stay Two Stray (TSTS) and Jigsaw learning models on the learning outcomes of class V SDIT Mutiara Hati Rembang differs significantly. The next test conducted in the study was the N-Gain test. This N-Gain test was performed to examine whether or not there was an increase in the average learning outcomes of students in the control and experimental classes. This test is performed to determine the average growth in the two classes prior to and following treatment. This N-Gain test was carried out using the SPSS version 25

application. Table 6 shows the difference in average student scientific learning results between classes VA and VB at SDIT Mutiara Hati, Lasem District, Rembang Regency, based on pretest and posttest data.

Table 5. Results of the Independent Sample T-Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Interval of the Difference	
									Lower	Upper
Result	Equal variances assumed	1.1441	0.235	2.580	52	0.013	5.24176	2.03164	1.16497	9.31855
	Equal variances not assumed			2.603	50.674	0.012	5.24176	2.01357	1.19851	9.28501

Table 6. Results of the Average Increase Test (N-Gain)

Class	Average			
	Pretest	Posttest	N-Gain	Category
Experiment	50	79.86	0.56	Medium
Control	48	74.62	0.46	Medium

Table 6 shows a rise in the average outcomes of learning science in the control class, with pretest and posttest results of 0.46, which falls into the moderate range. Meanwhile, in the experimental class, there was an increase in the learning science findings from the pretest and posttest of 0.56, which falls into the moderate range. Thus, the Two Stay Two Stray (TSTS) learning model is more effective than the Jigsaw learning model on the results of learning science at SDIT Mutiara Hati Rembang. The following graphic depicts the growth in the results of learning science from the pretest and posttest of the control and experimental courses, as shown in Figure 1.

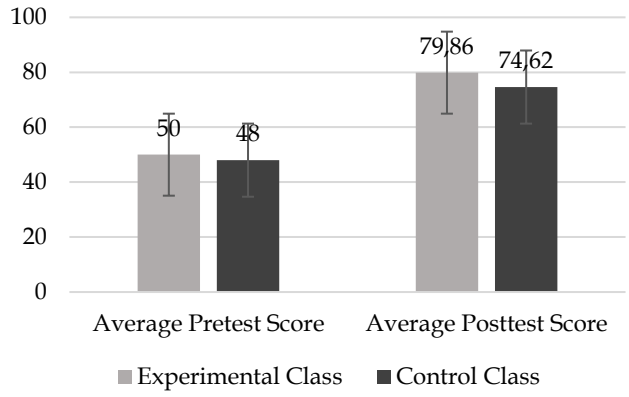

Figure 1. Diagram of Improvement in Pretest and Posttest Learning Outcomes

According to the diagram in Figure 1, the control class and the experimental class have nearly the same learning ability, but the experimental class that received the Two Stay Two Stray learning model treatment experienced a higher average increase in learning outcomes compared to the control class that received the Jigsaw learning model treatment, which is consistent with the research conducted by (Astuti & Radia, 2023); (Rahayu et al., 2020), our research results revealed that the use of the Two Stay Two Stray learning model was more successful on the scientific learning outcomes of grade V elementary school pupils than the Jigsaw learning model. Another finding that is in line is the research conducted by (Alti et al., 2023), whose research results stated that the character of responsibility of grade V elementary school students using the Two Stay Two Stray learning model was significantly higher than the Jigsaw learning model. Thus, based on the findings of the current study, which are supported by previous research, it is possible to conclude that the Two Stay Two Stray (TSTS) learning model is more effective than the Jigsaw learning model in improving the science learning outcomes of grade V SDIT Mutiara Hati Rembang students. In learning activities, of course, an effective and engaging learning model is required.

(Vermunt & Donche, 2017); (Chaudhary & Singh, 2022); (Gligorea et al., 2023), argues that there are several aspects to consider in choosing a learning model, including the nature of the material to be studied, the amount of student ability, and the competencies to be obtained. One of the learning models is the cooperative learning model. Cooperative learning is a strategy in learning that involves student collaboration in achieving common goals (Hasanah & Himami, 2021); (Yang, 2023). Cooperative learning can improve behavior in group

work in elementary school students (Veldman et al., 2020); (Dzemidzic Kristiansen et al., 2019). In achieving learning objectives, this study will apply the Two Stay Two Stray and Jigsaw cooperative learning models. Both cooperative learning strategies have their own pros and downsides. The Two Stay Two Stray learning model can be implemented in all subjects and for all levels of education (Aji & Wulandari, 2021); (Respati & Qohar, 2021); (Ekayani et al., 2020), noted that the Two Stay Two Stray learning model is a learning process carried out in groups with the purpose of students being able to work together to solve challenges, be responsible, and encourage each other to be able to excel.

The Two Stay Two Stray learning model has the advantage of focusing on student thinking activity, can be implemented at all levels or classes, learning becomes meaningful, encourages student motivation and learning outcomes, gives students the opportunity to determine concepts in solving problems, improves communication skills and creativity, students become more open to friends, and student learning motivation increases. Meanwhile, the disadvantages of the Two Stay Two Stray cooperative learning methodology include its extended implementation period, there are some students who are less interested in learning in groups, requires a long preparation, and requires expertise in managing the class (Tong et al., 2022); (Le et al., 2018). According to (Gede Widayana & Kevin Balsono, 2023), the Jigsaw learning model involves student activity in a democratic and open learning atmosphere to be able to develop their attitudes, knowledge, and skills.

The Jigsaw learning model also has advantages and disadvantages when applied during learning (Antara et al., 2024). The Jigsaw learning model has advantages, namely that it can create students' ability to think critically and structured, provide students with opportunities to exchange ideas so that they gain broad knowledge, and train students to be confident in expressing their opinions. Meanwhile, the disadvantages of the Jigsaw learning model are that it takes a long time to implement, class conditions become unconducive when forming groups, and students who are less active will depend on active students (Sukmawati et al., 2023); (Kamaludin & Sundarasen, 2023); (Brown et al., 2024).

Conclusion

There is a notable difference in the effectiveness of applying the Jigsaw and Two Stay Two Stray (TSTS) learning models to the learning outcomes of class V SDIT Mutiara Hati Rembang, according to the results and discussions that have been presented. The findings of the independent sample t-test analysis demonstrate this, with a sig. (2-tailed) value of 0.013 which is less than 0.05 (0.013 <0.05). Consequently, Ha is approved and H0 is refused. Furthermore, the average control class increased by 0.46 while the experimental class increased by 0.56 according to the N-Gain test results. Therefore, when it comes to SDIT Mutiara Hati Rembang's learning results, the Two Stay Two Stray (TSTS) learning model outperforms the Jigsaw learning model.

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Conflict of Interest

The author's interest in the publication of this article is as a form of proof of performance in the form of research outputs in the form of publications in scientific journals that have been required. There is no conflict of interest whatsoever.

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