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Numerical Ability Analysis: The Impact of the Two Stay-Two Stray Learning Model on the Sequence and Series Topic in Islamic Boarding School

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Abstract. Numerical ability is very important to possess by students in learning mathematics. Increased numerical ability impacts learning outcomes. The purpose of this study was to determine the impact of the Two Stay-Two Stray learning model on the numerical ability of students on the sequence and series topics. The research method used was a quasi-experimental method with a post-test-only control design research design. The assessment instrument used the problem description. Based on the analysis of the post-test score by using a t-test of two uncorrelated samples obtained $t_{observed} = 2.955 > t_{critical} = 2.002$ ($\alpha = 0.05$) with an average post-test score of 81.6 in the experimental class and 76 in the control class. A significant result of numerical ability between the control class and the experimental class was found. It can be concluded that the Two-Stay Two-Stray model produced a greater post-test mean score than the conventional model.

1. Introduction

Mathematical learning is expected to make students have good numerical abilities, such as counting and thinking logically when working on math problems [1,2]. Numeric ability related to quickly and precisely in calculating the basic mathematical calculation operations [1,3]. This ability is important possessed by every student in the process of learning mathematics because it also affects the ability to solve mathematical problems [2]. Therefore, the teacher must help in increasing students' numerical abilities [4].

The reality at this time many students who have difficulty in learning mathematics because of the low numerical ability possessed [2]. The stages of mathematics learning implemented currently do not involve students yet actively in the learning process [5]. As a result, the process of learning mathematics in schools is only memorized and not training the mindset of students. Teachers should improve learning patterns and seek innovation in the process of learning mathematics [3, 6]. The problem of the learning process that often heard is the learning activities with learning methods which still centered on the teacher and not yet variation in the learning model [7]then we need a learning model that allows students to be able to support their abilities and encourage students in the learning

process [8]. One model of cooperative learning that can be applied is the Two Stay-Two Stray learning model.

Two Stay-Two Stray learning model is a learning model in which two students who live in groups provide information to group members who visit, then two other students visit other groups to look for information, after visiting, students return to the original group to discuss the results of information obtained from other groups [9, 10]. Several studies have shown that the Two Stay-Two Stray learning model is better than conventional learning models [10]. The Two Stay-Two Stray learning model can be applied to mathematics learning, such as in sequence and series topic [11]. Sequence and series topic is one topic that requires a variety of solutions [12], so we need good skills to teach them [13]. Many students find it difficult to learn the topic of sequence and series, especially in understanding the concept of the tribe in the sequence, difficulty understanding the main problem so that students are difficult to write down what is known and determining the steps of solving problems about the sequence and series [14]. For this reason, research is needed to improve students' ability to solve problems related to sequences and series topics.

Various studies on the Two Stay-Two Stray learning model have been studied because this model has a positive impact on learning, which can improve learning outcomes [15–19] mathematical communication skills of students [10] concept understanding [20] and various other mathematical abilities [21–35]. Research on the relationship of numerical ability in students has also been carried out by previous researchers [1, 2, 36–38]. Based on previous research, we are interested in researching with the renewal that seeing numerical abilities using the Two Stay-Two Stray learning model. We know that not yet previous research has examined the numerical ability by applying the Two Stay-Two Stray learning model. Then, the purpose of this study is to determine the impact of the Two Stay-Two Stray learning model on students' numerical ability on the sequence and series topics.

2. Research Method

The type of research method in this study is a quasi-experimental study with a post-test only control design. The research design is depicted in Figure 1.
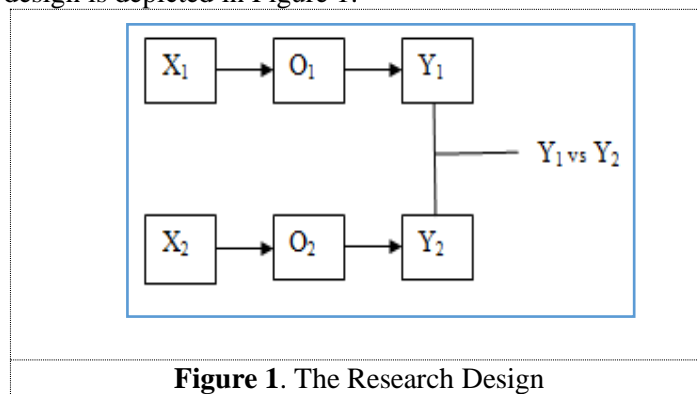
Figure 1. The Research Design

X_1= Experimental Class
X_2= Control Class
O_1= Treatment with the Two Stay-Two Stray model
O_2= Treatment with Conventional models
Y_1= Experimental class using the Two Stay-Two Stray model
Y_2= Control class using Conventional models

The final test after the learning method called the post-test. Data collection techniques in this study using a description test. To test the research hypothesis, we used the t-test for two-sample uncorrelated. Before conducting the hypothesis test, a prerequisite test is carried out, namely the normality test and the homogeneity test [39].

Assumptions for normality test:

H_0: normally distributed data

H_1: not normally distributed data

Test: If $L_{Count} \leq L_{Table}$ then, H_0 is accepted, so both data are normally distributed.

Assumptions for homogeneity test:

H_0: homogeneous data

H_1: not homogeneous data.

Test: If the value of $\chi^2_{count} \leq \chi^2_{table}$ then H_0 is accepted, so both data are homogeneous.

After the normality and homogeneity tests are carried out, it will be continued with the test for two-samples correlated with the formulation of the right-side test hypothesis as follows:

Variable:

μ_1: numerical abilities that apply the Two Stay-Two Stray model

μ_2: numerical abilities that apply the Conventional model

Hypothesis test:

$$H_0: \mu_1 \leq \mu_2$$
$$H_1: \mu_1 > \mu_2$$

Test: If $t_{count} \leq t_{table}$, then H_0 is accepted.

3. Results and Discussion

Based on the research design, the results of the statistical analysis of the post-test numerical ability of students in sequence and series topic as in Table 1.

Table 1. Data of numerical ability post-test

Groups	X_{max}	X_{min}	Measuring Central Tendency			Measuring of Group Variance	
			$\bar{x}$	M_o	M_e	R	Sd
Experimental	96	72	81.6	76	80	24	7.093
Control	88	64	76	68	76	24	7.575

Based on post-test data, the highest value in the experimental class is 96 and the control class is 88, while the lowest value in the experimental class is 72 and the control class is 64. The average in the experimental class is 81.6 which is greater than the average of the control class that is equal to 76. It can be concluded that the post-test of the experimental class treated with the Two Stay-Two Stray learning model is higher than the control class that treated with a conventional approach.

Before the t-test is carried out, the prerequisite test is the normality test and homogeneity test first. A normality test is used to determine whether the data is normally distributed or not. The results of the normality test of the post-test data group are presented in Table 2.

Table 2. Normality test results of post-test

Groups	L_{count}	L_{table}	Test Decision
Experimental	0.152	0.159	H_0 is accepted
Control	0.135	0.159	H_0 is accepted

Based on normality test results that summarized in Table 2, the experimental group with L_{count}=0.152 and L_{Table}= 0.159, then H_0 is accepted. For the control class group with L_{count}= 0.135 and L_{Tabel}= 0.159 then H_0 is accepted. In each group, $L_{count} \leq L_{table}$, so the null hypothesis for each group is accepted [40]. So it can be concluded that the data in each group come from populations that are normally distributed. Then the homogeneity test will be carried out. The variance-test of data in this study used the Bartlett test. Calculation of homogeneity test data of students in each group with the homogeneity test of the post-test, with a significance level (α)= 5% have listed in Table 3.

Table 3. Homogeneity test of post-test

Groups	χ^2_{count}	χ^2_{tabel}	Test Decision
X_1 and X_2	0.125	3.481	H_0 is accepted

Based on Table 3, it was found that the homogeneity test for the experimental class and the control class had $\chi^2_{count} = 0.125$ and χ^2_{table}= 3.481. Because of $\chi^2_{count} \leq \chi^2_{table}$ then H_0 is accepted, so it can be concluded that the sample came from the same population variance. Because of the results of the normal distribution test indicate that the data come from normally distributed populations and the homogeneity test shows that the data come from the same population variance, further testing is needed, namely the parametric test or t-test with two-samples uncorrelated [41]. The data tested is the result of the post-test of numerical ability with sequence and series topics. The results of the calculation of the two sample uncorrelated t-tests can be seen in Table 4.

Table 4. The t-test of post-test for two-sample uncorrelated

Groups	t_{count}	t_{table}	Test Decision
X_1 and X_2	2.955	2.002	H_0 is accepted

Based on data analysis, it can be concluded that t_{count} =2.955 and a significance level of (α)= 5% is obtained t_{table}= 2.002 so, $t_{count} > t_{table}$ indicating that H_0 is rejected. Thus, it can be said that there is a significant difference in the average value of the post-test results between the numerical ability of the experimental class and the control class. So it can be concluded that the Two Stay-Two Stray learning model is better than the conventional learning model. Two Stay-Two Stray learning model is a learning model in which two students who live in a group provide information to group members who visit, then two other students visit other groups to look for information, after visiting students return to the original group to discuss the results of the information obtained from other groups. The learning stages of the Two Stay-Two Stray consist of 3 stages as describe in Figure 2:

Figure 2. Stages in Two Stay-Two Stray learning model
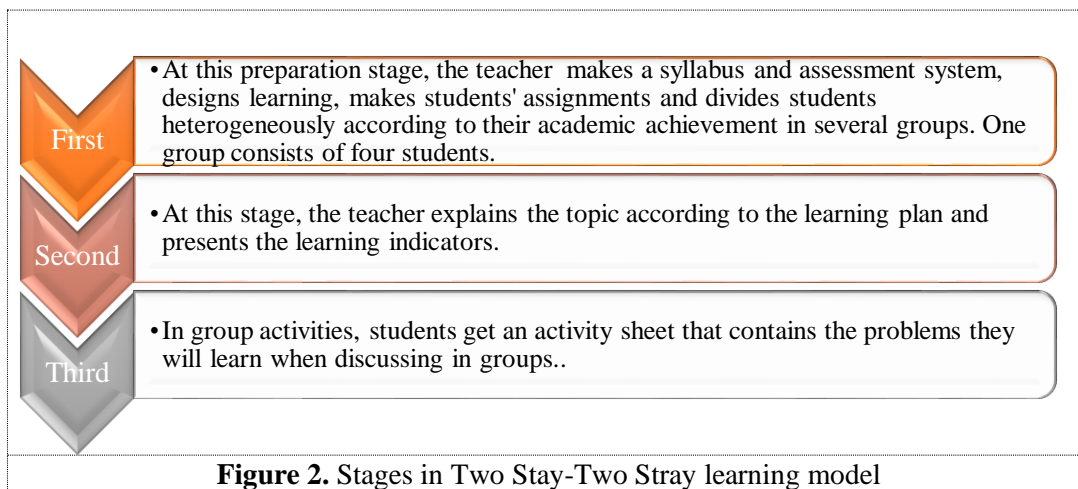
After getting an activity sheet that contains problems related to the concept of the topic and its classification, students discuss and study it in groups. The group learning procedure follows the steps: (1) Students work together in groups (2) Two group members are guests to the other two groups. (3) Two people in the group are tasked with distributing work results and information to guests. (4) Guests excuse themselves and return to the original group and provide information from other groups. (5) Each group discusses the results of their work. The scheme for changing group members in this learning method is as follows in Figure 3 (to facilitate explanation, the case is discussed for the number of students of twelve people).
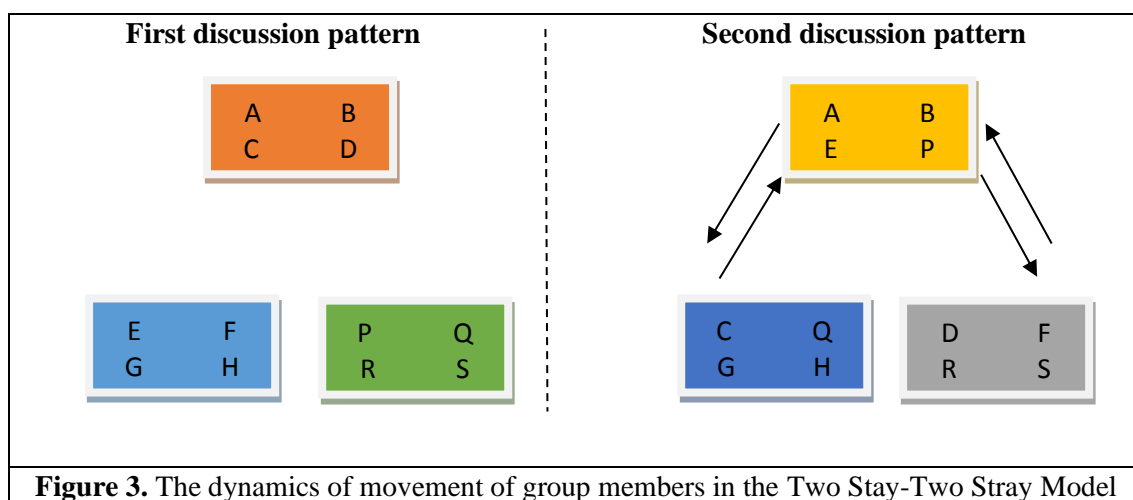
Figure 3. The dynamics of movement of group members in the Two Stay-Two Stray Model

After discussing to solve the problems on the activity sheet, one group can present the results of their group work to be discussed with other groups. Then the teacher directs the students and discusses the results of the activity sheet. At the last are group evaluation and appreciation. Each student is given a question containing questions that correspond to the topic that has been learned then the teacher gives a gift or award to the group that answers with the highest score. This stage aims to find out how much students understand the topic by applying the Two Stay-Two Stray learning model.

The strengths of the Two Stay-Two Stray learning model are that it is easily broken down into pairs, more tasks can be done, teachers are easy to monitor, can be applied to all classes / levels, learners' learning tendencies become better, they are more oriented to activeness, it is expected that brave learners expressing their opinions, increasing students 'cohesiveness and confidence, students' speaking abilities can be improved and help improve interest and learning achievement [42]. During the learning process using the Two Stay-Two Stray model, participants are more active in following

the learning process. Students recall the concepts that have been learned first and then provide information to other group members, so students can be better to understand the concept and easier to remember the lesson. Students' responses to the Two Stay-Two Stray learning model have a positive response and this shows that students are interested in the Two Stay-Two Stray learning model in line and series topic.

Students' interest in the Two Stay-Two Stray learning model can be seen based on the learning atmosphere when the learning model is applied, participants feel happy and look active in delivering topic to their friends, and students easily understand what their friends are saying, helping students communicate well with participants other students, as well as making students motivated in learning by using the Two Stay-Two Stray learning model on sequence and series topic [43]. Based on the process that has been done, activities between students who live the same as the activities of students who visit because both of them get the same topic and able to understand the same topic. After the learning topic is finished, the students are given a post-test so that the researcher can find out whether there is an influence of the Two Stay-Two Stray learning model on the numerical ability of students [44]. In the Two Stay-Two Stray learning model, some students do not respond when reviewing concepts, questions, and answers about the topic that has been previously discussed. Besides, another student still afraid to express opinions and still rely on friends. At the stage of concluding, students respond well because they can understand the learning topic. The process of learning control class with conventional models runs well and some students are active in asking questions when educators explain the topic or when given questions about the practice of sequence and series topic, but some participants chatted while the educator explained the topic and when the students recorded the topic. There are differences in the activities of students during the learning process, there are those who try and actively ask questions during the learning process or to work on problems, but there are also students who are not focused, chatting and only see the results of their friends' answers without trying to work on the problem, the same as the experimental class, participants students in the control class were given a post-test question after the learning topic was completed [45].

The Two Stay-Two Stray learning model makes students more active in understanding subject topic finding information. Students recall the concepts that have been learned first and then provide information to other group members, so students can better understand the concept and easier to remember the lesson. Students can discuss with other groups so that they get more input or criticism and get lots of knowledge. The stages in the Two Stay-Two Stray learning model are as follows Preparation, at this stage, the teacher makes a syllabus and assessment system, designs learning, makes students' assignments and divides students heterogeneously according to their academic achievement in several groups. One group consists of four students. Teacher presentation, At this stage, the teacher explains the topic by following the learning plan and presents learning indicators[46]. Group activities, In group activities, students get an activity sheet that contains the problems they will learn when discussing in groups [47], After getting an activity sheet that contains problems related to the concept of material and its classification, students discuss and study it in groups of four students [48]. Formality, after discussing to solve the problems on the activity sheet, one group can present the results of their group work to be discussed with other groups, then the teacher directs students and discusses the results of the activity sheet. Group evaluation and awards, each student is given questions containing questions that are in accordance with the topic that has been studied than the teacher gives a gift or award to the group that answers with the highest score, this stage aims to find out how much students understand the material with the application Two Stay-Two Stray learning model.

Based on this, students with the application of the Two Stay-Two Stray learning model produce better numerical abilities than students who applied conventional learning. By the results of this study which states that students who obtain the Two Stay-Two Stray learning model are better than students who obtain conventional learning of numerical ability [49]. The results of this study are in line with the results of previous studies which show that the TSTS model has a good effect on the learning process. Research conducted by Astuti obtained statistical analysist_{count}= 3.057 andt_{table}=1.994 with

= 0.05. then$H_0$is rejected and$H_1$is accepted [50]. With the acceptance ofH_1, it means that student mathematics learning outcomes through the TSTS type cooperative learning model is better than student mathematics learning outcomes using conventional learning models [19]. Research conducted by Yunus whose results indicate that students' mathematical communication skills can be increased by learning with the TSTS model [10]. Research by Asmawati showed that the average learning outcomes in learning LC 5E and TSTS assisted by LKPD were higher than expository learning [9].

4. Conclusions

Based on the results of the study and discussion of the post-test values by t-test for two uncorrelated samples were obtained t_{count} = 2.955 >t_{table} = 2.002 (α = 0,05) with an average post-test value of the experimental class 81.6 and a control class 76, after t-test two uncorrelated samples obtained significant results between the average value of the numerical ability of the control class and the experimental class. It can be concluded that the Two Stay-Two Stray model produces a better post-test average value than conventional models.

Based on the conclusion of this research, several suggestions for future researchers can be proposed, it is expected to be able to study the problem with a wider range for the development of science in the world of research, which should in future research try to improve other abilities, especially in the field of mathematics using the cooperative learning model TSTS type (Two Stay-Two Stray).

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