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Research Article

Numerical Skills Analysis Gifted Young Scientists: The Impact of the Team Assisted Individualization (TAI) Learning Model

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Abstract

Indonesia has many gifted young scientists, who need to get support and good opportunities to work. Numerical ability is one element that must be mastered in mathematics. This study aims to determine the effect of numerical ability of students who take part in learning using the Team Assisted Individualization (TAI) learning model with those who follow conventional learning models. The type of research is quasi experimental design. The instrument used to test numerical ability on the topic of sequences and series is an essay. Data were analyzed from the results of the posttest using t-test. Based on the calculation, obtained that t_{count} of 3,977 and t_{table} of 2,005, it can be concluded that t_{table} = table means that the Team Assisted Individualization (TAI) learning model has a good impact on the numerical ability of students.

Keywords

Indonesia's gifted young scientists ,Team Assisted Individualization (TAI), numerical ability, sequence and series

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Introduction

A biochemist from the United States Bruce Alberts said, Indonesia has many gifted young scientists, who need to get support and good opportunities to work. Bruce Alberts is a biochemist, President of the National Academy of Sciences (NAS) for the period 1993-2005, and special envoy for science by Indonesia by President Barack Obama in 2009-2011. Before serving as NAS President, Alberts spent more than 30 years of his career as a researcher. The book "Molecular Biology of the Cell", his work along with six other researchers, became textbooks used by many universities in various parts of the world (Hartati, Purnama, Heriati, & Kinarya, 2019). Bruce Alberts said that most of Indonesia's gifted young scientists received doctorates from other countries, such as Germany, Japan, Britain, and others. They continue to return to their homeland and become young professors at various universities, even though they know that the total funding for research in science in their country is very small when compared to other countries (Figure 1).

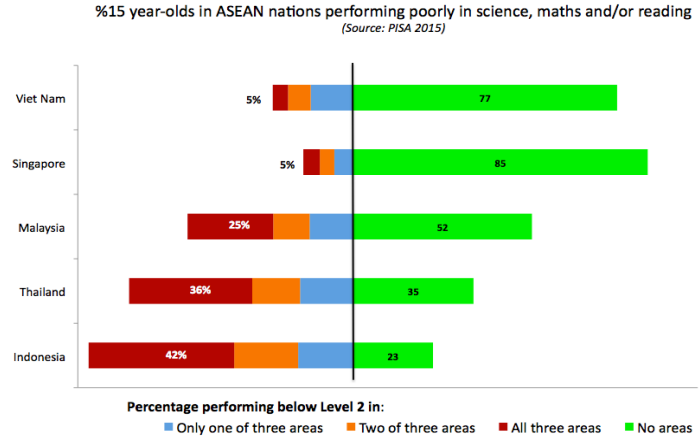

Figure 1

Comparison of Performing Poorly in Science, Math, and Reading

One of the influential factors in the achievement of mathematics learning is numerical ability (Leder, 2019). Students will have difficulty learning mathematics if they do not have sufficient numerical abilities (Ramadhani, Huda, & Umam, 2019). This means that numerical ability has an important role in the achievement of learning mathematics (Ahmed, 2016). Numerical ability is a special ability to calculate that affects the ability of students to understand and solve mathematical problems (Hartinah et al., 2019). Numerical ability is the ability to work in numbers to understand concepts related to numbers, as well as abilities related to accuracy and speed in using basic calculation functions so that the better the numerical ability of students (Ozsoy, 2019), the better also in understanding the concepts expressed in the form of numbers and it is easier to think and solve problems with numbers (Huda et al., 2019). The correlation between high numerical ability in

mathematics with results for the field of study is quite high, meaning high numerical ability cause high learning outcomes (Torii & Carmen, 2013), and vice versa low numerical ability causes learning outcomes are also low (Sumarni et al., 2019). Based on the elaboration of the numerical abilities of students need to be considered in supporting success in learning mathematics (Becker, Lauterbach, Spengler, Dettweiler, & Mess, 2017). The Previous research can illustrate the relationship between numerical ability and student learning outcomes (Munifah et al., 2019), numerical ability as a benchmark in mathematics learning achievement (Abdurrahman et al., 2019), The development of students' mathematical abilities can be seen from their numerical ability and learning achievement, as well as to improve the ability to solve mathematical problems (Habibi et al., 2019). Numerical ability in previous research has never been associated with the TAI learning model (Ulger, 2018), so researchers intend to examine the numerical ability with the TAI learning model.

TAI learning model is a learning model that combines cooperative learning with individual learning, the model that provide opportunities for students to solve problems individually before and after discussing with the group, students have the task of correcting the answers of a group of friends and providing assistance to group members experiencing difficulties. According to (Stacey & Garbic, 2006) TAI is a cooperative learning model where students work individually to complete mathematical assignments with curriculum topics using their teaching (Diani et al., 2019). Based on the explanation, the TAI learning model is an alternative to increase the numerical ability of students. The previous research found that TAI learning model can be improve learning outcomes, the quality of the process and learning achievement, the ability of understanding and solving mathematical problems (Munifah et al., 2019), student activity and learning outcomes, and competence (Rahmawati, Lestari, & Umam, 2019).Besides, TAI can positively change students' attitudes towards mathematics, as well as the TAI learning model affect mathematics learning achievement (Sondergaard & Ryberg, 2018). In this paper, we develop research in terms of students' numerical abilities using the TAI learning model to selecting the effectiveness of learning models and to examine students' numerical abilities through the sequences and series lessons.

Numerical abilities can be assessed through teaching Sequences and series lesson to students (Sagala, Umam, Thahir, Saregar, & Wardani, 2019), because the sequence and series topic includes indicators contained in numerical abilities namely algebraic, arithmetic and series (Sriyakul et al., 2019). The previous research found that sequence and series lesson can improve numerical and problem solving abilities simultaneously (Muhamad Syazali et al., 2019), also can improve student activities and learning outcomes (America, Role, Chac, Giancarlo, & Orozco, 2019). Besides that, sequence and series topics are able to develop learning tools based on problem solving oriented to the mathematical reasoning and

communication skills (Balsa, 2019). Therefore, the researcher would like to observe the impact of the Team Assisted Individualization (TAI) learning model on the numerical ability of students using sequences and series topics.

Problem of Study

Numerical ability is one part of counting operations in mathematics and is very needed in solving problems in mathematics. Numerical ability is the ability, accuracy, and accuracy in counting and usually the tests being tested are mathematical and numerical sequence. Numerical ability is very closely related to the level of intelligence and knowledge of a student. The intended knowledge includes ideas, concepts, and understandings that have been possessed by humans. Numerical ability is very helpful for students in understanding material, analyzing each problem, and applying mathematical concepts in everyday life and students do not experience difficulties in learning.

Basically the numerical ability of students is different, there are students so high in numerical intelligence and there are vice versa so that it affects the course of learning. Based on the above thinking, the authors see that students' numerical ability is a factor that can affect student learning outcomes in mathematics. Therefore, the authors intend to examine and prove the influence of numerical ability on mathematics learning outcomes of young students who excel in school.

Methods

Research Design

This study uses a quasi-experimental method by designing research objects in the control group and the experimental group (Sumintono & Widhiarso, 2014).Test parameters seen from the results of the posttest. This research design can be seen in Figure 2.

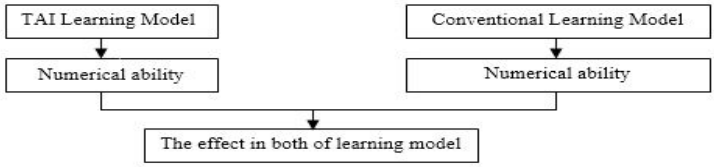

Figure 2.

Research Design of TAI Learning Model and Conventional Learning Model

Participants

This population is all of the class XI Senior High School (SMA) classes in Bandar Lampung where there are 3 schools that have gifted students. From 3 schools randomly selected samples, one class as an experimental class, and one class as a control class. In the experimental class there were 20 female students and 12 male students, while in the control class there were 21 female students and 10 male students.

Data Collection Tools

The research instrument was an essay and documentation of numerical ability. The description test includes questions based on indicators of numerical ability that are tested on students who have studied sequence and series topic. Then, the test results are analyzed to determine the validity, reliability, level of difficulty and distinguishing power.

Validity test uses the product moment correlation formula, namely:

$$r_{xy} = \frac{n\sum_{i=1}^{n} X_i Y_i - (\sum_{i=1}^{n} X_i)(\sum_{i=1}^{n} Y_i)}{\sqrt{(n\sum_{i=1}^{n} X_i^2 - (\sum_{i=1}^{n} X_i)^2)(n\sum_{i=1}^{n} Y_i^2 - (\sum_{i=1}^{n} Y_i)^2)}}$$

The value of r_{xy} is the value of the correlation coefficient of each item or item item before being corrected. Then look for the corrected item-total correlation coefficient with the following formula:

$$r_{x(y-1)} = \frac{r_{xy}\, S_y - S_x}{\sqrt{S_y^2 + S_x^2 - 2r_{xy}\,(S_y)(S_x)}}$$

Information:

r_{xy} = the value of the correlation coefficient on item to -i before being corrected

X_i = the value of the respondent's answer to the question to-i

Y_i = the total value of respondents to-i

n = the number of test takers

S_y = total standard deviation

S_x = standard deviation of items to-i

$r_{x(y-1)}$ = corrected item-total correlation coefficient

The value of $r_{x(y-1)}$ will be compared with the table correlation coefficient $r_{table} = r_{(\alpha,n-2)}$. Jika $r_{x(y-1)} \geq r_{table}$, then the instrument is valid (Novalia & Syazali, 2014).

Reliability testing uses the Alpha formula. The Alpha formula referred to is:

$$r_{11} = \left(\frac{n}{n-1}\right)\left(1 - \frac{\sum S_i^2}{S_t^2}\right)$$

Information:

r_{11} = Test reliability coefficient

n = The number of items that were issued in the test

$\sum S_i^2$ = The sum of the variance scores for each item

S_t^2 = Total score variance.

In this study, the tools used to analyze using SPSS software.

Data Analysis

Data were analyzed using statistical methods. Hypotheses were tested using t-tests to see the impact of learning models on numerical ability. The impact can be measured by calculating the effect size. The effect size is explained in the Cohen formulation in the following equation.

$$d = \frac{\bar{x}_1 - \bar{x}_2}{S_{gab}}$$

$$S_{gab} = \sqrt{\frac{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2}{n_1 + n_2 - 2}}$$

$\bar{x}_1$ = mean of the experimental class group
$\bar{x}_2$ = average control class group
n_1 = number of sample experimental classes
n_2 = number of control class samples
S_1^2 = experimental class group variance
S_2^2 = experimental control class group variance.

The effect size calculation according to Cohen is divided into several criteria as in table 1

Table 1.

The Categories of Effect Size

The number of d	Categories
$0.8 \leq d \leq 2.0$	Large
$0.5 \leq d \leq 0.8$	Medium
$0.2 \leq d \leq 0.5$	Small

Based on Table 1, the criteria for effect size of the large category are at the interval $0.8 \leq d \leq 2.0$, the medium category is at the interval $0.5 \leq d \leq 0.8$ and the small category lies at the interval $0.2 \leq d \leq 0.5$. This aims to measure whether the TAI learning model has a large, medium, or small impact.

Process

Based on the theory of the learning model Team Assisted Individualization (TAI) is a learning model that adapts learning to individual differences in students academically and in the learning process can increase students' knowledge, abilities, and motivation by group learning. This learning model students are divided into teams consisting of four or five people with different levels of intelligence, where students examine each other's answers, test, and help each other so that they are able to work on problems and solve them. The end of learning is given a quiz (posttest) to see how students understand the material being taught, besides that in the learning process it is necessary to emphasize the attitude of cooperation and mutual help to get answers to a problem. This is a good exercise to develop students' numerical abilities.

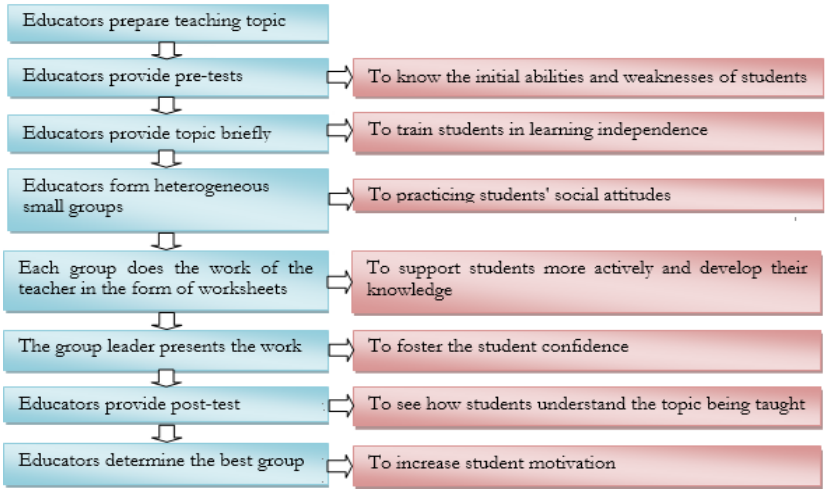

Figure 3

The Outline of the TAI Learning Model

Figure 4.

The Discussion during Learning Process in Study (Left with group and Right with the instructor of Learning)

Figure 3 illustrates the steps of the Team Assisted Individualization (TAI) learning model, the author prepares teaching material that will be completed by a group of students, the writer gives a pretest to students or sees the average daily value of students so that educators know the weaknesses of students in specific field. The author gives the material briefly. The author forms a heterogeneous but harmonious small group based on students' daily test scores, each group of 4-5 participants (Figure 4), then each group does the work in the form of worksheets, and the authors provide individual assistance for those who need it. The group leader presents the results of his group work in front of the class and the writer gives a posttest to be done individually and the writer determines the best group to the less successful group (if any) based on the results of the correction.

Result and Discussion

The effect of the Individual Assisted Individualization (TAI) learning model on students' numerical abilities was measured using treatments in the form of sequences and series subjects. There will be two hypotheses of this problem, first, the TAI model has an influence on the numerical ability of students. Second, the TAI model has no influence on the numerical ability of students. Therefore, the hypothesis is tested using the t-test.

Before the t-test, the hypothesis is tested with the normality test and homogeneity test first. The variables are taken from the experimental class and the control class. From there, it is known that each class comes from a normal distribution population and has the same variant so that it can be continued to carry out t-tests. The data to be tested as an analysis is the data of student learning outcomes after being subjected to sequences and series treatments in the class. From the post-test, we can observe the numerical abilities of students which have been summarized in Table 2.

Table 2.

Numerical Ability Posttest Results

Class	X_{max}	X_{min}	Measuring Central Tendency			Size of Group Variance	
			$\bar{X}$	M_e	M_o	R	S
Experiment	96	48	70.57	76	76	48	13.61
Control	80	32	56	60	60	48	13.81

In Table 2, the experimental class was treated using the TAI learning model and the control class using the conventional learning model. Learning consist of 4 meetings, 3 meetings is the teaching and learning process, and 1 meeting is an evaluation (posttest). Posttest is a way to collect data as material for analysis. Students must answer 5 essay questions about sequences and series lessons. The answers from these students show how numerical abilities they have. The average scores on the numerical ability tests obtained have differences in the two classes (Pahrudin, Irwandani, Triyana, Oktarisa, & Anwar, 2019). The average score of the experimental class was 70.57 and the average score of the control class was 56. Numerical ability data obtained by testing the hypothesis using a t-test with a significant level (α) = 0.05 obtained t_{count} = 3.977 and t_{table} = 2.005 means $t_{count} \geq t_{table}$ H_0 is rejected. This shows the impact of each learning model on numerical ability. Besides, the hypothesis have the effect size1.063. From Table 1, it is mean that the effect size including on large criteria (Abdurrahman et al., 2019). So, the TAI learning model has influence on the numerical ability. Based on the results, we can say that the analysis method to test the magnitude of the effect of a treatment, can use the effect size as in (Syazali, 2015).

This result also supported by previous research, it said that the TAI learning model in teaching arithmetic operations can improve student learning outcomes. If equipped with handouts, TAI model also improve the quality of student learning processes, the understanding of mathematical concepts and solving mathematical problems. Students who learning through TAI model have better learning outcomes than students not, it is based on student activity, like more interest and enthusiasm in learning, increase in students' cognitive and psychomotor competencies. TAI can be applied to slowly change the way students view about mathematics (Latifah et al., 2019). The results of this study are also consistent with Rosy Pardirla's research which states that the learning model of Team Assisted Individualization (TAI) is better than conventional learning models (Novoa, Johann, Morillo, & Inciarte, 2019) The steps of the TAI learning model can be seen in Figure 3.

Based on Figure 3, students' numerical abilities can be achieved by applying a series of TAI learning models. Educators preparing the subjects and students to start the learning activity, then educators give pretest to students to find out the initial abilities and weaknesses of students (Syazali et al., 2019).Educators present brief lessons to train students in learning independence (Maskur, Syazali, & Utami, 2019). Furthermore, educators form students in groups based on students' daily test scores, one group consisting of 4-5 participants (Syahrir et al., 2019).Each group does the work on the worksheet and the educator provides help individually to those who need it(Networks, Channels, Participation, Moreno, & Trejo, 2019). Correcting test results involves students practicing rigorous and honest attitudes(El Islami et al., 2019), and the most important thing is that they understand where the error is and how the correct answer is in each question(Balsa, 2019).Finally, with this study group, students can exchange ideas, share knowledge, and discuss to determine which answer is more appropriate(Networks et al., 2019). Then, the group leader presents the results of his group's work. At the end of the session, the educator gives an evaluation of student learning (posttest) individually to see how successful the learning model is applied to the numerical abilities of students(Jaimes, 2019).

Conclusion

Based on the theoretical basis, data analysis and result, it can be concluded that there is an impact between each learning model on numerical ability, so there are differences in numerical ability of students who are treated using the TAI learning model and students who are treated with conventional learning models. So, the researcher suggests that to realize the Team Assisted Individualization (TAI) learning model, educators should give more time so that the TAI learning model can be applied optimally, especially in preparation, because learning outcomes depend on the teacher as well. As the results of research that has been done, that

there is a positive relationship between initial ability and numerical ability with learning outcomes, besides that there is also a significant relationship between the level of conservation ability and numerical ability with learning achievement of Natural Sciences. This confirms that there is a significant relationship between numerical ability with students on mathematics learning achievement of Gifted Young Scientists.

Recommendations

The teacher should know the level of numerical ability and how students learn so that they can apply the right learning methods and get students who have high mathematical learning achievements. Further research needs to be done on other factors that affect mathematics learning achievement.

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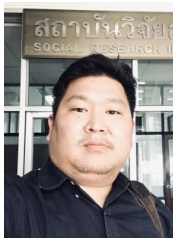

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