ICSAT INTERNATIONAL PROCEEDING
ISBN: 978-623-7496-62-5
Vol, 11 Issue 2

Comparing the Effectiveness of Moodle-Based STAD and TAI Cooperative Learning in Teaching Mathematics in Junior High School

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Abstract
The development of information technology in education, like the emergence of digital media, eases us in obtaining information. An educational application called Moodle, STAD (Student Team Achievement Division), and TAI (Team Assisted Individualization) are parts of cooperative learning. It is an experimental study comparing the learning output of Mathematics using LMS Moodle with two types of cooperative learning, namely STAD and TAI. The model is considered effective if the learning outcomes reach a score of 75. The hypothesis was analyzed using inferential statistics (t-test for independent sample / Mann Whitney U). The findings show that in the class taught with Moodle-based STAD cooperative learning, the percentage of students who obtained scores in the Highest Category was 13, and 87% of students reached scores in High Category, meaning that, classically, students passed the completeness criteria. Six percent of students in the class taught with Moodle-based TAI cooperative learning obtained the highest score, and 58% passed the standard score, so classically, they also passed the completeness criteria. Consequently, STAD cooperative learning is more effective than Moodle-based TAI to be applied to junior high school students in Mathematics classes.

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Keywords*:* Moodle; STAD; TAI; Cooperative.

INTRODUCTION

Nowadays, we are entering the 4.0 era, indicated by the rapid development of digital information technology. It offers much easiness in receiving information. Using information and communication technology for education is promising to improve the learning output. Based on World Bank Group (2020) data in Indonesia, more than 530,000 schools closed to minimize the spread of the Coronavirus (Covid-19). It impacted 68 million students from pre-school to university levels and made digital technology an urgent need. The technology platform used in learning is called e-learning, where students and teachers use electronic media in learning. E-learning conducted online can be accessed by students and teachers anywhere and anytime. Nowadays, many innovations in teaching have emerged with e-learning. E-learning is likely going to be used for a long period.

The concept of e-learning was developed from a distance learning system. While distance learning does not emphasize information technology-based learning, e-learning more focus on information technology-based learning. Many companies support the development of e-learning, and they facilitate various platforms, including *Moodle Learning Management System*.

ISBN: 978-623-7496-62-5
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Moodle software can be modified by adding multimedia like flashes (moving animation), audio, or videos (picture and sound). Moodle is open-source software that can be downloaded freely. It is the most familiar open-source program among e-learning programs like a tutor and Learning Management System (LMS). It was first developed in August 2002 with version 1.0. Moodle stands for Modulator Object-Oriented Dynamic Learning Environment, which aims to facilitate teachers and students to learn online (Wicaksana, 2020).

Currently, many LMS programs are developed to be integrated into learning and training, including in Mathematics classes. Those programs are Moodle, Edmodo, Google Classroom, Canvas, Blackboard, Sakai, WiZiQ, ATutor, and Schoology. Based on a survey conducted by Capterra (2018) on the popularity of the LMS platform based on the subscribers, active users, and online attendance, Moodle, Edmodo, and Schoology are in the top ten. Each platform has strengths and weaknesses, especially when integrated into Mathematics class, as it has a unique learning approach. Despite the weaknesses it has, the LMP platform can make mathematics more interactive and facilitate students to develop their abilities in terms of cognitive, psychomotor, and affective areas.

Nowadays, the development of platforms in learning is highly related to the current applied learning method. A cooperative learning system is a method that should be considered because it facilitates students to learn in small groups with different ability levels to collaborate. Students rely on online learning, so the learning method should not be monotonous. Indeed, it should facilitate students to interact with each other during learning. Hamid and Jusmiana (2020) strengthened it by the study that cooperative learning guided by e-learning is effective in mathematics classes. One of the learning methods which actively involve students and can improve their learning output is the STAD (Student Team Achievement Division) and TAI (Team Assisted Individualization), which are parts of cooperative learning. Umam and Supiat (2019) stated that STAD offers a mathematics learning concept involving intensive student interaction. Teaching Math using STAD cooperative learning integrating e-learning offers a fun atmosphere and familiarizes students with the development of digital technology. Slavin in Nurmala (2021) stated that Team Assisted Individualization (TAI) is a pedagogic program that tries to suit learning and students with different characteristics academically. It also motivates students to learn in groups. Rahmat (2022) also stated that STAD and TAI cooperative learning have similar main components: group, quiz, and reward. Both methods rely on the group as the key to learning. Activities in groups and interaction among students let students better understand the material. Quiz and rewards motivate students to understand the material optimally, and they can also measure students' understanding. Based on the description, it is important to compare the application of two Moodle-based cooperative methods, STAD and TAI, in teaching Mathematics.

METHOD

It is an experimental study comparing the learning outcomes of students taught using Moodle with two different types of cooperative learning, STAD and TAI. The independent variable was cooperative learning methods consisting of STAD and TAI with Moodle. The dependent variable is the learning mathematics and students' learning activities. The learning design is the Post Test Only Comparative Group Design.

Table 1. Post-Test Only Comparative Group Design

	Classes	Treatment		Post Test
R	K_1	X_1	O_1	OE

ISBN: 978-623-7496-62-5
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K_2	X_2	O_2	OK

Note:
K_1 = the class treated with TAI cooperative learning (Experimental class 1)
K_2 = the class treated with STAD cooperative learning (Experimental class 2)
X_1 = Treatment with TAI cooperative learning
X_2 = Treatment with STAD cooperative learning
O_1 = *Post-test* for Experimental class 1
O_2 = *Post-test* for Experimental class 2

The assessment indicator used to categorize students' scores is:

Table 2. Score Categories

Mastery Levels	Categories
85 – 100	Very high
65 – 84	High
55 – 64	Medium
35 - 54	Low
0 – 34	Very low

Source: Adawiyah (2017)

Yusuf (2018) stated that one of the indicators used to measure learning effectiveness is that the learning score should be at least 75. The inferential statistic was used to test the hypothesis. The hypothesis was tested using statistics with a t-test /*Mann Whitney U* with a significance level of 0,05. The Null Hypothesis (H_0) stating that "Moodle-Based STAD and TAI Cooperative Learning in teaching mathematics in Junior High School have different effectiveness" is accepted if the significance level of $p = 0{,}05$. Meanwhile, it is rejected if the significance level of $p \neq 0.05$. The inferential statistic was performed using SPSS. However, before testing the hypothesis, we performed a prerequisite test consisting of normality and homogeneity tests.

RESULT AND DISCUSSION

Descriptive Analysis

The research findings indicate the mathematics learning results after studying with TAI and STAD as below:

ISBN: 978-623-7496-62-5
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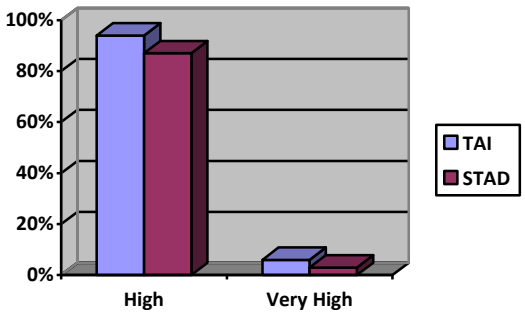

Figure 1. *Comparison of learning mathematics results of classes taught with Moodle-based STAD and Moodle-based TAI.*

Figure 1 shows that 87% (27) of students taught with STAD got scores in the high category, while only 13% (4) got very high scores. From the data, it can be seen students were dominantly in the high category.

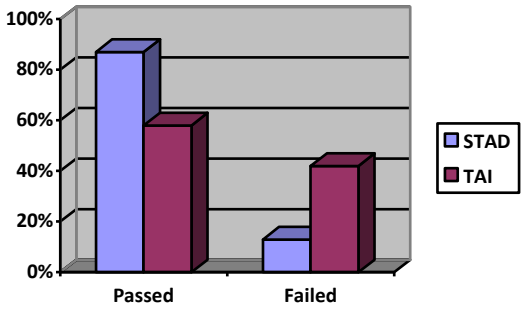

Figure 2: *Comparison of mastery of student learning STAD and* TAI

Figure 2 illustrates the outcomes of learning using the STAD method. Four students, or 13%, did not pass the standard score, while 27 students, or 87%, passed. Thus, STAD cooperative learning can produce a better output.

Then, in terms of knowledge, 13 or 42% of students passed the standard score, while 18 or 58% did not. Thus, TAI cooperative learning can result in good learning output too.

Standard Score

The standard score is the lowest score students should obtain to pass a subject. It has to be determined at the beginning of the academic year based on the discussion of some teachers teaching a similar subject or different subjects but with similar characteristics (Depdiknas, 2008). The minimum standard score applied in Junior High School measures students' learning achievement.

1. Data about Students' Learning Outcomes

a) Results of the Normality Test

The normality of data was tested using SPSS. It was to identify whether the data used in the study came from a normally distributed population or not. The data is normally distributed if the p-value in the Kolmogorov-Smirnov test is higher than the value of alpha $\alpha = 0{,}05$. Results of the computation of the normality test are presented in the table below:

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Table 3. Results of Normality Test of Data of Students' Mathematics Learning Outputs

Classes	P values	Alpha	Decisions	Conclusions
TAI	0,061	0,05	Nilai-$p \geq \alpha$	Normal
STAD	0,000	0,05	Nilai-$p < \alpha$	Not Normal

The normality test of learning outcomes using *the Kolmogorov-Smirnov* test in the TAI class showed the value of $p = 0{,}061 > \alpha$, so it can be concluded that data in the TAI class are normally distributed. However, in STAD class, the value of $p = 0{,}000 < \alpha$; thus, it is concluded that data in STAD class did not distribute normally.

b) Homogeneity Test

The homogeneity test aims to know whether the samples come from a population homogeneously distributed or not. One of the methods to identify it is by using the *Test of Homogeneity of Variance.* The homogeneity criteria are the p-value from *Based on Mean* on *Bartlett's* test is bigger than the value of alpha = 0,05. The computation of homogeneity test data is presented in table 3.2. is as below:

Table 4. Results of Homogeneity Test on Learning Output

Test of Homogeneity of Variance

		Levene Statistics	df1	df2	Sig.
Values	Based on Mean	1.199	1	60	0,844

Based on the table above, the p-value of *Based on Mean* = 0,844. Because the $p = 0{,}844 > \alpha = 0{,}05$, data in this came from a homogenous variance population. Because data are not normally distributed, the hypothesis was tested using the *Mann-Whitney U* test.

Table 5. Results of *the Mann-Whitney U* test

	P values	Alpha	Decision	Conclusion
STAD-TAI	0,014	0,05	Nilai $p < \alpha$	H_1 is accepted

The hypothesis test above used *Mann Whitney U Test* to compare the outcomes of learning using STAD and TAI cooperative design/ the value of $p = 0{,}000 < \alpha$ thus, it can be concluded that the alternative hypothesis is accepted where there is a significant difference in learning outcomes of students taught with STAD cooperative learning and TAI cooperative learning.

The comparison of learning output based on the effectiveness of STAD and TAI cooperative learning is based on the classical completeness of learning. The research findings show that implementing both learning types had brought students to pass the minimum standard score classically. 87% of students taught with STAD and 58% with TAI passed the minimum standard score. The results are much higher than the set standard. Descriptively, there is a difference in the learning results of students taught with STAD and TAI cooperative learning.

2. Data of Students' Learning Activities

Regarding the learning activities of students taught with STAD, 87% of students scored in the high category, while the rest (13%) had very high scores for learning activities. While in the class taught with TAI, we found that 98% of students had learning activity scores in the high category, and 2% had very high scores. It indicates that descriptively, students taught with STAD have higher learning motivation than students taught with TAI. Also, 13% of students taught with STAD did not reach the

minimum standard criteria, and 87% passed. While in the TAI class, 42% of students passed the minimum standard criteria, and 58% did not. Descriptively, STAD results in a higher learning activities index than TAI. Furthermore, it can be concluded inferentially that using Moodle in TAI cooperative learning is more effective to be applied at Junior High School than in STAD cooperative learning.

CONCLUSIONS

Based on the data analysis above, it can be concluded that Moodle-based STAD cooperative learning is more effective than Moodle-based TAI to be applied to junior high school students in Mathematics classes. A further study should compare the effectiveness of both learning models in different research subjects (e.g., Senior High School students or elementary school students) as those learners have different characteristics from subjects treated in the present study.

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