Implementation of TTW and TPS learning models to mathematics learning outcomes in terms of students' mathematical communication ability

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Abstract: The goal of this study was deciding if the learning model has an impact on the achievement of mathematics learning in terms of student communication abilities in mathematics. The models being compared are the Think Talk Write learning model, the Think Pair Share model, and direct learning. The analysis used a quasi-experimental testing procedure. The population is all students of class VIII SMPN Wonosobo Regency in the academic year 2018/2019. The sample consisted of 269 students and was divided into three groups: 90 in the first experimental class, 91 in the second experiment class and 88 as the control class. The data of the study were analyzed using a two-way analysis of variance with unbalanced cells. The TTW learning model produces effective instruction in mathematics than the TPS and direct learning paradigm, and the TPS learning model produces better mathematics learning achievement than the direct learning model. These results show the same results for each group of communication abilities in mathematics. 2) Students with high mathematical communication abilities better math performance than middle and low income student mathematics communication abilities, and students with moderate communication abilities in mathematics have better learning performance as students with poor and intermediate mathematics communication abilities.

1. Introduction
Mathematics is a mathematical discipline that forms the foundation for technological advancement and plays an essential role in creating human capital. It can even be argued that modern technology without science, no advanced technology exists [1]. The facts show that in Indonesia, mathematical communication abilities are still lacking. This is known from the Pattern International Mathematics and Science Research (TIMSS) international survey. From the global TIMSS survey [2], The facts show that mathematical communication abilities are still weak in Indonesia. The (TIMSS) survey indicates this, based on the results of the international TIMSS survey. Some of these difficulties include mathematics lessons that do not appear to be related to everyday life, the monotonous way of presenting mathematics lessons from abstract to concrete concepts, not making children happy to learn.

The capacity to communicate orally in the form of verbally conveying ideas or verbs to others, to re-express the outcomes of the discussion, to affect the interlocutor positively, to make presentations to the audience according to the plan [3]. The willingness to listen with sympathy would allow people to...
understand the content of other people's conversations, and others will feel cared for and valued. The willingness to express views with sympathy would make it possible for people to express their thoughts only and respectfully so that the message arrives so other people feel respected. The ability to communicate verbally can be seen in the conversation activities. In personal communication skills, various requirements can be assessed/observed during the discussion [4]. Where learning communication in mathematics fosters interaction and expression Ideas in the classroom so students learn in an engaging environment. In general, it can be concluded that mathematical communication consists of written and verbal communication [5].

Innovation in mathematics learning activities is carried out by choosing a learning method or model that suits the individuality and material of the student and can develop student character so that student interest can increase students' mathematical abilities [6]. Another approach that is deemed suitable to improve the mathematical communication abilities of students is through group discussions. In group discussion activities it is possible for students to realize their knowledge so that it is easier to understand the philosophy being taught and to convey their ideas in written and oral form. Cooperative learning is learning that prioritizes students, this is evidenced by student activities during student learning with material activities and assignment processes, as well as providing explanations to groups [7]. One alternative to support this is to apply the cooperative learning model. Cooperative learning is student-centered learning, this is evidenced by student activity during student learning with material activities and assignment processes, as well as providing explanations to groups [8]. At this time there are many learning models that can be applied while learning. Among them, this method can be done through cooperative learning. In this study, the cooperative model to be used is the TTW and TPS types.

TTW is formed by thinking, writing and speaking. TTW is a strategy that can facilitate training in fluent language writing and verbal language [9]. TPS is a teaching method that can be used to assess teacher or student understanding [10]. In an effort to improve student learning outcomes, one way that can be used is to use the TPS model [11]. Learning models that use TPS from the results of the study get results that can improve mathematical problem solving skills and mathematical communication abilities [12]. In addition to the learning model, student achievement is influenced by students' mathematical communication skills.

2. Research Methods
Type of research is an experiment using Factorial Template 3 x 3. In this report, for the academic year 2018/2019, All class VIII SMPN students at Wonosobo Regency were population. The sampling process in the analysis was stratified random sampling of the cluster. There are two kinds of data collection techniques in this research, namely documentation and tests. In the initial ability of students, a population normality test was carried out using the method Lilliefors, a population variance homogeneity test using the test Bartlett, and a balance test using a one-way variance analysis of different cells [13]. Test the balance of students in the experimental class one, the experimental class two and the control class. The research data were in the form of mathematics learning outcomes test scores and were analyzed using two-way ANOVA with different cells. Hypothesis testing aims to determine whether there are differences in the influence between each learning model and mathematical communication skills and their interactions on mathematics learning outcomes. The prerequisite test of the hypothesis test consists of a population normality test using themethod Lilliefors and a homogeneity test of population variance using the test Bartlett. Hypothesis testing uses two-way variance analysis of different cells [13].

3. Results and Discussion
The results of the content validity test have been validated by 3 validators on each test, and both have been declared valid. Centered on the test results of the test instrument for mathematical communication ability, of the 10 test items tested, there were 7 items that could be used as an instrument, while the results of the test instrument test results of learning mathematics showed that of the 35 items of the mathematics learning outcomes test instrument on the test In this test instrument, there are 25 test items
for student learning outcomes that can be used. The conclusions of the population Proof of normality, the homogeneity test of population variance and the balance test of the students’ initial ability showed that the sample it derived from a naturally distributed community. The data on the results of students’ mathematical communication tests that have been obtained are then grouped into high, medium and low mathematical communication groups. Before testing the hypothesis, a preconditional evaluation is done, namely the population normality test and the population variance homogeneity test on the value of mathematics learning outcomes.

The consequences of the population normality test carried out 6 times for each group of learning models and the level of mathematical communication abilities of students showed that the sample it derived from a naturally distributed community. The results of the homogeneity test of population variance which were carried out twice on the learning model and the level of mathematical communication abilities of students showed that the populations being compared had the same or homogeneous variance. Based on the prerequisite test for fulfilling the hypothesis test, it can be done hypothesis testing by using two different cell pathways. 1). On main effect A (row), the test statistical $F_a = 19.85$ and $F (0.05; 2; 269) = 3.00$. Value $F_a$ lies inside thus $H_0A$ is rejected. 2). On main effect B (column), the statistical value of the test is $F_b = 10.65$ and $F (0.05; 2; 265) = 3.00$. Value $F_b$ lies inside thus $H_0B$ is rejected. 3). The key influence of AB (interaction), the statistical value of the test was $F_{ab} = 1.09$ and $F (0.05; 2; 265) = 2.36$. Value $F_{ab}$ lies outside thus $H_{0AB}$ is accepted. Because $H_0A$ is rejected, $H_0B$ is rejected, while there are values for the learning model variable and mathematical communication abilities, additional post-ANAVA experiments need to be conducted using the method Scheffe.

Before the multiple comparison test between rows was carried out, first the marginal mean of each row and the mean of each cell was calculated. Presented in table 1.

| Learning Model | Mathematical communication | Marginal Mean | $n$ |
|---------------|---------------------------|--------------|-----|
| TTW           | High                      | 65.53        | 90  |
|               | Medium                    | 60.76        |     |
|               | Low                       | 58.83        |     |
|               |                           | 61.90        |     |
| TPS           | High                      | 60.09        | 91  |
|               | Medium                    | 50.35        |     |
|               | Low                       | 54.35        |     |
|               |                           | 54.38        |     |
| Conventional  | High                      | 56.91        | 88  |
|               | Medium                    | 45.63        |     |
|               | Low                       | 40.98        |     |
|               |                           | 47.77        |     |
| Average Marginal | High                      | 60.78        |     |
|               | Medium                    | 53.25        |     |
|               | Low                       | 50.15        |     |
|               |                           | 54.38        |     |

Furthermore, the outcomes of many lines are provided for a description in Table 2.

| Test decisions | $F_{obs}$ | $2F_{at}$ | of test decisions |
|---------------|-----------|-----------|-------------------|
| $\mu_1 = \mu_2$ | 13.37     | (2) (3.00) = 6.00 | $H_0$ rejected   |
| $\mu_2 = \mu_3$ | 46.00     | (2) (3.00) = 6.00 | $H_0$ rejected   |
| $\mu_1 = \mu_3$ | 9.96      | (2) (3.00) = 6.00 | $H_0$ rejected   |

Comparing the critical region, it appears that there is a significant difference between, and Having regard to the average marginal, it can be concluded that: a) on $H_0$ the test decision $H_0$ is rejected. Seeing the marginal average in the TTW learning model is 61.90, and the marginal average of the TPS learning model is 54.38, which means that the mean TTW learning model is greater than the marginal average learning model of the TPS, consequently, the TTW learning model produces better performance than the TPS learning model, b) on $H_0$ ; the test decision $H_0$ is rejected. Seeing the marginal average in the TPS learning model is 54.38, and the marginal average of the direct learning is 47.77, which means that the average TPS learning model is higher than the marginal average of the direct learning, so the TPS
learning model produce better achievement than direct learnings, and c) on H₀: the test decision H₀ is rejected. Seeing the marginal mean of the TTW learning model is 61.90, and the marginal average of the direct learning is 47.77, which means that the mean of the TTW learning model is greater than the marginal average of the direct learning, so the TTW learning model produces better performance than direct learnings. Furthermore, the multi-column comparison overview is provided in Table 3.

| H₀       | F₀obs | 2F₀ | of test decisions |
|----------|-------|-----|------------------|
| μ₁ = μ₂  | 9.67  | (2) (3.00) = 6.00 | H₀ rejected     |
| μ₂ = μ₃  | 4.17  | (2) (3.00) = 6.00 | H₀ received     |
| μ₁ = μ₃  | 24.87 | (2) (3.00) = 6.00 | H₀ rejected     |

By comparing with critical areas, it appears that there is a significant difference between and while there is no difference. By considering the marginal mean of each column, it can be concluded. a) At H₀: the test decision is rejected. Looking at the marginal mean of students with high mathematical communication abilities of 60.78, and the marginal mean of students with moderate mathematical communication abilities of 53.25, which means that the marginal mean of students with high mathematical communication abilities is greater than the marginal mean of students with moderate mathematical communication abilities. In order to gain higher academic success for students with strong abilities to mathematically think than students with modest capacity to think. b) At H₀: the test decision is accepted. This means that students who have moderate mathematical communication abilities have the same good learning achievement as students with low mathematical communication abilities, c) At H₀: test decisions rejected. Looking at the marginal mean of students with high mathematical communication abilities of 60.89, and the marginal mean of students with low mathematical communication abilities of 50.15, which means that the marginal mean of students with high mathematical communication abilities is greater than the marginal mean of students with low mathematical communication abilities, so that students who have high mathematical communication abilities have improved learning results than students with low mathematical communication abilities.

Based on these results it can be seen that the TTW model provides better learning achievement than the TPS model, this is because in TTW learning students are asked to think about problems first, then communicate or convey orally, or talk about what is the solution to existing problems. After that, students are asked to write down what has been discussed or conveyed previously, so that it will make students understand more about the solution to the existing problems. seen from the level of mathematical communication skills, students with high mathematical communication skills have better learning achievement than students with moderate communication skills, but students with moderate mathematical communication skills have the same learning achievement as students with low mathematical communication skills. This shows that students' mathematical communication skills have an effect on student achievement, students with high mathematical communication skills are more likely to convey what they think than students with moderate and low communication skills. Students with high mathematical communication skills tend to have broader insights, thus affecting their learning achievement.

The results of other studies indicate that the use of the TPS learning model in mathematics learning is better than direct learning. That is, from these differences, there is an effect of implementing the TPS model on Mathematical communication abilities of students [14]. The TTW model offers improved learning outcomes for mathematics. Compared to the TPS and PBI learning models and the TPS learning model, the results of mathematics learning are better than the PBI in the circle material. So that the TTW learning paradigm is most effectively used in circle materials [15]. Another research also found that overall students who were taught the TPS form of cooperative learning model demonstrated higher learning outcomes relative to students who were taught direct learning [16]. Focused on this report's findings, it was assumed that the achievement of the mathematical communication skills of students
utilizing the immersive media-assisted TTW learning paradigm was of a strong category. Whereas access to students’ mathematical communication abilities utilizing the ordinary learning paradigm was very limited [17]. The TTW version of cooperative learning process has also been found to be higher than the cooperative model of the NHT version [18]. Teachers have demonstrated a variety of advantages correlated with mathematical correspondence. Teachers consider mathematical correspondence to be most helpful to track the learning process of their students [19]. An enhanced peer-guided mutual mathematics communication system designed to support students’ mathematical creation and mutual peer tutoring activities [20], also according to students who apply TTW better mathematical representation skills than students who apply expository [21]. The metacognitive abilities of students with TTW were better than the metacognitive abilities of students with GI [22].

4. Conclusion
Following are the conclusions of this study: (1) The model for TTW learning delivers greater learning outcomes than the model for TPS learning and direct learning, the model for TPS learning produces better learning performance than direct learning. (2) Students with strong mathematical communication ability have better learning results than students with moderate and low mathematical communication ability. Students with moderate mathematical communication ability get better instruction results than mathematically inferior students communication abilities (3) Students with strong mathematical communication ability have better learning results than students with intermediate and poor mathematical communication ability. Students with intermediate mathematical communication abilities have better learning results than students with low mathematical communication abilities. (4) in each category of students' mathematical communication skills, the TTW learning model provide better learning outcomes from TPS learning model and conventional, as well as the the TPS learning model offers improved guided learning results. The following are suggestions that the author can convey: the principal should provide encouragement and motivation to mathematics teachers to carry out learning innovations by using varied learning models in accordance with the subject matter taught so that students can obtain better and optimal learning outcomes. Particularly in mathematics on the subject matter of flat-sided building, learning innovation can be carried out by applying the TTW and TPS cooperative learning models, learning with the TTW and TPS learning models should be used as an alternative strategy in learning to be implemented in the development of classroom learning, especially To improve student learning outcomes, learning mathematics using the TTW or TPS model should be applied for a long period of time in the classroom by teachers, with the aim of the learning process being more varied, when learning uses the cooperative learning model, the formation of study groups should be more pay attention to the heterogeneity of students in a class, including the level of students' mathematical communication abilities.

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