The effect of think-pair-share cooperative learning on student mathematical communication skills

A Irma$^{1,2,*}$, D Juandi$^1$, J A Dahlan$^1$, and R Nirawati$^3$

$^1$Sekolah Pasca Sarjana Pendidikan Matematika, Universitas Pendidikan Indonesia, Jl. Dr. Setiabudi No. 229, Bandung 40154, Indonesia
$^2$Program Studi Pendidikan Matematika, Universitas Islam Negeri Sultan Syarif Kasim Riau, Jl. H.R. Soebrantas No. 155 Km.15 Simpang Baru Panam, Pekanbaru, Indonesia
$^3$Program Studi Pendidikan Matematika, STKIP Singkawang, Jl. STKIP Kelurahan Naram Singkawang, Kalimantan Barat 79251, Indonesia

* Corresponding author’s email: ade.irma@uin-suska.ac.id

Abstract. This study is stimulated by the insufficient mathematical communication skills of students and the implementation of Think-Pair-Share models in schools. This study aims to investigate whether there is a disparity in mathematical communication skills between students who take Think-Pair-Share learning and the ones who take conventional learning. This research is a quasi-experimental study. Data analysis techniques used by researchers were descriptive statistics and the Mann Whitney U test. The instrument used was a descriptive test to measure students’ mathematical communication skills. The results showed that (1) there are differences in mathematical communication skills between students using the Think-Pair-Share cooperative learning model with students using conventional learning models, (2) the student communication skills of the treated group are better than that of the untreated one. Thus, in general Think-Pair-Share learning model influences students` mathematical communication skills.

1. Introduction
The fact shows that mathematical communication skills in Indonesia are still relatively low. This is known from the international survey of The Trend International Mathematics and Science Study (TIMSS). From the results of the TIMSS international survey [1], Indonesia was ranked 38 out of 63 in mathematics learning. The aspects assessed in mathematics are knowledge of facts, procedures, concepts, application of knowledge and understanding of concepts. According to the report of the study, only 28% of Indonesian students answered correctly, while the International average was 47%. When compared to other countries Indonesia’s ability to translate questions into language mathematical ideas diagrams or graphs is still below the average.

Meanwhile, the results of the report of the Program for International Student Assessment (PISA) survey, which is a global economic and development cooperation organization (OECD) program, show that in 2009, the achievement of Indonesian students was 68th out of the 74 countries surveyed. The average score of students’ abilities in other countries is 496. The aspects assessed in PISA are comprehension, problem-solving, reasoning and communication skills [2]. It needs to be designed learning that familiarizes students to construct their thoughts both with the teacher, friends and the mathematics material of itself. A person's mathematical understanding cannot be seen and heard, but
mathematical communication facilitates students "voicing" what they think about their mathematical knowledge [3]. To improve that students’ mathematical communication skills one of the way is to apply the right learning model.

According to [4] another way that is considered appropriate for developing students' mathematical communication skills is to discussion groups. Group discussion makes it possible to the students to construct their knowledge so they are easier to understand the concepts taught and communicate their ideas on oral and written forms. One alternative to support this is to apply a cooperative learning model. Cooperative learning is a learning system that seeks to utilize peers (other students) as learning resources, in addition to teachers and other sources [5].

There are several types of cooperative learning model. One type of cooperative learning model that can encourage the active participation of students in the classroom is the cooperative learning type Think-Pair-Share. The cooperative learning model Think-Pair-Share is a type of cooperative learning model that allows every student to show participation to others [6]. According [7] it is also a technique which involves presenting students with a task or question and giving them time to think by individually.

Based on the background that has been described, the author feels interested in researching theory and practice with the title The Effect of Think-Pair-Share Cooperative Learning on Student Mathematical Communication Capabilities.

2. Experimental Method
This study is quasi-experimental research with Non-Equivalent Control Group Design [8]. The populations in this study were all junior high school students who divided into two groups, i.e. control and experimental groups. The sample selection uses a cluster sampling or random sampling technique. In general, the research procedure can be divided into three parts, namely: the stages of preparation, implementation, and completion. In the preparation stage, the steps are as follows: (1) Establish a research schedule; (2) Preparing learning devices namely Learning Implementation Design (RPP) and Student Worksheets (LKS); (3) Prepare and compile data collection instruments; (4) Provision of the pretest. A pretest was given to the experimental class and control class. The results of the pretest were then analyzed to see whether the abilities of the two classes were the same or not; (5) Arrange group formation.

The learning process carried out in the experimental class with Think Pair Share learning model and control class with conventional learning models. At this stage, the researcher will do the following: (1) The researcher gave the post-test questions in the form of tests of the same skills of mathematical; (2) Communication in the class of experimental and the control class after the lesson material studied was completed; (2) Analyzing the post-test results obtained from the class of experimental and the control class; (3) Conclude from the results obtained by the analysis of the data used.

The test is used to obtain data on student learning outcomes in the experimental class and control class on skill of mathematical communication before using cooperative learning with the Think-Pair-Share model obtained from the pre-test value. Whereas about communication skills after using the Think-Pair-Share learning model will be obtained through the test sheet conducted at the end of the meeting (post-test). The data to be analyzed by researchers is the mathematical communication skills of students by applying cooperative learning with the Think-Pair-Share learning model in the experimental class and compared with the results obtained by the control class. Before the treatment is carried out, the researcher gives the initial ability test (pre-test) to the students to find out the initial abilities of the students.

3. Result and Discussion
3.1 Descriptive Statistics Pre-test and Post-test of Experimental Classes and Control Classes
Table 1 shows that the average pretest scores for the group of experimental and the control group is not much had different. The average pretest in the experimental group was 7.68 with a standard...
deviation of 2.262 while the average group of control score was 7.76 and the standard deviation was 2.760. From the standard deviation values for both groups, it can be concluded that the distribution of pretest data in the two groups is not different.

Table 1. Descriptive Statistics of Experimental and Control Classes

|                | N   | Minimum | Maximum | Mean   | Std. Deviation |
|----------------|-----|---------|---------|--------|----------------|
| Experiment     | Pretest | 28      | 3       | 12     | 7.68           | 2.262          |
| Experiment     | Posttest | 28     | 19      | 32     | 25.93          | 4.363          |
| Control        | Pretest | 29     | 3       | 13     | 7.76           | 2.760          |
| Control        | Posttest | 29     | 18      | 32     | 22.97          | 3.914          |
| Valid N (listwise) |     | 28      |         |        |                |                |

From the table above it is also known that the average post-test score for both groups is different. The post-test average in the experimental group was 25.93 with a standard deviation of 4.363 while the average score of the control group was 22.97 and the standard deviation was 3.914. From the standard deviation values mentioned above, it can be concluded that the distribution of post-test data in the two groups is different.

3.2 Pre-test

The Mann Whitney U statistical test was used, the results indicated that asymp. Sig. (2-tailed) greater than 0.05, it means that there is no difference in students' skills of mathematical communication between the two classes, so it can be continued by giving treatment to the experimental group and conventional learning to the control one (Table 2).

Table 2. Test Statistics Pretest

|                | Pretest |
|----------------|---------|
| Mann-Whitney U | 401.000 |
| Wilcoxon W     | 836.000 |
| Z              | -.080   |
| Asymp. Sig. (2-tailed) | .936 |
| a. Grouping Variable: Class | |

3.3 Post-test

Using the Mann Whitney U statistical test, the results are shown Table 3. Table 3 shows that Asymp. Sig. (2-tailed) namely 0.015 smaller than 0.05, which means there is a difference between variable X and variable Y. The conclusion is there are differences in skill of mathematical communication between students who use learning of cooperative and Think-Pair-Share models with Mathematical communication skills of students who use conventional learning.

Table 3. Test Statistics Posttest

|                | Posttest |
|----------------|---------|
| Mann-Whitney U | 254.500 |
| Wilcoxon W     | 689.500 |
| Z              | -2.426  |
| Asymp. Sig. (2-tailed) | .015 |
| a. Grouping Variable: Class | |
Seeing whether there are differences in skills of mathematical communication between students who use learning of cooperative and the Think-Pair-Share Model and students using learning of conventional summarized that there are differences in skill of mathematical communication between students who use learning of cooperative and Think-Pair-Share models with students using learning of conventional. This finding also reveal that the average posttest score of the class of experimental is greater than the class of control, meaning that it can be concluded that skill of mathematical communication between students using learning of cooperative and Think-Pair-Share models are better than skill of mathematical communication using learning of conventional. All students are involved in the discussion and sharing stages of the think-pair-share model. This is the same thing with the opinion of Karge et al. [9] that in pair with their friends student can discuss to provide a deeper understanding of the topics they are studying, and indirectly it can improve skill of communication of student. The implementation of the think-pair-share model in the basic science concept subject was successful as it improved student activeness and communication skills, in line of [10].

4. Conclusion
Based on the data analysis as explained earlier, it can be concluded that there is a difference between the skills of mathematical communication of students learning using learning of cooperative Think-Pair-Share models and students using learning of conventional. The application of Think-Pair-Share cooperative learning models in mathematics learning is better than conventional learning. That is, from the existence of differences, there is the influence of the application of Think-Pair-Share mode cooperative learning to students' mathematical communication skills.

5. References
[1] Mullis IV, Martin MO, Foy P and Arora A 2011 TIMSS 2011 international results in mathematics (Chesnut Hill: TIMSS & PIRLS International Study Center)
[2] Schleicher A and Tamassia C 2000 Measuring Student Knowledge and Skills: The PISA 2000 Assessment of Reading, Mathematical and Scientific Literacy Education and Skills
[3] Andriani A, Dewi I and Halomoan B 2018 Development of Mathematics Learning Strategy Module, Based on Higher Order Thinking Skill (HOTS) To Improve Mathematical Communication and Self Efficacy on Students Mathematics Department Journal of Physics: Conference Series 970 1 p.012028
[4] Putra FG, Widyawati S, Asyhari A and Putra RW 2018 The Implementation of Advance Organizer Model on Mathematical Communication Skills in terms of Learning Motivation Tadris: Jurnal Keguruan Dan Ilmu Tarbiyah 31 pp.41-6
[5] Wade W 2011 Stretegi Pembelajaran Inovatif Kontemporer(Jakarta: Bumi Aksara)
[6] Johnson DW, Johnson RT and Smith KA1998 Maximizing instruction through cooperative learning ASEE Prism. 76 p.24
[7] Nataliasari I 2014 Penggunaan Model Pembelajaran Kooperatif Tipe TPS untuk Meningkatkan Kemampuan Penalaran dan PemecahanMasalah Matematis Siswa MTS Jurnal Pendidikan dan Keguruan 1 1
[8] Creswell J W 2012 Research Design Pendekatan Kualitatif, Kuantitatif, dan Mixed (Yogyakarta: PustakaPelajar)
[9] Karge BD, Phillips KM, Jesse T and McCabe M 2011 Effective strategies for engaging adult learners Journal of College Teaching & Learning (TLC) 8 12 pp.53-6
[10] Nurulaeni F 2019 Think-Pair-Share Model: Improving Activeness and Communication Skills of Prospective Elementary School Teachers Journal of Physics: Conference Series 1233 1 p.012081