Reciprocal teaching approach towards mathematics learning outcome of elementary school teacher education students

M T Muanifah1,*, N Rhosyida1, T Trisniawati1, R Anggraheni2, N Maghfiroh3, A Kurniasih4 and H Sa’diyah5

1 Universitas Sarjanawiyata Tamansiswa, Jl. Batikan UH III/1043, Yogyakarta, Indonesia
2 SD Negeri Sumberharjo, Jl. R.E. Martadinata No.36, Sumberharjo, Pacitan, Jawa Timur, Indonesia
3 SDIT Nurul Islam Dua, Tempurejo, Widodaren, Ngawi, Jawa Timur, Indonesia
4 SDIT LHI, JL. Karanglo, Jogorangan, Banguntapan Bantul, Yogyakarta, Indonesia
5 SMP Muhammadiyah 3 Depok, Jl. Rajawali No.10, Mrican, Depok, Sleman, Yogyakarta, Indonesia

*mtmuanifah43@gmail.com

Abstract. The purpose of this paper is to describe the effectiveness of the reciprocal teaching approach towards mathematics learning outcomes of elementary school teacher education students, the effectiveness of group presentation learning towards mathematics learning outcomes and to compare the effectiveness of reciprocal teaching approaches and group presentation learning in terms of mathematics learning outcomes of towards mathematics learning outcomes of elementary school teacher education students. This type of research is a quasi-experimental quantitative research. This research was conducted at elementary school teacher education program in Universitas Sarjanawiyata Tamansiswa. The subjects of this study were students of the 3rd semester, namely classes 3A and 3C. Data Analysis technique of quantitative used one way anova and independent sample t-test. Based on the results of the research, it can be concluded that mathematics learning using a reciprocal teaching approach was more effective than mathematics learning using group presentations towards mathematics learning outcomes.

1. Introduction
Mathematics is a basic science that plays an important role in the development of science and technology [1,2]. The rapid development of science and information technology has a positive impact on the development of information in education [3]. Mathematics is expected to contribute in developing logical, analytical, systematic, critical, creative and cooperative thinking skills [4]. Because mathematics is important in all aspects of life, it becomes one of the subjects that needs to be taught as early as possible in elementary school, junior high school, high school and even college.

The objectives of learning mathematics in schools are (1) to practice thinking and reasoning in drawing conclusions, (2) to elaborate creative activities that involve imagination, intuition and discovery by developing the thinking of divergent, original, curiosity, making predictions, guessing and trial-and-error, (3) to develop problem-solving skills, (4) to develop the ability to deliver the information or
communicate the ideas through oral speech, graphics, maps, or diagrams in explaining the ideas [5]. The expected outcomes of learning mathematics are that students have creative, critical, scientific, honest, disciplined and diligent personalities [6]. The National Council for Accreditation of Teacher Education stated that mathematics teachers should have a deep understanding of how students learn mathematics and use their specific pedagogical knowledge for teaching and learning mathematics [7]. Based on this statement, it can be concluded that mathematics learning is an activity that not only requires students to understand the learning material but also requires them to have a mathematical personality. Therefore, Primary Teacher Education (PGSD) students as prospective teachers should be able to understand the learning material of mathematics in elementary school by using special pedagogical knowledge so that they can deliver the material to the students well and be able to direct the students to have the expected personality and abilities.

Generally, the learning process is an activity that results in a change in behavior, while the learning understanding is an activity carried out by lecturers in order to change the students’ behavior for the better [8]. Often, students’ understanding is not comprehensive and ultimately results in neglect of mathematics content integration in certain themes. Several factors suspected to be the trigger are the weak mastery of mathematical knowledge either factually, conceptually, procedurally or metacognitively as well as the lack of students’ learning independences so that their concentration becomes disturbed [9]. One of the educational tools that can be applied to improve students’ learning outcomes is the application of learning approach, which requires students to understand the material in mathematics courses. One of the learning approaches which can be applied is the approach of Reciprocal Teaching.

Reciprocal Teaching is an approach of evidence-based dialogical instructional that has been shown to improve the reading comprehension in literacy [10]. The four strategies of reading comprehension that traditionally have formed reciprocal teaching are predicting, clarifying, questioning and summarizing. These four cognitive reading abilities, through reciprocal teaching, are also applied to support and to solve the mathematics sentence problems [11]. Thus, the researchers innovated to apply the reciprocal teaching approach in mathematics learning by using four reading comprehension strategies, namely predicting, clarifying, solving and summarizing as the main stages for the students, and including individual presentations as the additional stages. Teaching and learning through Reciprocal Teaching is expected to motivate students’ active participation in the class with the target of improving their lateral thinking ability [12]. In addition to the improvement in the ability of mathematical lateral thinking, mathematical persistence is expected to increase. Persistence is the tenacity that gives more emphasis on the positive side, namely the mental attitude to cultivate and encourage enthusiasm, optimism, and belief and perseverance in dealing with a problem [13].

The observations that had been conducted during the learning of mathematics for the lower-grade elementary school showed that most students had not prepared any text books or notebooks when the learning began. The students did not prepare the material to be studied before the course. They also rarely asked the lecturers and paid less attention to mathematics learning. Even worst, some of them cheated on exams. Then, the students’ achievement in mathematics tended to have low average scores for each class, probably due to the lack of students’ understanding in mathematics. Good learning outcomes will be obtained when the students are able to understand the learning material, and the learning material can be understood well if at least students are willing to read the material conveyed.

Based on the description above, it is necessary to conduct a study related to the application of the reciprocal teaching approach in terms of mathematics learning outcomes of the students of elementary school teacher education.

2. Methods
This study used a quantitative approach with a quasi-experimental research type and used a posttest control group design. The posttest-only control group design is a research design in which there are at least two groups, one of which does not receive a treatment or intervention, and the data are collected on the outcome measured after the treatment or intervention [14]. The subjects of this study were the
third semester students (class 3A and 3C) majoring in Elementary School Teacher Education of Sarjanawiyata Tamansiswa in the academic year of 2019/2020, exclusively who took the mathematics subject matter for higher-grade of elementary school.

The data analyzed were the primary data, which was the test given to students. The test was conducted to determine the level of the students’ learning outcomes in mastering the mathematics subject matter for higher-grade of elementary school. The data analysis method used in this study was the one sample t-test and the independent sample t-test. The research method can be seen in the figure 1.

3. Results and discussion

3.1. Results

From the results of the try-out that had been carried out on the students of class 3F and 3J who had taken the subject matters of higher-grade elementary school mathematics, a valid and reliable test instrument was obtained. Then, the test instrument was given to two research classes, namely class 3A and 3C which consisted of 39 students and 41 students. The results of the study were in the form of quantitative data obtained from the students’ mathematics scores. The data of the students’ mathematics learning outcomes can be seen in the description in table 1 below.

| Class   | N  | Average | Min. | Max. |
|---------|----|---------|------|------|
| Experiment | 39 | 74.8    | 45   | 93   |
| Control  | 41 | 64      | 36   | 90   |

Based on table 1, it can be seen that the lowest and highest mathematics learning outcomes of the experimental class (reciprocal teaching) are 45 and 93 with an average of 74.8. Meanwhile, the lowest and highest mathematics learning outcomes of the control class (group percentage) are 36 and 90 with an average of 64. So, it can be stated that the average score of learning outcomes of the experimental class is higher than the control class.

The prerequisite test had been done by using the Kolmogorov Smirnov test to see the normality of the two research classes. The results of the prerequisite test that have been carried out can be seen in table 2 below.

| Class    | N  | Sig.  | Test decision      | Conclusion           |
|----------|----|-------|--------------------|----------------------|
| Experiment | 39 | 0.169 | H₀ is accepted     | Normal distribution  |
| Control  | 41 | 0.200 | H₀ is accepted     | Normal distribution  |
Table 2 above shows that the research subjects are from the research populations that are normally distributed with a significance value. The probability (sig) of the experimental class is higher than the significance level, i.e. $0.169 > 0.05$. So, $H_0$ is accepted and the value is significant. The probability (sig) of the control class is also higher than the significance level, i.e. $0.200 > 0.05$, then $H_0$ is accepted. After that, the scores of the two research classes were analyzed to find the homogeneity by using the Levene test. The result states that the significance level is more than $0.05$, i.e. $0.862 > 0.05$. Thus, $H_0$ is accepted, which means that the two research classes have homogeneous variance.

The results of the mathematics learning data were then tested by employing the independent sample t-test hypothesis. The hypothesis of the research is $H_0$: the mathematics learning by using the reciprocal teaching approach is not more effective than the mathematics learning by using group presentations in terms of the students’ mathematics learning outcomes. The results of the analysis show that the significance value is $0.000 < 0.05$, meaning that $H_0$ is rejected. This means that mathematics learning by using the reciprocal teaching approach is more effective than the mathematics learning by using group presentations in terms of the students’ mathematics outcomes.

3.2. Discussion

The approach of reciprocal teaching was applied in class 3A which consisted of 39 students. The reciprocal teaching approach applied to the research class was a modified reciprocal teaching approach. The modification was merely done by adding individual students’ presentations. The researcher innovated to apply the reciprocal teaching approach in mathematics learning by using four reading comprehension strategies, which are predicting, clarifying, solving and summarizing, as the main stages of students [10] and including individual presentations as the additional stages. The reciprocal teaching model of learning is beneficial so that learning objectives are achieved through independent learning activities and students are able to explain their understanding to others, studied step by step because the knowledge is not given at once to students [15].

Here, students were asked to predict the content of the learning material they were going to study and to clarify the material they had predicted by reading the material from various references. In the problem solving stage, the students were asked to think about how to explain the mathematics material for elementary students so that it could be accepted and understood well by the elementary students. At the summarizing stage, the students were asked to summarize the material they had read. Then, it turned to the final stage, namely presenting their summarized material in the hope that the lecturer would know whether the students had understood the material presented or not.

Compared to the average score of the experimental class with the control class score as seen in Table 1, it seems that students in the experimental class more understand about the material to be studied than those in the control class. In addition, the significance value of the hypothesis test also shows that $H_0$ is rejected, so it appears that the reciprocal teaching approach is more effective than the cooperative approach with group presentations.

This finding is also in line with the condition in the field. When the mathematics lecture of higher-grade elementary school was about to begin, the experimental class students were ready for the lecture because they prepared a notebook containing the summary of the material to be studied and there was a discussion among students about the material to be studied. In addition, the readiness of the experimental class students in attending the lectures was showed during the presentation. Other students gave responses or asked questions to the students presenting in the class and the students who were presenting can provide answers to questions and responses from their friends. For example, in learning the circumference and the area of a circle, the student explained that to find the circumference of a circle could be obtained by measuring the length of the circumference of the circle by means of a thread and then it was divided by the diameter of the circle which was close to the value of $\pi = 3.14 \ldots$. Meanwhile, to find the area of a circle, students could explain that the area of a circle could be obtained by dividing the circle into 16 parts, and then arranged to form a parallelogram shape. From the formula of a parallelogram area, the area of a circle was obtained, i.e. $\pi r^2$. Likewise, when finding another formula for the area of a flat shape, the students could apply the similar concept. This means that the students’
understanding of the material being studied is good. Students are directed to be able to develop the initial stimulus to get ideas and mathematical knowledge in accordance with their needs for the achievement of learning goals [15].

Meanwhile, for the control class, student readiness can be said to be very lacking. Only a few students seemed to have prepared the notebooks for the lecture. Even when class had begun, the group of students going to make a presentation was not ready yet. Students’ unpreparedness was also seen during the presentation in which students tended to read and rely solely on slides and papers. So, when delivering material about the circumference and area of a flat shape, the students only provide the formula without giving the steps for finding the formula. When asked by the lecturer about how to find the formula from the rectangle, the students could not answer. They also seemed unprepared in answering questions from other students. This could be seen from the length of time the presenter took to answer the questions because the presenters were still discussing the answer of the questions. Students’ unpreparedness in understanding the material was also showed in the students who did not make a presentation. When a student did not make a presentation, only few or even no student read the material before the class. During the presentation, students tended to chat with their friends rather than pay attention to the presentation. Perhaps, this is what causes the mathematics learning outcomes of the control class students to be lower than the experimental class. Reciprocal Teaching Approach and prior ability of mathematics gave a better role than conventional teaching approach in improving students’ mathematical reasoning ability, its gain, and mathematical self-concept as well [16].

Based on the data on the students’ mathematics learning outcomes as well as the reality in the field, we can see that the application of the learning approach is very influential with the willingness to understand the mathematics material so that it will greatly impact the students’ learning outcomes. Therefore, selecting the right learning approach will help students to better understand the mathematics material.

4. Conclusion
From the results of the study, the application of the reciprocal teaching approach in mathematics learning in class 3A is more effective than the cooperative approach of group presentation type in class 3C in terms of students’ mathematics learning outcomes. This can be seen from the lowest scores, the highest scores and also the average scores of the students who were given the treatment with the reciprocal teaching approach in class 3A (i.e. 45, 93 and 74.8) were higher than the lowest scores, the highest scores and also the average of those who were given the treatment with cooperative approach of group presentation types, i.e. 36, 90 and 64. Good mathematics learning outcomes can indicate that the students’ understanding of mathematics is also good.

Acknowledgment
Thank you to the students of Elementary School Teacher Education of Universitas Sarjanawiyata Tamansiswa who have collaborated in carrying out learning.

References
[1] Trisniawati, M T Muanifah, S A Widodo, and M Ardiyaningrum 2019 Effect of Edmodo towards interests in mathematics learning J. Phys. Conf. Ser., 1188(1)
[2] Trisniawati, M T Muanifah, N Rhosyida, S A Widodo, and M Ardiyaningrum 2019 Exploration towards attitude of students in elementary school teacher education in mathematics learning J. Phys. Conf. Ser. 1315(1)
[3] N P A N United 2012 Rapid Development of Information Technology in the 20 th Century pp 1–8
[4] Depdiknas 2006 Peraturan Menteri Pendidikan Nasional No. 22 tahun 2006 Tentang Standar Isi
[5] E Ekawati 2013 Peran, Fungsi, Tujuan dan Karakteristik Matematika Sekolah J. P4TK Mat.
[6] E T Ruseffendi 2006 Pengantar Membantu Guru Mengembangkan Kompetensinya dalam Pengajaran Matematika untuk Meningkatkan CBSA
[7] M S Sumantri and R Satriani 2016 The effect of formative testing and self-directed learning on mathematics learning outcomes Int. Electron. J. Elem. Educ. 8(3) 507–524
[8] D Putriani and C Rahayu 2018 Reciprocal teaching of comprehension-fostering and comprehension-monitoring activities. Cognition and Instruction Int. J. Trends Math. Educ. Res. 1(1) 22
[9] Trisniawati, M T Muanifah, and M. Ardiyaningrum 2018 Penerapan E-Learning Edmodo ditinjau dari Hasil Belajar Mahasiswa PGSD Universitas Sarjanawiyata Tamansiswa Trihayu J. Pendidik. Ke-SD-an 5(1) 509–514
[10] Palincsar A S and Brown A L 1984 Reciprocal teaching of comprehension-fostering and comprehension-monitoring activities Cognition and Instruction (2) 117–175
[11] Meyer K 2014 Making Meaning in Mathematics Problem-Solving using the Reciprocal Teaching Approach Literacy Learning: The Middle Years 12 7–14
[12] Priatna N., Martadiputra B A P, and Wibisono Y 2018 Developing geogebra-assisted reciprocal teaching strategy to improve junior high school students’ abstraction ability, lateral thinking and mathematical persistence J. Phys. Conf. Ser. 1013(1)
[13] Costa L A K B 2012 Belajar dan Memimpin dengan Kebiasaan Pikiran 16 Karakteristik Penting untuk Sukses (PT indeks)
[14] Frey B 2018 The SAGE encyclopedia of educational research, measurement, and evaluation (CA SAGE Publ. Inc) 1–4
[15] Mulyono D, Asmawi M, and Nuriah T 2018 The Effect of Reciprocal Teaching, Student Facilitator and Explaining and Learning Independence on Mathematical Learning Results by Controlling the Initial Ability of Students Int. Electron. J. Math. Educ. 13(3) 199–205
[16] Prasetio D A, Sumarmo U, and Sugandi A I 2018 Improving Student’S Mathematical Reasoning and Self Concept By Using Reciprocal Teaching J. Innov. Math. Learn. 1(3) 283