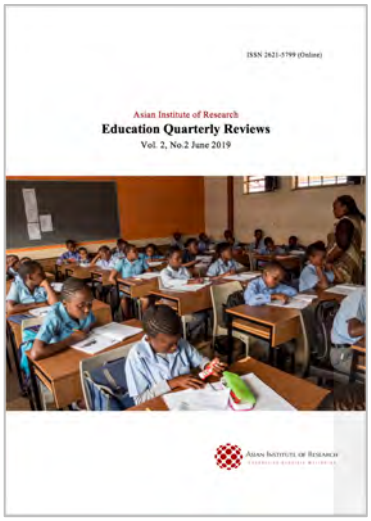

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The Effect of Reciprocal Peer Tutoring Strategy Assisted by GeoGebra on Students' Mathematical Communication Ability Reviewed from Gender

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Abstract
The purpose of this study is to examine the effect of reciprocal peer tutoring strategy assisted by geogebra on students' mathematical communication ability reviewed from gender. The method in this study is the experimental method. The sample was consisted of 72 tenth grade students of SMAN 11 Medan and drawn using simple random sampling technique. The instrument has consisted of a prior mathematics knowledge test and mathematical communication ability test. Treatment consisted of teaching equations and inequalities learning the material to the experimental group using reciprocal peer tutoring strategy assisted by geogebra, while the control group was taught using expository strategy. The data analysis is done by using Analysis of Covariance (ANCOVA). The results show that: (1) reciprocal peer tutoring strategy assisted by geogebra affects students' mathematical communication ability significantly, (2) gender doesn't affect students' mathematical communication ability significantly, (3) There is no interaction between strategy (reciprocal peer tutoring strategy assisted by geogebra and expository strategy) and gender (male students and female students) on mathematical communication ability.

Keywords: Reciprocal Peer Tutoring Strategy, Geogebra, Mathematical Communication Ability, Gender

1. Introduction

At least there are two important reasons which make mathematical communication is important in mathematics learning, that is mathematics as language and mathematics learning as a social activity. Mathematics not only as a tool to aid thinking, a tool to find pattern or solving problem but also as an invaluable tool for communicating a variety of ideas clearly, precisely, and succinctly and as social activity such as interaction between students, communication teacher and students is an important part in mathematics learning for nurturing children's mathematical potential (Baroody, 1993). National Council of Teachers of Mathematics (NCTM) also expresses the opinion about the importance of communication in mathematics learning. According to NCTM, communication is an essential part of mathematics and mathematics education (NCTM, 2000). Similarly, Umar (2012) explained that mathematical communication is one of the core learning, so it needs to be developed in mathematics learning activities.

Similarly, in the learning process of curriculum 2013, the students who already have the mathematical understanding ability are demanded to be able to communicate it. That is the last level on the scientific approach, which is observing, asking, collecting information, associating, and communicating. The learning process which consists of five levels listed on Cultural and Education Ministry Regulation of the Republic of Indonesia number 81A in 2013 Appendix IV on Implementation of the Curriculum.

Based on the survey results of the Programme of International Student Assessment (PISA) in 2015, Indonesia is on the 62nd rank of 72 countries. Based on the survey results known that Indonesia's position is increased compared with survey results in 2012, Indonesia is on the 64th rank of 65 countries. Although Indonesia's position is increased Indonesia's achievement is still under the average of other Organization of Economic Cooperation and Development (OECD) countries.

The students' mathematical abilities in PISA are divided into six levels. The sixth level as the highest achievement level and the first level as the lowest achievement level. Each level shows mathematics competency level which must be achieved by students. One of the mathematical abilities at the third level until the sixth level 6 that students must achieve is mathematical communication ability. This is in accordance with the seven principles of mathematical abilities used in 2015 PISA framework, that is communication, mathematising, representation, reasoning and argument, devising strategies for solving the problem, using symbolic, formal, technical language and operation, and using mathematical tools.

Based on survey results of PISA in 2015 can be seen that for under second level questions, the percentage of Indonesian students who gave correct answers was higher than the average percentage of students from other OECD countries, that is 42.3% of 13%. While, for the fifth and sixth level questions, the percentage of students who gave correct answers was far lower than the average percentage of students from other OECD countries, that is 0.8% of 15.3%. On the previous explanation has been explained that one of the mathematical abilities that must be achieved by students at the third level until the sixth level is mathematical communication ability. It means that mathematical communication of Indonesian student is still low.

Students' mathematical communication ability which still low can also be seen from the cases found by a researcher at SMAN 11 Medan which will be used as a research location. Based on the results of observations and interviews at that school, it was found that students' mathematical communication ability included in the low category. There are many learning strategies which can be used to develop students' mathematical communication ability. One of them is the reciprocal peer tutoring strategy. Furthermore, NCTM stated that technology is important in mathematics learning and teaching. It affects mathematics which is taught and enhance students' learning. Therefore, the researcher will apply reciprocal peer tutoring strategy assisted by geogebra. Furthermore, this study will be reviewed by gender. Ajai and Imoko (2015) stated that literature about gender and academic achievement in mathematics was found with different views and findings. Therefore, to solve this problem, the researcher will do research entitled "The Effect of Reciprocal Peer Tutoring Strategy Assisted by GeoGebra on Students' Mathematical Communication Ability Reviewed from Gender.

2. Literature Review

2.1 Reciprocal Peer Tutoring Strategy Assisted by GeoGebra

Initially, Reciprocal Peer Tutoring was developed and tested for children with academic needs by Pigott, Fantuzzo, and Clement in 1986. While GeoGebra was first developed by Markus Hohenwarter in 2001. In the Reciprocal Peer Tutoring strategy, students gather in groups, two or more people in one group are trained to work together on certain academic tasks (Fantuzzo et al., 1990). While GeoGebra is a dynamic program which has the facility to visualize or demonstrate mathematical concepts and as a tool to construct mathematical concepts (Syahbana, 2016).

Reciprocal Peer Tutoring Strategy is one of the student-centered learning strategies. Currently, teachers are required to be able to apply learning methods that are more student center (Sapta et al., 2018). With the implementation of reciprocal peer tutoring strategy assisted by geogebra, students in one group take turns to act as tutors and tutees for teaching and observing academic material with teacher supervision. With the exchange of roles and assistance from the GeoGebra software, each student is given the opportunity to develop and practice their mathematical communication ability. This statement is supported by Benware and Deci (1984) who found that students who learn to teach a peer have higher values of conceptual learning, are more intrinsically motivated, and consider themselves more actively involved with the environment than students who are expected

only to remember information provided. In addition, research conducted by Yang et al. (2016) showed that the students' mathematical communication ability in the experimental class or which is taught by computer-supported reciprocal peer tutoring improved significantly.

Learning theory which supports the Reciprocal Peer Tutoring strategy is Vygotsky's theory. Vygotsky (1978) views the definition of teachers widely, and he states that a colleague (peer) or even a tool can act as a teacher. According to Slavin, there are two important concepts in Vygotsky's theory, that is Zone of Proximal Development and Scaffolding. Zone of Proximal Development is a gap between actual development and potential development, with another word is a child can do something without adult's assisting and is a child can do with directing adult or work together with colleague's friend. While scaffolding is giving to a child big amount for beginning learning steps and then to decrease the assisting and to give a chance to the children taking away the responsibility that so big soon after he can do himself (Syafari, 2017).

2.2 Mathematical Communication Ability

Mathematical communication has an important role in the learning of mathematics because through mathematical communication students can express, explain, describe, hearing that take students on a deep understanding of mathematics (Paridjo and Waluya, 2017). Besides, can be explained that mathematical communication ability is the skill of students in expressing the set of problem or idea in mathematics by using a concrete object, picture, graph, table or mathematical symbols as the content of the message to be delivered (Damayanti & Setianingsih, 2017).

The indicators of mathematical communication ability used in this study are formulating the component of the known elements and the asked elements (Saragih, 2007), use the language of mathematics to express mathematical ideas precisely (NCTM, 2000), explaining a situation or problem by using symbols, tables, diagrams, or other media (Qohar & Sumarmo, 2013), and declare the situation or picture of a problem in mathematical model (Maghfiroh, 2017).

2.3 Gender

Haralambos and Holborn (2004) state that there is prove which can explain that female student have better learning achievement level than male students. According to them, female students are motivated and more diligent than male students in doing the assignment. The statement is in accordance with the research conducted by Triyadi (2013) which shows that the female students have more dominant mathematical communication ability than male students. While Ormord (2009) states that there is a gendered tendency that male students have better abilities in mathematics and science naturally while female students have better abilities in reading naturally. The statement is in accordance with Husain (2014) which stated that mathematical communication of male students is higher than female students.

2.4 Hypotheses

The hypothesis in this study consisted of: (1) reciprocal peer tutoring strategy assisted by geogebra affects students' mathematical communication ability significantly, (2) gender affects students' mathematical communication ability significantly, (3) There is interaction between strategy (reciprocal peer tutoring strategy assisted by geogebra and expository) and gender (male students and female students) on mathematical communication ability.

3. Method

This study uses a quantitative research approach with experimental rmethods in the form of factorial design. This study was conducted at SMAN 11 Medan, which is one of the senior high schools in the city of Medan, North Sumatra Province, Indonesia.

3.1 Population and Sample

The population in this study was all students of tenth-grade students of SMAN 11 Medan in the academic year of 2018/2019 which consists of nine classes with the total student is 317 students. The sample is chosen randomly using simple random sampling technique. The researcher chooses X-IPA-5 class as an experimental group which taught by reciprocal peer tutoring strategy assisted by geogebra and X-IPA-6 class as the control group which taught by expository strategy. The learning material for both classes is Equations and Inequalities. The research sample based on gender is listed on Tabel 1.

Table 1. Total Sample of Research-Based On Gender

Groups	Male	Female	Total
Experimental Groups	16	20	36
Control Groups	16	20	36
Total	32	40	72

3.2 Instrumentation and Validation

The instrument in this study is prior mathematics knowledge tests which consist of 12 questions with a reliability coefficient of 0.811 and mathematical communication ability tests which consist of 5 questions with a reliability coefficient of 0.855. The prior mathematics knowledge tests were given before treatment in the experimental group, and the control group was applied.

3.3 Method of Data Analysis

Data analysis was conducted with the Analysis of Covariance (ANCOVA). This is because in this study there are two main factors namely learning strategy and gender and there is one covariate variable, namely students' prior mathematics knowledge. Before conducting ANCOVA, the assumptions discussed in Pallant (2007) have been examined. These assumptions are level of measurement, independence of observations, normality, homogeneity of variance, influence on covariate measurement, homogeneity of regression slopes and linearity.

4. Results

After checking the assumptions, ANCOVA analysis could proceed in order to examine the effect of reciprocal peer tutoring strategy assisted by geogebra on students' mathematical communication ability reviewed from gender. So, the SPSS output of ANCOVA in this study is listed in Table 2.

Table 2. Inferential Results on Mathematical Communication Ability Tests

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	15407.416[a]	4	3851.854	279.439	.000	.943
Intercept	7040.633	1	7040.633	510.774	.000	.884
Prior Mathematics Knowledge	14124.742	1	14124.742	1.025E3	.000	.939
Strategy	435.085	1	435.085	31.564	.000	.320
Gender	14.721	1	14.721	1.068	.305	.016
Strategy * Gender	1.004	1	1.004	.073	.788	.001
Error	923.543	67	13.784			
Total	423333.980	72				
Corrected Total	16330.960	71				
a. R Squared = .943 (Adjusted R Squared = .940)						

Based on Table 2, the significance number of the prior mathematics knowledge variable is 0.000, and it shows that the significance number is less than the predetermined α of 0.05. Therefore, it means that (by ignoring the effect of learning strategy) at the 95% confidence level there is a linear correlation between prior mathematics knowledge variable and mathematical communication ability variable. It means that analysis of covariance assumption which requires linearity between accompaniment variable (prior mathematics knowledge) and the response variable (mathematical communication ability) have been achieved.

Furthermore, for the strategy obtained the F value of 31,564 with a significance value of 0,000. This means that learning strategies affect mathematical communication ability significantly. For gender, the F value of 1.068 with a significance value of 0.305. This means that gender doesn't affect mathematical communication ability significantly. Or in other words, there is no significant difference between the scores of mathematical communication ability of male and female students. There are significant differences between the experimental group and the control group with the scores of the mathematical communication ability of the experimental group students higher than the scores of the mathematical communication ability of the control group students. For interactions between strategy and gender, the F value of 0.073 with a significance value of 0.788. This means that there is no interaction between the strategy (Reciprocal Peer Tutoring assisted by GeoGebra and expository) and gender (male and female students) on students' mathematical communication ability. It can also be described through the graph in Figure 1.

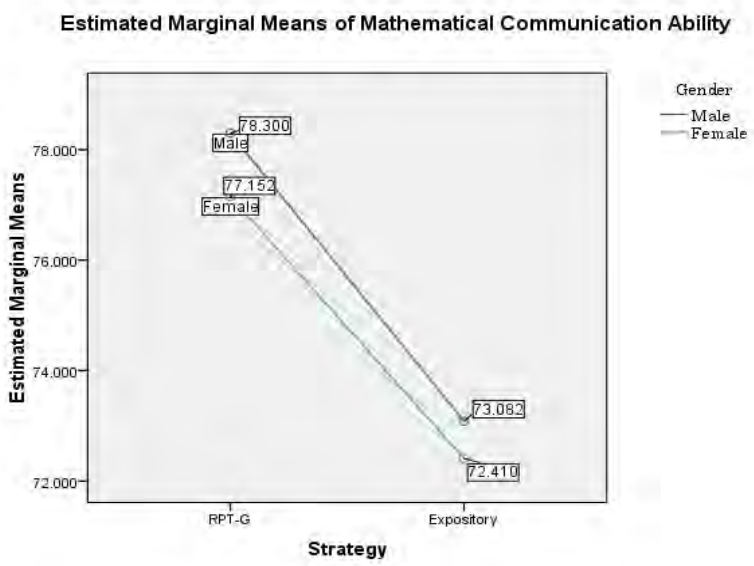

Figure 1. Graph of the Interaction between Learning Strategies and Gender on Students' Mathematical Communication Ability

Based on Figure 2, it can be seen that in the reciprocal peer tutoring strategy assisted by geogebra (RPT-G) and expository strategies, the mean score of mathematical communication ability of female students in the experimental class and control class was lower than male students. Therefore, there is no interaction between learning strategies and gender on students' mathematical communication ability.

5. Discussion

The result shows that the reciprocal peer tutoring strategy assisted by geogebra affects students' mathematical communication ability significantly. It means that the first hypothesis in this study was accepted. The result of this study is in accordance with the results of the study of Henson et al. (2009), which states that Reciprocal Peer Tutoring (RPT) is more effective than traditional learning on improving student performance significantly for Algebra courses.

Then, the result of the study shows that gender doesn't affect mathematical communication ability significantly. It means that the second hypothesis in this study was rejected. The results of this study are in accordance with the results of the study of Hidayat & Dwiningrum (2016), which states that there is no significant effect ($p > 0.05$) of gender characteristics on mathematics learning achievement.

Furthermore, based on the results of the study, it was also found that there was no interaction between learning strategies (reciprocal peer tutoring assisted by geogebra and expository) and gender (male and female students) on students' mathematical communication ability. This means that the third hypothesis in this study was rejected. The results of this study are in accordance with the results of the study of Akay (2011), which states that there is no significant interaction between group and gender on students' mathematical achievements.

6. Conclusion

Based on the results of research data analysis, it can be concluded that the reciprocal peer tutoring strategy assisted by geogebra affects students' mathematical communication ability significantly. But, gender doesn't affect students' mathematical communication ability significantly, and there is no interaction between learning strategies (reciprocal peer tutoring strategy assisted by geogebra and expository strategy) and gender (male students and female students) on students' mathematical communication ability.

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References

Ajai, J.T. & Imoko, I.I. (2015). Gender differences in mathematics achievement and retention scores: A case of the problem-based learning method. International Journal of Research in Education and Science (IJRES), 1(1), 45-50.

Akay, G. (2011). The Effect of Peer Instruction Method On The 8th Grade Students' Mathematics Achievement In Transformation Geometry and Attitudes Towards Mathematics. A thesis submitted to the graduate school of social sciences of Middle East Technical University.

Baroody, A. J. (1993). Problem-solving, Reasoning, and Communicating, K-8, Helping Children Think Mathematically. New York: Macmillan Publishing Company.

Benware, C. A., & Deci, E. L. (1984). Quality of learning with an active versus passive motivational set. American Educational Research Journal, 21, 755-765. http://doi/10.3102/00028312021004755

Damayanti, A. & Setianingsih, R. (2017). Profile of Students' Mathematical Communication Abilities in Learning Using Reciprocal Peer Tutoring Strategy. Jurnal Ilmiah Pendidikan Matematika, 3(6), 107-114.

Fantuzzo, J. W., Polite, K., & Grayson, N. (1990). An evaluation of reciprocal peer tutoring across elementary school settings. Journal of School Psychology, 28(4), 309-323. http://dx.doi.org/10.1016/0022-4405(90)90021-X

Haralambos, M. & Holborn, M. 2004. Sociology: Themes and Perspectives Sixth Edition. London: Harper Collins Publisher.

Henson, L. D., Hagos, L. C., & Villapando, R. A. (2009). The Effectiveness of Reciprocal Peer Tutoring (RPT) on the Academic Performance of Students in Mathematics. Proceedings of the 2nd International Conference of Teaching and Learning, INTI University College, Malaysia.

Hidayat, A. & Dwiningrum, S. I. A. 2016. Pengaruh Karakteristik Gender dan Motivasi Belajar Terhadap Prestasi Belajar Matematika Siswa SD. Jurnal Prima Edukasia, 4(1), 32 – 45. https://doi.org/10.21831/jpe.v4i1.7692

Husain, S. A. A. (2014). Perbedaan Kemampuan Komunikasi Matematis Siswa Laki-laki dan Siswa Perempuan. FMIPA: Universitas Negeri Gorontalo.

Maghfiroh, M., Baiduri, & Ummah, S. K. (2017). Analysis of Students' Mathematical Communication of Junior High School Through The SAVI (Somatic, Auditory, Visualization, Intellectually) Approach. Mathematics Education Journals, 1(2), 72-81.

National Council of Teachers of Mathematics. (2000). Principles and Standards for School Mathematics. Reston, VA: The National Council of Teachers of Mathematics, Inc.

Ormrod, J. E. (2009). Psikologi Pendidikan Membantu Siswa Tumbuh dan Berkembang. Jilid 1. Jakarta: Erlangga.

Pallant, J. (2007). SPSS survival manual: A step by step guide to data analysis using SPSS for windows. New York: McGraw-Hill/Open University Press.

Paridjo & Waluya, S. B. (2017). Analysis Mathematical Communication Skills Students In The Matter Algebra Based NCTM. IOSR Journal of Mathematics (IOSR-JM), 13(1), 60-66. https://doi.org/10.9790/5728-1301056066

Qohar, A. & Sumarmo, U. (2013). Improving Mathematical Communication Ability and Self Regulation Learning of Yunior High Students by Using Reciprocal Teaching. IndoMS. J.M.E., 4(1), 59-74. https://doi.org/10.22342/jme.4.1.562.59-74

Sapta, A., Hamid, A., & Syahputra, E. (2018). Assistance of Parents in the Learning At Home. Journal of Physics: Conference series, 1114(2018), 012020. https://doi.org/10.1088/1742-6596/1114/1/012020

Saragih, Sahat. (2007). Mengembangkan Kemampuan Berpikir Kritis, Logis dan Komunikasi Matematik Siswa SMP Melalui Pendekatan Matematika Realistik. Disertasi tidak diterbitkan. Bandung: UPI.

Syafari. (2017). Developing Algebra Structure Module and Model of Cooperative Learning Helping Concept Map Media for Improving Proofing Ability. International Education Studies, 10(3), 207-214. https://doi.org/10.5539/ies.v10n3p207

Syahbana, A. (2016). Belajar Menguasai GeoGebra (Program Aplikasi Pembelajaran Matematika). Palembang: NoerFikri Offset.

Triyadi, R. (2013). Kemampuan Matematis Ditinjau dari Perbedaan Gender. Skripsi tidak diterbitkan. Bandung: UPI.

Umar, W. (2012). Membangun Kemampuan Komunikasi Matematis dalam Pembelajaran Matematika. Jurnal Ilmiah Program Studi Matematika STKIP Siliwangi Bandung. 1(1). 1-9.

Vygotsky, L. S. (1978). Interaction Between Learning and Development. In Gauvain & Cole (Eds.) Reading on the Development of Children. New York: Scientific American Books. Pp. 34-40.

Yang, E. F. Y., Chang, B., Cheng, H. N. H., & Chan, T. W. 2016. Improving Pupils' Mathematical Communication Abilities Through Computer-Supported Reciprocal Peer Tutoring. Educational Technology & Society, 19(3), 157–169.