

CULTIVATING STUDENTS' PROBLEM-SOLVING SKILLS WITH LETTER WRITING ACTIVITY IN MATHEMATICS

Christina Maglipong¹, Ma. Jalou Jucoy²

¹University of Science and Technology of Southern Philippines, Lapasan Highway, Cagayan de Oro City, Philippines
Pedro "Oloy" Roa National High School, Calaanan, Cagayan de Oro City, Philippines

²For Correspondence; Tel. +639175490196, Email: chrismal71955@yahoo.com

ABSTRACT: This study was undertaken to determine the effectiveness of letter writing in fostering the problem-solving skills of students. The participants of this study were the Grade 8 students of Pedro "Oloy" N. Roa Sr. High School, Division of Cagayan de Oro City during the school year 2017-2018. Two (2) sections were used as participants and exposed to letter writing activity Math Pen Mate. One section was considered as the tutor, and the other as the tutee. One group Pretest-Posttest design was utilized in this research. Data gathered were analyzed using the statistical methods. The mean and the standard deviation were used to describe the participant's achievement level in Grade 8 Mathematics and problem-solving skills. Regression analysis was used to determine the effect of letter writing activity Math Pen Mate on students' achievement test. Results revealed that the letter writing activity Math Pen Mate positively influenced students' achievement score and problem-solving skills. The researchers then recommended that mathematics teachers may utilize this strategy in teaching mathematics and teach mathematics concepts focusing on developing student's problem-solving skills.

Keywords: letter writing activity Math Pen Mate, problem-solving skills, achievement

1. INTRODUCTION

Problem-solving is an essential skill to be taught to students. This is one of the skills they will use in real life situations, yet it is one of the hardest to be taught. Because word problem solving as a process is complex than activity, researchers and educators need to give more attention on mathematics instruction which focuses on developing students' problem-solving skills.

The National Council of Teachers in Mathematics [1] has stressed that the students who are encourage and supported to speak, write, read and listen in mathematics classes has two benefits: they communicate to learn mathematics and the learn to communicate mathematically. Communication becomes a tool in shaping their thinking. The students can explain, justify and analyze their strategies in problem-solving.

Thinking and problem-solving skills are divided into three domains; knowledge, application and reasoning. The students must acquire mathematics skills needed especially in problem-solving. Many students are struggling and this is a big problem that needed to be solved [2], [3]. It is important to get the bottom of this problem and find a solution. Programs or innovations could be prepared to assist those students who are struggling with mathematics.

On the other hand, writing activities in mathematics is not normally used in teaching however Mathematics educator must integrate writing for us to understand our students more on what they have learned and what do they need to know. But in Pedro "Oloy" N. Roa Sr. High School, there are students who are still in frustration level in reading and there is some who cannot comprehend. Many of this students struggle in writing. They do not enjoy it and they do not know what to write. All of these problems are obstacles in teaching problem solving especially that math problems are written in English. In order to solve any math problem, the student must understand first the problem before they can solve it. With this, the teacher must make intervention in such a way that it helps both the students and the teacher. Many researches have shown that peer tutoring is an effective strategy in helping the teacher in teaching students. This strategy creates a friendly

environment to help the students' challenges in Mathematics and to give students this opportunity to learn and study through peer tutoring.

In this connection, letter writing activity Math pen mate can help to the teacher in reinforcing the students' needs. Unlike the usual written assignment, math pen mate provides opportunity to communicate mathematically with others. This way the student can explain, justify and clarify solving problems activities. This intervention not only relates writing in Mathematics, but also helps the students on how to communicate mathematically with their pen mate in such a way that they both understand. Hence, their pen mate can help them understand the lesson, share ideas and strategies in solving Mathematical problems.

2. THEORETICAL AND CONCEPTUAL FRAMEWORK

This study is anchored on the theory of constructivism emphasizing the sociocultural learning theory pioneered by Vygotsky. Constructivism is a learning theory describing the process of knowledge construction [4]. Every child has an ability to imitate which leads to the claims of Vygotsky that every child has a higher level of cognitive development. He claims also that students who engage in a discussion are more likely to improved thinking than to those who work alone [5]. This claim where supported by the Conversational theory of Gordon Pask [6] where conversation about the lesson is an important part of learning. Vygotsky [7] viewed cooperative learning approach as important part of a process which leads to the social construction of knowledge. He suggested that students should talk and interact with each other in that way learning will take place.

Wertsch [8] clarifies Vygotsky's [7] claim that there is cognitive development if there is social interaction. The argument rests on the notion that the development of individual cognitive capacities begins when they interact and guide others or "other-regulation" until the student can understand and correct their selves; that is, until they have achieved "self-regulation." To make transition possible from other- to self-regulation is called intersubjectivity as elaborated by Rogoff [9]. For her, this the students who are

participants of the activity will discuss the activity. Communication about the activity, both verbal and nonverbal, is the way to reach their goal. Both tutee and tutor look for common idea on which to build a shared definition.

Woolfolk [10] explained the Piaget's and Vygotsky's that the main idea of social interaction is that interaction between the two students motivates them to learn and social interaction causes learning.

In the theory of Dewey [11] he stated that learning is an active social process gained through activities and first-hand experiences in life. The teacher must provide activities that the students will learn better. This is reinforced by the theory of Froebel [12] which stated that the learner learns only through his own activity.

The heart of constructivist is the empathy of the teacher for the learners. In peer tutorial, the tutor is also a student hence she/he can understand on how does her/his tutee feel in a certain topic [13,14]. Hence, the tutors can share their ideas on what they know and how they learn.

This study is also anchored on the socio-constructivist theory learning. In this theory, the learning environment should be created in such a way students can construct their mathematical knowledge through inquiry-based activities where students can make conclusion, generalization and communicate. Socio-constructivist theory calls for students to construct their knowledge with the help of other students. This interaction helps to enhance the students to think and learn.

3. LITERATURE REVIEW

Math Pen Pal

A math pen pal program is a written exchange from one school to another school. Phillips & Crespo [15] conducted a study about math pen pal. They investigated the use of math pen pal letters as a means of increasing the quality of written communication in Mathematics. They elaborated that pen pal exchange students became more able to communicate mathematically through writing. This letter writing provides the students with an opportunity in explaining their answer, asking the question, giving and requesting for an advice. They suggested that through this program students became more able to communicate mathematically through writing

Phillips and Crespo's study highlights many benefits of pen pal programs. One of which is that it allows students to communicate with another person other than their teachers or classmates which unusual in most academic programs hence this attracts the students [16] and noted the importance of communication in Mathematics by saying there would be no Mathematics without a language. Language has a vital role to play in the student ability solve a problem [17].

Barksdale, Watson, & Park [18] study demonstrates how pen pal letter writing offers a method to engage the students in recontextualization. The letter exchanges about culture between students from American university and Malawian university were analyzed and the authors saw improvements in the students' writing skills.

Problem Solving in Mathematics

On the study of Sajadi, Amiripour, and Rostamy-Malkhalifeh [19] on representation ability and problem-solving ability that relationship between two variables, they

found out the ability to represent have a direct relation between efficient representation and efficient word problem-solving ability. This ability has a factor in the students' ability to solve a problem. With this, the teacher must give more emphasis on the student's ability to represent. Bicer, Capraro, and Capraro [20] noted that one reason that students have difficulties in interpreting is because of lack of spatial skills or mathematical imagination.

In this regard, numerous studies have reported that improvement in problem-solving abilities is dependent on mathematical knowledge as well as cognitive and metacognitive abilities. Mathematics instruction calls for methods that support students' acquisition and development of these processes. Writing has been acknowledged as one possible method to improve students' problem-solving abilities [21].

Van de Walle, J. A., Karp, K. S., & Bay-Williams, J. M. [22] stated that students often reflect on the mathematical ideas in the tasks, formulating ideas more likely to be assimilated with their prior knowledge during the problem-solving activities. While solving worthwhile problems, students will be actively engaged in all NTCM's process standards: problem-solving, reasoning, communication, connections, and representation. While the students given an open-ended test, we are engaging them in higher order thinking skills.

Peer Tutoring and Discourse in Mathematics

In the study of Austin [23] on the effects of peer tutoring on fifth-grade students' motivation and learning in math, she have found peer tutoring to be a beneficial way to support and improve student motivation with regards to mathematics. It is very practical for classroom teachers to assist students. Students from an environment where teacher-directed instruction is prevalent are willing to participate and eager to share their thoughts. The teaching focus is taken from the teacher and placed on the student. Collaborative learning allows students to be in charge of their own learning.

Students may know to solve problems when the is no story involve but problems are represented in the story, solving them can be more challenging for the students because solving word problems requires the use of various cognitive processes in an integrated manner. For children that do not have an adequate knowledge base or low comprehension level, these tasks can be much more challenging [24].

Kourea, Cartledge, & Musti-Rao [25] and Miller, Topping and Thurston [26] pointed out the benefits for tutee during peer tutoring and those are effective learning, individual attention, free responding to his companion and friendship his peer. Also Peer tutoring is effective in enhancing their social and behavioral abilities, including communicating, sharing and cooperating with each other in the classroom.

The study of Pagon [27] on the effect on the student to student discourse to the students' Mathematics achievement and anxiety, he found out that student to student discourse is an effective method of teaching in improving students' achievement in Mathematics.

4. METHODOLOGY

Design and Setting

This study used one group pretest-posttest design since it focuses on investigating the effect of letter writing activity

Math Pen Mate on students' problem-solving skills as well as their achievement level. The study was conducted at Pedro "Oloy" N. Roa Sr. High School in P.N. Roa Subdivision, Calaanan, Canitoan, Cagayan de Oro City. It was formerly known as Calaanan National High School and on 2009 it was named after the person who donated the lot Mr. Pedro Oloy" N. Roa Sr. as a sign of gratitude. Pedro "Oloy" N. Roa Sr. High School offers both senior high and junior high. There are 27 junior high sections of which 8 sections are Grade 7, seven sections are Grade 8, six sections are Grade 9 and six sections are Grade 10. For this school year, the time allotted per subject is only 48 minutes. This study involves 2 sections from the Grade 8, one honor class and one heterogeneous class. The Grade 8 level has an average of 45 students.

Instruments, Validation and Statistical Treatment

This study used only one instrument, the teacher made test. This test has 12 multiple choices and 3 open-ended tests. The test composed of word problems involving a system of linear equation, linear inequalities in two variables and system of linear inequalities. The instrument was evaluated first by the researcher adviser and Mathematics experts for face and content validity. For the validity and reliability test, the questionnaire was administered to the Grade 9 students of Pedro "Oloy" N. Roa Sr. High School since they had taken the subject last 2016-2017. There were 45 items that went through item analysis where 35 items are multiple choice and 10 open-ended test. After the item analysis, only 15 items met the criteria of validity where 12 items are multiple choice and three (3) items are the open-ended test. This instrument obtained a reliability coefficient of 0.79.

The following statistical tools were used in the treatment of the data: the mean and the standard deviation were used to describe the participants' achievement test in Grade 8 Mathematics, problem-solving skills and achievement and the linear regression analysis were used to determine the effect of letter writing activity Math Pen Mate on students' problem-solving skills and achievement test.

5. RESULTS AND FINDINGS

Table 1. Mean and Standard Deviation on the level of Students on Problem Solving Skills

Problem Solving Skills		Tutors	Tutees
Mean		26.16	18.07
Standard Deviation		13.350	8.111
Descriptive Level		AP	D
<i>Legend: Mean Intervals Description Perfect Score = 48</i>			
41-48	Advanced (A)		
33-40	Proficient (P)		
24-32	Approaching		
<i>Proficiency (AP)</i>			
13-23	Developing (D)		
12 and below	Beginning (B)		

Table 1 above shows the pretest and posttest mean score and standard deviation of student's problem-solving skills. The mean scores on the problem-solving skills of tutors and tutees are 26.16 and 18.07. This means both groups did not reach the 75% standard criterion set by the Department of Education. However, the tutors' problem-solving skills are in approaching proficiency level while the tutees are in developing level. This result supported by the study of Paridjo et al [28] where the student who has better

mathematical communication skills has also the ability to solve problems.

Table 2. Dependent T-test result of the Students Pretest and Posttest Scores

	T-value	p-value
Tutee Pretest –Post Test	-16.404	0.000*
Tutor Pretest –Post Test	-13.216	0.000*

**Significant of 0.05 level*

Table 2 above shows the summary of the dependent t-test of the pre-test and post-test of the group tutees and the tutor. The t-value of the group of tutees is -16.404 with probability value of 0.001 which is lesser than 0.05 level of significance which led to the rejection of the null hypothesis. This suggests that the pretest and posttest scores differed significantly which implies that there were improvements in the student's ability to solve problems.

The table also shows the t-value of the group of tutors is -13.216 with probability value less than 0.05 level of significance which led to the rejection of the null hypothesis. This means that the pretest and posttest scores of tutors differed significantly which implies that there is an improvement on the tutor's ability to solve problems.

The above result is an indication that both groups improved in problem-solving. The tutee-tutor relationship has a good effect on the students' performance in problem-solving. The tutors and tutees tried their best in writing, explaining the answers and correcting the answer of their pen mate.

6. CONCLUDING STATEMENTS

Based on the findings, the researchers concluded that letter writing activity Math Pen Mate positively influenced students' achievement test scores and an effective method of improving students' problem-solving skills and the researchers recommended that mathematics teachers may utilize letter writing activities Math Pen Mate in the teaching Mathematics, teach mathematics concepts focusing on developing student problem solving and written communication skills and future research may be conducted on the effectiveness of letter writing activity Math Pen Mate and integrating technology in the elementary level.

REFERENCES

- [1] National Council of Teachers of Mathematics.(2000). Assessment Standards for School Mathematics. Reston, VA: NTCM, IN.
- [2] Mullis, I. V., Martin, M. O., Foy, P., & Arora, A. (2012). *TIMSS 2011 international results in mathematics*. International Association for the Evaluation of Educational Achievement. Herengracht 487, Amsterdam, 1017 BT, The Netherlands.
- [3] Tambychik, T & MohdMeerah, T.S. (2010). Students' Difficulties in Mathematics Problem-Solving: What do they Say? *Procedia - Social and Behavioral Sciences*. 8. 142-151. 10.1016/j.sbspro.2010.12.020.
- [4] Major, T. E. and Mangope, B. (2012). The Constructivist Theory in Mathematics: The Case of Botswana Primary Schools. *International Review of Social Sciences and Humanities*.

- http://irssh.com/yahoo_site_admin/assets/docs/15_IRS_SH-155-V3N2.202200518.pdf. May 5, 2017
- [5] Blanck, G.(1990).Vygotsky: The man and his cause. In L. Moll (Ed), Vygotsky and education: Instructional implication and application on sociohistorical perspectives. 31-58.Cambridge.Cambridge university press.
- [6] Pask, G. (1976). *Conversation theory: Applications in education and epistemology*. Elsevier Publishing Company.
- [7] Vygotsky, L. S. (1978.). *Mind in Society*. London: Harvard Press.
- [8] Wertsch, J. V. (1979). From social interaction to higher psychological processes: A clarification and application of Vygotsky's theory. *Human Development*, 22, 1-22.
- [9] Rogoff, B.(1990). *Apprenticeship in thinking: Cognitive development in social context*. New York: Oxford University Press.
- [10] Woolfolk, A. (2010). *Educational Psychology*, (11th Ed.) Pearson Education, Inc. ISBN 0137144547.
- [11] Gregorio, H. C.(1976).*Principles and methods of Teaching*. Quezon City, Philippines. RP Garcia Publishing Company, Inc.
- [12] Rafols, G. (2003).Problem Posing: Its Impact on Problem Solving in Fifth Grade Mathematics. *Mindanao Polytechnic State College*.
- [13] Macnab, D. S., & Cummine, J. A. (1986). *Teaching mathematics 11-16: A difficulty-centred approach*. Basil Blackwell.
- [14] Junsay, M. L. and Gerada, E. P. (2014).The effect of reflective journal writing to students' Critical thinking and mathematical Communication skills.http://serp-p.pids.gov.ph/documents/CPU/CPU_2016-08.pdf. May 5, 2017.
- [15] Phillips, E. and Crespo, S. (1995). Math Penpals1 Developing Written Communication in Mathematics. <https://files.eric.ed.gov/fulltext/ED385439.pdf>
- [16] Smith, J., Lombardi, M., Asmi, R., Hinrichs, M., Robertson, K., Buck, L. and Reid, A. (2017). Raising Cultural Awareness in Undergraduate Students through an Online Pen Pal Program. <https://scholarworks.umt.edu/cgi/viewcontent.cgi?article=1175&context=utpp>. Nov. 12, 2017.
- [17] Adams, A. (2000).Rehearsal or reorganization two patterns of literacy strategy use in secondary Mathematics class. *The Montana Mathematics Enthusiast*, 7, 371-390. 2000.
- [18] Barksdale, M. A., Watson, C., & Park, E. S. (2007). Pen Pal Letter Exchanges: Taking First Steps toward Developing Cultural Understandings. *The Reading Teacher*, 61 (1). <https://doi.org/10.1598/RT.61.1.6>
- [19] Sajadi, M., Amiripour, P. and Rostamy-Malkhalifeh, M. (2013).The Examining Mathematical Word Problems Solving Ability under Efficient Representation Aspect. <http://www.ispacs.com/journals/metr/2013/metr-00007/article.pdf>. June 14, 2017.
- [20] Bicer, A., Capraro R. M. andCapraro, M. M. (2013). Integrating Writing into Mathematics Classroom to Increase Students' Problem Solving Skills. *International Online Journal of Educational Sciences*, 5 (2), 361-369. College of Education, Texas A&M University, USA.
- [21] Kuzle, A. (2013). Promoting Writing in Mathematics: Prospective Teachers' Experiences and Perspective on the Process of Writing in doing mathematics as Problem Solving. *Center for Educational Policy Studies Journal* 3, No. 4, S. 41-59.
- [22] Van de Walle, J. A., Karp, K. S., & Bay-Williams, J. M. (2009). *Elementary and middle school mathematics: Teaching developmentally* (7th Ed.). Boston, MA: Allyn& Bacon/Merill.
- [23] Austin, J. (2008).On the Effects of Peer Tutoring on Fifth-Grade Students' Motivation and Learning in Math.https://digitalcommons.brockport.edu/cgi/viewcontent.cgi?article=1246&context=ehd_theses. January 30, 2018
- [24] Jitendra, A. K., Griffin, C. C., Deatline-Buchman, A., & Sczesniak, E. (2007).Mathematical Word Problem Solving in Third-Grade Classrooms. *The Journal of Educational Research*, 100(5),283-302, DOI: 10.3200/JOER.100.5.283-302.
- [25] Kourea, L., Cartledge, G., &Musti-Rao, S. (2007). Improving the reading skills of urban elementary students through total class peer tutoring. *Remedial and Special Education*, 28(2), 95-107.
- [26] Miller, D., Topping, K., & Thurston, A. (2010). Peer tutoring in reading: The effects of role and organization on two dimensions of self-esteem. *British Journal of Educational Psychology*, 80, 417-433.
- [27] Pagon,R (2013). Student to Student Discourse on Selected Topics in Algebra: It's Effect to Students Achievement and Mathematics and Mathematics Anxiety. Unpublished Thesis. Mindanao University of Science and Technology. Cagayan de Oro City. Philippines.
- [28] Paridjo, Waluya, S. W. (2017). Analysis Mathematical Communication Skills Students in the Matter Algebra Based NCTM. *Journal of Mathematics*. Vol. 13, Pp. 60-66.