

PAPER • OPEN ACCESS

Mathematics understanding and anxiety in collaborative teaching

To cite this article: B I Ansari and N Wahyu 2017 *J. Phys.: Conf. Ser.* **943** 012040

View the [article online](#) for updates and enhancements.

You may also like

- [The mathematics anxiety: Do prospective math teachers also experience it?](#)
D Juniati and I K Budayasa
- [Mathematics anxiety in dealing math exams](#)
T M Anugrah, T A Kusmayadi and L Fitriana
- [Exploring mathematics anxiety among senior high school students](#)
F Ambaranti and E Retnowati



ECS
The
Electrochemical
Society
Advancing solid state &
electrochemical science & technology

DISCOVER
how sustainability
intersects with
electrochemistry & solid
state science research

Mathematics understanding and anxiety in collaborative teaching

B I Ansari¹ and N Wahyu²

¹Mathematics Education Department, Serambi Mekkah University, Banda Aceh, Indonesia

²Mathematics Education Department, Syiah Kuala University, Banda Aceh, Indonesia

E-mail: bansuansari58@gmail.com

Abstract. This study aims to examine students' mathematical understanding and anxiety using collaborative teaching. The sample consists of 51 students in the 7th-grade of MTs N Jeureula, one of the Islamic public junior high schools in Jeureula, Aceh, Indonesia. A test of mathematics understanding was administered to the students twice during the period of two months. The result suggests that there is a significant increase in mathematical understanding in the pre-test and post-test. We categorized the students into the high, intermediate, and low level of prior mathematics knowledge. In the high-level prior knowledge, there is no difference of mathematical understanding between the experiment and control group. Meanwhile, in the intermediate and low level of prior knowledge, there is a significant difference of mathematical understanding between the experiment and control group. The mathematics anxiety is at an intermediate level in the experiment class and at a high level in the control group. There is no interaction between the learning model and the students' prior knowledge towards the mathematical understanding, but there are interactions towards the mathematics anxiety. It indicates that the collaborative teaching model and the students' prior knowledge do not simultaneously impacts on the mathematics understanding but the mathematics anxiety.

1. Introduction

Mathematical understanding is one of the cognitive aspects that need to be developed in mathematics classrooms. This is in line with the regulation of the Indonesian Minister of Education and Culture number 22 comment 2006 that one of the important abilities in mathematics learning is the ability to understand concepts [1]. The ability of understanding is the prior knowledge required for all students to achieve other cognitive abilities. The National Council of Teachers of Mathematics (NCTM) also implicitly mentioned the importance of mathematical understanding that the vision in school mathematics learning is that students understand what they learn [2]. Therefore, a student is considered as having a high mathematical proficiency if the student masters mathematical concepts.

Affective aspects are also necessary for students. One of the important affective aspects of mathematics learning is mathematics anxiety. Mathematics anxiety is a students' emotional reaction based on previous unpleasant experiences which impact the future learning [3]. Students who achieve good results are likely to avoid anxiety. On the other hand, students who achieve poor results are likely to hold high anxiety. Therefore, mathematics anxiety is one's attitudes showing fear or nervousness in solving mathematics problems or in mathematics learning. Anxiety has a negative



effect on learning. Students with high anxiety tend to work harder but their understandings tend to be poorer resulting in the increase of the anxiety. Students with medium mathematics anxiety are able to handle the problems in learning mathematics [4]. It is important to maintain the anxiety to be at the ideal level. Collaborative learning is one of the strategies that can be applied to manage anxiety in order to improve understanding.

2. Literature review

Review of some literature regarding mathematics understanding and collaborative teaching is presented in this section.

2.1. Mathematics understanding and anxiety

Mathematics understanding is one of the aims of each lesson as teachers are students' facilitator to understand the concepts being presented. Mathematics understanding can be measured using five indicators: (1) the ability to present the concepts learned, (2) the ability to classify objects based on the requirements to form the concepts, (3) the ability to apply concepts algorithm, (4) the ability to present concepts in various mathematical representations and (5) the ability to relate various concepts [5].

Students are usually confused and anxious when they face word problems causing the loss of mathematical concepts learned previously. Students need to manage their level of anxiety so that they will not lose the concepts learned. Students require to control the anxiety in learning mathematics as the anxiety is the disturbing tense and nervousness when one faces number manipulation and solves mathematics problems; this leads to one's being forgetful and loses her/his confidence [6]. Therefore, teaching model resolving students' anxiety in solving mathematics problems is needed.

2.2. Collaborative teaching

Collaborative teaching is one of the teaching model used to deal with anxiety as well as to improve students' understanding. Collaborative teaching is the form of teaching in which two or more teachers involved in managing the classrooms, starting from the planning stage to the students' evaluation; thus, teachers can improve their quality of learning [7]. One of the applications of the collaborative teaching is one teach-one assist. This type consists of two teachers involving one teacher explains in the classroom and the other assists the learning by supervising students who have difficulties in understanding the learning materials. Students are given many opportunities to be guided when they have materials they have not fully understood [8]. The guidance during the exercises process results in students having more time and chances to consult the teacher. Therefore, students can avoid any excessive anxiety or fear in proposing questions for any confusing materials.

The methods enable the improvement of students' understanding of concepts. Students do not only provide positive responses to the collaborative teachings but also are actively involved in the teaching and learning processes which in turn has a positive impact on their academic achievement [9].

3. Method

The method of this research is presented in a form of sampling technique, test administration, research procedure, and treatment.

3.1. Sample

The sample of this study is obtained from one of the Islamic public junior high schools in Jeureula. It was Madrasah Tsanawiyah Negeri (MTsN) Jeureula, located in one of the suburb areas near Banda Aceh. The sample consists of 51 students of 7th-grade around the age of 13 to 14. Based on their prior knowledge, the sample was classified into high, intermediate and low before being divided into the experiment group (26 students) and the control group (25 students). Pre-test, treatment, and post-test were given to the sample. All classes involved were heterogeneous in terms of the ability (Table 1).

Table 1. Sample based on prior knowledge

Prior Knowledge	Group		Total
	Experiment	Control	
High	6	4	10
Medium	12	16	28
Low	8	5	13
Total	26	25	51

3.2. Test

The test consists of five word problems related to the linear equations and linear inequalities in one variable. Some of the final problems are presented as follow.

- Kadir has x candies, Manda has twice as much as Kadir's, and Iwan has 10 candies more than Kadir's. Given that the sum of Kadir's, Manda's and Iwan's candies are 30, write the mathematical model of the problem and find out the number of candies owned by each person?
- Mr. Rifki sells a television for 1,650,000 rupiahs. He earns 10% profit from the sales. How much is the purchase price of the television?
- It takes six months to build a building by employing 100 workers, how long it takes to build the building when 50 people are employed?

3.3. Procedure

The sample of two groups is obtained randomly for the experiment and control group. The experiment group is treated using the collaborative teaching model in groups of five students and the control group is treated using the non-collaborative teaching model. Both groups are classified into the group of high, intermediate and low prior knowledge. The data collection was from early March 2017 to April 2017.

3.4. Treatment

The topics of linear equations and inequalities in one variable and both qualitative and quantitative ways as well as creating a mathematical model to solve problems were taught to both sample groups. The collaborative teaching used in the learning is the one teach-one assist type. The model is modified with two or more teachers in the classroom. When one teacher explains in the classroom, the other teacher assists the teaching and learning by monitoring the students who have difficulties in understanding the materials presented and solving problems. The core of this model is that the teachers work together in managing the classroom including planning the lesson and evaluating the students. After the treatment, post-test (containing five word problems) were administered to the students to examine students' understanding of the concepts. Furthermore, a student questionnaire consisting of 25 items were also conducted to measure students' mathematics anxiety level.

4. Results and discussion

The mathematics understanding and anxiety based on the research variables and prior knowledge is presented in Table 2.

Table 2. Mathematical understanding and anxiety based on students' prior knowledge

Research Variable	Mathematics Understanding				Mathematical Anxiety				Conclusion
	Experimental		Control		Experimental		Control		
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Prior Knowledge									
High	83.2	13.3	80.5	8.5					Ho is rejected
Intermediate	77.4	8.6	68.7	8.3	52.15	5,5	69.08	5.03	
Low	66.3	10.7	59.3	9.4					
Mean	75.6		69.5						

Table 2 indicates that based on the Mann Whitney test (1-tailed), at the significant level of 95% ($\alpha = 0.05$), there is no significant difference of students' mathematical understanding between the experiment and control group at the level of high prior knowledge. However, there is a significant difference at the level of intermediate and low prior knowledge. The level of students' mathematical anxiety in the class taught using collaborative teaching is ideal ($46 \leq x \leq 69$) compared to the class taught without collaborative teaching [10]. This means that the majority of students have a high mathematical anxiety when they solve mathematics problems in the non-collaborative teaching classroom. This is supported by the correlation between the mathematical anxiety and mathematical understanding that is high ($r = 0.679$), indicating that students with higher mathematical anxiety have lower mathematical understanding of concepts.

The interaction between learning model and prior knowledge is presented in Table 3.

Table 3. Interaction between learning model and prior knowledge

Source	Type I Sum of Squares	df	F	Sig.	Conclusion
Model (combination)	1983.962 ^a	5	4.016	.004	H ₀ rejected
Learning Model	124.254	1	1.257	.268	H ₀ accepted
Prior Knowledge	1148.412	2	5.811	.006	H ₀ rejected
Learning Model*Prior Knowledge	172.488	2	0.873	.425	H ₀ accepted
Error	4446.665	45			
Total	6430.627	51			

Table 3 indicates that there is no significant interaction between learning factor and student grouping on students' mathematical understanding ($\alpha > 0.05$). The students' ability is not influenced by the learning model and prior knowledge simultaneously. The influence is only found for the students with high prior knowledge but it has no impact for the students with medium and low prior knowledge. On average, the post-test results show that students from collaborative teaching have a higher score compared to the non-collaborative teaching classroom.

The interaction between learning model and prior knowledge and mathematical anxiety is presented in Table 4.

Table 4. Interaction between learning model and prior knowledge

Source	Type I Sum of Squares	df	F	Sig.	Conclusion
Model (combination)	268.115 ^a	5	1.863	.002	H ₀ rejected
Learning Model	236.052	1	8.199	.006	H ₀ rejected
Prior Knowledge	10.470	2	.182	.834	H ₀ accepted
Learning Model*Prior Knowledge	66.640	2	1.157	.024	H ₀ rejected
Error	1295.571	45			
Total	1563.686	50			

The results presented in Table 4 indicates that the interaction between learning factor and student grouping is significant ($\alpha = 0.024$). This means that there is an interaction between learning factor and student grouping.

Furthermore, we can make a qualitative comparison between students' mathematical understanding of the experiment and control group, as presented in Table 5.

Table 5. Correlations between mathematical anxiety and mathematical understanding of experiment group (*) and control group (**)

Anxiety level	Mathematics understanding (*)			N	Mathematics understanding (**)			N
	H	I	L		H	I	L	
High (H)	-	--	--	--	--	--	--	12
Intermediate (I)	10	14	--	24	8	2	--	10
Low (L)	--	--	2	2	--	--	3	3
Total	10	14	2	26	8	2	15	25

Table 5 indicates that mathematics anxiety in the control group is high while the mathematical anxiety in the experiment group is ideal for students' mathematical understanding being higher. The results of this study show that the mathematical anxiety of students in the collaborative teaching classroom is ideal (medium). This indicates that there is a difference of anxiety between students who are taught by the team of teachers and those who are taught by one teacher.

A study found that one teacher class can have a negative impact on students' performance due to the lack of time, energy and ideas in addressing individual student's case [11]. This results of this study are in line with the study reported that students provide positive responses towards the collaborative teaching-learning and are actively involved in the teaching and learning processes which in turn positively influence their academic performance [9].

When students' mathematical anxiety is under control, it will be a beneficial stimulus in both teaching and learning processes as well as in the examination [12]. The collaborative learning enables students to avoid high mathematical anxiety. It allows students to freely discuss with teachers regarding each material that has not been fully understood. The two teachers are the facilitators, moving around the classroom to guide students when the lesson start, enabling students to avoid the nervousness and fear of asking questions. This setting overcomes the possible problems arise better than the class that is having one teacher only. This means that the collaborative teaching strategies are successful in controlling students' mathematical anxiety so that it does not have a negative influence towards students' ability in learning.

Furthermore, the impact of collaborative teaching on the mathematical anxiety was also implied in the findings mentioning that of the major cause of anxiety is teacher's authority [13, 14]. This indicates that an authoritarian teacher can kill students' creativity. Therefore, teachers have to be able to eliminate prejudice of mathematics.

5. Conclusion

This study shows that the students who are taught using collaborative learning have a higher mathematical understanding and on average have an ideal mathematical anxiety (intermediate level). Students in the non-collaborative class have a lower mathematical understanding and higher mathematical anxiety (high level). In general, there is no interaction between learning factor and student grouping (high, intermediate, and low) on students' mathematical understanding, however, there is an interaction for students with medium and low prior knowledge.

References

- [1] MOEC 2006 *Regulation of minister of education and culture number 22 comment 2006* (Jakarta: BSNP)
- [2] NCTM 2000 *Principles and standards for school mathematics* (Reston: National Council of Teacher of Mathematics) p 127
- [3] Martinez J G R 1987 Preventing math anxiety: A prescription *Academic Therapy* **23** 117

- [4] Peker M 2009 Pre-service teachers' teaching anxiety about mathematics and their learning styles *Eurasia Journal of Mathematics, Science, & Technology Education* **5** 335
- [5] Kilpatrick J 2001 *Adding it up: Helping children learn mathematics* (Washington, DC: National Academy Press)
- [6] Mahmood S and Khatoon T 2011 Development and validation of the mathematics anxiety scale for secondary and senior secondary school students *British Journal of Art and Social Sciences* **2** 169
- [7] Sandholtz J H 2000 Interdisciplinary team teaching as a form of professional development *Teacher Education Quarterly* **27** 39
- [8] Khashan K H 2014 Conceptual and procedural knowledge of rational numbers for Riyadh elementary school teachers *Journal of Education and Human Development* **4** 18
- [9] Marilyn 2008 Co-teaching: A simple solution that isn't simple after all *Journal of Curriculum and Instruction (JoCI)* **2** 9
- [10] Puteh M 2016 Mathematics anxiety and its relationship with the achievement of secondary students in Malaysia *International Journal of Social Science and Humanity* **2** 6
- [11] Mirza M S and Zafar I M 2014 Impact of collaborative teaching (CT) on mathematics students' achievement in Pakistan *Journal of Research & Reflections in Education (JRRE)* **8** 13
- [12] Daneshamooz S, Alamolhodaie H and Darvishian S 2012 Experimental research about effect of mathematics anxiety, working memory capacity on students' mathematical performance with three different types of learning methods *ARPN Journal of Science and Technology* **2** 4
- [13] Zakaria E, Nordin N M, Ahmad N A and Erlina A 2012 Mathematics anxiety and achievement among secondary school students *American Journal of Applied Sciences* **9** 1828
- [14] Syamsuri, Purwanto, Subanji, and Irawati S 2017 Using APOS theory framework: Why did students unable to construct a formal proof? *International Journal on Emerging Mathematics Education* **1** 135