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Peer Tutoring with Realistic Mathematics Education in Inclusive Class to Improve Problem-Solving Skills

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ABSTRAK

Banyak guru yang belum siap mengajar siswa berkebutuhan khusus di kelas inklusi. Selain itu, metode dan pendekatan yang berkaitan dengan keefektifan pembelajaran matematika di kelas inklusi belum banyak digali khususnya yang berkaitan dengan keterampilan pemecahan masalah. Penelitian ini bertujuan menganalisis keefektifan metode peer tutoring dengan pendekatan Pendidikan Matematika Realistik terhadap keterampilan pemecahan masalah anak lamban belajar dan siswa kelas inklusi pada umumnya. Jenis penelitian ini adalah quasi eksperimen dengan desain One Group Pretest-Posttest design. Sampel penelitian ini dipilih secara sampling jenuh yang terdiri dari 31 siswa lamban belajar dan 62 siswa reguler yang tersebar dalam 3 kelas inklusi. Penentuan siswa lamban belajar didasarkan pada hasil tes kecerdasan dan hasil belajar siswa. Instrumen yang digunakan untuk mengukur keterampilan pemecahan masalah adalah esai berupa pretest dan posttest. Teknik analisis data yang digunakan yaitu analisis deskriptif kualitatif, kuantitatif, dan statistic inferensial. Hasil penelitian menunjukkan bahwa rerata skor posttest lebih tinggi dari rerata skor pretest berdasarkan keterampilan pemecahan masalah, Lebih dari 75% dari keseluruhan siswa. mendapatkan skor lebih tinggi dari kriteria pencapaian minimal. Hal ini menunjukkan bahwa metode peer tutoring dengan pendekatan Pendidikan Matematika Realistik efektif diterapkan di kelas inklusif untuk anak lamban belajar dan siswa umum dalam hal keterampilan pemecahan masalah.

ABSTRACT

Many teachers are unprepared to teach special-needs students in inclusive classes. In addition, methods and approaches related to the effectiveness of learning mathematics in inclusive classes have not been explored, especially those related to problem-solving skills. This study aims to analyze the effectiveness of the peer tutoring method with the Realistic Mathematics Education approach to the problem-solving skills of slow learners and inclusive class students. This type of research is a quasi-experimental design with a Group Pretest-Posttest design. The sample of this study was selected by saturated sampling consisting of 31 slow learners and 62 regular students spread over three inclusive classes. Determination of slow learners is based on the results of intelligence tests and student learning outcomes. The instrument used to measure problem-solving skills is an essay in the form of a pretest and posttest. The data analysis technique is descriptive qualitative, quantitative, and inferential analysis. The results showed that the average post-test score was higher than the average pretest score based on problem-solving skills, more than 75% of all students. Get a score higher than the minimum achievement criteria. It shows that the peer tutoring method with the Realistic Mathematics Education approach is effectively applied in inclusive classes for slow learners and general students regarding problem-solving skills.

1. INTRODUCTION

The inclusive class program is one of education systems being developed by some countries. Indonesia has been applied this system after the regulation of The Ministry of Education no. 70 in 2009 has applied. It is a system where allow students with special needs having the same services in regular classes with other regular students (Hermanto, 2010; Schunk, 1995). In inclusive class all student receive teaching that corresponds to their abilities and interests (Anastasiou et al., 2015; Ellis et al., 2021; Shokoohi-Yekta et al., 2011). Slow learner is one of the frequently conditions of students with special needs. The data shows that 14% students are categorized as slow learner (Shaw, 2010). Some terms related to slow learner are such as special needs, under-achievers, low attainders and low achievers (Al-Zoubi & Younes, 2015; Chere & Hlalele, 2014; Dunne et al., 2011). Slow-learner students can be defined as students with special needs in which they do not get appropriate learning based on their abilities (Chauhan, 2011; Muppudathi et al., 2014). Problem solving skills are the ability to analyze and to decide the strategy of solving mathematics in order to find best solution appropriately (Khazaal, 2015; Mwei,

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2017; Zhang & Chu, 2016). There are four steps that students must take when they solving problems (Chauhan, 2011; Dasaradhi et al., 2016). The first step understands the problem. Student need to understand data is known and unknown in the problem. Second step is devising a plan. It is an activity to find the relationship between known and unknown data to create a solution plan (Sclafani, 2007). Third step is carrying out the plan. This step is implementing what has been planned in order to find a solution according to the completion steps (Heuvel-panhuizen et al., 2014). Fourth step is looking back. It is rechecking the solution obtained, then thinking whether the solution steps or solutions can be used for other problems (Bernard et al., 2017; Rogowsky et al., 2015).

However, some researches show that slow-learners and students are generally still lack of ability to solve the problem (Mawaddah & Anisah, 2015; Sari, 2019). One of the reasons why they lack of problem-solving skill ability is they find it difficult to learn something in abstract. The conditions described are in line with the results of researcher observations (Malik, 2009; Shaw, 2010). The subject of the observation is 92 students separated in 3 inclusive classes that contain 31 slow learner students. Most of the students even had difficulty in understanding the problems. It shows those teachers need to develop learning process to increase problem solving skills, especially for slow learner students (Ahmad et al., 2015; Mami & Arayesh, 2010). In addition, educational services provided by teachers cannot facilitate students according to their special needs especially slow learners in inclusive classes. Some of the lessons done by teachers make slow learner students even more difficult (Bogdan & Biklen, 1982; Gravemeijer et al., 2000). This is supported by the research that states the use of models, methods, instructional media equated between regular and slow-learner students (Ahmad et al., 2015). There are methods have been implemented which able to accommodate regular and slow-learner students. Besides, there are also some methods which make slow-learner students having learning difficulties. Teachers' understandings related to inclusive education are still low. In addition, mathematics teachers are still incompetent handling slow-learner students (Pramitasari et al., 2019). Peer tutoring is a learning method which combines students with high and low achievements into small groups so they can assist each other (Scruggs & Mastropierim, 2009). It also allows the students to improve their individual abilities. These benefits of peer tutoring are not only for competent students but also for disabled or slow learner student (Huber & Carter, 2019; Mahoney, 2019; Sarid et al., 2020). Through peer tutoring learning slow learner students can obtain explanations from highly accomplished students. This can improve the learning achievement of slow learner students because sometimes a student is more receptive to the information given by a compatriot or another friend because of the absence of reluctance or embarrassment to ask. This opinion was corroborated by previous researcher who stated that peer tutoring teaching was more effective than teaching by teachers (Lie, 2008). This is because the background and experience of the students are similar to each other compared to the teacher scheme. It is in line with the result of other previous study that state interaction between students or between students and teachers can provide opportunities for students to express and develop their understanding. In this case, peer tutoring methods can be chosen as one of the learning methods that allow for more social interaction. Peer tutoring provides opportunities to join students with high achievement with slow learner students (Abdurrahman & Garba, 2014). Based on the explanations above, it is necessary to develop a method and learning approach which are able to facilitate regular and slow-learner students to improve their problem-solving skills. So that, student-centered learning becomes important to do(Chauhan, 2011; Dasaradhi et al., 2016). Based on the problems above, the researchers are interested in carrying out research that aims to analyze the effectiveness of peer tutoring method with realistic mathematics education approach in order to develop problem-solving skills of regular and slow learner students in inclusive classes.

2. METHODS

This type of research was a quasi-experiment with one-group pretest-posttest design. The subject of this research is 92 students separated in 3 inclusive classes. Some types of children with special needs in those classes are presented in Table 1.

Table 1. The Condition of Students with Special Needs

The Condition of Student	VII A	VII B	VII C
Deaf	1	-	-
Autism	-	2	1
Slow Learner	10	10	11
Normal	23	18	16

This research focused on the problem-solving skills achievement of normal and slow-learner students. In addition, the sampling technique of this research was saturation sampling by making all of subject as sample. Determinations of slow-learner students were based on the result of intelligence test and students learning outcomes. The instrument used in this research was a test to assess problem-solving skills achievement. The test was delivered in form of pretest to assess student competencies before having a treatment and posttest to assess student competencies after having a treatment. The time given to students to solve problem solving test is 50 minutes. The maximum score given for each question is 10. There are four steps that students must take when they solving problems. These four steps are: 1) understanding the problem; 2) Devising a plan; 3) Carrying out the plan; and 4) Looking back. After compiling the instrument, the validity test of content and constructs also reliability estimates with Alpha Cronbach would be done. The reliability coefficient value for the problem-solving test is 0.806. This indicates that between posttest and pretest the problem-solving ability is equivalent. The data of the test was done at the first and last out of 8 meetings. After collecting the data, normality test by using one-sample Kolmogorov-Smirnov would be done. After that researcher carried out the hypothesis test to show effectiveness of the used peer tutoring with realistic mathematic education by 1) examining if mean score of pretest higher than posttest by using paired t-test, and 2) examining whether 75% of the whole students gained score above the minimum criteria by using z test. The minimum criteria for slow-learner students were 60 and 75 for normal students.

3. RESULT AND DISCUSSION

Results

Before discussing the effectiveness of peer tutoring learning with realistic mathematics education approach, there will present the classification of slow learner students, the process of choosing tutors, and the implementation of peer tutoring learning combined with Realistic Mathematics Education approaches. In this study, an assessment of 92 grade VII students was conducted to classify students in the slow learner category or not. From the results of intelligence tests conducted by *Pusat Layanan Autis, Dinas Pendidikan, Pemuda dan Olahraga Daerah Istimewa Yogyakarta* (Autism Service Center), 31 students received intelligence potential examination results below average and very below average or within the IQ range of 75-90. After that, 31 students were observed scoring for all subjects. The results showed that the achievement of student learning outcomes under 60 in almost all subjects. It can be concluded that 31 students out of 92 students are in the slow learner category. In this study a total of 23 tutors were selected from 92 students. The selection criteria were modified into 3 criteria (Djamarah et al., 2010). The criteria for tutor selection were implemented in this study are: 1) student achievement of learning outcomes; 2) student communication skills; and 3) student gender. Peer tutoring learning activities combined with Realistic Mathematics Education approach (Bogdan & Biklen, 1982). The data of problem-solving skill ability is obtained through pretest and posttest score. Table 2 shows the data statistics of problem - solving skills from slow-learner students in the inclusive classes. While data of problem-solving ability of normal students in inclusive classes is show in Table 3.

Table 2. Data Statistic of Slow-Learner Students' Problem-Solving Skills

Data Statistic	*Pretest*	*Posttest*
Mean	26,77	67,53
Standard Deviation	11,34	9,92
The Highest Score	53,33	80,00
The Lowest Score	13,33	30,00

Table 3. Data Statistic of Normal Students' Problem-Solving Skills

Statistik data	*Pretest*	*Posttest*
Mean	58,60	78,36
Standard Deviation	9,92	7,24
The Highest Score	80,00	90,00
The Lowest Score	36,67	53,33

Base on Table 2 and Table 3 show that the mean score of posttest are higher than pretest for both of normal and slow-learner students. This enhancement score is also seen in every problem-solving skill

indicator. Then Table 4 and Table 5 present the mean score for each conceptual understanding of students.

Table 4. The Mean Score of Slow-Learner Students' Problem Solving Skills

Aspects of Conceptual Understanding	*Pretest*	*Posttets*
The ability understanding the concept	79,57	88,17
The ability construction the solution	13,98	57,52
The ability solving the problem	17,20	80,38
The ability looking back at the solution	5,91	31,18

Table 5. The Mean Score of Normal Students' Problem Solving Skills

Aspects of Conceptual Understanding	*Pretest*	*Posttets*
The ability understanding the problem	87,43	94,44
The ability construction the solution	46,78	74,56
The ability solving the problem	55,26	83,63
The ability looking back at the solution	48,25	55,56

The data are begun by examining whether the obtained data meet the normal and homogenous criteria. Through Kolmogorov Smirnov test, it was found that 1) sig. value = 0.213 for pretest and sig. value = 0.239 for posttest of slow learner students and 2) sig. value = 0.135 for pretest and sig. value = 0.173 for posttest of normal students. All of these significant were higher than α = 0,05 so the data gained normal distribution. The homogenous criteria were fulfilled because the data of pretest and posttest came from the same sample. Paired t-test and z test are done to verify the effectiveness of peer tutoring with realistic mathematics education approach. Data analysis of slow learner students shows that t-value = 18.03 > t-table=1.697, then H_0 is rejected at level of 0.05. As the result, the mean score of posttest is higher than pretest. Meanwhile, the result of z test shows that z-value = 1.97 > z-table = 1.645, so H_0 is rejected at level of 0.05. Based on the z test result, it shows that the percentage of posttest score reaching over 60 exceeds 75%. Data analysis of normal students shows that t-value = 15.08 > t-table = 1.697, then H_0 is rejected at level of 0.05. As the result, the mean score of posttest is higher than pretest. Meanwhile, the result of z test shows that z-value = 3.14 > z-table = 1.645, so H_0 is rejected at level of 0.05. Based on the z test result, it shows that the percentage of posttest score reaching over 70 exceeds 75%. Hypothesis tests conducted showed that peer tutoring learning with a Realistic Mathematics Education approach was effectively reviewed from the problem-solving skills of slow learner students. The problem-solving process before students are treated presented in Figure 1.

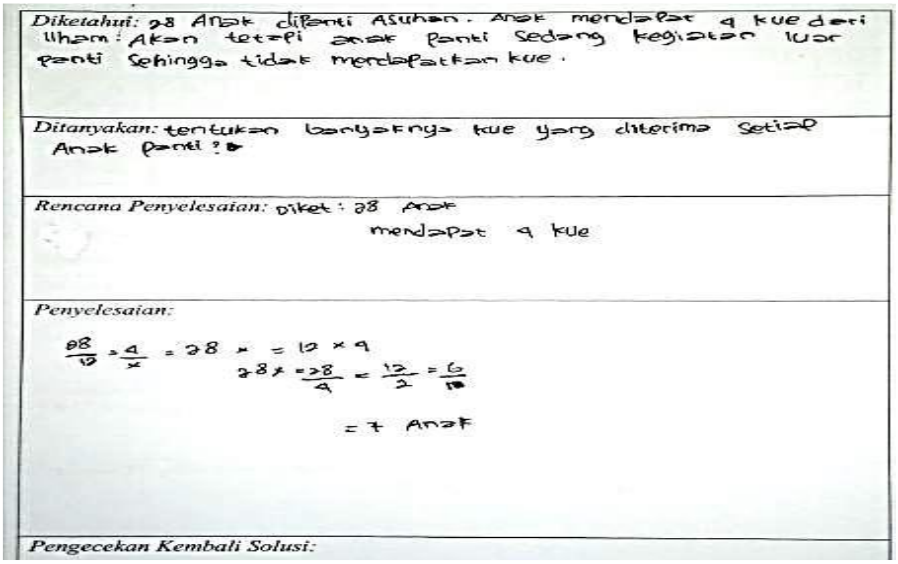

Figure 1. Example of student answer before treatment

While in Figure 2 are presented the problem solving process conducted by students after being given peer tutoring learning with a Realistic Mathematics Education approach.

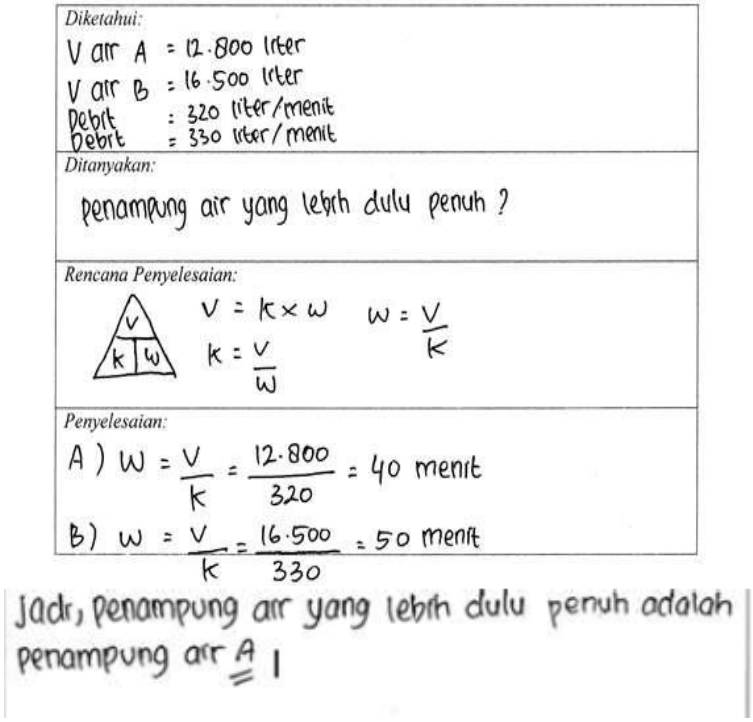

Figure 2. Example of student answer after treatment

From both images it can be observed that there is a difference between the problem solving process before treatment and after treatment. Before being treated, the majority of students' answers only write down problem solving (calculation) and information that is known and asked in the question. Students are still unfamiliar and unable to write down how to design solutions and looking back the solutions obtained. After being given peer tutoring learning with a Realistic Mathematics Education approach the students' answers are written more systematically and completely covering what is known, asked, design solutions, solutions, and recheck solutions.

Discussion

Peer tutoring with realistic mathematics education approaches is effective to develop problem solving skills in inclusive classes is possible for several reasons. One of them is increasing social interaction inside and outside school in peer tutoring learning. Social interaction has a good impact on students' cognitive development when considering the number of students in the group and the ability of the tutor (Thurston et al., 2020). One of the social interactions carried out in peer tutoring learning is discussion. Through this discussion students can improve their understanding a problem. Discussion among students can help students collect the information needed. Group discussion allows students to get information from other students. This result in line with several studies that show how discussions can increase the students' learning outcome and understanding (Francisco, 2013; Ryve et al., 2013; Soucy McCrone, 2005; Webb, 2009). The discussion process carried out in the tutoring group remains under the teacher control. Teachers have a significant role in managing group discussions. This is in accordance with the results of the study that teachers need to fostering the group discussions because students need help in focusing their mathematic reasoning on important mathematical concepts (Cengiz et al., 2011; Ryve et al., 2013). In the learning carried out in this study, the teacher periodically monitors discussions both inside and outside the classroom. The teacher asks the tutor or tutee about the obstacles faced in learning and then looks for a solution. Furthermore, peer tutoring learning also facilitates slow learner students to get guidance outside mathematics class. So, they will have more activities and exercises. This statement is in line with Shaw that claims one of strategies to assist slow-learner students is by providing opportunities to repeat and practice using various skills in different situations over and over again (Shaw, 2010). Mentoring carried out outside the classroom provides benefits for repetition activities. Repetition activities encourage students to understand the lessons better. Students who do not have the opportunity

for repetition will think that unnecessary to improve the previous lesson because they will get a different lesson at the next meeting (Istri Aryani & Rahayuni, 2016). Another benefit of repetition is students will often get the same material, so they will have a better memory (Prayoga et al., 2015; Suryasa et al., 2017).

In the repetition process carried out by students, they can find out the mistakes made before and correct them. This can increase the accuracy of students not to repeat the same mistakes. In addition, with repetition students will be more proficient in problem solving so that they can have good time management. Through good time management can make students better at solving other mathematic problems. This is in accordance with research that peer tutoring makes students' behavior more exploratory, time efficient, and more thorough (de la Hera et al., 2022). Peer tutoring also provides opportunities for students to share their opinions. Students can argue more comfortable in their groups or when presenting the results of their group discussions. This statement in line with research that peer tutoring makes students more motivated and builds their confidence (Martí et al., 2022). In this condition students can learn and able to solve math problems better. Peer tutoring learning method is applied by combining realistic mathematics education approach. The mathematics learning that uses realistic mathematics education approach is always started with real situations. Each beginning of worksheet activities is started with real situations as examples being studied. It is important because slow-learner students have weaknesses in abstract thinking so teachers need to associate the learning materials with students' daily life. Students will increasingly understand if the provided examples are more relevant. Through this provided situations, students can understand the problem easily. Besides, learning activities including mathematization and reflection are facilitated in realistic mathematics approach. Students are facilitated to perform the mathematization processes by processing the data through several mathematical representations in form of tables and graphs. Through this activity, students are get used to plan and choose the best solutions from various mathematics representations. The various mathematics representations which can complement each other is needed for the development of complete concept (Ainsworth, 2006; Elia et al., 2007; Tripathi, 2017). This activity is one of parts which assist students to develop their problem-solving skills in inclusive classes. In learning mathematics for slow learners, an environment with comfortable physical conditions is needed, including from a visual perspective, spatial planning, so that it becomes a conducive learning environment (Sh et al., 2015). So, improving the ability of slow learners, teachers can help them to improve their performance (Kaur et al., 2015). This assistance can be obtained through a peer tutoring approach. Peer tutoring can improve test scores (Alegre et al., 2019; Kim et al., 2021; Pugatch & Wilson, 2018). This peer tutoring combined with realistic mathematics education approach has a positive effect such as students are able to develop their problem-solving skills.

4. CONCLUSION

The peer tutoring learning combined with realistic mathematics education approach is effective to develop problem-solving skills of normal and slow-learner students in inclusive classes. Thus, these method and approach can be used as one of alternatives to implement mathematics learning in inclusive classes. In this research, some of other special needs students such as autism and deaf who participated in a learning process have not been anticipated and prepared in particular learning. So, even though there are special teacher companion, those students have not participated in tutoring process maximally. So it can be concluded that peer tutoring combined with this realistic mathematics education approach has a positive impact and most importantly is able to develop problem solving abilities.

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