Journal of Physics: Conference Series

PAPER • **OPEN ACCESS**

The effectivity of contextual teaching and learning (CTL) approach with Geoboard media on mathematics learning for four-grade elementary students

To cite this article: T Trimurtini *et al* 2020 *J. Phys.: Conf. Ser.* **1663** 012050

View the article online for updates and enhancements.

IOP ebooks™

Bringing together innovative digital publishing with leading authors from the global scientific community.

Start exploring the collection–download the first chapter of every title for free.

This content was downloaded from IP address 114.125.84.224 on 29/10/2020 at 18:09

Journal of Physics: Conference Series **1663** (2020) 012050 doi:10.1088/1742-6596/1663/1/012050

The effectivity of contextual teaching and learning (CTL) approach with Geoboard media on mathematics learning for four-grade elementary students

T Trimurtini*, T R Safitri, E F Sari and N Nugraheni

Elementary Teacher Education, Universitas Negeri Semarang, Indonesia

*Corresponding author's e-mail: trimurtinipgsd@mail.unnes.ac.id

Abstract. Mathematics problems for elementary school are about the circumference and area of two-dimensional figures. Students only memorize the formula without understanding the meaning of the rim and area. The objective of this research is to examine the effectivity of the CTL approach with Geoboard on mathematics learning. The research population was 126 four graders of public elementary schools in Tamansari Kebumen School Group. One experimental class and one control class were selected. Both of the studies were given a pre and post-test. The data consisted of learning outcomes that were analyzed using a z-test and t-test, as well as student activities that were analyzed using descriptive statistics. The research results showed that: 1) the mastery learning of the experimental class reached 75%; 2) the experimental class average of learning outcome was higher than the control class; 3) the increase of learning outcomes were classified as 'medium'; and 4) the student activities in solving problems enhanced from 88.34% to 96.66%. The research concluded that the CTL approach with geoboard media is sufficient to be applied in mathematics learning for the four-grade students of public elementary schools in Tamansari Kebumen School Group.

1. Introduction

Mathematics is one of the disciplines beneficial for developing the power of thought and argumentation skills, which contributes to solving daily problems as well as gives support in enhancing the development of science and technology. For that reason, mathematics as a basic science has to be mastered by students, especially during their elementary education. Mathematics is different at every level of education. In Indonesia, the scope of mathematics at first to the sixth grade of elementary level covers numbers, geometry, measurements, and simple statistics. In addition to the content standards, which include the scope of the materials in the description of intended competencies, there are standards for the mathematics learning process, according to the 2013 Curriculum (K-13). The learning process standard emphasizes the modern pedagogical aspect, i.e., the scientific approach of observing, questioning, experimenting, synthesizing, presenting, and creating. Therefore, teachers must do effective learning, which is the benchmark of a teacher's success in classroom management. Learning is said to be useful if the students could achieve the established criteria.

The 2018 PISA (Programme for International Student Assessment) report revealed that the results of mathematics learning are low, as evidenced by the decline in average scores from the previous year. Indonesia ranks 72 out of 78 countries, having a mathematics score of 379 [1]. This low PISA score unveiled that Indonesian children are not able to apply the mathematical system in everyday life. In

Content from this work may be used under the terms of the Creative Commons Attribution 3.0 licence. Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI.
Published under licence by IOP Publishing Ltd

addition to the PISA results, the soft mathematics skill has been explained by Kemendikbud through a study entitled Indonesia National Assessment Program (INAP). In 2016, 77.13% of the elementary student throughout Indonesia had low competency, 20.58% of them were in the fair category, and only 2.29% classified as useful. This has been the foundation for researchers to enhance mathematics education quality by creating and developing various mathematical problems in everyday life and culture [2].

The mathematics learning outcomes of students in public elementary schools of Tamansari Kebumen School Group were low, proven by the final odd semester exam score. Seen from the minimum completeness criteria (72), out of 126 students, 70 learners (56%) have passed the minimum score while the other 56 students' scores (44%) were under the mastery learning criteria. This still needs to be improved, keeping in mind each student must study thoroughly. Furthermore, all students were given diagnostic problems on circumference and area, and the results turned out to be not so good. In other words, it was clear that the students thought the topic was complicated.

The interview and observation results showed that the reason underlying the low score of mathematics learning was the students' lack of understanding of circumference and area. Instead, they only memorized the given formulas. Other than that, the absence of media and teaching aid has become one of the driving factors of the low score. These pre-research results are suitable for the general opinion of mathematics that it is a tedious and irrelevant subject having abstract materials that cause fright of failure in the students. This is a big challenge to overcome [3].

Mathematics learning will be meaningful when related to daily life to find and build their understanding through real learning experiences [4][5]. For elementary school students, learning must be held interactively and fun for them to enjoy the learning process. The contextual Teaching and Learning (CTL) approach is an approach that involves students actively in the learning process to find concepts by connecting materials with the students' knowledge and experiences in daily life [6]. This approach provides many examples of ways used by teachers who have successfully employed CTL to help students achieve academic excellence.

On the other hand, the students needed to be assisted with geoboard media, leading to an understanding of circumference and area. In this study, the Geoboard serves as a learning aid. It is an essential manipulative tool that is easily designed and used in Math classrooms [7], primarily in numeracy, geometry, and measurement learning [8]. Moreover, Geoboard is beneficial in instilling concepts or understanding of geometry, such as introducing two-dimensional shapes, circumference, and area.

Previous studies on the CTL approach using geoboard media have been said to be successful. Research by Listrijanah [9] explained that learning using Geoboard could increase students' learning achievement compared to tangram. Masitoh [10] stated that the developed Geoboard effectively improves the students' conceptual understanding of circumference and area. Further, Kistian [11] elucidated that the CTL is more effective than the conventional method as it conforms to the characteristics of mathematics so that it helps students comprehend concepts. This research intends to examine the effectivity of Contextual Teaching and Learning with geoboard media on mathematics learning for four-grade students of public elementary schools of Tamansari Kebumen School Group.

2. Methods

The research population was 126 four graders of public elementary schools of Tamansari Kebumen School Group who come from five schools in the school group. One experimental and one control class were selected. A pretest and post-test were given to both the experimental and control class (see table 1). CTL approach with geoboard media was applied to the practical class while the other type performed the conventional method.

The data were collected through the objective test and non-test instrument in the form of an observation sheet. The post-test scores were analyzed using the Z-test to examine the students' score completeness. The t-test was used to measure the average prayer of the experimental class and the control class, and the n-gain test to determine the increase of the average score. Meanwhile, the data

collected through non-test, i.e., observation of the students' problem-solving, were evaluated using descriptive statistics.

Table 1. Participant.

Group	Pretest	Post-test
Experimental	22	22
Control	29	29
Total	51	51

3. Result and discussion

Before learning, the students of the experimental class and control class were asked to work on the pretest. The materials given were the same for both courses. After the materials about circumference and are of two-dimensional figures have been taught, the post-test was administered. The pre- and post-test results are presented in the following table 2.

Table 2. The pretest and post-test results.

Class	Pretest			Postest		
	Highest score	Lowest score	Average	Highest score	Lowest score	Average
Experimental	78	33	49.3	96	67	82.4
Control	70	22	45.2	96	63	70.9

3.1. Test of mastery learning

This test aims at revealing whether or not the experimental class and control class test results have passed the minimum mastery criteria. The proportion used was 75%, with a minimum score of 72. The calculation of the test of mastery learning is displayed in table 3.

Table 3. The test of mastery learning.

Class	The student completing the minimum score	Z_{count}	Z_{table}	Criteria
Experimental	20	1.7256	1.64	H_0 rejected
Control	15	-2.8883		H_0 accepted

The calculation results compared to the criteria

Based on the calculation in Table 3, the Z_{count} of the experimental class was 1.2567, and the one-tailed proportion Z_{table} test with a significance level of 0.05 was 1.64, then $Z_{count} > Z_{table}$, which was 1.7256 > 1.64, so the H_0 was rejected and H1 was accepted. Meanwhile, the control class obtained Z_{count} = -2.8883, and the one-tailed proportion Z_{table} test with a significance level of 0.05 was 1.64, then $Z_{count} < Z_{table}$, which was -2.8883 < 1,64, so the H_0 was accepted and H_1 was rejected.

As the H_0 is rejected, then the proportion of students of the experimental class reaching the minimum mastery criteria was > 75%. For that reason, it concluded that the students had passed the classical completeness. On the other hand, as the H0 was accepted in the control class, the students sticking out the minimum mastery criteria was < 75% so that the control class' learning outcomes are not completed classically.

3.2. Test of two-average equality

The test intends to find out the equality level of average scores from both the experimental and control class. Table 4 shown, the t_{count} = 4.0567 and t_{table} was 1.6766 so the $t_{count} > t_{table,}$ which means that the H_0 was rejected. This showed that the learning outcome average of the experimental class was higher than the control class.

Table 4. The two-average equality test results.

Sample Class	N	Average	T_{count}	t_{table}	Criteria
Experimental	22	82.4091	4.06	1.67	H_0 rejected
Control	29	73.0345			

The calculation results compared to the criteria

3.3. Test of average increase (N-Gain)

The last hypothetical test was measuring the increase of student competency before and after the treatment in the experimental and control class. The test results in table 5 show an escalation of the average cognitive score in the experimental and control class, which was categorized as 'medium.'

Table 5. The N-Gain test results.

Class	Average		N-Gain	Category
	Pretest	Post-test		
Experimental	49.3182	82.4091	0.6529	Medium
Control	45.2069	73.0345	0.5078	Medium

3.4. The student improvement in solving contextual problems

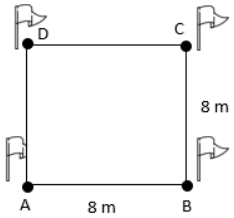
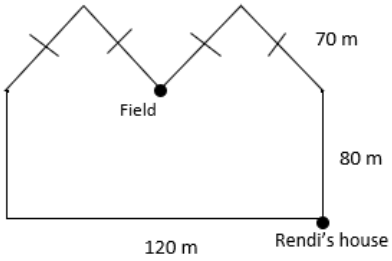
The sub-materials taught in the object classes include: 1) the circumference of square and rectangle, 2) the area of square and rectangle as well as court the rank and roots, 3) the circumference and area of a triangle, and 4) the circumference and area of a combined figure. The CTL approach with Geoboard has made the students actively involved in the learning process as it provides a real experience. When contextual problems are being used, it means that teachers place mathematics in a practical situation to use maths explicitly. These problems focus on mathematics as a starting point to introduce maths' utility, motivate them to complete the given issues, even further, to show the students how maths serves as a solution [3].

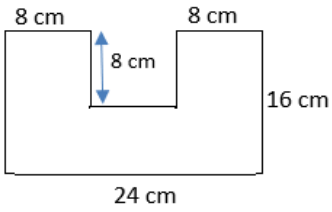
Figure 1. Teachers and students using Geoboard.

In this research, teachers initiated learning by giving apperception related to real-life to build the students' comprehension of the learned materials then directed them to perform a particular activity concerning the topic being discussed. Student worksheets were handed out to the students to be worked on through discussion and changing information between classmates. The Geoboard was provided by the teacher to assist students in understanding the topic. It is a 40 cm x 40 cm wooden, durable board with bars on it placed each 4 cm. However, this board could only be used for teaching two-dimensional figures. It can be seen in figure 1 that the students, assisted by the teacher, are creating two-dimensional figures on the Geoboard.

Assessment during the classroom learning process is one of the factors that determine learning achievement [12]. In this study, the student activities were assessed using the given worksheets. The description of contextual problems that the students worked in groups is shown in table 6.

Table 6. Contextual problems in the student worksheets.

No	Sub materials	Problems
1	The circumference of the square and rectangle	1. Anisa will run around a square schoolyard. She starts running from flag A and is already on flag B. How many meters more does Anisa have to travel to reach the starting point, which is flag A?  2. Father's plot of land is rectangular in shape. Around the land is planted with pine trees with a spacing of 4 m. The length of the land is 12 m and the width is 10 m. How many pine trees are needed?
2	The area of square and rectangle as well as square rank and root	1. A square floor has a side length of 6 m. The floor will be installed square tiles measuring 30 cm x 30 cm. Determine the number of tiles needed to cover the floor. 2. Father has a rectangular land with a length of 20 m and a width of 10 m. He will use 50 m^2 of the land to plant corn. Then how much father's remaining land is still empty?
3	The circumference and area of a triangle	1. Tika walks around an equilateral triangle with a side length of 7 m and she has walked around the park three times. a. Draw the triangle b. What is the distance Tika traveled? 2. If one matchstick is 4 cm long. What is the area of the area bounded by the matches in the following picture? 
4	The circumference and area of a combined figure	1. Look at the following picture!  Sunday has arrived. Rendi is going to play ball on the field. What is Rendi's closest distance to travel from home to the field?

No	Sub materials	Problems
		2.  Pak Dadu wants to sell land in the form of a combined shape. Before selling it, Pak Dadu measures the land. What is the area of Pak Dadu's land?

The results of students working on the worksheets can be seen in figure 2. It can be known that their scores started from 83.3 to 100, and the overall average reached 95. If seen from the early to the final meeting, the score increased from 88.34 to 96.6. Some contextual problems are presented in the form of images. This is related to the opinion of the importance of using pictures when learning to the measurement for students in the primary school because here, there is a process of changing from using tools to measuring using formulas [13]. In addition, students will show a better ability to solve problems if the contextual problems given are close to the student's real-life [4][5][14].

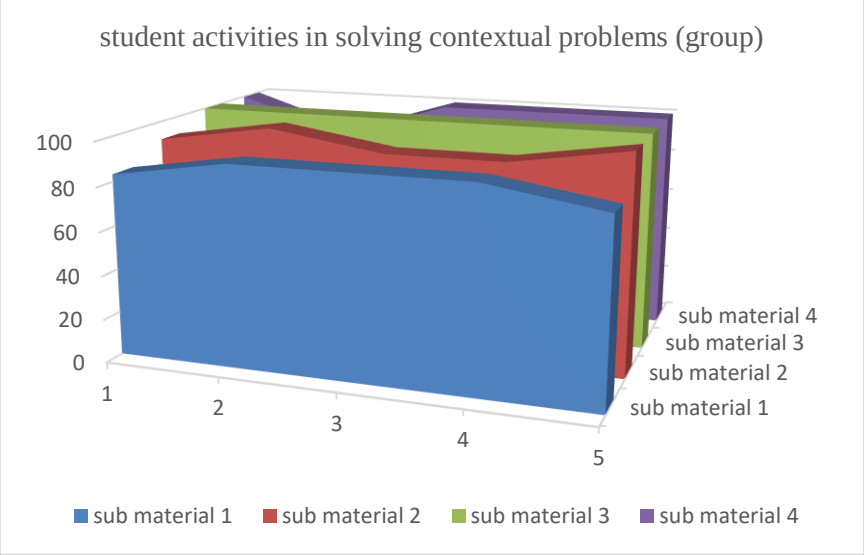


Figure 2. The students' scores in solving contextual problems.

The questions answered by the students lead to contextual problems in the form of solving problems in daily life. According to other research [15], problem-solving is the primary goal of learning mathematics in school, given that mathematical skills are essential in everyday life and the workplace. Therefore, not all contextual problems presented in the worksheets are non-routine problems yet can be solved by referring to the use of the area and circumference formula being studied. According to Polya [16], assessment of student activities in working on contextual problems using problem-solving steps include problem understanding, strategic planning, problem-solving, and re-checking.

Based on table 7, the problem understanding and strategic planning got the maximum percentage of 100%, the problem-solving acquired 92.5%, and the re-checking obtained the lowest rate of 85%. Contextual problems presented in the worksheets were varied for each subject taught, expecting that the students would know better the benefits of maths in life. These steps need to be introduced to the students

as they need to know when and how to use mathematics in everyday life [17]. Contextual teaching and learning (CTL) is a learning approach where the teacher associates learning material with the real conditions of students and encourage students to use their knowledge in their daily lives [18].

Table 7. Student activity in solving contextual problems according to Polya's.

Problem-solving steps	Sub-materials 1	Sub-materials 2	Sub-materials 3	Sub-materials 4	Average	Percentage
Problem understanding	2	2	2	2	2	100.0%
Strategic planning	4	4	4	4	4	100.0%
Problem-solving	3.6	3.4	4	3.8	3.7	92.5%
Re-checking	1	2	2	1.8	1.7	85.0%
Total						94.4%

On the other hand, guiding students to learn with manipulative media can be useful because it helps students understand how to manipulate objects to represent the mathematical concepts being learned [19]. Geoboard media can help students' understanding from the concrete stage in the form of contextual problems to more abstract completion step by representing the problems about the circumference and area into formations on the Geoboard. This is similar to other research, which also showed that Geoboard makes it easier for students to know the circumference and area of a two-dimensional figure because there is an element of fun in its use, namely by playing a rubber band to form various flat shapes in question [20]. Through exploring geoboard activities, students can more easily solve problems in geometry[11][21]. Hence, by learning to use Geoboard, students' psychomotor abilities are also honed.

Based on the above explanation, it concludes that the application of the CTL learning approach in the experimental class can boost the students' enthusiasm in participating in learning as the teacher associated the materials with the daily lives so that it was easier for them to understand the topic. Besides, by using the approach, geoboard media in the experimental class can attract the students' attention to participate in learning actively. Students with rapid activities and valiant curiosity towards learning mathematics have better achievement than those having leisure activities.

4. Conclusion

Based on the discussed results, it concludes that the Contextual Teaching and Learning (CTL) approach with Geoboard was practical for four-grade mathematics learning, particularly for the students of Tamansari Kebumen School Group. This is indicated by the completeness of learning achieved, which was more than 75%. Significantly, the average post-test results in the experimental class were higher than the average post-test results in the control class. The CTL approach requires authentic assessment; thus, judgment is not only done at the end of learning but also during the learning process so that student activities in solving contextual problems are observed and assessed. The results showed an increase in student activity from the initial meeting (88.34%) to the last meeting (96.66%). Contextual problems presented in the learning process with the CTL approach have brought a good understanding of two-dimensional figures' circumference and area. Geoboard media assists the students in understanding the given problems from the concrete stage (representation of the circumference) to abstract completion steps (formations on the Geoboard). Generally, it can be said that the use of the CTL approach assisted by geoboard media was influential in mathematics learning for four-grade students of state elementary schools of Tamansari Kebumen School Group, not only cognitively but also psychomotor.

References

[1] OECD 2019 *PISA 2018 results (volume I): What students know and can do, PISA* (Paris: OECD Publishing)
[2] Dasaprawira M N, Zulkardi Z and Susanti E 2019 *J. Math. Educ.* **10** 303–14

[3] Clarke D and Roche A 2017 *J. Math. Behav.* **51** 95-108
[4] Mahendra I W E, 2015 *JISAE* **1** 28–39
[5] Kusumah Y S, Sabandar J and Herman T 2015 *IndoMS-JME* **6** 53–62
[6] Selvianiresa D and Prabawanto S 2017 C *J. Phys.: Conf. Ser.* **8945** 012171
[7] Mudaly V and Sibiya M R 2018 *Int. J. Sci. Res.* **11** 90–8
[8] Bennett A, Maier E and Nelson L T 1987 *Looking at geometry* (Salem: Math Learning Center)
[9] Lastrijanah L, Prasetyo T and Mawardini A 2017 *Didakt. Tauhidi J. Pendidik. Guru Sekol. Dasar* **4** 87–99
[10] Masitoh M 2018 *Ibtida'i: J. Kependidikan Das.* **5** 49–60
[11] Kistian A 2018 *Bina Gogik* **5** 13-24
[12] Arsaythamby V and Zubainur C M 2014 *Procedia - Soc. Behav. Sci.* **159** 309–13
[13] Smith J P, Males L M and Gonulates F 2016 *Math. Think. Learn.* **18** 239–70
[14] Hoogland K, Koning J, De Bakker A, Pepin B E U and Gravemeijer K 2018 *Stud. Educ. Eval.* **58** 122–31
[15] Trimurtini A F, Liftiah and Widihastrini F 2020 *Int. J. Sci. Technol. Res.* **9** 4246–49
[16] García T, Boom J, Kroesbergen E H, Núñez J C and Rodríguez C 2019 *Stud. Educ. Eval.* **61** 83–93
[17] Van Dooren W, Lem S, De Wortelaer H and Verschaffel L 2019 *J. Math. Behav.* **53** 96–104
[18] Suryawati E, Osman K and Mohd T S 2010 *Procedia - Soc. Behav. Sci.* **9** 1717–21
[19] Carbonneau K J, Min R, Borysenko N, Hall C and States U 2020 *Contemp. Educ. Psychol.* **61** 101846
[20] Masturoh I and Khaeroni 2017 *Primary* **09** 189–210
[21] Figueira-Sampaio S, Elias E, Carrijo A and Cardoso A 2013 *Procedia - Soc. Behav. Sci.* **93** 151–57