Correlation between mathematic learning outcomes and self-regulated learning in the covid-19 pandemic situation

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Abstract. The COVID-19 pandemic brought major changes in the education field in Indonesia. The face-to-face learning system that usually dominates the school learning system has changed to an online learning system. The purpose of this study is to reveal how much the correlation between mathematics learning outcomes and students self-regulated learning in elementary schools when online-based learning systems were applied during the COVID-19 pandemic. This research is a quasi-experiment of the fractions topic which applied to 54 students from one of the elementary schools in central Jakarta, Indonesia. Mathematics learning outcomes test and self-regulated learning questionnaires are given before and after online learning is conducted. Online learning is done with a group of the WhatsApp application and learning videos that are broadcasted through the YouTube channel. The results of the study show that the correlation between mathematics learning outcomes and self-regulated learning of elementary school students is 0.424. Based on the criteria from Guilford, the magnitude of the correlation value is in the medium criteria. The results of the study concluded that there is a correlation between mathematics learning outcomes and students self-regulated learning. The higher the student mathematics learning outcomes, the higher the self-regulated student circulation, and vice versa.

1. Introduction

Mathematics is one of the universal sciences which learned by students at every level of education, starting from elementary school to university level. It aims to teach students with many thinking skills that are beneficial to daily life. One of the hot issues in the management of basic education is the effectiveness of student learning outcomes in learning mathematics. Learning outcomes can be defined as students' abilities obtained from the process and representation of their learning experiences. These learning outcomes can be seen from the development of attitudes, knowledge, and skills [1]. If it is related to the cognitive term, the achievement of students' mathematical learning outcomes is still in the low category. This is consistent with the results of the TIMSS survey which was released in 2015. In the Mathematics achievement distribution data for grade 4 students published by TIMSS, it is stated that there are still so many countries that have score under the minimum set by TIMSS of 500 [2]. The low
learning outcomes of mathematics can be caused by several factors, especially those from internal factors related to students' attitudes in responding to their learning activities. Whereas self-regulated learning is considered as part of the representative learning attitudes needed by students to achieve performance and the fulfillment of learning experiences. Students who act independently in the learning process have a causal relationship with their learning outcomes and experiences [3]. If it is based on the implementation of distance learning during the COVID-19 pandemic, the success of learning activities depends on the attitudes and learning styles needed in the online environment, and this indicates that self-regulated learning has a very large influence on the effectiveness of learning activities [4]. Self-regulated learning refers to the active behavior of students in managing their learning activities which are based on the elements of awareness and emphasis on responsibility. Self-regulated learning is expected to be able to encourage students to be actively involved in learning and reflecting it into various situations according to the goals and strategies they get from their external environment [5-9]. Students can also manage their learning experiences by using various strategies to achieve optimal learning outcomes [10-12]. This statement indicates that self-regulated learning is very relevant when it comes to constructivism learning theory. Students independently reconstruct the knowledge they already have with the new knowledge they receive and utilize their own strategies to support their success in learning. Meanwhile, the teacher only acts as a facilitator who builds student knowledge through learning experience. The indicators of self-regulated learning used in this study include, 1) learning initiatives; 2) Diagnosing learning needs; 3) Setting learning targets or objectives; 4) View learning difficulties as challenges; 5) Utilize and search for relevant sources; 6) Choosing and determining learning strategies; 7) Evaluating the learning process and outcomes; 8) Self Efficacy (self-concept) [13]. One of the approaches assumed able to improve students' mathematical learning outcomes and self-regulated learning during the COVID-19 pandemic is using the Concrete-Pictorial-Abstract (CPA) approach. The CPA approach consists of three parts of teaching that build students' conceptual understanding which explicitly teaches meaningful direct manipulative connections, representational images, to abstract concepts and symbols [14-18]. Manipulative objects are used to support students' mathematical understanding in context, by creating situations that involve tools / equipment in teaching and learning activities. At the pictorial stage, learning switches to using image mediators to represent the use of real objects. The abstract stage only includes the use of numbers and symbols to solve mathematical problems. The CPA approach is a systematic approach in which the skills that have been mastered must be integrated into the next stage, so that each learning stage creates a complete unit. Manipulative learning will run effectively if a relationship is found between concrete objects and the abstract concepts they represent [19]. Based on this background, the problem formulation used is, "Is there a correlation between the achievement of mathematical learning outcomes and students' self-regulated learning during the COVID-19 pandemic? Furthermore, the hypothesis in this study is that there is a correlation between the achievement of mathematical learning outcomes and students' self-regulated learning during the COVID-19 pandemic?"

2. Experimental methods
This research was conducted from May to June 2020. The type of research used was quasi experimental research with a research design in the form of a Nonequivalent Control Group Design. The mathematical learning outcomes pretest and the initial scale of self-regulated learning were given before the students received the action, and this aimed to determine the students' understanding of the subject matter they had received and the initial self-regulated learning that the previous students had. After the action is carried out, students are given a posttest to determine the achievement of students' understanding and self-regulated learning during the learning process.

The population in this study were all elementary school students in the Central Jakarta area, Indonesia. While the research sample consisted of two study groups of fifth grade students involving one public elementary school in the city of Central Jakarta, DKI Jakarta Province, Indonesia. The total sample consisted of 54 students, with the experimental class (CPA approach) and control (conventional approach) each of 27 students. The sampling technique used was purposive sampling technique. The
Sample selection was considered based on: (1) Class V students were in the age range 10-11 years. This age range corresponds to the concrete operational development stage conveyed by Piaget, that children at that age still need a concrete learning approach. (2) Does not interfere with the school program in preparing the National Examination for grade 6 students. (3) The school implements online learning as an alternative solution for teaching and learning activities during the COVID-19 pandemic. This research was conducted online using the help of instructional videos, WhatsApp Group, YouTube and Google Form.

Descriptive analysis of the correlation between mathematical learning outcomes and self-regulated learning is determined based on the magnitude R. Correlation criteria using the Guilford Empirical Rules are as Table 1 [16]:

Table 1. Guilford empirical rules.

| R value                  | Interpretation                     |
|--------------------------|------------------------------------|
| 0.00 < r < 0.20          | Very weak relationship (neglected, assumed not to exist) |
| 0.20 ≤ r < 0.40          | Low relationship                   |
| 0.40 ≤ r < 0.70          | Medium relationship                |
| 0.70 ≤ r < 0.90          | Strong / high relationship         |
| 0.90 ≤ r < 1.00          | Very strong / high relationship    |

The correlation hypothesis between the achievement of mathematical learning outcomes and self-regulated learning, namely:

H₀ : ρ₁ = ρ₂ There is no correlation between the achievement of mathematical learning outcomes and students' achievement of self-regulated learning.

H₁ : ρ₁ ≠ ρ₂ There is a correlation between the achievement of mathematical learning outcomes and the achievement of students' self-regulated learning.

Testing criteria: If the p-value (2-way sig.) Is greater than 0.05 then H₀ is accepted. Apart from these criteria, H₀ is rejected.

3. Results and discussion

3.1. Results

The normality test results of the post-test of mathematical learning outcomes with self-regulated learning have a p-value (sig.2-direction) below 0.05 which means rejecting H₀, so it can be interpreted that the data is not normally distributed. Then the hypothesis testing is done using the Spearman' Rho correlation test. The following is a recapitulation of the results of the correlation test for achievement of mathematical learning outcomes with self-regulated learning:

Table 2. Results of correlation test achievement of mathematical learning outcomes with self-regulated learning.

| Correlation Test | Measured parameters             | Spearman’ Rho | Correlation coefficient | p-value (sig.2-way) |
|------------------|--------------------------------|---------------|------------------------|---------------------|
|                  | Learning outcomes               | Self-Regularated Learning |                      |                     |
| Achievement      | 1.000                           | 0.424         |                        | 0.001               |
|                  | Self-Regulated Learning        | 0.424         | 1.000                  |                     |

Table 2 shows the correlation value between the achievement of mathematical learning outcomes and students' self-regulated learning of 0.424. When connected with the correlation test criteria using the Guilford Empirical Rules, the correlation value between the achievement of mathematical learning outcomes and self-regulated learning is classified as medium.
outcomes and students' self-regulated learning has a moderate relationship. This is in line with the p-value which has a value less than 0.05 which means that $H_0$ is rejected, so it can be concluded that "There is a significant correlation between the achievement of mathematical learning outcomes and students' self-regulated learning".

3.2. Discussion

The achievement of mathematical learning outcomes and students' self-regulated learning cannot be separated from the magnitude of the influence of the learning activities presented using the Concrete-Pictorial-Abstract (CPA) approach. Learning activities are presented with the help of learning videos, WhatsApp groups, YouTube, and google forms. While assignments in this learning are presented in the form of Student Worksheets which are designed by considering self-regulated learning indicators, mathematics learning materials in fractions material, and learning stages that are in accordance with the stages of the CPA approach. Students are also formed into several heterogeneous small groups, based on the consideration of students' diverse Mathematical Initial Ability. This approach stimulates student involvement in reconstructing their knowledge with learning stages that are interrelated with one another [20]. When students have succeeded in manipulating concrete objects, they will turn to the use of mathematical images and symbols. The Concrete-Pictorial-Abstract approach can foster students' interest in learning activities. This interest was very visible when the students were in the concrete and pictorial stages. The learning process with the CPA approach uses manipulative objects that are fun and if students are happy, they will be more enthusiastic in learning [21]. The following shows the use of manipulative objects used by students in learning simple fractions material for grade 5 elementary school students, using the CPA approach. The manipulative concrete object for teaching the material of simple fractions is bread. Examples are as follows:

Pooh cut a slice of bread A into 2 pieces, then gave him sprinkles on 1 part of bread. From the figure 1 below, choose the image of the slice of bread that best suits Pooh's wishes?

![Figure 1. Manipulative section on student’s worksheet.](image)

The reason: …………………………………………………………………………………………………………………

Then, Pooh now wants to subtract how many pieces of bread that have been jammed from bread A and B. To make it easier to count, Pooh slices the bread with the same number of pieces. Now choose the bread package image that best suits Pooh's wish.
Students' interest in the use of manipulative objects such as the bread above (figure 2), in learning will affect student initiative to manage their learning activities. This learning initiative is part of the individual's personality in addressing the goals to be achieved during the learning process. Self-regulated learning is considered to be a combination of skills possessed by students with a willingness that comes from within [22]. So it can be said that self-regulated learning will not grow if it is not based on a strong willingness to learn. This approach also has stages in accordance with the cognitive development of elementary school students. So it is not surprising that students will more easily understand the learning given by the teacher. The results also showed that the increase in learning outcomes of students who received learning with the Concrete-Pictorial Abstract approach was significantly better than students who received conventional learning [23].

The development of self-regulated learning also plays an important role in student involvement to achieve maximum learning outcomes, especially when learning is done by online. Coincides with students' awareness and sense of responsibility to achieve their learning goals. Self-regulated learning is also seen as an indicator that can explain differences in the achievement of student learning outcomes [24-26]. When students have high learning achievement, it means that internally they have been able to perform better self-management than students who have low learning achievement. When the teacher facilitates the students with group learning activities, students have the opportunity to add and diagnose their learning needs by asking and answering questions raised by their friends through the WhatsApp group. Even based on the results of a survey conducted on students' parents, as many as 44% of parents admitted that students would ask their parents for help when they experienced frequent difficulties in learning. Learning that is carried out online also encourages students to get used to finding their own learning resources by utilizing the strategies and ideas they have. Students with high self-regulated learning have their own learning initiatives and strategies, so that this can have a positive impact on the achievement of mathematical learning outcomes [27]. The results also show that students will experience a significant increase in learning outcomes in their learning environment, in line with increased learning independence [11]. So, it can be concluded that self-regulated learning can act as a mediator which can significantly affect mathematical learning outcomes.
4. Conclusion
It can be concluded that there is a correlation between the achievement of mathematical learning outcomes and the achievement of self-regulated learning of students who get learning using the Concrete-Pictorial-Abstract (CPA) approach during the COVID-19 pandemic. When students succeed in achieving self-regulated learning in a good category, students can internally manage their learning process in order to achieve optimal mathematical learning outcomes, and this is transformed into a causal law that is interrelated with one another. Although the CPA approach is not the best approach to improve student achievement of mathematical learning outcomes and self-regulated learning, the findings in this study indicate that the CPA approach is one of the factors that can influence the achievement of both mathematical learning outcomes and self-regulated learning.

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