Increasing self-regulated learning of elementary school students through the concrete-pictorial-abstract (CPA) approach during the COVID-19 pandemic

by Hafiziani Eka Putri

Increasing self-regulated learning of elementary school students through the concrete-pictorial-abstract approach during the COVID-19 pandemic

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Abstract: This research was motivated by limited self-regulated learning (SRL) elementary school students. The aim of this research was to understand the increase in SRL of elementary school students apply the Concrete-Pictorial-Abstract (CPA) approach which was reviewed as a whole and based on Early Mathematical Ability (EMA) during the COVID-19. This study was applied with a quasi-experimental method through a nonequivalent control group. Determination of the sample through purposive sampling on fifth-grade elementary school students in Central Jakarta. The sample coincide of 27 students each for the CPA and the conventional class. Measurement through a scale of SRL. This research informs the students' SRL on CPA learning that is significantly better than SRL with conventional approach reviewed as a whole and in the medium EMA group., however, based on the high and low EMA groups, SRL students who received CPA learning were not significantly better than those with conventional learning.

Abstrak: Penelitian ini dilatarbelakangi *self-regulated learning (SRL)* pada siswa SD yang terbatas. Maksud riset ini untuk memahami peningkatan SRL siswa Sekolah Dasar melalui pendekatan *Concrete-Pictorial-Abstract* (CPA) yang ditinjau keseluruhan dan berdasarkan Kemampuan Awal Matematis (KAM) selama COVID-19. Riset ini diterapkan dengan metode quasi eksperimen dengan *nonequivalent control group*. Penentuan sampel melalui *purposive sampling* pada siswa kelas 5 SD di Jakarta Pusat. Sampel berjumlah masing 27 siswa pada kelas CPA dan kelas konvensional. Pengukuran melalui skala sikap self-regulated learning. Penelitian ini menginformasikan SRL siswa pada pembelajaran CPA lebih baik secara signfikan dibandingkan dengan SRL siswa dengan pendekatan konvensional diamati pada kseluruh siswa maupun KAM sedang, namun berdasarkan KAM tinggi dan rendah, SRL siswa yang menerima pembelajaran CPA tidak lebih baik secara signifikan dibandingkan dengan pembelajaran konvensional.

INTRODUCTION

Mathematics was a science that presents a noteable role in the enhancement of science. However, the importance of learning mathematics was not balanced with the success of students in completing an increase in learning outcomes. This failure can be influenced by several factors, one of which comes from within the student. This obstacle was also increasing with changes in the learning system that require learning activities to be carried out online as a solution to dealing with limitations that arise during the COVID-19 pandemic. The success of learning depends on the attitude students should have in the online learning environment (Purwanto et al., 2020). This is in line with the objectives of the 2013 curriculum in Permendikbud 81 A of 2013, that attitudes are used as one of the basic aspects of student achievement competencies. Therefore, there was a need for synergy between cognitive development and learning attitudes that can encourage the effectiveness of the process and student learning outcomes. Attitudes in learning that are considered to be synergistic with the cognitive development process are the ability of students to regulate their learning activities or commonly known as self-regulated learning (SRL). SRL can affect process performance in mathematics learning situations (Suhendri, 2011). Students who have SRL will actively construct their knowledge based on a predetermined goal orientation (Saks & Leijen, 2014). This goal orientation provides validation for the reasons for the enforcement of an action.

SRL or independence in learning is a person's ability to process and regulate their learning activities with or without the help of others. They have the autonomy to plan and evaluate learning activities independently, and motivation was one of the main elements that can foster independence in students (Kistner et al., 2010; Latipah, 2015; Suryahadikusumah & Dedy, 2019). This indicates that independent learning can be interpreted as self-direction that comes from individual initiative to develop cognitive skills. SRL can also be defined as students having the freedom to manage and organize the learning process according to the goals to be achieved, find relevant learning resources, choose strategies and compare their learning outcomes with certain standards based on their awareness and responsibility (Bungsu et al., 2019; Saks & Leijen, 2014; Sumarmo et al., 2019). This indicates that SRL was based on constructivism (Jarvela & Jarvenoja, 2011; Kistner et al., 2010) where students can build initiatives to organize each stage of their learning to produce new knowledge and learning experiences by creating new, better learning habits. While the teacher only acts as a facilitator who will provide learning situations that can stimulate the cognitive, affective, and psychomotor development of childrens.

The activeness of students in managing learning activities will greatly influence the improvement of their learning achievement. Several research results reveal that SRL has a positive relationship with student learning achievement (Clarebout et al., 2010; Kistner et al., 2010; Rusmiyati, 2017; Vrieling et al., 2012; Wolters & Hussain, 2015). It can be said implicitly that SRL has a causal relationship with the achievement and improvement of student learning outcomes in online learning (Barnard-Brak et al., 2010). When students have high learning achievement, it can be assumed that these students can perform better SRL than students who have low learning achievement, and this is one indicator that can explain differences in student achievement. The importance of SRL from an early age will form students who are independent and confident in experiencing difficulties (Labudasari & Rochmah, 2019). When relating it to mathematics learning that is carried out online, SRL implicitly aims to minimize students' dependence on the help of others in supporting their success while studying.

Students can be stated to have had good SRL if they have met the following indicators: 1) Have a learning endeavour; 2) Diagnose learning requirement 3) Organize learning goals; 4) Assess learning difficulties as challenges; 5) Utilize of and search for relevant sources; 6) Determine the learning strategy; 7) Assessing learning phase and output; 8) Self-Efficacy (Confidence) (Sugandi, 2013). This was in line with research states

that 54.2% of high school students had low SRL (Savira & Suharsono, 2013). The research in junior high school obtained the students obtained the information student SRL tends to be low, especially in completing assignments and additional assignments from the teacher. Students in school mostly tend to learn to follow the guidance of the teacher only, wait to be arranged by the teacher, especially on assignments or homework, then students often imitate their work without motivation and are not sure of their potential (Surya et al., 2018). Thus, it can be said that there were still so many students who have low SRL. The factors causing the low SRL can be related to the inaccuracy of the implementation of learning that is not by the reality of student cognitive development. This is similar with research on the cognitive mapping of high school students showing male students of 26.67% and female students of 63.15% were still in the concrete operational stage (Mutammam & Budiarto, 2013). Even though the research sample used was high school students, the output of the research showed that there were still so many high school students who were at the cognitive stage equal to primary school students. So that it can be the basis for research showing that there are still so many students who have low SRL.

Learning carried out online also demands a regeneration of the implementation of learning that can stimulate students' interest in their learning activities. Students will find it easier to manage their learning activities if they have a sense of interest in learning activities presented by the teacher. This is by the research result on learning in the last decade that learning will run effectively if students are in a happy state (Darmansyah, 2011). The learning approach that is thought can improve SRL is the Concrete-Pictorial-Abstract (CPA) learning with the practice of online learning. Online learning was carried out to avoid transmission of COVID-19 to students. COVID-19 was contagious and highly progressive infectious which can affect healthy persons after trivial contacts (Antonio et al., 2003). The study revealed the impact of COVID-19 in extensive periods of emergency remote teaching and learning (Hartshorne et al., 2020). Thus, to prevent the transmission of COVID-19, face-to-face learning in the classroom is transferred to online learning by entire schools. Online learning can be done using various electronic devices that are connected to the internet such as a notebook, tablets, and smartphones (Setiawan et al., 2017). In this study, online learning through the CPA and conventional approaches used the support of YouTube, WhatsApp, and Google forms.

The CPA approach consists of three steps of approach adapted to Bruner's learning phase which include enactive, iconic, and symbolic. The CPA approach is an instructional approach and has three main stages starting with the concrete stage, where students are directly involved in manipulating real objects that are closely related to everyday life. Pictorial as a form of representation of real or concrete objects that can be represented through two-dimensional forms in the form of images. The pictorial stage can be used as a relational that connects concrete and abstract. While the abstract is in the form of modeling mathematical concepts in the form of symbols (Hui et al., 2017; Putri, 2015, 2019; Putri et al., 2019; Wahyudy et al. 2019; Yuliyanto, Putri, et al., 2019). The CPA approach is also in line with the learning theory expressed by Piaget that elementary school students are usually around 6-12 years of age who are as yet at the stage of intellectual development in concrete thinking operations, which in their learning still require the help of objects that can be captured by the five senses (Hidayati, 2012).

Manipulative learning will work effectively if a relationship was found between concrete objects and the abstract concepts they represent. It takes time to build a relationship between the two, especially when applied to students. Childrens are better can identify the relationship amongst concepts and manipulatives when they had the opportunity to compare them (Laski et al., 2015). If it is based on the stages contained in the CPA approach, the CPA approach provides a learning situation so that students have the opportunity to identify the relationship between mathematical concepts in the concrete and abstract phases. This approach also complements it with representative stages that bridge the two constructions. The CPA approach emphasizes concept understanding, where the use of appropriate teaching materials according to cognitive

stages was needed to ensure that students understand mathematical concepts in a multisensory manner, this multisensory learning consists of seeing, listening, movement, and touch activities (Putri, 2015). Based on this, the CPA makes students a center in learning activities. Students will process and practice new skills and knowledge with the guidance of the teacher, but then the teacher deliberately minimizes their support when students begin to move towards a more independent learning stage. The skilled stage that has been mastered must be integrated into the next stage because the capabilities and structures from the previous stage have a contribution and operate at a higher stage, the CPA approach is also considered to be in line with the constructivism view (Putri, 2015).

The researchers state that learning independence can be improved by contextual-based learning (Suhandi & Kurniasri, 2019). The CPA approach can also improve students' attitude dispositions towards classroom learning (Cooper, 2012). Based on these results, the CPA approach is expected to improve students' SRL. If you review the results of other studies, the CPA can improve the mathematical representation (Nugroho & Jailani, 2019; Putri, 2015), student learning outcomes (Yuliyanto, Putri, et al., 2019), increase spatial sense (Putri, 2019), students' self-efficacy (Yuliyanto, Turmudi, et al., 2019), elementary school students' self-efficacy mathematics (Putri et al., 2020), and reduce mathematical anxiety (Putri et al., 2019). In addition to the learning approach factor, EMA was also considered as one of the factors that can influence the increase in students' SRL. EMA was also used as a description of students' readiness to accept learning activities (Lestari, 2017). Based on these reviews, the problem in this study is: Are the improve in SRL of students who accept the CPA learning better than students who accept the conventional approach observed from overall students and EMA (high, medium, low)? The reason for classification through EMA due to EMA is a student learning competency obtained on the previous topic. All students have different initial potential. Related to this, the need for teacher attention before starting learning because the learning process is much influenced by students' initial understanding. (Surya et al., 2016).

METHOD

Research Method

This type of research was a quasi-experimental with Nonequivalent Control Group Design. The study was carried out by giving treatment to the experimental class (X) and conventional learning. To see the improvement in SRL, pretest (O1) and posttest (O2) were carried out in the two learning groups.

Participants

The population used in the research were all elementary school students in the Central Jakarta. The research sample consisted of two study groups of fifth-grade students involving one public elementary school in the city of Central Jakarta. The total sample of the experimental class (CPA) and control (Conventional) each amounted to 27 students. The sampling method used was the purposive sampling. The sample selection is based on the following considerations: (1) Fifth-grade students are in the age range 10-11 years. Students in this age range were at the concrete operational stage conveyed through Piaget's theory, that students need a concrete learning approach. (2) Does not change the school program in preparing the National Examination for sixth-grade students (3) The school was implemented online learning as an alternative solution for learning activities during the COVID-19.

Materials

The research instrument used was an attitude scale to measure SRL. Due to instrument testing through validity and reliability on the SRL attitude scale, all items have high validity (r_{xy}= 0,81) with 18 valid statements from 29 statements. The reliability of the instruments in the study was high (r_{11}= 0,88). The indicators used in increasing SRL are: 1) Having learning endeavour; 2) Diagnosing learning requirements; 3) Arrange learning

targets; 4) View learning difficulties as challenges; 5) Utilize and search for relevant sources; 6) Choosing and determining learning approach; 7) Assesing the learning process and output; 8) Self-efficacy (Sugandi, 2013). Before conducting the research, students were classified according to their initial abilities. This classification was done by using the EMA test, which was then classified into three ability criteria, namely high, medium, and low. EMA was used as a description of students' readiness to receive learning, providing pre-requisite material. The EMA test instrument used in this study was listed in **Table 1** below:

TABLE 1. Blueprint of Early Mathematical Ability Test Instruments

Indicators	Questions
Perform arithmetic calculations	9 - 3 x 4 + 7 - (12 : 2) : 3 =…
Determine the least common multiple and the greatest common divisor	Lamp A flashes every 8 seconds. Lamp B flashes every 12 seconds. Lamp C flashes 16 seconds. If this period the three lights blink together for the first time, how many seconds will you watch when the lights flash the second time?
Perform calculations on the measurement of length and weight units	50.000 cm + 2,5 km : 5 hm – 20 dam : 100 m = … dam
Specifies the decimal and percent	Determine the fraction form of the following decimal and percent! 0,12 =…
Performs root calculations	64 x $^3\sqrt{216}$: $^3\sqrt{27}$ =

Procedures

This study was applied to two study groups, namely a class with the CPA approach as an experimental group and a class with conventional learning labeled the control class. Before the learning process be held, both groups were given the EMA test. The pretest was given at the beginning of the learning process to determine the initial scale of students before treatment. After that, students were given the CPA and conventional learning treatment in each group for five meetings. At the conclusion of the lesson, students were received a posttest to determine the increase in students' SRL through data processing between the pretest and posttest to determine n-gain. This research was conducted online using the support of learning videos uploaded via Youtube, WhatsApp Group, and Google Form.

Data Analysis

Data analysis was carried out through descriptive and inferential analysis. Descriptive analysis of the increase in SRL was determined based on the n-gain. The classification is contained in **Table 2** below:

TABLE 2. N-Gain criteria

Range	Classification
g > 0,70	High
0,3 ≤ g < 0.70	Medium
g < 0,30	Low

Inferential analysis in this reseach was carried out with the support of SPSS version 25. By testing the hypothesis using the Mann-Whitney U test, because scala comes from data that are not normally distributed.

RESULTS

The increase in SRL can be seen based on the amount of N-gain. Based on descriptive analysis, the overall increase in SRL can be observed in **Table 3** below:

TABLE 3. Overall Self-Regulated Learning Improvement

Scale	Approach	Scale	$\bar{x}$	sd	N-*gain*	Criteria

		Lowest	Highest				
Initial Scale	CPA	26	52	36,30	6,37	0,211	Low
Final Scale		27	57	42,37	7,22		
Initial Scale	Conventional	27	52	36,70	5,84	0,018	LOw
Final Scale		27	60	37,70	6,53		

Based on **Table 3**, the increase in SRL of students who received CPA was higher than conventional approach. Although the criteria at improvement in the two learning groups are both classified as low criteria. A summary analysis of the increase in SRL related on learning reviewed of the EMA can be observed in **Table 4**:

TABLE 4. Improvement of Student SRL based on Learning in terms of EMA

EMA group	Approach	N-gain score		$\bar{x}$	sd	Criteria
		Lowest	Highest			
High	CPA	-0,17	0,83	0,202	0,405	Low
	Conventional	-0,04	0,89	0,424	0,656	Medium
Medium	CPA	-0,71	0,63	0,179	0,329	Low
	Conventional	-1,43	0,53	-0,018	0,375	Low
Low	CPA	0,10	0,76	0,328	0,254	Medium
	Conventional	-0,04	0,11	0,033	0,109	Low

Table 4 informs the enhance in SRL of students with CPA approach, especially the medium and low EMA groups, higher than students who got conventional learning. Whereas the high EMA group, the SRL of students who received the CPA was lower than students with conventional learning. The results of the average difference test for the increase in SRL that was reviewed as a whole were presented in **Table 5**:

TABLE 5. Hypothesis test for the Improvement of SRL based on Learning is reviewed as a whole

Approach	*Mann-Whitney U test*	*Z*	*p-value*	Note
CPA	226,000	-2,396	0,017	H_0 rejected
Conventional				

Reviewing the results in **Table 5** showed that the increase in SRL has a p-value of 0.017<0.05, so it can be stated that H_0 was rejected. This means that overall, the increase in SRL who received CPA was significantly better than who received conventional approach. The hypothesis test for the increase in SRL which is reviewed based on the EMA through the Mann Whitney U test can be observed in **Table 6**:

TABLE 6. Hypothesis Test for the Improvement of SRL based on Learning in terms of EMA

EMA group	Approach	*Mann-Withney U*	Z	*p-value*	Note
High	CPA	5,000	0	1,000	H_0 accepted
	Conventional				
Medium	CPA	111,500	-2,304	0,021	H_0 rejected
	Conventional				
Low	CPA	4,000	-0,391	0,696	H_0 accepted
	Conventional				

Through **Table 6** it can be understood that p-value of 1.000 and 0.696 0.05, there was an increase in SRL in the high and low EMA, respectively, so that H_0 was accepted. Therefore, for the high and low EMA groups, the increase in SRL who received CPA learning was not significantly better than students who got conventional. Meanwhile, medium EMA group has a p-value of 0.021<0.05, so H_0 was rejected. Thus, the increase in SRL in the medium EMA group students who received CPA was significantly better than those who accepted conventional. The following was presented in **Figure 1** to further clarify the increase in SRL on each indicator:

FIGURE 1. Improvement of Self-Regulated Learning based on Indicators

Based on **Figure 1**, it can be understood that those who received CPA learning have higher SRL than students who accepted conventional approach when viewed related on increase in each indicator. The highest increase of students who received CPA learning lies in indicator 7, which is evaluating the learning process and outcomes. While the lowest increase was seen in indicator 5, namely utilizing and searching for relevant sources, and 8, namely self-efficacy, where both indicators accept conventional learning.

DISCUSSION

When analyzing the procedural stages, assignments in this learning were presented in the form of student worksheets with learning activities carried out with the help of learning videos uploaded via Youtube, use of WhatsApp groups, and google forms. The presentation of teaching material and the implementation of learning was arranged based on consideration of achievement of SRL indicators used in the study, fraction material that was by the achievements of the Basic Competencies in five-grade and the learning stages adjusted to the three stages of the CPA approach. The CPA approach allows students to construct their knowledge, by transforming the knowledge they have acquired in the previous stage and integrating it into the next stage (Flores, 2010; Putri, 2015). When students have succeeded in manipulating concrete objects, they will move on to representations of these objects visually using pictures, and the finale with the use of symbols and numbers. The CPA approach also stimulates students to master math skills with multisensory activities. This multisensory learning consists of seeing, listening, movement, and touch. Even though the learning activities carried out are only virtual in online learning. However, the learning that was carried out could build contextual-based concepts in students' thinking, even though it did not present it directly. This active concrete-icon-abstract progress centered on Bruner's work which was explained from a learning perspective (Hui et al., 2017). That is, this development describes how a student enacted a role in the cognitive development process. Based on this opinion, it can be said that the CPA approach was compatible with SRL.

Descriptive analysis showed students in CPA learning have improved preferable than students in conventional both reviewed of whole and medium and low EMA groups. Whereas inferential, it showed that the increase in student SRL with the CPA approach was significantly better both in terms of overall and based on medium EMA. However, students who received the CPA approach in the high and low EMA didn't do obviously better than students who accepted the conventional approach. **Figure 2** below provides evidence of this description:
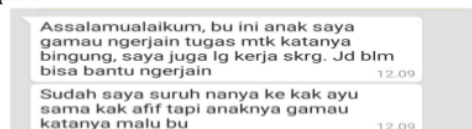
FIGURE 2. Parents Report via WhatsApp Regarding Student Difficulties Asking for Help

The meaning of **figure 2** is as follows: "Assalamualaikum, my son refuses to do his math assignment, because he didn't understand. I couldn't help, because I was working. I had suggested asking you and Mr. Afif, but he refused out of embarrassement". **Figure 2** supports the findings of descriptive statistics showed that students' SRL in the EMA group was experiencing the lowest increase among other EMA groups. These obstacles are due to the students' lack of confidence asking for personal help. The ability to demand assistance was a strategy in establishing SRL (Hendriana et al., 2017). When students are involved in difficult assignments, students should have the initiative to ask teachers and peers for help. The initiative to ask for help is related to the SRL indicator, namely learning initiatives and the ability to diagnose learning needs. Based on the increase in each indicator, the two indicators experienced the lowest increase. This showed that SRL development could be started by increasing each indicator. However, students in the low EMA tended to experience a higher SRL increase than those in the high and low EMA. The study said that students in the low EMA group experienced a higher SRL than students in the high and medium EMA (Fauzi, 2011). This explanation showed that the CPA approach provides benefits for students who had difficulty learning mathematics (Putri, 2015). Another reseach revealed the enhance in self-efficacy of low EMA students on CPA learning was higher when compared to other EMA groups, and significantly preferable than students who got conventional (Putri et al., 2020). Self-efficacy was one of the main indicators and factors that influence SRL. The increase in SRL can also be caused by the use of manipulative objects in mathematics learning activities that can create more enjoyable learning feel so that students were motivated to learn (Putri et al., 2020; Surya, 2015). Although inferential, the students' SRL increase with the CPA approach in high and low EMA was not better than students in conventional approach. Referring to the results of observations during online learning, some students tend to have difficulty representing concrete objects and images into mathematical symbols. So that in a few situations, students only succeed in completing the learning assignments contained in the concrete and pictorial sections. Students tended to prefer stages that did not involve mathematical numbers and symbols, especially students in the low EMA criteria. However, in the high EMA group students, this indicates that students were not used to new learning habits so that it requires a long enough period to adapt. (Yuliyanto, Putri, et al., 2019). Especially when developing SRL.

Based on the average increase in each indicator, students who received CPA learning were better than students who accepted conventional. Even in several indicators, childrens with conventional learning experienced a drastic decline. The indicator with the highest stratum of improvement in CPA learning was the ability of students to evaluate the process and learning outcomes and the ability to set targets or learning objectives. If it is related to CPA learning, each stage of learning has learning assignments and achievements that need to be mastered by students. Each stage has a relationship with one another. To master a stage, Students must master the previous stage. And if they had difficulty with a certain stage, then they must evaluate the previous stage. Increasing SRL will certainly enact a role in the achievement of student learning outcomes (Clarebout et al., 2010; Kistner et al., 2010; Rusmiyati, 2017; Vrieling et al., 2012; Wolters & Hussain, 2015) especially when learning is applied online (Barnard-Brak et al., 2010).

CONCLUSION

Thus, the increase in student SRL based on descriptive analysis shows that students who received CPA learning are higher than conventional both in terms of the whole and EMA medium and low. Students who were in the high EMA group experience the opposite. Students with conventional learning tended to have higher self-regulated learning. This can be because these students have good learning readiness and they are used to conventional learning. Meanwhile, students who accept the CPA approach still

need time to get used to the new learning method. However inferential, the increase in independent learning of students who got CPA learning was not significantly better for students with distant conventional learning in whole and EMA (high and low). CPA learning can be used as a solution to the approach applied in online learning even though the results obtained in this study were still not maximal. This may be due to time constraints in conducting research. Therefore, it takes a longer time to apply the CPA approach in classroom learning, as well as to build an intense learning situation and closeness even though learning is applied online, to optimize student potential.

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