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ENHANCEMENT OF ELEMENTARY SCHOOL STUDENTS' SPATIAL SENSE ABILITY THROUGH CONCRETE PICTORIAL ABSTRACT APPROACH

Hafiziani Eka Putri*[a], Idat Muqodas[b], Mukhamad Ady Wahyudy[c], Gia Nikawanti[d]
[a,b,c] Elementary Teacher Education Program, Universitas Pendidikan Indonesia
Jalan Veteran No.8, Purwakarta, Indonesia
[d] Elementary Teacher Education Program, STKIP Purwakarta
Jalan R.E. Martadinata No.43, Purwakarta, Indonesia
*Corresponding author: *hafizianiekaputri@upi.edu

ABSTRACT

This research is motivated by the low spatial sense ability of elementary school students in West Java, Indonesia. Meanwhile, the education curriculum in Indonesia requires elementary school students to have geometric abilities. Geometry abilities are closely related to students' mastery of spatial sense ability. The present study aimed to investigate the enhancement of elementary school students' spatial sense ability through the Concrete-Pictorial-Abstract approach, seen from Mathematical Prior Ability and as a whole. It is a quasi-experiment with pre-test and post-test control group design in Mathematics in the topic of 3 dimension geometry (3D geometry) involving 131 elementary school students in Subang and Karawang, West Java, Indonesia. The present study is conducted by using two study groups; a group that implements a concrete pictorial abstract learning approach as the experimental group and group which implements conventional learning as the control group. Both descriptive and inferential data analysis show that students with concrete pictorial abstract learning approaches have better spatial sense ability enhancement rather than students with conventional learning, seen as a whole and in every mathematical prior ability. The results showed that the highest enhancement in spatial sense ability of elementary school students was in the group of students with low mathematical prior ability, followed by the group of high mathematical prior ability, and the lowest enhancement in spatial sense ability of elementary school students was in the group of students with middle mathematical prior ability. Therefore, concrete pictorial abstract learning can improve elementary school students' spatial sense ability, especially for students with low mathematical prior ability.

Keywords: spatial sense ability, concrete-pictorial-abstract (CPA) approach, elementary school students

Introduction

The national curicullum of Indonesia from elementary school to high school requires the student to mastery the geometric ability. Geometric ability which related to 2 dimensional form and 3 dimensional for is a part of spatial sense ability (SSA) (Braconne dan Marchand, 2012).Every conception about geometry connected with spatial sense ability (Pavlovicova dan Zahorska, 2015).*Spatial Sense Ability*(SSA) is the one of 8 *multiple intelligences* which important be owned by every people.SSAis very demanded to solve several problems in the daily life(New Jersey Mathematics Curriculum Framework, 1997).For instance, SSA will be useful for communicating about the position and relations among several things, provide and receive direction, and imagine the transformation which happened in the position or form

size, a map reading, driving, looking at a mirror, and etc. (Bennie dan Smit, 2005; Gardner, 2003).

However, in the reality, spatial sense ability of student in Indonesia is still low(Dwirahayu, 2012; Syahputra, 2011;Abdussakir, 2010, Putri, 2017). The low spatial sense ability of student may due to the choosing of approach or learning method which applied in the class.On the learning of geometry, teacher tends to give information by mechanical nature and memorizing. The student rarely has opportunity to describe a problem solving either oral or written. This condition, can be a reason why student mathematics ability not developed, one of them is student spatial sense ability (Goldin, 2002; Hwang, dkk.,2007).Therefore, one way to obtain the maximum in the improvement of spatial sense ability is by choosing a learning approach which give more opportunity in the reconstructing their knowledge through interaction with their environment. Then, one way to obtain the maximum result in order to imrpove student spatial sense ability i.e. by choosing learning approach which provide a broadness to student in the reconstruction of their knowledge through interaction with their environment.

The interaction between students and their environment will be more meaningful if the students are given the opportunity to recognize learning material relationship which provided with the benefits in the problem solving of everyday life.To choose the best learning approach should be adapted with the development of student thinking growth.Alimin (in the Yuliawaty, 2011) stated that, there are four steps of hierarchical learning which can helps the student to solve the learning problem. The four steps are: (1) Concrete learning step. (2) Semi concrete learning step, (3) Semi abstract learning step, and (4) Abstract learning step. One approach which using the hierarchical steps and also provide an opportunity to reconstruct their own knowledge through environmental interaction is concrete pictorial abstract (CPA) approach. This CPA approach sometimes is called by concrete representational abstract (CRA) approach or concrete semi concrete abstract (CSA). CPA approach consists of three steps learning, that is the student learn through physical manipulation of concrete things, followed by learning through pictorial representation from concrete things manipulation, and lastly, by problem solving using abstract notation (Witzell, 2005).

The activities order is important when using CPA approach in teaching and learning activities.The activity with concrete material should be done earlier togive an impression to student that mathematical operation can be used to solve the problem in real life. Pictorial representation shows the visual representation from the manipulation of concrete things will helps the student to visualize mathematical operation when to solve the mathematical problem. It is necessary to the teacher to explain how picture examples are related to concrete examples. The formal work with symbols is to show how the symbol provides a short and efficient way to represent the numerical operation. In the end, students need to achieve the highest abstract level that is able to use symbols with masterly in various mathematical abilities. However, the symbols meaning have to be experienced using the real things deeply.Otherwise, their performance in the symbolic operation is only as a repetition or memorization abilities (procedure of memorization).

Riccomini (2010) stated that the objective of CPA teaching and learning is to make sure overall understanding of the student on the learned mathematical concept/material. Therefore, if the students not indicate the masterly of material on the abstract step, thus the teaching and learning process back to the pictorial step. As well as, if the student not showing the masterly in the pictorial step, thus, the teaching and learning process back to concrete step. The benefit of CPA approach is on the intensity and theconcreteness which helps student to maintain a frame work in their memory to solve the problem (NCTM, 2000).

Previous study indicated that CPA approach is very efective to helps school or univerity student who has difficulty in mathematics learning. Witzell (2005) conducted a

study to six and seven grade student whose stude algebra,concluded that student who learn to solve transformation equation of algebra through CPA learning approach obtaining the higher test result compared to the control class (student with conventional learning process).The succesfull of CPA apprroah is consistent to the student with performance of mathematics learning track record low, medium and high. Witzel, Mercer, and Miller (in Sousa, 2007) stated that the student who using the order of CPA approach in learning process has fewer procedural mistake when solving algebraic variable than traditional class. The other finding from the research by Yeo, Wong, dan Ho (2005) which conducted to the student of Tamasek Junior College Singapore, showed that learning with CPA approachmay help student with visualization problem, and make relationship to repair certain integral expression and to evaluate a volume on the topic of advanced calculus subject. Putri (2015) stated that CPA learning application improves spatial sense ability of prospective elementary teacher students. Therefore, can be concluded based on previous study, teaching and learning using CPA approachemphasize on constructivism expected to enhance student spatial sense ability.

Besides teaching and learning approach, there is other factor which suspected influenced to the achievement and improvement of spatial sense that is Initial Mathematical Ability (IMA) of student. This is in line with Arends statement (1997) who mentioned that, the ability of student to study new ideas depends on their initial knowledge and to mastery a mathematical concept requires a mastery of the other mathematics basic concepts. Therefore, it is also demanded to study the suitability between learning application with CPA approach on every level of IMA to enhance student spatial sense.

Based on previous explanation, thus the objective of this research is to conduct a study which focused on the effort to improve spatial sense ability of elementary school student through teaching and learning using CPA approach. The research question is whether spatial sense ability of elementary school student can be improved through the application of CPA approach in the mathematics teaching and learning, for both reviewed as a whole and also based on mathematics initial ability?.

Methodology

The population in this study is the entire elementary school student from Jawa Barat province of Indonesia. The sample number is 131 students from 2 elementary school located at Subang and Karawang residences. This research was conducted during eight month from January to August 2019. This research using quasi experiment with the control groups are pretest and posttest. The design selection like this because in this experiment not always external variables which influence the experimental implementation can be controlled, and the sample in experiment group or control group were not selected randomly (Sugiyono, 2012). Ruseffendi (2010) described the design experiment like this as follow:

O X O
O----- O

Where:
O = Pretes dan posttes of spatial sense ability.
X = Mathematics learning with CPA approach.

This study was conducted with two learning groups that is learning group with CPA approach as experiment group, and conventional learning group as control group.This experiment is about the implementation of teaching and learning process using CPA approach with the intention of developing and improving spatial sense ability (SSA) elementary school student. To understand deeply the influence of CPA and conventional appraoach implementation in the developing and improving SSA studwnt, thus this research considering mathematics initial ability (MIA).

MIA of student on experiment and control groups known through MIA test which conducted before the teaching and learning process started. Then, the students from both two sample groups were given posttest SSA. Pretest and posttest which used in this research are tests with indicator and similar problem item type. The variable in this research consist of three part that is independent variable, control variable, and dependent variable. The independent variable is CPA learning approach and conventional learning approach. The dependent variable is spatial sense ability. The variable control is student initial mathematics ability (low, medium and high).

Literature review

Spatial Sense Ability (SSA)

Thera are many terms that usually used to mention SSAamong which is*spatial ability*, *spatial orientation*, *spatial reasoning* dan *spatial insight*. SSA is part of geometric ability which related to 2D form and 3D form. The relationship between geometric and SSA described clearly by Braconne dan Marchand (2012), which mentioned that learning geometric particularly in 3D geometric improves student spatial sense. Simiarly, Bennie and Smit (2005), explained that there is relationship between SSA and performance in geometrc and general mathematics ability.

The word spatial sense describes the interaction of a student in 3D-space, both concrete and visual. In general, one sentence that can describe a spatial sense is as the ability to interact in a spatial environment and to work in visual images (Malati, 2005). Spatial sense is an intuitive feeling for form and space. This involves traditional geometrical concepts, including the ability to recognize, visualize, represent, and change geometric shapes. Students who study geometry can apply spatial sense and knowledge about the properties of shapes and spaces for real life.

Guay and Mc Daniel (in Bishop, 1980) define spatial sense ability at two levels, namely: (1) Low-level spatial abilities are abilities that require visualization of two-dimensional configurations, but there is no mental configuration of visual images; and (2) High-level spatial abilities are abilities that require visualization. Lehler, Jacobson, Kemeny, and Strom (1999) state that spatial experience may not necessarily lead to spontaneous knowledge of mathematical knowledge, but only lay the foundation for its development. Del Grande (1987) notes that, since early pralinguistic child behavior, this behavior is basically "space". A child thinks at this stage that he is dominated by the experience of seeing, touching, listening, moving, etc. The spatial experiences and geometric relationships students are used as a basis for developing spatial knowledge and geometry.

Every student has a level of development which sometimes is different each another. Every student is a unique person, thus, it needs different efforts to fullfill their learning needs. Otherwise, the gap ability among students will become too large, consequently this will reduce the opportunity for students to develop the knowledge which needed for meaningful interactions in heterogeneous groups.

The relationship between spatial sense abilities and mathematics can be seen from the results of the following research. Clements and Battista (1992) state that there are varied results in the relationship between spatial sense and performance in geometry and mathematics in general, and there is also an indirect relationship between spatial ability and non-geometrical concept learning. Likewise the results of research conducted by Bishop (1980) found a relationship between mathematical problem solving and spatial visuo ability.

By paying attention to these various opinions, to overcome the problem of the lack of students' spatial sense abilities, it is necessary to design a learning that provides opportunities for students to build their knowledge by utilizing the knowledge that students have and provide a comfortable learning environment. Students have the opportunity to communicate

their ideas, learning to draw conclusions from shared thoughts. Learning design like this is one of the characteristics of the use of learning approaches that follow the flow of constructivism. The appropriate learning approach is learning by using the CPA approach.

To measure the ability of spatial sense, a clear indicator is needed. In this study, indicators of the spatial sense abilities studied are: Solving mathematical and real-world problems using geometric models; Develop, understand, and apply various strategies to determine the perimeter, area, surface area, angle size, and volume; Analyzing the nature of three-dimensional shapes by drawing and building models and interpreting two-dimensional representations of three-dimensional shapes; Identify, explain, compare, and classify the geometry of fields and spaces.

Concrete-Pictorial-Abstract Approach

The Concrete-Pictorial-Abstract (CPA) approach is usually also referred to as the Concrete-Representational-Abstract (CRA) approach or the Concrete-Semiconcrete-Abstract (CSA) approach. Regardless of the name, the three teaching approaches are similar and were originally based on Bruner's thought in 1960. The CPA approach consists of three stages of learning, namely: (1) Physical manipulation of concrete objects, (2) Pictorial representation of concrete manipulation, and (3) Solve problems using abstract notation (Witzell, 2005). In line with this, Cooper (2012) explains the three sequential stages of learning with the CPA approach, namely: (1) The concrete stage is the initial stage involving students physically interacting to manipulate concrete (manipulative) objects, (2) The pictorial stage is the transition phase that involves students working with representations of concrete models, which are usually in the form of drawing circles, points, calculations, or geometric drawings, and (3) The abstract stage is the final stage where a mathematical concept is symbolically modeled using numbers, variables, and other mathematical symbols.

Learning with CPA approach provides a conceptual framework for creating a meaningful relationship among the concrete, pictorial, and abstract understanding stages. The steps of learning with CPA approach according to Flores (2010) are as follows: (1) Select concrete (manipulative) objects that will be used to introduce conceptual understanding of the material that will be studied by students; (2) Guide students to participate independently in using of concrete (manipulative) objects by giving instructions and signal; (3) Change the use of manipulative objects with pictures or paintings; (4) Use strategies that can help students remember the steps of learning that have been done before. This serves as a process of transition from the use of pictures or paintings to the use of numbers or symbols only; and (5) Encourage students to only use numbers or symbols in completing the given mathematics tasks, and this activity focuses on fluency.

The utilization of manipulative objects in mathematics teaching and learning is important to help students understand the mathematical concepts. The importance of using manipulative objects was also raised by Skemp (in Turmudi, 2012) which stated that the provision of manipulative objects for students in mathematics learning activities could be used as a basis for further learning at the level of more abstract.

After carrying out learning with the CPA approach, there may be a case where students fail to solve problems in the abstract stage. For this case the teacher needs to identify the reason why the students not understand the concept. Riccomini (2010) provides suggestions, namely: (1) re-teach the concept at a concrete stage; (2) re-teaching the concept at the stage of representation; (3) give students the opportunity to speak in their own language in explaining the solution and how they got the solution. This statement gives the meaning that if students do not show mastery at the pictorial stage, then learning returns to the concrete stage. Similarly, when students do not demonstrate mastery at the abstract stage, the learning returned to the pictorial stage.

Several studies support the effectiveness of this approach, including research conducted by Witzel (2005) of sixth and seventh grade students who were identified as having difficulties in learning algebra. Students who learn how to solve the transformation of algebraic equations through the CPA approach obtain higher test results than control class students (receiving traditional teaching). In addition, students who use CPA, the errors procedural order is less when solving algebraic variables (Witzel, Mercer, and Miller in Sousa, 2007).

Thus it can be concluded that learning using the CPA approach is a learning approach that pays attention to the sequence of the three stages of learning, namely starting with the use of concrete objects, then students are given the opportunity to make pictorial representations of concrete objects, and ultimately students work in abstract notation. By passing through these three stages of learning, it is expected that students will understand mathematical concepts clearly and correctly, and feel the direct benefits when learning mathematics. The mathematical process to hone and develop the spatial sense abilities of elementary students can be done through giving questions (problem situations) in the Student Worksheet given at each meeting that is designed in such a way based on the stages in learning with the CPA approach.

Relationship betwen Spatial Sense Ability (SSA) and Concrete-Pictorial-Abstract (CPA) Approach

The linkage of concrete stage learning activities with the ability of spatial sense can be seen from the statement of Van Niekerk (Bennie and Smit, 2005) which states that an individual must have experience with real objects (cubes) before being able to describe them verbally and then make a mental picture in his thinking . Likewise with the opinion of Human (in Bennie and Smit, 2005) which states that the activity of observing changes in position, size, shape of real objects related to flat arising and building space can practice spatial sense abilities.

The link between the spatial sense ability and activities at the pictorial stage of learning with the CPA approach can be seen through the opinion of Malati (2005) which states that, to hone the spatial sense ability can be done by identifying the forms of interaction of the spatial sense ability itself, namely designing and drawing configurations of spatial objects such as cubes and buildings. One aspect of spatial sense is the ability to communicate the visual image process to others in a meaningful way through communication in the form of images.

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The linkages of the carried out activities at the abstract stage to develop and improve spatial sense abilities are explained by Sousa (2007) and Wessel and Van Niekerk (in Malati, 2005) states that, one of the four skills that can activate the spatial sense ability is skills mentally. Mental skills are described as mental abilities to manipulate spatial images and to understand their interrelations. The ability to implement the mental manipulation is useful to reflect on the mental thought process which used in problem solving. Thus, the application of CPA approach in mathematics learning is expected to develop students' spatial sense abilities.

Conventional Approach

Conventional learning in this study is classical expository learning, the teacher explains the subject matter, students are given the opportunity to ask questions, and then do the exercises, and students learn individually.

Findings

The Spatial Sense Ability (SSA) test in this study was classified into two types of tests, namely the pretest given prior to the treatment/learning activity and the posttest given after the treatment/learning activity. What will be measured is the increase in students' SSA after the treatment which given in the two learning groups (one group using the CPA approach and the other group with the conventional approach). The improvement criteria are grouped based on the N-Gain proposed by Meltzer (2002) presented in the Table 1 as follows:

Table 1
N-Gaincriteria

Interval	Improvement criteria
(<g>) ≥ 0,7	High
0,7 > (<g>) > 0,3	Medium
(<g>) ≤ 0,3	Low

Table 2 is the results of a descriptive analysis of the SSA improvement of students as a whole:

Tabel 2
Summary of Descriptive Analysis of Student SSA as a Whole

Type of Test	Learning	Score		$\bar{x}$	Sd	N-Gain
		The smallest	The biggest			
Pretest	CPA	12	42	24,42	6,24	0,77
Postest		34	57	50,29	5,77	
Pretest	Convensional	12	43	27,19	6,58	0,44
Postest		17	54	40,64	8,45	

From Table 2 it can be seen that the average score ($\bar{x}$) posttest and the N-Gain score of the learning group with the CPA approach are better than the conventional learning group. Based on the N-Gain criteria from Hake, it is known that the increase in spatial sense ability of students who learn with the CPA approach is in the high category, whereas students who learn with the conventional approach are in the moderate category). The results of the SSA descriptive analysis of students based on high, medium, and low of IMA are presented in the Table3 below.

Table3
The SSA descriptive analysis of students based on high, medium, and low of IMA

IMA Groups	Type of test	Pembelajaran	Score		$\bar{x}$	*Sd*	*N-Gain*
			The smallest	**The biggest**			
High	Pretest	CPA	21	42	29,40	5,76	0,76
	Postest		41	57	51,20	4,34	

IMA Groups	Type of test	Pembelajaran	Score		$\bar{x}$	*Sd*	*N-Gain*
			The smallest	**The biggest**			
	Pretest	Convensional	20	43	30,10	7,37	0,46
	Postest		30	54	42,90	8,45	
Medium	Pretest	CPA	15	36	24,78	5,50	0,77
	Postest		35	57	50,21	5,46	
	Pretest	Convensional	16	40	27,35	6,21	0,45
	Postest		22	50	41,13	7,26	
Low	Pretest	CPA	12	31	19,79	5,82	0,79
	Postest		34	57	49,86	7,66	
	Pretest	Convensional	12	31	23,11	6,23	0,36
	Postest		17	49	35,67	12,61	

From Table 3 it is obtained that the two learning groups (CPA and conventional approaches) are increase variatively. It also can be seen that there is an increase in the SSA of students who learning with the CPA approach is greater than students who use conventional learning. The distribution of N-Gain scores shows the increase in SSA of students who use learning with the CPA approach. In each IMA group is in the high category and the increase in SSA of students who use conventional learning is in the moderate category.

The descriptive analysis results above will be strengthened by inferential analysis, where each improvement in the average SSA score, both as a whole and based on the IMA score will be tested hypothetically, at a significance level of 0.05. The initial step is conduct by doing a normality test. The SSA score normality test for students as a whole who learning using CPA and conventional approaches using the Kolmogorov-Smirnov test aided with softwareSPSS Version 25. The data on the results of the normality mathematics mathematical scale normality test results are illustrated through the Table 4 as follow:

Table4
Normality Test Results Improvement of Students' Overall SSA Score

Teaching and Learning	*Kolmogorov Smirnov*		
	Statistic	*df*	*p-value (Sig.)*
CPA	0,152	65	0,001
Convensional	0,148	65	0,001

The normality test results of the improvement in the overall student SSA score from Table 4 shows the abnormal distribution. The next step is directly to the average difference test using the Mann-Withney U test. The proposed hypothesis is as follows:

H_0: $\mu_1 \leq \mu_2$. The improvement in SSA of elementary school students who received learning with a CPA approach not better than students who received conventional learning reviewed from overall students

H_1: $\mu_1 > \mu_2$. The improvement in SSA of elementary school students who learn with a CPA approach is better than students who learn with conventional approach reviewed from overall students

Berikut hasil uji perbedaan rata – rata peningkatan skor KSS siswa secara keseluruhan:
The following Table 5 is the results of the test for the average difference in the overall SSA score for students as a whole:

Table5
Recapitulation of Average Difference Test Results for Overall Students' Spatial Sense Ability (SSA) Score

Learning	*Mann-Withney U*	Z	*p-value*	*(p-value*	Remark
CPA Conventional	688,000	-6,715	0,000	0,000	H_0rejected

Table 5 provides information about the increasing in SSA of primary school students who learn CPA approach which is better than students who get conventional learning, reviewed from overall students. Data on the results of normality tests for increasing SSC scores of students based on the IMA group (high, medium, and low) are illustrated through the Table 6 asfollow:

Tabel 6
Normality Test Results for Students' SSA Score Improvement Based on the Group's Initial Mathematics Ability (IMA)

IMA Group	Teaching and learning	*Kolmogorov Smirnov*		
		Statistic	*df*	*p-value (Sig.)*
High	CPA	0,191	10	0,200
	Convensional	0,252	10	0,072
Medium	CPA	0,137	42	0,046
	Convensional	0,138	42	0,043
Low	CPA	0,316	9	0,010
	Convensional	0,248	9	0,118

From Table 6 it can be seen that the high IMA group is normally distributed, so the next step is to do a homogeneity test. Differently, the moderate and low IMA groups are not normally distributed. Data on increasing SSA scores of students who are in the medium and low IMA groups will subsequently be directly tested using the Mann-Withney U test aided bysoftware that isSPSS Version 25.

Homogeneity test score of SSAimprovement scores of students in the high IMA group uses the Levene Test with the help of SPSS Version 25 software. The hypothesis testing criteria that used are if the p-value (sig. 2-way) is less than 0.05, then H0 is rejected, and in other cases H0 is accepted. The test results show that the variance of the two populations is not homogeneous. The next step is to take an average test using the t 'test. Hypothesis testing the average high IMA score as follows:

H_0: $\mu_1 \leq \mu_2$Theimprovement in SSA of elementary school students who received learning using the CPA approach not better than students who received conventional learning in reviewed from students' IMA in the high category.

H_1: $\mu_1 > \mu_2$The improvement in SSA of elementary school students who received learning with CPA approach not better than students who received conventional learning reviewed from overall students and students' IMA in the high category.

The following Table 7 is the recapitulation of the test results of the average difference in the improvement in students SSA scores based on the high IMA group:

Table 7
Recapitulation of Average Difference Test for Students' SSA Score Increase Based on High IMA Groups

Learning	*t'*	*Df*	*p-value*	Remark
CPA Convensional	2,762	13,440	0,016	H_0rejected

From Table 7 it can be seen that the t score obtained is 2.762 and has a p-value (sig. 2 directions) below 0.05 and rejects H0. Thus, it can be concluded that, the increase in SSA of primary school students who get learn with CPA approach is better than students who get conventional learning reviewed from overall students and the IMA of students in the high category.

There is one more stage in the average difference test that has not been presented yet, the test for the difference in the average increase in SSA using the Mann-Withney U test in the medium and low IMA groups. The hypothesis for increasing SSA scores based on moderate IMA groups is as follows.

H_0: $\mu_1 \leq \mu_2$The increase in SSA of elementary school students who received learning using CPA approach not better than students who received conventional learning reviewed from students' IMA in the medium category.

H_1: $\mu_1 > \mu_2$The increase in SSA of elementary school students who received learning with a CPA approach better than students who received conventional learning reviewed from students' IMA in the medium category.

Hypotheses for SSA improvement scores based on low IMA groups are as follows:

H_0: $\mu_1 \leq \mu_2$The improvement of SSA of elementary school students who received learning using the CPA approach is not better than students who received conventional learning reviewed from students' IMA in the low category

H_1: $\mu_1 > \mu_2$The improvement of SSA of elementary school students who received learning with the CPA approach isbetter than students who received conventional learning reviewedfrom students' IMA in the low category.

The following Table 8 ispresents the results of the test of the average increase in the overall SSA score of students and based on the IMA group (moderate and low) using the Mann-Withney U test:

Table8
Recapitulation of Average Difference Test Results for Students' ImprovementSSA Scores Based on Medium and Low ofIMA

Category	Learning	*Mann-Withney U*	Z	*p-value*	Remark
Medium IMA	CPA Convensional	291,000	5,647	0,000	H_0rejected
Low IMA	CPA	22,000	2,588	0,005	H_0rejected

Table 8 provides information about the improvement in SSA of primary school students who received learning with the CPA approach better than students who received conventional learning reviewed from students' IMA in the medium and low categories.

Discussion

Improvement in the SSA of students who study with the CPA approach is better than students who learn with the conventional approach. SSA students who learn with the CPA approach as a whole or in each IMA category have a high improvement. This is because learning with the CPA approach in this study is learning that emphasizes the active role of students by building their own knowledge, through the stages of learning by using concrete (manipulative) objects, then to the pictorial stage, and to the abstract stage. These stages of learning provide opportunities for students to build new knowledge by making connections with old knowledge that owned by students previously. These three stages of CPA support one another and the implementation is carried out in an integrated manner to increase student success in learning (Putri, 2018; Yusuf, Sunardi, & Abdurrahman, 2003).

Another finding from the results of this study is that the improvement in SSA of students with low mathematical initial ability is better than students with moderate and high mathematical initial ability. These findings are in line with the statements of Jordan, Miller and Mercer (in Sousa, 2007) which suggest that the CPA approach benefits most students and has been proven effective in helping students who have difficulties in learning mathematics, because the CPA approach moves gradually from objects which is then through the picture and then to the symbol. Of course students from low IMA have more learning difficulties than students from medium and high IMA.

Learning with the CPA approach provides many opportunities for students to reconstruct their thinking. For example, interactions with concrete objects increase the memory of students in procedural stages to solve mathematical problems, because this allows students to take information in a variety of sensory choices: visual, auditory, tactile (touch / touch) and kinesthetic. Students can connect concrete objects in class to pictorial representations in most work and testing situations. So when a student finds it difficult to solve a mathematical problem, he will be able to make drawings that are similar to the use of concrete objects manipulation. Learning activities that emphasize student activities in learning with the CPA approach have in common with the characteristics of the learning approach that adheres to the flow of constructivism. Thus, the results of previous studies using approaches with constructivism understandings, can be used as relevant examples in showing the success of increasing student SSA in the implementation of learning with the CPA approach.

Limitations

The results of the study to improve the spatial sense ability of elementary students reviewed in overall, moderate and low IMA only applied to 131 students in the two elementary schools that were used as research samples, because the distribution of sample data was not normally distributed. While the results of research related to increasing spatial sense ability of elementary students in terms of high IMA applied to the population, namely for all elementary students in West Java, Indonesia, because the distribution of data in the sample is normally distributed.

Recommendation

Based on the results of the study its kown that the increase in students' spatial sense skills both reviewed as a whole and based on IMA is better than students who get conventional learning. Based on this, it is recommended that the application of the CPA approach can be used as an alternative learning approach used for elementary students to improve their spatial sense abilities. Increasing the spatial ability of students who learn with the CPA approach based on the IMA group category (low, medium, high) has an increase in SSA on high criteria. From the three IMA group categories, students with low IMA

categories had the highest improvement scores. Therefore it can be recommended that the CPA approach is very suitable to improve the SSA of elementary school students with low IMA.

Conclusion

Improvement of Spatial Sense Ability Students who get learning with the CPA approach are better than students who learn with conventional approaches, both reviewed by students as a whole and based on IMA groups (high, medium, low). Increased spatial sense ability of students who learn with the CPA approach in each IMA group (high, medium, low) is at a high criteria, while students who learn with a conventional approach to improve SSA are at the medium criteria. The highest increase in SSA occurred in students who studied with the CPA approach in the low groupcriteria.

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