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The Effectiveness of Computer-Assisted Instruction on Students' Cognitive Skill to Know Geometric Shapes

Nurul Khotimah[1]*, Nur Ika Sari Rakhmawati[1], Rachma Hasibuan[1]
[1]Department of Early Childhood Education, Universitas Negeri Surabaya, Jl. Lidah Wetan, Lakarsantri, Surabaya, 60213, Indonesia

*Penulis koresponden
Nurul Khotimah
nurulkhotimah@unesa.ac.id

Abstract
Cognitive skill, the important aspect in early childhood development, consists of three skills such as learning and problem solving, symbolic thinking and logical thinking. The activities in recognizing geometric shapes in children aged 4-5 years are by mentioning geometric shapes, showing geometric shapes, and geometric grouping shapes. The result of observation shows children are difficult to distinguish between square and rectangular shapes when asked. Thus, educational media to overcome these problems as well as to meet the industrial revolution 4.0 challenge is so needed. This study aims to determine the effect of CAI (Computer Assisted Instruction) on children aged 4-5 years in recognizing geometric shapes. This is quantitative descriptive research using a quasi-experimental design with a non-equivalent control group design. The population used were 75 children aged 4-5 years. Data were collected using observation and documentation. The assessment indicators used are to mention geometric shapes, show geometric shapes, connect 2- and 3-dimensional geometry shapes (surrounding objects), and group surrounding objects. Computer-Assisted Instruction (CAI) in recognizing geometric shapes was used 3 times. The average score before treatment was 10.77, while after treatment was12.66. Through the Mann-U Whitney test, the hypothesis was sig = 0,000 < alpha (0.05) meaning that Ho was rejected and Ha was accepted. Therefore, it can be concluded that CAI (Computer Assisted Instruction) is an effective media to recognize geometric shapes in children aged 4-5 years.

Keywords
computer-assisted instruction; cognitive skill; geometric shapes; early childhood education

INTRODUCTION

Early childhood education can provide opportunities for children through activities to optimize their development and growth, one of which is cognitive skill. Cognitive skill is psychological processes related to how individuals learn and think about their environment (Sohn & Carlson, 2003). Based on development theory, children adapt and interpret the objects and events around them. The children learn the characteristics and functions of objects, such as toys, furniture, and food. Developing children's cognitive skills is very important as it is stated that one item of the 2013 curriculum that must be achieved by children aged 4 - 5 years is to solve problems, think logically and think symbolically.

With their cognitive skills, children are able to recognize, compare, differentiate and remember what is seen and what is heard. Children aged 4-6 years have been able to organize cognitive skill only in short-term memory (Davis, et al., 2011; Willstedt-Svensson, et al., 2004). The observations in several kindergartens find that children's cognitive skills are low, one of which is in recognizing geometric shapes. Children aged 4-5 years have been able to mention and show geometric shapes, grouping various geometric shapes such as triangles, squares, rectangles, and circles, mentioning and showing geometric objects (Aslan & Arnas, 2007; Clements, et al., 1999; Elia & Gagatsis, 2003).

Furthermore, a research about teaching and learning of geometry is conducted to improve cognition and geometry skills for improving children's understanding of identifying and connect4 geometrical shapes namely square, triangle, circle, and rectangle (Clements, et al., 1999). In addition, another research shows that children aged 4-5 years can form geometrical concepts, identify and name geometries such as circles, triangles, squares, and rectangles (Bussi & Baccaglini-Frank, 2015).

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Meanwhile, the formation of children's geometric concept begins with identifying shapes, investigating shapes, separating images of objects around, such as triangles, rectangles, circles around us like wheels, books, roofs, wall clocks and so on (Clements, et al., 1999).

There are several reasons why geometry needs to be taught (Watan, 2018; Watan & Sugiman, 2018). First, geometry is the only science that can link mathematics to physical forms of the real world. Second, geometry links ideas from other fields of mathematics to be drawn. Third, geometry can provide non-singular examples of mathematical systems. Geometry shapes can be divided 2 dimensions and 3 dimensions (Tomaz & David, 2011). A flat shape (2 dimensions) is a shape that has length and width but not tall and thick such as triangle, square, rectangle, and circle. While 3 dimensions is a shape that has length, width, and height such as cupboards, chalk boxes, picture frames, etc. (Guven & Baki, 2010).

The preliminary observations in several Kindergarten in Beji sub-district shows that most of the teachers teach using worksheet rather than playing. This makes children feel bored and lazy to learn. Teachers should be creative and innovative that can attract children's interest in learning. The problems that occur in some kindergartens are on cognitive development of children aged 4-5 years regarding geometry concepts that are still low where children are not familiar with the names of each geometric shape, and unable to classify geometric shapes based on their shapes. In mentioning various geometric shapes activity through the folding paper to form a mosque image, some children are able to mention geometric shapes but not match because they find it difficult to distinguish between square and rectangular shapes.

When the teachers show objects around the class and ask for geometric shapes, few children can answer the questions correctly and correctly but neither do most of them. The other children are silent and do not want to know. The results of interviews with class teachers reveal that the ability of most children in recognizing geometric shapes is still low, especially in cognitive skills. The following problem mentioned before in some kindergartens need to be solved. The appropriate strategy to overcome the problem was by using Computer-Assisted Instruction (CAI). CAI was computer-based equipment to convey the content of the lesson by providing exercises and analyzing children's learning progress using media (Soe, et. al., 2000). In line with that, game for children using computer music techniques also uses cranking games that aim to improve sensing abilities for early childhood. Computer-aided media learning is more effective and encourages the development of the causes of education today (Cotton, 2008; Romanelli, et. al., 2009).

Through CAI, children are given the opportunity and freedom to think, imagine, and recognize their potential and also to develop their creativity. In addition, CAI media can increase children's learning motivation and be able to provide direct learning experiences to explain about recognizing geometric shapes (Yusuf & Afolabi, 2010; Giessen, 2015). The learning process shows the improved outcome compared to those who do not use any strategy. In addition, computer-based learning can attract children's attention and make children more enthusiastic to learn.

Some other evidence also shows that children will easily absorb all information especially in recognizing geometric shapes when learning firsthand with new things. The role of learning by using multimedia media is more attractive for children (Chambers, et. al., 2006; Kingsley & Boone, 2008). Multimedia can improve learning especially in children's cognitive, so children are more interested in learning (Weiss, et. al., 2006; Gunawan, 2018). CAI is a media used as an interesting and fun learning strategy for children in recognizing geometric shapes and an activity that can influence children's attention so that it can facilitate them in recognizing geometric shapes. CAI media can satisfy the children's will to play. Through CAI media, children will learn and absorb everything that happens in their playing environment by using interesting games that can stimulate aspects of development.

The benefits using CAI media were: (1) to test the effect of CAI media on improving skill to recognize geometric shapes in children aged 4-5 years; (2) to generate joy learning process so that their motivation increase for children aged 4-5 years in recognizing geometric shapes; and (3) to combine text, images, audio, music, animated images or videos in a single unit that supports each other so that learning objectives are achieved (Barrow, 2009; Kusumaningrum, et. al. 2018).

This study supports some of the previous studies as a reference that students prefer multimedia presentations to the traditional classroom instructional method (Apperson, et. al., 2006; Ogochukwu, 2010). The statement proves that learning through CAI (Computer Assisted Instruction) media attracts more children's attention to learn than traditional methods. Learning many things can be well done through multimedia rather than through direct traditional methods (Bryant, 2011). Computer-assisted teaching is significantly more effective than traditional methods in terms of improving children's learning difficulties (Soe, et. al., 2000).

Similar research shows that CAI (Computer-Assisted Instruction) media can improve learning without a significant effect on attitude (Dalton, et. al., 1989; Abouserie, et. al., 1992). The use of computer-

Exp	O1	X	O2
Con	O3		O4

Figure 1. Magnetization As A Function of the Applied Field

based media can improve understanding of children with autism spectrum disorders (Pennington, 2010). Furthermore, the results of a computer-assisted program can overcome problems in children who are less attentive and as teacher training to overcome children with special needs (Ramdoss, et. al., 2012).

The advances in computer media-based technology can motivate children's learning compared to traditional games. In line with the statement, learning using interactive media can influence children's cognitive growth (Lee & Vail, 2004; Kirkorian, et. al., 2008; Hardika, et. al. 2018). But in another study, CAI media can be used as a medium that can develop their skill to recognize geometrical shapes of children aged 4-5 years (Gambari, et. al., 2014).

METHOD

This quantitative research used a Quasi-Experimental Design research design with Nonequivalent Control Group Design. This design was divided into a control group and an experimental group. The pre-test was given in the experimental group before treatment using CAI (Computer Assisted Instruction) and then, the posttest. For the control group, pretest and posttest were given but that teaching was conventional with the teacher's method, not CAI. The treatment results are known accurately, and the comparison between the control group with the teaching method and the experimental group with treatment through CAI media. The following is the Nonequivalent Control Group Design research design as it is displayed in Figure 1.

The population was 75 children aged 4-5 years. The researchers used the Krecjie table with an error rate of 5% to determine the sample size of the population. There were 62 children as sample so 31 children for each school. Data were collected using observation and documentation. The observation before and after CAI (Computer Assisted Instruction) media. The first observation was made before, namely to find out the problems about recognizing geometric shades and the second observation after the application of CAI media. The researchers used observation sheets in the form of a checklist to determine the process, conditions, media use after the application of CAI. Documentation was to record ongoing events in the form of images, photographs, data instruments for assessment during the pretest, treatment, post-test, validation sheets as well as supporting data to obtain data about the ability to recognize geometric shapes through CAI media.

Data collection instruments used observation sheets to recognize geometric shapes and validation sheets in the form of material experts and media experts. Data analysis techniques used statistical package computer software for social science called SPSS for windows 23 edition. The stages of data analysis are used as follows: (1) descriptive analysis; (2) in the validity test and reliability test, if the data used is valid and reliable, then continue to the next analysis, but the invalid and not reliable data must first be rechecked, even if necessary, data can be retaken to get valid and reliable data; (3) the data normality test is used to determine the results before treatment (Pretest) and after the treatment (Posttest) to recognize shapes. This test is used to determine whether the data is normally distributed or not. The normality test used is the Kolmogorov-Smirnov statistical test; (4) if the data is normal, it can be continued with the parametric statistical test with the t / test, if the data are not normally distributed, then proceed using the non-parametric Mann-U Whitney test; and (5) to determine the effect that is given by comparing the results of Pretest and Posttest on the target of the trial conducted using the value of a = 0.05 if the value of $t_{observed} > t_{table}$. Thus, it obtains a significant influence but if $t_{observed} > t_{table}$, then there is no significant effect.

RESULTS

Research on CAI (Computer Assisted Instruction) skill to recognize geometrical shapes of 62children aged 4-5 years conducted in Beji, Pasuruan City, East Java, Indonesia. The learning tool was validated in term of its contents of the research instrument. This validation was conducted by media experts and material experts. The results of content validation or instrument shows that validator advises observational instruments to recognize geometric shapes of children aged 4-5 years.

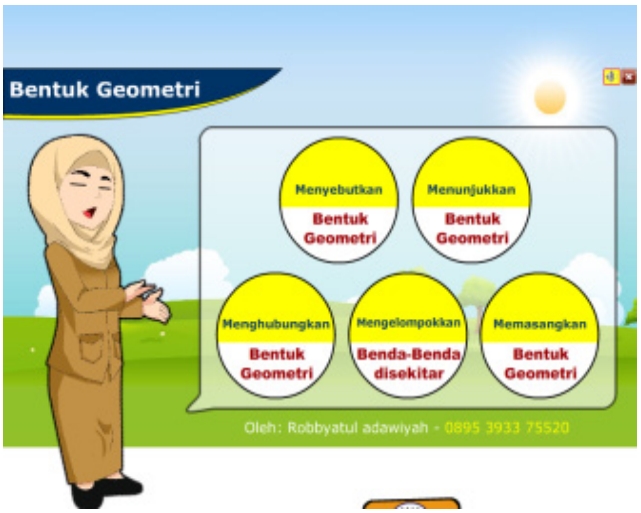

Figure 2. Magnetization as A Function of the Applied Field

It could be indicated that children were able to match shapes according to their geometric shapes to connect 2-dimensional and 3-dimensional geometry (surrounding objects), then able to pair shapes according to their geometry so that they were able to group geometric shapes with surrounding objects.

Furthermore, the validator suggested that the media used was CAI (Computer Assisted Instruction) media in mentioning geometric shapes, showing geometric shapes, connecting 2-dimensional and 3-dimensional geometry shapes, grouping objects around. So that, the media used was not biased on the instruments. Treatment was conducted 3 times in 3 weeks. The treatment given in this study was CAI (Computer Assisted Instruction) media. Here are the data from the results that have been collected as follows:

Treatment I

The first Treatment was begun by playing CAI (Computer Assisted Instruction) media using laptops. Every child has the opportunity to play CAI (Computer Assisted Instruction) media by mentioning 2-dimensional and 3-dimensional geometric shapes (surrounding objects). while playing CAI (Computer Assisted Instruction) media, children were asked to press the "Enter" button and then to enter the first indicator, containing button in which there is a "2-dimensional geometry shape" button such as triangle, circle, square, rectangle, after that the children were asked to press 2-dimensional shape button and follow the commands that have been provided, for example, a circle, will automatically sound "circle" and the children were asked to recite the word heard.

For 3 dimensional geometric shapes such as surrounding objects, the children were asked to press the 3-dimensional button with objects around it, for example, the cupboard will automatically sound" cupboard "and the children were asked to recite the word heard. Then, one by one the children were called to take turns playing using CAI media with the help of a laptop.

Treatment II

In the second treatment, the children were asked to enter the second indicator that is "shows the geometric shape". When the children pressed the second indicator button, they immediately saw a geometric shape like a triangle. Before working on, the children had to hear the commands provided then showed the 2-dimensional geometric shape such as a triangle while a 3-dimensional triangle of ruler by pressing the button.

The third indicator was "connects 2-dimensional and 3-dimensional geometry shapes (surrounding objects)", where in the indicator the children immediately saw the geometric shapes connecting 2-dimensional and 3-dimensional geometry shapes (surrounding objects, for example in a 3-dimensional drawing of children's blackboard) and asked to connect to 2-dimensional shapes such as rectangles. Before working on, the children had to first hear the commands provided, after that the children connected 2-dimensional and 3-dimensional geometry shapes.

Treatment III

In treatment III, the children were asked to enter the fourth indicator which is "grouping objects around". When children pressed the fourth indicator button, they immediately saw a geometric shape such as a triangle. Before working on, they had to first hear the commands provided. After that, they were asked to classify objects around them.

Table 1. Description of Control Variables

Statistics	**Pretest**	**Posttest**
Mean	10,77	12,16
Median	11,00	12,00
Modus	12,00	12,00
Standard Deviation	1,73	1,13
Variance	2,98	1,27

Table 2. Description of Experimental Variables

Statistics	**Pretest**	**Posttest**
Mean	11,45	14,45
Median	12,00	16,00
Modus	12,00	16,00
Standard Deviation	1,75	2,00
Variance	3,06	3,99

Table 3. Test Results of Pretest Control Validity

Indicator	**Correlation**	**sig.**	**Category**
Pre_1	0,839	0,000	Valid
Pre_2	0,833	0,000	Valid
Pre_3	0,794	0,000	Valid
Pre_4	0,834	0,000	Valid

The results showed that the children felt enthusiastic to use the media because they had never learned using CAI (Computer Assisted Instruction) media where they easily understood the information provided in learning to recognize geometric shapes. In addition, through CAI (Computer Assisted Instruction) media, children could also imagine, explore their potential, and increase their creativity. So that, children got new experiences and experience improvements in recognizing geometric shapes because playing is children's need. The Computer Assisted Instruction (CAI) media design can be seen in Figure 2.

This CAI media was made on Adobe Flash 6.0 application to make it more interesting when learning to recognize geometric shapes. CAI has 4 indicators in the media such as to mention geometric shapes, show geometric shapes, connect 2-dimensional and 3-dimensional shapes and group the surrounding objects. The pretest and posttest results of 31 children aged 4-5 years were explained based on mean, median, mode, standard deviation, and variance. This can be seen from the following Table 1.

In Table 1, it can be seen that there is the influence of CAI (Computer Assisted Instruction) media on increasing skill to recognize geometric shapes in children aged 4-5 years of control class that is indicated by the increase in the pretest and posttest statistical score. The average pretest score was 10.77 while the posttest was 12.16. The median and pretest mode are 11 while the posttest is 12. The standard deviation and variance values tend to decrease from the pretest value of 1.73 and 2.98 to the posttest value of 1.31 and 0.127.

In Table 2, it can be seen that the effect of CAI (Computer Assisted Instruction) media on increasing skill to recognize geometric shapes in children aged 4-5 years of Experiment class is shown by the increase of pretest and posttest statistical value. The average value of the pretest was 11.45 while the posttest was 14.45.

The median and pretest mode was 12 while the posttest was 16. The standard deviation and variant values tended to remain from the pretest values of 1.75 and 3.06 to the posttest values of 2.00 and 3.99. Validity test based on the Pearson correlation value among indicators where the total number of indicators was Called valid if the value of r (correlation) was greater than r table or the value of sig. < alpha (0.05). The validity test results are as follows in Table 3. Based on Table 3, the value of sig. < Alpha (0.05), that it was concluded that the items of pretest control indicator were valid.

Table 4. Test Results of Posttest Control Validity

Indicator	Correlation	sig.	Category
Pre_1	0,630	0,000	Valid
Pre_2	0,844	0,000	Valid
Pre_3	0,858	0,000	Valid
Pre_4	0,579	0,000	Valid

Table 5. Test Results of Posttest Experiment Pretest Validity

Indicator	Correlation	sig.	Category
Pre_1	0,892	0,000	Valid
Pre_2	0,933	0,000	Valid
Pre_3	0,833	0,000	Valid
Pre_4	0,934	0,000	Valid

Table 6. Test Results of Experiment Posttest Validity

Indicator	Correlation	sig.	Category
Pre_1	0,950	0,000	Valid
Pre_2	0,878	0,000	Valid
Pre_3	0,823	0,000	Valid
Pre_4	0,950	0,000	Valid

Table 7. Reliability Test Result

Group	Cronbach's alpha	Posttest
Pre-control group	0,823	Reliable
Post -control group	0,792	Reliable
Pre-experimental group	0,840	Reliable
Post-experimental group	0,841	Reliable
Pre-control group	0,823	Reliable

Based on Table 4, the value of sig. < Alpha (0.05) so that it was concluded that the items of the posttest control indicator were valid. Based on Table 5, the value of sig. < Alpha (0.05) so that it was concluded that the items of the Experiment pretest indicator were valid. Based on Table 6, the value of sig. < Alpha (0.05) so that it was concluded that the items of the Experiment posttest indicator were valid. While reliability test used Cronbach's Alpha value. If the Cronbach's alpha value > 0.60, it was declared reliable. It can be seen in the following Table 7. Cronbach's alpha value of pretest and posttest in Table 7, was greater than 0.60 so it could be concluded that the indicator was reliable.

To test hypotheses based on the results of data obtained from pre-test and post-test found the influence of CAI (Computer Assisted Instruction) media on increasing skill to recognize geometric shapes in children aged 4-5 years when the data normality test was first performed. Normality test was done to test whether the analyzed data had normal distribution or not. This data calculation was done using Kolmogorov-Smirnov statistics. The data testing criteria were as follows:

Hypothesis

H_o: Data is normally distributed

H_a: Data is not normally distributed

Data were normal if the Sig. Kolmogorov-Smirnov Test > alpha was 0.05. Based on Table 8, it was found that the value of Sig. the pretest control and experimental pretest data were smaller than 0.00, meaning that Ho was rejected. So, it was concluded that the data were not normally distributed.

In Table 9, it was found that Sig. Value of posttest control and experimental data were smaller than 0.00 meaning that Ho was rejected. Thus, it was concluded that the data were not normally distributed. In testing normality, it was concluded that the data were not normally distributed so that the statistical method used to determine the difference in the effects of the two samples were so free that was the Mann-Whitney statistic. The Mann-Whitney test results were displayed in Table 10.

Table 8. Control Normality Test

Pretest-Posttest-Control Group		
N	31	31
Test Statistic	,245	,314
Asymp. Sig. (2-tailed)	,000	,000

Table 9. Experimental Normality Test

Pretest-Posttest-Control Group		
N	31	31
Test Statistic	,397	,297
Asymp. Sig. (2-tailed)	,000	,000

Table 10. Mann-Whitney Control Test

Indicator	Pretest	Posttest
Mann-Whitney U	224,500	102,000
Wilcoxon W	720,500	598,000
Z	-3,952	-5,619
Asymp. Sig. (2-tailed)	,000	,000

In Table 10, the value of sig = 0,000 < alpha (0,05) means that Ho was rejected. Thus, it can be said that there is an influence of CAI media on increasing the skill to recognize geometric shapes in children aged 4-5 years.

Hypothesis:

H_o : There was no influence of CAI (Computer Assisted Instruction) media on increasing the skill to recognize geometric shapes in children aged 4-5 years.

H_a : There was an influence of CAI (Computer Assisted Instruction) media on improving the skill to recognize geometric shapes in children aged 4-5 years

Hypothesis test results indicated that there was a significant increase on children's skill in the experimental group to recognize geometric shapes when compared with the control group. Children's cognitive improvement in recognizing shapes was caused by learning through Computer Assisted Instruction (CAI). Children were more enthusiastic in learning because the games presented were more interesting and suitable in the current conditions. The children preferred the digital-based games than traditional games.

In line with some studies of interactive "Hopscotch" games for children using computer music techniques (Lucht, et. al., 2010; Goodwin, 2015). This study used traditional hopscotch games for children using computer technology. There are various kinds of animal sounds and cartoon characters in the game that can improve children's cognitive skill in recognizing geometric shapes. Similar research shows there is a positive effect in the use of computer-assisted teaching (CAT) on the mathematical concepts of probability material (Gönen, et. al., 2016; Gürbüz & Birgin, 2012).

DISCUSSIONS

Cognitive development is a developmental stage for the basic skill possessed by children to think. Children's cognitive development is a skill to think. Meanwhile, cognitive development refers to the thought process of children's life since the conceptual cycle of up to 6 years (Davis, et. al., 2011). Another opinion stated that cognitive skill is one aspect of children's development related to all psychological processes on how individuals learn and think about their environment (Sohn & Carlson, 2003). Thus, it can be concluded that cognitive development in children's skill referring to the thought process in basic skills to solve a problem and understand the environment around him.

Geometry is the study of the measurement of the earth. The term "geometry" comes from Greek. "Geo" means earth and "metro" means as measuring. Geometry is a branch of mathematics that explains the properties of lines, angles, fields, and spaces (Bussi & Baccaglini-Frank, 2015). Geometry is the science of mathematics that studies the relationship between space and the shape and size concepts (Battista, 2002). Geometry shapes include triangles, squares, and circles with real objects or images

(Aslan & Arnas, 2007). The concept of geometry in children starts from identifying shapes such as rectangles, circles, and triangles, investigating buildings and separating images, and children can learn the concept of location, among others under - above, left-right, and lay the initial foundation of understanding geometric shapes (Bussi & Baccaglini-Frank, 2015). Based on the previous description, it can be concluded that geometry is the science of mathematics that studies geometric shapes such as triangles, squares, circles.

Computer Assisted Instruction is a model for teaching assistance needs. In this model, the children directly interact with the computer, and they can also explore all the provided programs and use them as learning media without the help of the teacher (Cotton, 2008; Lee & Vail, 2004; Gambari, 2014). Furthermore, CAI is the use of computers to convey the contents of the lesson by providing exercises and analyzing children's learning progress (Pennington, 2010; Suminah, et. al., 2018). CAI can be made as a tutor or as a substitute for the teacher in the classroom (Soe, et. al., 2000; Hia, et. al., 2020; Pambudi & Gunawan, 2019). Based on some experts' opinions, it can be concluded that the CAI media is a computer-based media to deliver the content of the lessons for which children can directly interact directly with computers or with the help of teachers.

CONCLUSION

Based on research problem and the results, it can be concluded that the ability to recognize geometric shapes of children aged 4-5 years has a significant effect after being given CAI (Computer Assisted Instruction). Thus, CAI media is a more effective medium used in the learning process to recognize geometric shapes of children aged 4-5 years.

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