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The Effect of CPA-Based Multimedia Articulate Storyline Batik Motif on Elementary Students' Mathematical Representation

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Abstract

Mathematical representation is a fundamental ability to develop students' thinking skills. But in reality, this ability is still low. The investigation aims to ascertain the impact of CPA-based articulated storyline multimedia on the Mathematical Representation Abilities (MRA) of elementary school students. The research uses CPA-based articulate storyline multimedia in learning activities. A type of experimental research with pre-experimental designs, one group pretest-posttest. 44 pupils from one of Karawang Regency's elementary schools in West Java made up the sample. Data were obtained through MRA tests in the form of descriptions, students' daily journals, interviews, and photo documentation of research activities. The MRA test questions used were valid and reliable. Based on Guilford's criteria, the results of the test validity and reliability calculation are in the high category (Retrieved from zero point eighty-four). Descriptive data analysis was conducted by finding the simple linear regression equation and the coefficient of determination. Inferential data analysis was performed with a t-test. Descriptive results showed that using CPA-based multimedia articulated storyline affected the Mathematical Representation ability (MRA) of elementary school students. Based on hypothesis testing, it is known that CPA-based articulate storyline multimedia significantly affects the mathematical representation skills of elementary school pupils. The implication from

research is that multimedia articulate storylines based on CPA represent alternatives for enhancing elementary school pupils' mathematical representation ability in learning two-dimensional mathematics.

Keywords: Batik motif; CPA approach; Mathematical representation; Multimedia articulate storyline; Two-dimensional figure

1. Introduction

One of the targets and policies of the 2030 SDGs is the presence of quality education. The development of the globalization era is very fast, demanding that every human resource be of good quality, both in science and technology. One of the Goals of the SDGs 2025-2030 policy direction is the implementation of the curriculum by strengthening teaching by focusing on mathematics (Bappenas, 2017). The objective of the independent curriculum in learning mathematics states that students are required to have higher-order thinking skills. The National Council of Teachers of Mathematics suggests that five higher-level thinking skills are used as a reference for the mathematics education process, one of which is the ability to represent mathematics (Putri et.al, 2020)

Mathematical Representation Ability (MRA) is a fundamental skill that underpins the development of thinking skills. This ability allows individuals to communicate their mathematical ideas, thereby facilitating problem-solving effectively. Furthermore, mathematical representation skills are not limited to problem-solving; they also play a crucial role in interpreting a wide range of phenomena, including social, physical, and mathematical (Nurfitriyanti et al., 2020; Putri et.al, 2020; Radiusman & Simanjuntak, 2020; Salma & Sumartini, 2022; Wulandari et al., 2024; Yuliawati, 2021).

However, previous research shows that students' mathematical representation skills still need to improve. Other research results concluded that the achievement of representation indicators, both visual, expression, and words, still needs to be improved (Cahyaningrum et al., 2023; Sintia & Effendi, 2022). Likewise, the study's results state that students can achieve indicators of symbolic representation ability very well but have failed to meet the overall performance indicators for image and verbal expression representations (Fitrianingrum & Basir, 2020; Kusuma & Amelia, 2018; Meisy Sella Maria et al., 2022). Similarly, Ainsworth's research suggests that some learners need help understanding the need for correlation between different types of representations both orally and in writing (Putri et.al, 2020).

One of the causes of low mathematical representation skills is the application of inappropriate learning approaches. The learning process that tends to be deductive makes it difficult for students to apply mathematical formulas in everyday life. Low-ability learners will need help using symbolic or pictorial representations (Kusumaningrum & Nuriadin, 2022; Riwayati et al., 2023; Yuliawati, 2021). However, there is hope in the form

of the Concrete-Pictorial-Abstract (CPA) approach, which is likely to overcome this problem.

The CPA approach is adapted to the development of students' mindsets, especially the concrete operational stage. This approach has three stages, namely: 1) concrete, students carry out learning using real objects to be easily understood in learning; 2) pictorial, a learning stage that uses visual media about the material being taught; and 3) abstract, students can apply material using mathematical formulas. The learning stages in CPA can improve students' mathematical representation skills because students are able to be active in learning (Putri et.al, 2020; Yuliawati, 2021).

Applying the CPA approach in learning mathematics will be more interesting if the teaching materials are presented using interactive multimedia combined with Indonesian culture, which is rich in mathematical elements. One of the Indonesian cultures that is rich in mathematical elements is batik. Batik is an example of intercultural and multicultural perspectives as it reflects the interaction between various cultures and is a cultural heritage that is valued by various communities in Indonesia and abroad (Serepinah & Nurhasanah, 2023; Sunardiyah et al, 2023). Indonesian batik has various motifs that are rich with elements of geometry. Geometry is part of the branch of mathematics. Therefore, the interactive multimedia in this research is named articulate storyline Indonesian batik motif. The articulate storyline multimedia used in this research contains animated videos and virtual reality. The application of an articulate storyline that contains animated videos and virtual reality in learning can improve students' understanding of abstract things or events that cannot be presented directly in the classroom and can improve student learning outcomes on the concept of the material being taught (Allen et al., 2020; Firdaus et al., 2022; Hamid & Alberida, 2021; Haryanto et al., 2019; Jais & Amri, 2021; Sindu et al., 2020; Siregar et al., 2021; Supriadi et al., 2019). Based on the description that has been stated, this research is focused on the formulation of the problem of whether there is an effect of the application of multimedia articulate storyline of Indonesian batik motifs based on the CPA approach on students' mathematical representation skills.

2. Literature Review

2.1 Mathematical Representation Ability (MRA)

The concept of representation, a fundamental concept in mathematics, plays a crucial role in explaining mathematical phenomena. Originating from Cartesian philosophy, the idea of representation is often likened to a mirror reflecting the soul (Putri et.al, 2020). As Berner (Syafri, 2017) points out that students' ability to solve problems successfully is heavily reliant on their representation of the problem.

The importance of representation skills, according to Jones (Salma & Sumartini, 2022), suggests that the need for representation skills is used to build ways of thinking and mathematical concepts and to understand concepts to solve problems. Representation

skills are also acquired to express and understand all problems in mathematics. Representation is a form of learner interpretation used to find solutions to problems in mathematics by symbolizing or symbolizing objects. Words, pictures, graphs, concrete objects, and diagrams are forms of representation used in mathematics. Mathematical representation skills are needed to help students transform abstract ideas into fundamental ideas.

MRA is categorized into three forms of representation: verbal, image, and symbolic. Villegas' research (Fitrianingrum & Basir, 2020) explains that 1) Verbal representation is a form of representation described by written and oral statements based on the problem; 2) Image representation is a form of representation in the form of diagrams, graphs, tables, and images; 3) Symbolic representation is a form of representation with mathematical symbols or mathematical equations.

The indicators of MRA used in this study are pictorial representation, symbolic representation, and verbal representation. Pictorial representation is when students express mathematical ideas through graphing, drawing, or diagrams. Symbolic representation is when students are able to symbolize a problem in mathematics. Verbal representation of the world Problem, namely, students are able to translate problems with their interpretations in written form (Norairi et al., 2022; Nurhaliza & Firmansyah, 2021; Yuliyanto et al., 2019; Zulfah & Rianti, 2018).

Representation skills have various benefits for both teachers and learners, including providing information to learners about how to think when dealing with mathematical problems, being able to solve problems in a mathematical context, and being able to solve issues contextually. In line with this, Kalathil and Sherin, Putri, et al. (2024) found three benefits of representation for the continuity of learning, including: 1) Representation is used as a form of information for teachers that explains how to think about problems in the context of mathematics; 2) Representation is used to provide patterns in given problems; 3) Representation is used as a tool to develop thinking when solving mathematical problems in the classroom. Thus, students need to master mathematical representation skills because they have significant benefits in education and problem-solving in everyday life.

2.2 Concrete-Pictorial-Abstract (CPA) Approach

The Concrete-Pictorial-Abstract (CPA) approach is an approach based on Bruner's theory of enactive or concrete, iconic or pictorial and symbolic or abstract. The enactive stage is a learning stage where students are given the opportunity to be able to manipulate concrete objects directly. The second stage is the iconic stage, where students manipulate concrete objects into images, and the symbolic stage, where students manipulate images into mathematical symbols (Radiusman & Simanjuntak, 2020). This is in line with Hoong (Yuliyanto et al., 2019), arguing that this approach is adapted from Bruner's model to be able to be adapted to mathematics learning in solving mathematics learning difficulties. From the three stages in this CPA approach, students start learning by using concrete

objects and continue with pictorial representations. The third stage is solving problems with abstract forms. The following illustrates the three stages of CPA according to Witzel (Imelda et al., 2021) in Figure 1.

Figure 1. Stages in CPA

This approach, known as the CPA approach, is new to Indonesia but well-established in Singapore. It is also referred to as the CRA (Concrete-Representational-Abstract) or CSA (Concrete-Semi concrete-Abstract) approach (Putri, 2015). Emphasizes that the CPA approach is an intervention in mathematics learning that holds the potential to enhance students' abilities significantly (Anggraeni & Susano, 2022). Further supports this, stating that the CPA approach provides a conceptual framework that encourages students to think meaningfully (Asfara et. al., 2022). The CPA approach plays a crucial role in testing various ideas and enables students to express their mathematical ideas using symbols.

The CPA approach has three stages, namely 1) the concrete stage is the first stage contained in the CPA approach, where students are given instructions to carry out activities in order to understand the environment in real terms by providing concrete objects; 2) the pictorial stage, students after carrying out activities in real terms will be directed to have thoughts in manipulation with real objects such as images, 3) the abstract stage, students are expected to be able to master abstract thinking symbolized by numbers or mathematical symbols. These three stages cannot be exchanged because they are related to one another (Wahyudy et al., 2019). Learners will easily follow the learning process because learners are brought to reality, apply it with images, and transform it into abstract mathematical concepts.

2.3 Articulate Storyline 3 interactive multimedia

Interactive multimedia is media that is used to support the delivery of learning materials so that the process will be effective and motivate students. Providing interactive multimedia on the material is expected to improve the ability of mathematical representation so that students can solve problems with representation skills that students can solve problems with mathematical thinking skills and the ability to think mathematically. As argued in the principle of using digital technology in learning, learning has an important role in developing mathematical representation skills (Putrawangsa & Hasanah, 2018).

The use of interactive multimedia can improve the quality of the learning process and improve learning outcomes. Interactive multimedia can be an important motivator for learners in language teaching; audiovisual media provides engaging content and materials, and media is a way to meet the needs of visual, kinesthetic, and visual learners. It is a way to meet the needs of visual, kinesthetic, and auditory learners (Firdaus et al., 2022). In

addition, the advantages of using interactive multimedia include learning becomes more interesting so that it can motivate learners to learn, learning materials being clearer, meaning that students can easily achieve learning goals and teachers can easily achieve learning objectives; teachers find it easy to combine several learning methods, learners are easier to achieve learning objectives, and learners are easier to achieve learning objectives. With these learning methods, students are more likely to achieve learning goals and be active in learning activities (Heliawati et al., 2022).

One of the software that can be used as interactive multimedia is Articulate Storyline 3. Interactive multimedia articulate storyline 3 is a device released by the third Articulate Company, released the third Articulate Company after Articulate Storyline 1 and Articulate storyline 2. Articulate Storyline 3 is a software that looks like PowerPoint but has superior features. It is the point, but it has superior features. Articulate Storyline 3 is an academically designed media or tool for developing interactive learning that works on any device (Simanullang, 2023). In Articulate Storyline 3, there are interesting characters, quizzes, buttons, URL links, and features. Trigger link functions to direct a section or page to where we want it to (Firdaus et al., 2022; Nasril & Desyandri, 2023; Prasetyo et al., 2023; Simanullang, 2023). Articulate Storyline 3 also features audio, video, images, and animations and is easy to use. It can be used online and offline and on mobile phones or laptops anywhere and anytime. Used anywhere and anytime. The features contained in it articulate a very interesting storyline so that they can help in the learning process and the ease with which it articulates in the learning process, and the ease with which it articulates the storyline has problems with space and time limitations that can be overcome.

Interactive multimedia articulate storyline 3 has several advantages. Namely, this application has the feature of adding characters, links, and URL buttons, layers that separate objects from each other. It triggers that function to direct to the desired place and can be published (saved) in various formats such as LMS, HTML5, articulate storyline three online, CD, and Word. Thus, this media will look more comprehensive, interactive, and effective. Interactive multimedia based on articulate storyline three can also be useful as a medium to increase and expand knowledge in the classroom, providing accurate information that can help students think and develop further. In addition, the media can contain detailed explanations of spatial network material so that not only critical thinking skills but also mathematical representation skills are improved. Mathematical representations will support and facilitate students' understanding if given instructions that support the representation of understanding before being used to explain mathematical concepts (Rahlan & Sofyan, 2021). Instructions, materials, and sample images about the material can be conveyed through interactive multimedia articulate storyline three so that learning materials can be conveyed in more detail, clearly, and completely. Thus, children will find it easier to learn, so students' mathematical representation skills will also improve.

The aims of this research are to develop interactive multimedia articulate storyline 3 based on the CPA approach to enhancing MRA. The development of interactive multimedia articulate storyline 3 based on the CPA approach is not just a creation but potentially a game changer. This media is designed to train students in solving problems in everyday life related to mathematical concepts. The development of this media is not only interesting but also a tool for improvement. Problem-solving activities using interactive multimedia are expected to significantly improve the mathematical representation skills of elementary school students, thus providing hope for a brighter future in mathematics education.

3. Research Methodology

The research employs a quantitative approach, utilizing experimental methods. An experimental study seeks to determine the effect of specific variables on other variables under conditions of rigorous control. This one-group pretest and posttest design is conducted on one group without a control or comparison group (Creswell & Creswell, 2018; Sugiyono, 2019). The design of this study is as follows.

O X O

Figure 1. One-group Pretest-Posttest Pre-Experimental Research Design

Description:
O = Test (pre-test and post-test)
X = Mathematics learning using multimedia articulate storyline Indonesian batik motif based on CPA approach

A research instrument in the form of a descriptive test of Mathematical Representation Ability (MRA) consisting of 14 items was prepared based on indicators of MRA. This instrument has been validated based on expert judgment from three mathematics lecturers (two lecturers from the Elementary School Teacher Education study program at the University of Education Indonesia and one lecturer from the Elementary School Teacher Education study program at Institut Pangeran Dharma Kusuma Indramayu) and has been empirically tested. There are three indicators of MRA used in this study, namely verbal, visual, and symbolic representations (Norairi et al., 2022; Nurhaliza & Firmansyah, 2021; Putri, 2015; Zulfah & Rianti, 2018) which can be seen in Table 1.

Table 1. Indicators and Description of MRA

Indicator	Description
Verbal Representation	Students can write down the solution steps in written words.
Visual Representation	Students can create geometric drawings of two-dimensional buildings and create drawings of two dimensions to clarify and illustrate the problems and solutions used.
Symbolic Representation	Students can create a problem mathematical model at hand and solve the problem using mathematical symbols.

Based on the indicators in Table 1, the MRA test data were analyzed based on the scoring guidelines with the following steps: (1) The preparation of the answer key, in conjunction with the scoring rubric; (2) the verification of students' responses by the answer above key; and (3) the determination of the score awarded to students' responses by the established scoring guidelines (Saila et al., 2024). The following are the assessment guidelines used in this study.

Table 2. Guidelines for Assessing Students' Mathematical Representation Skills

Skor	Verbal	Visual	Symbolic
0	No answer		
1	Only a few correct explanations of what he knows.	Only a few pictures are correct.	Only a few of the math models are correct.
2	It is a mathematically sound explanation but only partially complete and correct.	creates an image, but it is incomplete and incorrect.	Finds the mathematical model correctly but is wrong in finding the solution.
3	The mathematical explanation is reasonable and correct, but there are minor language errors.	Draws the picture correctly but incomplete.	Finds the math model correctly and finds the solution appropriately.
4	Mathematical explanations make sense and are organized and logical.	Draw the picture correctly and completely.	Find the math model correctly, calculate correctly, and find the solution correctly.

Source: Zulfah & Rianti (2018)

Other data were collected with documentation in the form of relevant theoretical studies and photographs during the research. The first stage of data collection, namely this test question, was given to students who were used as research samples before the use of multimedia articulate storyline Indonesian batik motifs based on the CPA approach (pre-test). The second stage is that students are given treatment in the form of using multimedia articulate storyline Indonesian batik motifs based on the CPA approach in classroom learning. The third stage is after the use of multimedia articulate storyline Indonesian batik motifs based on the CPA approach, and the final test (post-test) is carried out.

The MRA test questions used were valid and reliable. Based on Guilford's criteria, the results of the calculation of test total validity in the high category (Retrieved from zero point eighty-four). Reliability testing uses the following formula:

$$r_{11} = \frac{n}{n-1}\left(1 - \frac{\Sigma_1^n \sigma_{i^2}}{\sigma_{i^2}}\right)$$

Description:
r_{11} = Reliability coefficient
n = Number of items
σ_{i^2}= Question variant
$\Sigma \frac{n}{1} \sigma_{i^2}$ = Number of item variants

After processing the reliability data, the reliability instrument benchmark can be seen below:

Table 3. Reliability criteria

Reliability coefficient	***Reliability criteria***
$0{,}90 \leq r \leq 1{,}00$	*Very high*
$0{,}70 \leq r \leq 0{,}90$	High
$0{,}40 \leq r \leq 0{,}70$	*Medium*
$0{,}20 \leq r \leq 0{,}40$	*Low*
$r \leq 0{,}20$	*Very low*

The reliability test was conducted with a result of 0.84. The mathematical representation ability test instrument has a high correlation category because it is in the range of $0.70 \leq r \leq 0.90$. So, it is suitable for research.

Data was examined descriptively and inferentially. Descriptive analysis was carried out by finding the simple linear regression equation and the coefficient of determination, while inferential analysis was conducted by t-test. The following points are the study's hypotheses: Ho = there is no effect of the application of multimedia articulate storyline of Indonesian batik motifs based on the CPA approach. Meanwhile, H1 = there is an effect of the application of multimedia articulate storyline of Indonesian batik motifs based on the CPA approach. The criteria for testing the hypothesis of the pre-test and post-test scores in the experimental group are if the p-value (sig. 2-tail) is greater than 0.05, then Ho is accepted, and in other cases, Ho is rejected. After analyzing the study's results, a discussion will be made that is related to the theoretical studies collected through documentation.

The population under investigation in this present study is comprised of every pupil enrolled at the elementary level in the Purwasukasi region of West Java Province, which encompasses the districts of Purwakarta, Subang, Karawang, and Bekasi. This study focuses on elementary school students in Purwasukasi, as the rationale for selecting this population is based on the assumption that they are accepted through the same entrance selection system. Thus, each school's student body has a standard set of traits and core competencies. Forty-four pupils from one of Karawang's public elementary schools made up the study's sample. The sample was selected using the purposive sampling technique,

which considers specific considerations (Sugiyono, 2019). The rationale for this decision is that fourth-grade students are already familiar with the learning environment in the classroom. It is assumed that they have successfully adapted to the transition, as mentioned earlier, which pertains to the atmosphere and cadence of the learning process that occurs when progressing from kindergarten to elementary school. The selected elementary schools are in high clusters with A accreditation. Given the prevalence of A-accredited elementary schools in Purwasukasi, the findings of this study are anticipated to offer insights into the mathematical representation skills of students with comparable characteristics.

4. Results

4.1. Descriptive Analysis of the Effect of Multimedia Articulate Storyline Motif Batik Indonesia Based on CPA Approach

The impact of employing multimedia and an Indonesian batik motif-based narrative structured around the CPA approach on mathematical representation abilities can be quantified by identifying a straightforward linear regression equation and the coefficient of determination. The calculation of simple linear regression is discussed as follows.

Simple Linear Regression Equation

The general form of the simple linear regression formula is shown below,

$$Y = \alpha + \beta X$$

Description:
Y = Bound variable
α = Constant
X = Independent variable
β = Regression coefficient

Descriptive analysis to see the effect of using multimedia articulate storyline of Indonesian batik motifs based on the CPA approach on MRA was processed using SPSS Statistics 23 for Windows software. A recapitulation of the results of the calculation of constants and coefficients of linear regression equations based on the research data can be seen in Table 3.

Table 3. Recapitulation of Constants and Coefficients of Simple Linear Regression Equations

Model	*Unstandardized Coefficients*	
	B	***Std. Error***
Constant	18,527	3,708
Pretest	1,259	0, 298

It can be seen in Table 3 that the simple linear regression equation is Y= 18.527 + 1.259X. Based on this equation, the constant value is 18.527, and the regression coefficient

is 1.259, which has a positive sign. Therefore, it can be concluded that each implementation of the effect of using multimedia articulate storyline of Indonesian batik motifs based on the CPA approach affects students' representation skills by 1.259.

Determining the Coefficient of Determination

The results of the calculation to determine the coefficient of determination of the percentage effect of using multimedia articulate storyline Indonesian batik motifs based on the CPA approach is done by finding the R Square value using SPSS Statistics 23 for Windows software can be seen in the table below.

Table 4. Coefficient of Determination Test Results

R	*R Square*	*Std. Error of the Estimate*
0.546	0,298	4.888

The coefficient of determination test results show that the R Square value is 0.298. Then, to calculate the coefficient of determination (D), use the following formula.

$D = R\ Square\ x\ 100\ \%$
$D = 0{,}298\ x\ 100\ \%$
$D = 29{,}8\%$

The calculation shows that the use of multimedia to present Indonesian batik motifs based on the CPA approach can influence students' MRA by 29.8%. Other factors account for the remaining 70.2% influence.

4.2. Inferential Analysis of the Effect of Multimedia Articulate Storyline Indonesian Batik Motif Based on CPA Approach

Inferential analysis to determine whether there is a significant effect of using multimedia articulate storyline Indonesian batik motifs based on the CPA approach is carried out by calculating the average difference test on the experimental class data from the before and after tests. The Levene test for homogeneity will be performed to see if the data is generally normally distributed. The t-test is used when the test data is homogenous and regularly distributed. The Mann-Whitney test is performed when the data is known to be non-normally distributed. Below is a recapitulation of the normality test.

Table 5. Normality Test of Experimental Class

Learning	**Test**	***Shapiro-wilk***		
		Statistics	***df***	***p-value (sig.*2-arah*)***
CPA	*Pre-test*	0.976	44	0.481
	Post-test	0.974	44	0.427

It can be seen in the table above that Ho can be accepted. It is drawn from a population with a normal distribution. Therefore, it is necessary to test the homogeneity of

variance using the Levene test. Below is a recapitulation of the experimental group's variance homogeneity test in Table 6.

Table 6. Homogeneity Test of Experimental Class

p-value	Significance (α)	Interpretation
0.000	0.05	Not Homogen

The homogeneity test results obtained showed that the data does not have a homogeneous variance. It can be concluded that the data is normally distributed and does not have a homogeneous variance, so the average difference test will be carried out using the t-test. The following is the hypothesis used to test the average difference in the increase in students' KRM in terms of overall is as follows.

The homogeneity test results obtained showed that the data does not have a homogeneous variance. It can be concluded that the data is normally distributed and does not have a homogeneous variance, so the average difference test will be carried out using the t-test. The following is the hypothesis used to test the average difference in the increase in students' KRM in terms of overall is as follows.

$H_0 : \mu_1 = \mu_2$ There is no effect of using multimedia to articulate storyline Indonesian batik motifs based on the CPA approach to improving students' mathematical representation skills.

$H_1 : \mu_1 \neq \mu_2$ There is an effect of using multimedia articulate storyline of Indonesian batik motifs based on the CPA approach to improve students' mathematical representation skills.

The criteria for testing the hypothesis of pre-test and post-test scores in the experimental group is if the p-value (sig. 2-tail) is greater than 0.05 then H_0 is accepted. The table below shows the average difference in pre-test and post-test scores in the experimental group.

Table 7. Test the Difference in the Mean Scores of the Pre-Test and Post-Test of the Experimental Class

Score	Average	T_{score}	*df*	t_{table}	*p-value (sig.*2-arah)	Description
Pre-test	12.18	-22.889	58.608	1,671	0.000	H_0 rejected
Post-test	33.86					

Considering the data presented in Table 7, it can be concluded that Ho must be rejected. Therefore, it may be inferred that there is a noteworthy impact associated with the utilization of multimedia, an articulated storyline incorporating Indonesian batik motifs, and a CPA approach to enhance students' proficiency in mathematical representation skills

5. Discussion

Based on the results of the study, it is known that the use of multimedia articulate storyline Indonesian batik motifs based on the CPA approach has a significant effect on improving students' mathematical representation skills. This is possible because Batik motifs are closely related to geometry learning in Indonesia. In addition, Indonesian students are familiar with Batik as it is one of the Indonesian culture, promoting more contextual learning. Batik motifs are very relevant in the introduction of flat shapes, as many motifs use geometric elements that can be identified as flat shapes. Many batik motifs consist of flat shapes such as triangles, squares, circles, and polygons. This allows students to recognize and distinguish various shapes. Through batik design, students can learn how different shapes can be arranged and combined to create a harmonious composition, providing an understanding of space and geometric arrangement. For instance, from Yogyakarta there are Batik Kawung that is rich with ellipse and square shapes and Batik Parang that has circle and parallelogram shapes. Another example is Batik Tilusauyunan from Bogor shows many parallelograms and half circle shapes. Lastly, Batik Pucukrembung from Sumatra consists of square, triangle, rectangle, and rhombus shapes. Using batik motifs as teaching aids makes learning more interesting and relevant, connecting art with geometry directly. Thus, batik is not only a means to learn flat shapes, but also enriches students' intercultural and multicultural perspectives on the interrelationship between art, culture, and mathematics (Andriani & Septiani, 2020; Ida Lydiati, 2020; Sari et al., 2021). Moreover, the use of digital media, such as an articulate storyline, made the lesson more engaging, thus making students more motivated to learn geometry shapes. Articulate Storyline is one of the best software in e-learning (Nurmala et al., 2021). The articulate storyline also has several advantages as multimedia in learning activities; among others, it has the feature of adding characters, links, URL buttons, and layers that separate objects, can be published in various formats such as HTML5, and articulate storyline online, and can be filled with a combination of multiple media such as images, text, audio, video simultaneously (Firdaus et al., 2022). In this research, the advantages of an articulate storyline are utilized to incorporate images of batik motifs in Indonesia, accompanied by text, audio, and video, whose learning activity steps are arranged based on the CPA approach. The selection of Indonesian batik motifs is considered capable of giving a familiar impression and motivating students to learn according to their daily lives. Something that students commonly see makes it easier for them to make connections between the mathematics material learned and problem-solving in everyday life (Nuraini & Afifurrahman, 2023). The learning stages in the CPA approach start from the concrete stage. Students are given the opportunity to understand a concept using concrete objects that can be manipulated (Asfara et al., 2022; Imelda et al., 2021; Yuliyanto et al., 2019). The relationship between learning at the concrete stage and mathematical representation skills is stated by Hwang, et al that representation is a form of modeling concrete objects in the real world and entering abstract concepts (Putri et.al, 2020).

The use of an animated video entitled "Day in my life Ganeta" made by utilizing an articulate storyline is an introduction to learning activities at the concrete stage. This video tells the daily activities carried out by Ganeta s the main character of the animation video. One of the animated videos of Day in My Life Ganeta tells about students who are given an assignment by their teacher to bring batik cloth from home, to be exhibited in class learning activities. This assignment is to build students' knowledge in learning the shapes and properties of flat shapes (square, rectangle, triangle, trapezoid, parallelogram, rhombus, kite, and circle). Animated videos related to learning materials can be seen at the following link: https://youtu.be/xdfcl7ZF_wU. The activity of watching the animated video in the scene of looking at the batik exhibition represents the concrete stage in the CPA approach, which aims to hone students' visual representation skills by recognizing the shapes of flat shapes expressed in batik motifs. After watching the exhibition, to hone verbal and symbolic representation skills, students are asked to describe the shapes of flat shapes and write down the characteristics of the flat shapes they find in batik motifs. Modeling concrete objects through animated video visualization can be used as a medium to hone verbal, visual, and symbolic representations. This is following the opinion that the use of visualization in the form of learning videos at the concrete stage is beneficial for students to gain new knowledge accompanied by a deep understanding of the concept (Aisyah & Madio, 2021; Putri, 2015; Yuliyanto et al., 2019). The appearance of the Garneta animation video at the concrete stage can be seen in Figure 2.

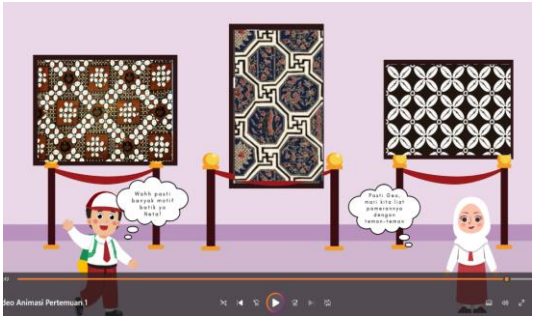

Figure 2. Display of the Learning Animation Video Section in the Articulate Storyline Concrete Stage showing Batik Kawung Motif from Yogyakarta

The second stage in learning the CPA approach is pictorial. After the learners watch the animated video on the concrete stage, they are then directed to the virtual reality museum, which presents various Indonesian batik motifs. Virtual reality access to the articulate storyline developed in this study can be clicked through the link: https://bit.ly/Artsteps_BangunDatar. This pictorial stage can be used as a bridge for students to enter the abstract stage. At this stage, students carry out learning activities to represent concrete objects in images. The application of a learning approach that uses images can help develop visual representations used by students in solving math problems and problems in everyday life (Purwadi et al., 2019; Putri, Nuraeni, Herlina Arrum, et al.,

2024; Radiusman & Simanjuntak, 2020). An example of a virtual reality museum image at the pictorial stage can be seen in Figure 3.

Figure 3. The Pictorial Museum Virtual Reality Multimedia Presents the Narrative in a Pictorial Format

The last stage in the CPA approach is the abstract stage. At this stage, students are given questions that are abstract in nature to analyze the properties, area, and perimeter of each flat shape listed on the student worksheet and contained in the articulate storyline multimedia. Teaching mathematics that includes geometric shapes associated with numbers can help solve problems in mathematics and improve mathematical representation skills. The use of abstract forms with the CPA approach leads to symbolic representations in the form of numbers, numbers, or words (Putri et.al, 2020). An example of a worksheet for students in the abstract section of the articulate storyline multimedia can be seen in Figure 4.

Figure 4. Example of Abstract Stage Learner Worksheet on Articulate Storyline Multimedia

As explained in the research method section, the measurement of influence uses 14 test items given during the pre-test and post-test. The following is an example of the

answers to the pre-test and post-test questions of one of the students sampled in this study.

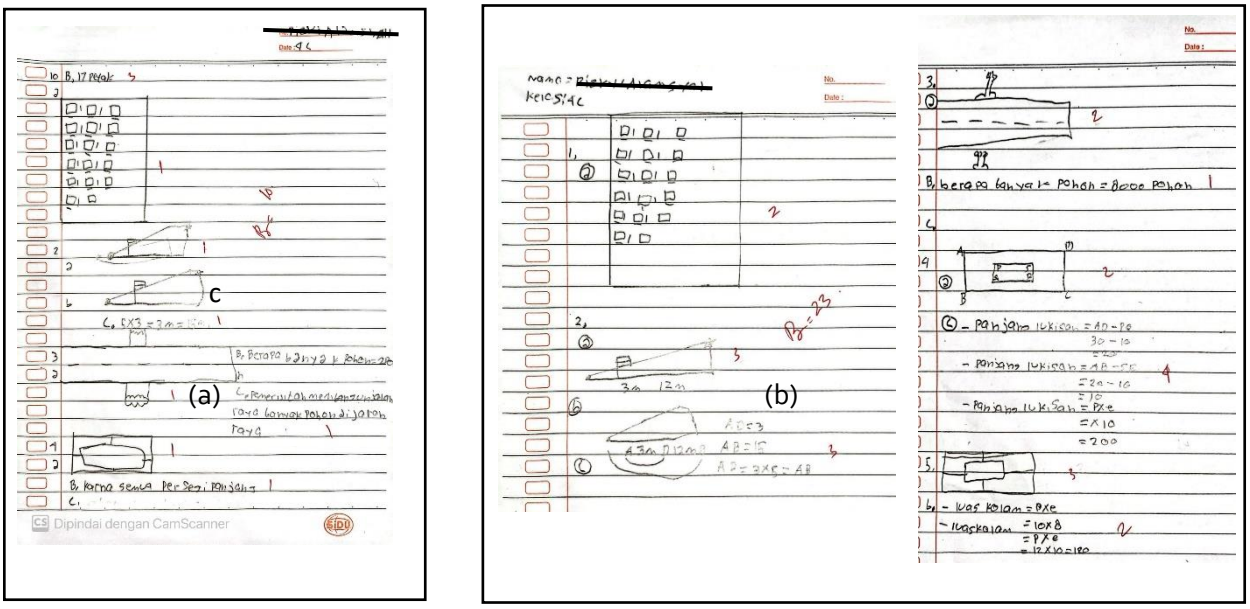

Figure 5. (a) Example Pre-test Student Answers; (b) Example Post-Test Student Answers

Based on the analysis of the answers given in the figure above, it can be seen that during the pre-test, the student was only able to provide answers to 5 out of 14 questions. However, in the post-test, the student was able to provide answers to 9 out of 14 questions. The student's score also increased from 10 on the pre-test to 23 on the post-test, with the ideal maximum score of 54. Thus it is clear that the use of multimedia articulate storyline of Indonesian batik motifs based on the CPA approach can improve students' mathematical representation skills.

Multimedia articulate storyline of Indonesian batik motifs based on the CPA approach can be applied by teachers in learning practices with several steps, as follows: 1) the teacher provides an opportunity to watch an animated video entitled "day in my life ganeta" which is displayed through a projector or can be watched by students through the youTube channel https://www.youtube.com/@nopi_krisnawati with the following video titles: Ganeta daily: square and rectangle part 1, triangle part 2, triangle and trapezoid part 3, rhombus and kite part 4, flat shapes part 5; 2) after watching the animated video, students are directed to visit the virtual reality museum which has three spaces, namely concrete space, pictorial space, and abstract space in which there are various forms of flat shapes; 3) students are given assignments in the form of student worksheets whose questions refer to the animated videos and virtual reality museums they have seen with the links https://bit.ly/LKPD-Pert1; https://bit.ly/LKPD_Pert2; https://bit.ly/LKPD_Pert3; https://bit.ly/LKPD_Pert4; https://bit.ly/LKPD_Pert5. By following the techniques outlined, educators can experiment with multimedia articulate storyline Indonesian batik motifs

based on the CPA as a substitute teaching tool that can improve primary school students' mathematical representation abilities.

6. Conclusion

Based on the results of the study, it was concluded that the use of multimedia articulate storyline Indonesian batik motif based on the CPA approach significantly improves students' mathematical representation skills in learning mathematics in elementary school. Thus, the multimedia articulate storyline of Indonesian batik motifs based on the CPA approach can be used as an alternative learning media to improve the MRA of elementary school students. The use of CPA-based multimedia Articulate Storyline Indonesian batik motif in this research is limited to grade 4. Therefore, further research could try to develop similar multimedia for other grade levels. Further research also needs to be done because other factors still affect the improvement of MRA of elementary school students besides the use of interactive multimedia articulate storyline 3.

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