DEVELOPMENT OF CPA-BASED INTERACTIVE MULTIMEDIA TO IMPROVE ELEMENTARY SCHOOL STUDENTS' MATHEMATICAL CREATIVE THINKING SKILLS

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ABSTRAK

Penelitian dilatarbelakangi rendahnya keterampilan berpikir kreatif matematis siswa SD pada materi bangun datar. Penelitian bertujuan mengembangkan multimedia interaktif berbasis pendekatan Concrete-Pictorial-Abstract (CPA). Metode penelitian adalah Research and Development (R&D) dengan model 4D meliputi Define, Design, Develop, dan Disseminate. Produk yang dikembangkan berupa multimedia interaktif yang memadukan teks, gambar, animasi, audio, serta latihan interaktif berdasarkan tahapan CPA. Subjek penelitian 30 siswa kelas kontrol dan 29 eksperimen salah satu SD di Cikarang Utara, Bekasi. Instrumen meliputi observasi, wawancara, angket validasi ahli, angket respons pengguna, serta tes KBK matematis. Data dianalisis secara kuantitatif dan kualitatif. Hasil menunjukkan multimedia interaktif memperoleh kategori sangat valid berdasarkan penilaian ahli dengan rincian skor ahli materi memberikan penilaian 92,5%, ahli media 92,5%, dan ahli bahasa 85%. Secara keseluruhan, rata-rata persentase kelayakan produk mencapai 90%, yang menempatkan produk pada kategori sangat valid dan layak digunakan. Berkaitan dengan kepraktisan, hasil angket siswa diperoleh rata-rata 93% (sangat praktis). Hasil efektivitas dengan N-Gain munjukkan skor KBK sebesar 0,69 (69%) dengan kategori sedang. Hal ini menunjukkan siswa menilai media multimedia interaktif menarik, mudah dipahami, dan sangat membantu memahami materi dari tahap konkret hingga abstrak. Produk dinyatakan layak dan efektif memfasilitasi kelancaran, keluwesan, keaslian, dan keterperincian berpikir kreatif matematis. Dengan demikian, multimedia interaktif berbasis pendekatan CPA berpotensi menjadi media yang efektif dan praktis meningkatkan kualitas pembelajaran matematika di SD.

Keywords: Concrete-Pictorial-Abstract; Keterampilan Berpikir Kreatif; Multimedia Interaktif; Pembelajaran Matematika

ABSTRACT

The research was motivated by the low mathematical creative thinking skills of elementary school students on the material of flat shapes. The study aimed to develop interactive multimedia based on the Concrete-Pictorial-Abstract (CPA)

approach. The research method was Research and Development (R&D) using the 4D model, including Define, Design, Develop, and Disseminate. The product developed was an interactive multimedia that combines text, images, animation, audio, and interactive exercises based on the CPA stages. The research subjects were 30 control class students and 29 experimental class students of an elementary school in North Cikarang, Bekasi. The instruments included observation, interviews, expert validation questionnaires, user response questionnaires, and mathematical KBK tests. Data were analyzed quantitatively and qualitatively. The results showed that interactive multimedia obtained a very valid category based on expert assessments, with a score breakdown of material experts giving an assessment of 92.5%, media experts 92.5%, and language experts 85%. Overall, the average percentage of product feasibility reached 90%, which places the product in the very valid and suitable category for use. Regarding practicality, the results of the student questionnaire obtained an average of 93% (very practical). The effectiveness results with N-Gain showed a KBK score of 0.69 (69%) in the moderate category. This indicates that students considered interactive multimedia interesting, easy to understand, and very helpful in understanding the material from the concrete to the abstract stage. The product was declared feasible and effective in facilitating fluency, flexibility, originality, and detail of mathematical creative thinking. Thus, interactive multimedia based on the CPA approach has the potential to be an effective and practical medium to improve the quality of mathematics learning in elementary schools.

Keywords: Flat shapes; creative thinking skills; interactive multimedia; CPA approach; elementary school

A. Introduction

Mathematics education has an important role in shaping students' thinking skills, which are needed to face the challenges of the 21st century (Mailani, Rarastika, Purba, Napitupulu, & Malau, 2025). Mathematics not only functions as a tool for calculating and solving numerical problems but also as a tool for developing logical, critical, creative, and systematic thinking skills (Son, Darhim, & Fatimah, 2020). Mathematics is one of the most important subjects in the primary and secondary education curriculum, serving as a foundation for students' cognitive development, reasoning skills, and problem-solving (Isa & Qudus, 2024). Mathematics is a field of study that plays a vital role in the development of science and technology. It can develop and enhance students' logical, analytical, systematic, critical, and creative thinking skills (Patih et al., 2020). As the basis of science and technology, mathematics is also a means to train logical, systematic, and critical thinking skills, which are very much

needed in everyday life and the world of work (Salingay & Tan, 2018). One of the skills currently receiving attention in mathematics instruction is mathematical creative thinking. This ability is necessary for students to generate various alternative solutions, discover different problem-solving strategies, and develop new ideas for dealing with mathematical and everyday life problems (Aseha & Nurdin, 2025).

Mathematical creative thinking skills are an individual's ability to generate diverse, unique, and effective ideas, methods, or strategies for solving mathematical problems. This ability encompasses fluency, flexibility, originality, and elaboration (Sahliawati & Nurlaelah, 2020). Students who have good mathematical creative thinking skills tend to be able to see a problem from various perspectives, find more than one solution, and develop their ideas in detail and systematically (Arifin, Suyitno, Adhi, & Rachmani, 2020). Therefore, developing creative mathematical thinking skills is an important goal in mathematics learning in elementary schools

However, mathematics learning in elementary schools still faces various challenges. Based on observations and interviews conducted at SDN Mekar Mukti 02, it was found that fourth-grade students' mathematical creative thinking skills are still relatively low. Mathematics learning is still dominated by lectures and direct examples provided by teachers, resulting in students receiving more information than constructing their own knowledge. As a result, students receive fewer opportunities to explore various alternative problem-solving methods and are less trained in developing their mathematical creativity.

This problem is also evident in the material on plane figures. This material is a crucial part of elementary school geometry instruction, requiring students to understand the shapes, characteristics, and relationships between plane figures (Rahayu, 2023). Based on Phase B Mathematics Learning Outcomes, students are expected to be able to describe the characteristics of various plane figures, group figures based on their characteristics, and perform composition and decomposition of plane figures in various forms. These abilities require not only conceptual understanding but also creative

thinking skills to discover various possible arrangements, groupings, and problem-solving related to plane figures.

The low level of students' mathematical creative thinking skills is influenced by various factors, one of which is the use of learning media that is not optimal (Firdaus, Suryanti, & Azizah, 2020). In the learning process, teachers still rely on textbooks and verbal explanations, making abstract concepts difficult for students to grasp. In fact, elementary school students are in the concrete operational stage according to Piaget's theory of cognitive development. At this stage, students understand concepts more easily through real objects, direct experiences, and visual representations than through abstract symbols (Agustyaningrum, Pradanti, & Yuliana, 2022). Therefore, learning media are needed that can bridge students' understanding from concrete experiences to abstract concepts.

One approach considered appropriate for the developmental characteristics of elementary school students is the Concrete-Pictorial-Abstract (CPA) approach. The CPA approach teaches mathematical concepts through three stages: concrete, pictorial, and abstract (Shafiee & Meng, 2023). The Concrete-Pictorial-Abstract (CPA) approach has been widely recognized as an effective learning strategy, initially developed and widely implemented in the Singapore education system (Hui, Hoe, & Lee, 2017). In the concrete stage, students learn using real objects or manipulatives. In the pictorial stage, students begin to understand concepts through pictures or visual representations. Next, in the abstract stage, students are introduced to symbols, numbers, and more abstract mathematical concepts. This approach allows students to build conceptual understanding gradually, making learning more meaningful (Azzumar & Juandi, 2023).

Various studies have shown that the CPA approach can improve students' understanding of mathematical concepts, problem-solving abilities, and higher-order thinking skills. Through systematic stages, students have the opportunity to independently construct concepts based on their learning experiences. Furthermore, the CPA approach also provides students with space to explore various possible answers,

potentially enhancing their creative mathematical thinking skills (Griseldis, Khasanah, Septiani, & Prananto, 2024).

In addition to appropriate learning approaches, the use of technology in learning is also a crucial factor in improving the quality of the teaching and learning process. Developments in information and communication technology have led to the emergence of various innovations in more interactive and engaging learning media. One such innovation is interactive multimedia. Interactive multimedia is a learning medium that integrates various elements such as text, images, animation, audio, video, and user interaction into a single, integrated learning system (Firdaus et al., 2020). The use of interactive multimedia allows students to learn more actively because students not only receive information but are also directly involved in the learning process through various interactive activities. Research said the use of Canva-based interactive multimedia has a significant positive impact on improving students' critical thinking skills compared to conventional learning media (Yuliyanto, Utami, Fujiarti, Andriyantono, & Ramdani, 2025).

In the context of mathematics learning, interactive multimedia can help visualize abstract concepts, making them easier for students to understand. Material on plane figures, often considered difficult, can be presented through animations, simulations, and engaging interactive activities. This way, students gain a more concrete and meaningful learning experience. Interactive multimedia can also increase student motivation because it provides a fun learning experience that aligns with the characteristics of today's digital generation (Gimin & Mujiono, 2022).

Although various studies have addressed the use of interactive multimedia and the CPA approach separately, research integrating interactive multimedia with the CPA approach to improve mathematical creative thinking skills in geometric shapes is still relatively limited, particularly at the elementary school level. Most previous studies have focused on improving learning outcomes or understanding of mathematical concepts. However, mathematical creative thinking skills are a crucial competency that needs to

be developed early on to enable students to face various challenges and problems in the future (Yuliyanto, Hidayati, & Syafitri, 2023).

Based on these conditions, there is a research gap that needs to be addressed, namely the suboptimal development of learning media that integrates the CPA approach with interactive multimedia to train the aspects of fluency, flexibility, originality, and detail in elementary school students' mathematical creative thinking. Therefore, this study develops interactive multimedia based on the Concrete-Pictorial-Abstract (CPA) approach on plane geometry material as an alternative solution to improve the quality of mathematics learning.

The development of interactive multimedia based on CPA is expected to help students understand the concept of plane figures gradually, starting with concrete objects and pictorial representations and ending with abstract symbols. Furthermore, the developed media is expected to provide opportunities for students to explore various ideas, discover alternative problem-solving methods, and develop mathematical creativity through interactive and meaningful learning activities.

Based on the description, the objectives of this study are: (1) to develop interactive multimedia based on the Concrete-Pictorial-Abstract (CPA) approach on the material of plane figures for fourth grade elementary school students; (2) to determine the feasibility level of interactive multimedia developed based on expert validation; and (3) to determine the potential of interactive multimedia based on the CPA approach in improving elementary school students' mathematical creative thinking skills. The results of this study are expected to provide theoretical contributions in the development of technology-based mathematics learning media as well as practical contributions for teachers and schools in creating more innovative, interesting, and student-centered mathematics learning.

B. Research Methods

This study used the Research and Development (R&D) method with a 4D development model consisting of the Define, Design, Develop, and Disseminate stages (Gall, Gall, & Borg, 2010). The research subjects

were 59 fourth-grade students of SDN Mekar Mukti 02 Bekasi, with 30 students in the development stage and 29 students in the field trial stage.

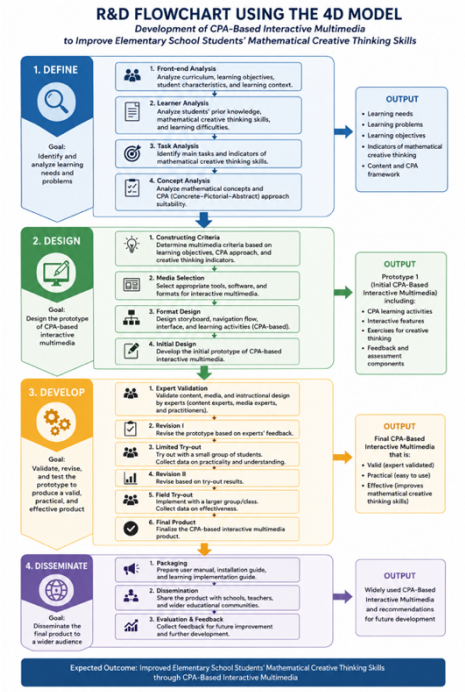

Figure 1 R&D Flowchart 4D Model

The research instruments consisted of validation sheets from media experts, material experts, and language experts, user response questionnaires, and a mathematical creative thinking skills test. Data analysis was conducted quantitatively using validation percentages, user response analysis, learning completion, and N-Gain to determine media effectiveness. The research instruments used were compiled based on a grid adapted to success indicators. The following is a detailed outline of the research instrument grid:

Table 1 Media Expert Validation Sheet Grid

Indicator	Assessment Aspects
Media Functionality	Interactive multimedia is used according to the learning material.
	Interactive multimedia used is in accordance with learning objectives.
	The use of interactive media is in accordance with learning outcomes.
Illustration	The Interactive Multimedia used can provide illustrations that match the actual situation.
	Interactive multimedia can make it easier for students to imagine.
Media Quality and Appearance	Interactive Multimedia presentations attract students' attention.
	The Interactive Multimedia used is not difficult to use.
Attractiveness	Interactive Multimedia is useful for improving creative thinking skills.
	The use of Interactive Multimedia can reduce students' dependence on teachers.
	The use of interactive multimedia can minimize misperceptions that occur in students.

Table 2 Material Expert Validation Sheet Grid

Assessment Indicators	Aspect
Material Eligibility	Suitability of the material to the level of students' cognitive development.
	Helping students improve their creative thinking skills.
Curriculum Suitability	Suitability of material with CP (Learning Outcomes) and ATP (Learning Objective Flow).

Assessment Indicators	Aspect
	This material can function as an aid in the teaching and learning process.
Media Quality and Appearance	Interactive Multimedia presentations attract students' attention.
	The Interactive Multimedia used is not difficult to use.
	Instructions for using the media are clear and easy.
Attractiveness	The use of Interactive Multimedia can reduce students' dependence on teachers.
	The use of interactive multimedia can minimize misperceptions that occur in students.
	Interactive Multimedia makes students directly involved in learning.

Table 3 Linguist Validation Sheet Grid

Assessment Indicators	Aspects
Sentence Clarity	Spelling, capital letters, and punctuation are in accordance with the General Guidelines for Indonesian Spelling (PUEBI).
	The choice of words is adapted to vocabulary that is commonly understood by fourth-grade elementary school students.
	Sentences are structured simply, not convoluted, and easy for students to understand.
	The sentence structure is coherent and does not give rise to multiple interpretations.
Writing Consistency	The writing format (font type, font size, and numbering) is used consistently.
	The presentation of text is neatly arranged and uniform throughout all parts of the interactive multimedia.
Compliance with the CPA approach	The language used clearly supports concrete, pictorial, and abstract stages.
	Instructions in multimedia help students understand concepts from concrete to abstract gradually.
Support for Creative Thinking Skills	Language in multimedia can encourage students to think creatively.
	Sentences or instructions trigger students to provide various ideas or solutions.

Assessment criteria: 81-100% (very valid), 61-80% (valid), 4-60% (quite valid), ≤40% (less valid). 2) User response analysis: calculating the percentage of student and teacher responses to the attractiveness, ease, and usefulness of the media. 3) Improvement Analysis (N-Gain): calculating the difference between pretest and posttest results to determine the extent of skill improvement using the formula.

This instrument was used to obtain responses, assessments, and input from users (teachers and students) regarding the interactive multimedia being developed. The questionnaire was compiled based on indicators of practicality, attractiveness, and ease of use of the media.

This test is a descriptive test designed to measure students'

abilities in terms of fluency, flexibility, originality, and detail in creative thinking. The test instrument has been designed based on a grid adapted to indicators of creative thinking ability and the material on plane figures, as listed in the following table:

Table 4: Mathematical Creative Thinking Skills Test Grid

Question Indicator	Aspects
At home, you were asked to help your teacher group various geometric shapes to create a math poster. You were asked to name at least four different geometric shapes you know and write two simple characteristics of each one.	Fluency
In the home garden, various floor decorations in the form of flat shapes will be created to enhance the environment. These decorations should be flat shapes with four sides. Determine: Draw at least 2 different flat shapes that have four sides and can be used as plant decorations. Write the name of each of these flat shapes. Write down the number of angles of each plane figure that you draw. Name as many other flat shapes as possible that have four sides.	
Mrs. Rina wants to make several bases in the form of flat shapes with the same area, namely 48 cm2 from several types of flat shapes, then write down the dimensions of each flat shape.	Flexibility
Mother wants to make a rectangular photo frame from 40 cm of wire. The wire will be used entirely to form the perimeter of the frame. Determine: Determine at least 2 possible length and width sizes for the photo frame!. Write down all the length and width pairs you find.	Authenticity and Flexibility
Consider the following simple example: The example above shows a house composed of several flat shapes, for example, a square for the body of the house, a triangle for the roof, and a rectangle for the door. Determine: Make your own version of a house from at least 3 different flat shapes (it doesn't have to be the same as the example) You can use flat shapes such as squares, rectangles, triangles, circles, trapezoids, and others. Explain the function of each flat shape in the house you made (for example: as a roof, door, window, etc.) Make at least 1 variation of the shape of the house that is different from the first picture. Color the picture	Elaboration and Originality

Tests were administered before and after learning using media (posttest) to measure student improvement. Data analysis was conducted by examining differences in scores and calculating N-Gain values to determine the effectiveness of multimedia on students' mathematical creative thinking skills

C. Result and Discussion

Define Stage

The define stage is carried out through student needs analysis, learning achievement analysis, student characteristics analysis, mathematical Creative Thinking Skills analysis, and identification of learning problems. The results of the analysis indicate that students need learning media that

are interesting, interactive, and able to visualize abstract concepts more concretely. Based on the needs analysis, it was found that students need media that displays real objects first, then images, and then goes into formulas or symbols. Curriculum analysis shows that the material on plane shapes includes an introduction to shape, properties, circumference, and area. Student characteristics analysis shows that fourth-grade students are very interested in visuals, color, and sound, but still have difficulty concentrating if the explanation is too long.

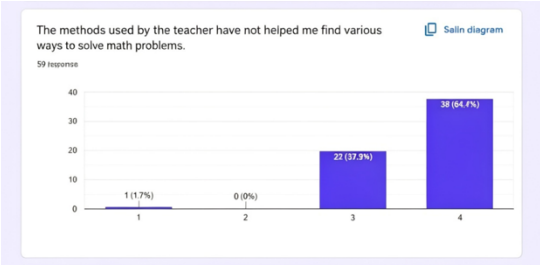

Figure 2 Needs Analysis Answers

The results of student responses to the statement that the method used by the teacher has not helped find various ways to solve mathematics problems, which is part of the student needs analysis instrument, with a total of 59 respondents. The data is presented in the form of a bar chart with a rating scale of 1 to 4, where the number 1 indicates the lowest disagreement, and the number 4 indicates the highest agreement. Overall, this data shows that most students feel that the learning methods applied so far are not varied enough and are not able to explore various alternative ways of adjusting or developing more diverse learning methods so that students can better understand and master various strategies for solving mathematics problems.

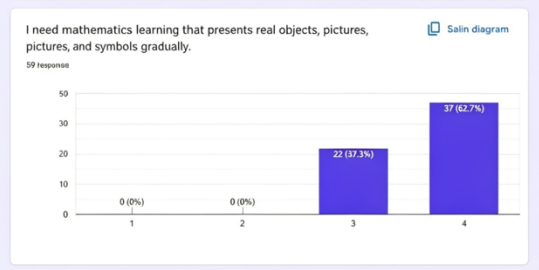

Figure 3 Needs Analysis Answers

The results of student responses to the statement that I need mathematics learning that displays real objects, images, and symbols in stages, which is part of the student needs analysis instrument, with a total of 59 respondents. The data is presented in the form of a bar chart with a rating scale of 1 to 4, where the number 1 indicates the lowest level of disagreement, and the number 4 indicates the highest level of agreement. Overall, this data shows that all students have a strong need for mathematics learning that uses a gradual and concrete approach. This

confirms that students need visual aids and clear stages in understanding mathematical concepts, so that the material is not directly presented in the form of abstract symbols or formulas. This finding is an important basis for designing more meaningful learning by prioritizing the use of real and visual media to make it easier for students to understand and master mathematics material.

Design Stage

At this stage, interactive multimedia design based on the Concrete-Pictorial-Abstract (CPA) approach is carried out systematically and in detail, starting from the preparation of basic concepts, learning flows, storyboard creation, flowcharts, interface design, material preparation, and the preparation of research instruments. All designs are arranged sequentially following the main stages in the CPA approach, namely the concrete stage, the pictorial stage, and the abstract stage, so that the concept of flat shapes can be presented gradually and in accordance with the cognitive development stages of elementary school students. In detail, the design stages from the beginning to the final product are presented in the following table:

Table 5 CPA-Based Interactive Multimedia Development Display Design

Table 6 CPA-Based Interactive Multimedia Development Process

Design	Main Activities	Content Details	Final Design
Compiling the Learning Flow	Determine the sequence of presentation of material and learning activities from the beginning to the end of learning.	Concrete Stage: Begin learning by presenting real objects in the surrounding environment that are flat (tables, blackboards, wall clocks, tiles, etc.). The goal is for students to recognize shapes based on real-life experiences.	Compiling the Learning Flow
Storyboard Making	Create a visual sketch of	Concrete Stage: The page	Storyboard

Design	Main Activities	Content Details	Final Design
	the appearance of each page, starting from the opening page, material, exercises, to the closing, complete with text, images, and voice instructions.	contains photos of real objects, accompanied by guiding questions: "What is this thing? Which part is flat?"	Making
Flowchart Preparation	Create a navigation flowchart that explains the relationships between pages, the functions of buttons, and the flow of user interactions.	The flow is linear yet flexible: Students must first learn the concrete stage, then move on to the image stage, and finally to the abstract stage. Navigation buttons are made active according to the stage being studied.	A flowchart that describes how each part in multimedia works and how it relates to the others.
Interface Design	Determining the visual appearance, color selection, type and size of letters, layout, and button design to be attractive and easy to use with real colors, the image stage is simpler, and the abstract stage focuses more on text and numbers.	CPA Compliance: Color and layout are adjusted according to level: the concrete stage displays more real colored image elements, the image stage is simpler, and the abstract stage focuses more on text and numbers.	Interface Design
Preparation of Materials & Activities	Writing teaching materials, audio narration, practice questions, and interactive activities tailored to competency achievement indicators. Concrete Stage: The activity of observing and matching real objects with their basic forms.	Writing teaching materials, voice narration, practice questions, and interactive activities that are adapted to competency achievement indicators. Concrete Stage: Activities of observing and matching real objects with their	Writing teaching materials, audio narration, practice questions, and interactive activities tailored to competency achievement indicators. Concrete Stage: The activity of observing and matching real objects with their basic forms.

Design	Main Activities	Content Details	Final Design
		basic forms.	

Develop Stage

The development phase resulted in interactive multimedia containing geometric shapes based on the CPA stages. The product was then validated by material experts, media experts, and language experts. After the product was completed, validation was conducted by three experts. The detailed assessment results are presented in the following table:

Table 7 Expert Validation Recapitulation Results

Assessment Aspects	Presentation	Criteria
Media Expert	92.5%	Very Valid
Subject Matter Expert	92.5%	Very Valid
Linguist	85%	Very Valid
Overall average	90%	Very Valid

The validation results showed that the multimedia received a very valid category. Media expert validation achieved a percentage of 92.5%, material expert validation achieved a percentage of 92.5%, and language expert validation achieved a percentage of 85%. The product was declared suitable for use after revisions were made according to the validator's suggestions. In addition to providing a score, the experts also provided suggestions for improvements. The following is a list of suggestions and follow-up actions taken.

Table 8: Validator Suggestions and Product Revision Results

Expert	Expert Advice	Researcher Follow-up
Media	It would be better to use interactive media according to learning achievements and objectives.	Adjust the sequence of materials and activities in the media to align with the CP and TP that have been formulated.
Material	Avoid questions that are too ambiguous, avoid open-ended questions, and ensure there is a scoring rubric for creative questions, balance LOTS-HOTS (ideal 30%-70%)	Revise all questions, prepare assessment rubrics, and organize question composition.
Language	Correct your spelling according to the directions	Correct spelling errors, punctuation errors, and inappropriate use of terms.

Based on expert assessments and constructive feedback for product improvement, the researchers conducted a comprehensive revision based on the suggestions of three experts. The CPA-based interactive multimedia product was declared feasible and ready for testing with

students. After the revisions, the media was trialed on a limited basis with eight students to assess its practicality. The results showed a very positive response, as shown in Table 9 below.

Table 9 Limited Trial Student Response Questionnaire Results

Statement	Agreement	Criteria
I feel happy when learning to use this CPA-based interactive multimedia.	92.5%	Very good
Learning with real objects, pictures, and symbols makes me more interested in learning.	90%	Very good
The colors, animations, and multimedia displays caught my attention.	95%	Very good
The writing and instructions in this interactive multimedia are easy to understand.	97.5%	Very good
I easily used this interactive multimedia without any difficulty and could follow the learning steps from concrete to pictures and to symbols well.	92.5%	Very good
The use of real objects (concrete) helps me understand mathematical concepts.	95%	Very good
Pictures (pictorial) help me understand the concept before going to the symbolic form.	92.5%	Very good
Symbols/numbers (abstract) become easier to understand after seeing concrete examples and pictures.	95%	Very good
This interactive multimedia helps me find more than one way to solve a problem, generate ideas from the given problem, and explain the answer in my own way.	92.5%	Very good
This interactive multimedia helps me understand math problems well.	95%	Very good
Overall Average	93%	Very Practical

Based on the results of the students' responses, it can be concluded that CPA-based interactive multimedia is very practical to use, easy to operate, interesting, and effective in helping students understand the material on flat shapes and training their creative thinking skills.

Disseminate Stage

The dissemination phase was conducted through a field trial on all students. Multimedia was used in learning about plane geometry, followed by a mathematical KBK test. The implementation results showed increased learning activity, student enthusiasm, and the ability to solve geometric problems through various alternative solutions. This phase involved a field trial on 29 students.

The effectiveness of the media was assessed by comparing scores before and after use, as well as calculating N-Gain.

Table 10 Comparison Results of Pretest and Posttest Scores

Statistics	Pretest	Posttest
Lowest Score	50	80
Highest Score	70	100
Average	59.31	87.24
Classical Completion	10.34%	96.55%
N-Gain Value	0.69	
Improvement Criteria	Moderate	

Analysis of the lowest score before learning showed that the lowest score for students was only 50. After using the learning media, the lowest score increased significantly to 80. This indicates that even students with the lowest initial ability experienced an increase in understanding of the material. The highest score changed from 70 to 100. This proves that the developed media is able to help high-ability students achieve complete mastery of the material.

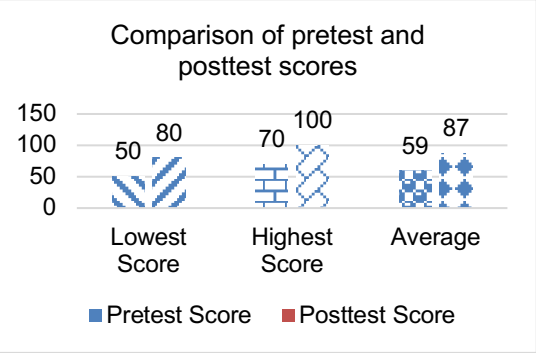

Figure 4: Graph of the Effectiveness of Interactive Multimedia in Improving Mathematical Creative Thinking Skills

The average percentage score of 59.31 is still below the general mastery limit, meaning that students' initial understanding of the material on plane figures is still low. Meanwhile, the average posttest score of 87.24 exceeds the mastery limit by a significant margin. There was an average increase of 27.93, which indicates the effectiveness of the media in delivering the material. Overall, the data proves that the development of interactive multimedia is effective. This media is able to change the initial condition where students have difficulty understanding the concept of plane figures to a condition where most students master the material well and have more developed creative thinking skills.

This research on the development of interactive multimedia based on the CPA approach was carried out following the 4D model stages: define, design, develop, and disseminate. Each stage was systematically designed and interconnected to produce a quality, feasible, and effective learning product in improving the creative thinking skills of elementary school students, especially in the material of plane figures. The following

discussion outlines the development process, product feasibility, trial results, and the relevance of the researcher's findings to previous theoretical studies and researchers.

The Define stage aims to identify and formulate basic problems and learning needs in the field. Based on observations and interviews conducted at SDN Mekar Mukti 02, it was found that mathematics learning on plane figures is still teacher-centered and conventional. Teachers predominantly use lecture methods and textbooks, while students tend to simply memorize the characteristics of plane figures without understanding the meaning and concepts behind them. This is in line with the opinion of (Agustyaningrum et al., 2022), which states that elementary school students are at the concrete operational stage according to Piaget's cognitive development theory, where students' understanding is highly dependent on real objects and visual representations, but current learning conditions do not facilitate this. As a result, students' mathematical creative thinking skills are still relatively low; data shows that only a small proportion of students are able to provide diverse, unique, or detailed answers in solving problems, while most are only able to provide one standard answer. Another identified problem is the lack of learning media that can bridge abstract mathematical concepts into more real and interesting ones. Based on curriculum analysis, the material on plane figures in Phase B requires students to not only recognize shapes but also be able to group, compose, and decompose plane figures—a skill that demands high creativity. This condition reinforces the need for the development of media that is integrated with the appropriate learning approach, namely the CPA approach (Azzumar & Juandi, 2023). The CPA approach is an effective strategy because it guides students gradually from concrete experiences and pictorial representations to symbolic understanding, so that learning becomes more meaningful and in accordance with how the brains of elementary school students work. Based on the results of the needs analysis, it was agreed that the product developed must include all three stages of CPA, be equipped with multimedia elements, and be specifically designed to train four

indicators of creative thinking: fluency, flexibility, originality, and detail.

Design Stage. At this stage, interactive multimedia products are designed based on the results of the needs analysis. The design includes developing a learning flow, creating a storyboard, designing the interface, selecting materials, and developing assessment instruments. Multimedia is designed with the principle that each material must be presented sequentially, starting from the concrete stage, the image stage, and the abstract stage. At the concrete stage, the media presents images of real objects in the surrounding environment that are in the form of flat shapes; at the image stage, simpler illustrations of flat shapes are presented; and at the abstract stage, students are introduced to symbols, formulas, and the general properties of flat shapes. The display design is made attractive with a combination of bright colors, a neat layout, and simple navigation, considering the characteristics of fourth-grade students who are easily attracted to visual elements but have a limited attention span. This is in accordance with the findings of (Firdaus et al., 2020), which emphasize that good interactive multimedia is media that integrates text, images, animation, and audio harmoniously and has a user-friendly display to increase student motivation and engagement in learning. In addition, in the material design, researchers included various types of exercises designed in stages, starting from basic understanding questions to open-ended questions that require high creativity. The preparation of these questions is based on indicators of creative thinking so that each activity in the media can train students to think flexibly, fluently, originally, and in detail.

Develop Stage. The development stage produces a finished product that is then tested for feasibility through expert validation and limited trials. Validation was carried out by three experts: a material expert, a media expert, and a language expert, to assess the suitability of the content, display quality, and clarity of the language used in the multimedia. The assessment results showed that this CPA-based interactive multimedia achieved an average feasibility percentage of 90%, categorized as Very Valid. The material expert gave a

score of 92.5% because the material was considered appropriate to learning outcomes, supported the CPA approach, and was able to train higher-order thinking skills. The media expert also gave a score of 92.5%, considering that the product had good functionality, an attractive appearance, and was easy to operate. Meanwhile, the language expert gave a score of 85% with minor improvements related to spelling accuracy and sentence simplicity to make it easier for students to understand. These results support the opinion (Gimin & Mujiono, 2022) that states that the development of technology-based media must go through a rigorous validation process to ensure quality and safety of use. Input provided by experts is then followed up to improve the product. After revision, the media was tested on a limited basis with eight students to assess its practicality and user response. The results showed an average student response rate of 93%, categorized as Very Good. Students were happy, interested, and greatly benefited from the learning sequence from concrete to abstract, presented through animation and interaction. This proves that the design was appropriate for student characteristics and learning objectives. As stated (Griseldis et al., 2024), media developed by considering the stages of student understanding will be very effective in increasing conceptual understanding and learning engagement.

Disseminate Stage. The final stage is the actual implementation of the product to assess its effectiveness in improving mathematical creative thinking skills. The field trial was conducted in class IVB of SDN Mekar Mukti 02, with 29 students. Learning was conducted using CPA-based interactive multimedia as the primary medium, and its effectiveness was measured by comparing the results of the pretest and posttest, as well as calculating the N-Gain value. Based on the test results presented in Table 7, a very significant improvement was observed after students used CPA-based interactive multimedia. The results are described in detail as follows:

Average Score Improvement: The average student score increased from 59.31 in the pretest to 87.24 in the posttest, or an increase of 27.93 points. The initial score indicated that student understanding was still low

and had not yet reached the learning completion limit, while the final score exceeded the learning completion standard, which is generally set at 75. This confirms that learning using CPA-based media is very effective in transferring knowledge and improving student understanding. This is in line with research. (Azzumar & Juandi, 2023) which concluded that the CPA approach helps students build a gradual and in-depth understanding of concepts, so that learning outcomes are much better than conventional methods.

Improvement in Highest and Lowest Scores: The lowest score increased from 50 to 80, and the highest score increased from 70 to 100. These changes indicate that the developed media has a positive impact on all students, both those with low and high initial abilities. Students with weak understanding are helped by the presentation of concrete objects and clear visualizations, while students with high abilities can develop their potential through the available challenging questions (Agustyaningrum et al., 2022). In his study, he emphasized that learning that is appropriate to the stage of cognitive development can equalize understanding and reduce the ability gap between students.

Classical Mastery: Before the lesson, only 10.34% of students had completed the lesson. This figure jumped dramatically to 96.55% after the lesson. This means that almost all students in the class have mastered the material on plane figures well. This high completion rate proves that interactive multimedia can make learning more meaningful, interesting, and easy to understand, in line with the objectives of developing learning media as stated by Firdaus et al. 2020), namely facilitating students to be able to learn independently and thoroughly.

N-Gain Value: The N-Gain value obtained was 0.69, which falls within the criteria for moderate improvement. This value indicates that the change in students' creative thinking abilities is not a superficial change, but rather a significant and meaningful change.

This improvement occurred because multimedia was designed not only to present material, but also to deliberately train the four aspects of creative thinking: Fluency: Students are trained to name many types of flat shapes and their properties, Flexibility: Students are accustomed to finding

various ways to solve and group shapes with different criteria, Originality: Through drawing and designing activities, students are encouraged to create new shapes, and Detail: Students are trained to explain the steps and reasons for their answers in detail.

This result is in line with the opinion (Griseldis et al., 2024), which states that the integration of a systematic approach with interactive media provides ample space for students to explore ideas, ultimately honing their higher-order thinking skills and mathematical creativity. Furthermore, these results also support research (Gimin & Mujiono, 2022) which states that technology-based multimedia can significantly increase learning motivation, and high motivation is the main key to the growth of creativity in students. Overall, the interactive multimedia based on CPA developed in this study has proven to be able to address the existing research gap. Unlike previous studies that applied CPA alone or developed multimedia without a specific approach, this study combines both in an integrated manner and has proven effective. This product is able to transform a passive learning atmosphere into an active one, abstract into real, and boring into enjoyable. This is in line with the goals of 21st-century mathematics education proposed by Mailani et al. 2025), namely creating learning that is able to develop logical, critical, and creative thinking skills from the elementary school level. The CPA approach at the concrete and pictorial stages provides familiarity in learning.

Thus, it can be concluded that interactive multimedia based on the CPA approach is not only suitable for use in terms of material, display, and language, but also empirically effective in improving students' conceptual understanding and creative mathematical thinking skills in the material of plane figures. This product is clear evidence that learning innovations that combine scientific approaches with technology can be an effective solution to improve the quality of mathematics education in elementary schools.

The research results show that interactive multimedia based on CPA can support the learning process in accordance with the developmental characteristics of elementary school students. The essence of the CPA approach is guidance in learning,

which consists of concrete stages giving opportunities to manipulate learning objects, pictorial stages of students having a bridge to visualize topics, and abstract stages as the core of mathematics learning that utilizes symbols (Yuliyanto & Turmudi, 2020). Concrete, pictorial, and abstract stages help students gradually understand the concept of plane figures. Furthermore, the interactive features in multimedia provide opportunities for students to explore various ideas and problem-solving strategies. The stages of learning with the CPA approach always create as close as possible a mathematics to the daily lives of students (Putri, Yuliyanto, Nikawanti, Rahayu, & Majid, 2020). The use of multimedia also supports the development of four indicators of mathematical creative thinking skills: fluency, flexibility, originality, and detail. Thus, interactive multimedia based on CPA can be an alternative innovative learning medium to improve the quality of mathematics learning in elementary schools.

D. Conclusion

This research successfully developed interactive multimedia based on the Concrete-Pictorial-Abstract (CPA) approach on plane geometry material for fourth-grade elementary school students. The product was developed using a 4D model consisting of the Define, Design, Develop, and Disseminate stages. The validation results showed that the developed multimedia was in the very valid category and was suitable for use in learning. The implementation of the media showed potential in improving students' mathematical creative thinking skills, which included aspects of fluency, flexibility, originality, and detail. Therefore, CPA-based interactive multimedia can be used as an innovative learning medium to support mathematics learning in elementary schools. Based on the research results, the researcher provides the following recommendations: For teachers, this multimedia can be used as an alternative learning medium on plane geometry material. It is recommended that teachers guide students in following the CPA sequence for maximum understanding of the concept. For schools, it can support the development of similar media for other subjects to realize technology-based learning. For further research, it can develop multimedia

with broader material, add automatic evaluation features, or trial it at other grade levels to see more general effectiveness.

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