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Developing Question-Based Learning Media by Applying Computational Thinking for Elementary School Students

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ABSTRACT

This study aims to introduce question-based computational thinking to elementary school students. The background is the study that education in Indonesia needs to be improved in order to answer the global competition in the 21st century which is full of technological and information developments. In today's era everything is integrated with computers and technology, therefore it is necessary to be equipped with Computational Thinking which is believed to be able to train the brain to get used to thinking logically and structurally so that they are faster. Therefore, the development of Computational Thinking learning media was carried out by teaching using questions consisting of 4 categories and totaling 17 questions which were applied to the media. The media development model used was ADDIE (Analyze, Design, Development, Implementation, Evaluate) with a sample of 6 students from grade 6 SDIT 'Alamy Subang. The results of this study indicate that: The instructional media has been evaluated and rated "Very Good" by experts with an average percentage of feasibility of 96.19%. Computational Thinking skills possessed by students vary and have different abilities in each question category and have different levels of difficulty according to the abilities possessed by each student. Students' responses to learning media are enabling students to learn new things and get an average percentage score of 87.11% and are included in the "Very Good" category.

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1. INTRODUCTION

The progress of a country cannot be separated from the advancement and development of its infrastructure. Education plays a crucial role in this development. The educational process is intertwined with development as it is closely related to the cultivation of high-quality human resources. Education is a conscious effort to create a learning environment and learning process, enabling students to actively develop their potential to possess spiritual and religious strength, self-control, personality, intelligence, noble character, and necessary skills for themselves, society, nation, and country (Fajarwati *et al*., 2016) (Indonesian Law No. 20 of 2003 concerning the National Education System). The challenges posed by a dynamic educational curriculum require Indonesia to be more responsive in crafting a strategic educational framework to address the 21st-century global competition characterized by technological and informational advancements. This was emphasized by Indra Charismiadji, an expert in 21st-century education, and the President Director of PT. Eduspec Indonesia (see https://www.tribunnews.com/pendidikan/2016/11/17/merancang-pembelajaran-modern-lewat-metode-computational-thinking?page=all). To meet the demands of this 21st-century global competition, there is a need for tools and human resources/teachers that meet the standards to ensure the delivery of quality education. Teachers play a vital role in education in Indonesia; they are at the forefront of carrying out the educational mission in the field, which is a crucial factor in realizing a high-quality and efficient education system. In this context, teachers need to have the ability to convey information to students and present it in an engaging manner through teaching media. This is because the benefits of instructional media can enhance and direct a child's attention, leading to motivation for learning.

The 21st-century global competition demands that students continue to develop various skills related to science and technology. The NSTA (National Science Teaching Association), an organization of educators in the United States and Canada, states that 21st-century skills are developed in the educational world, such as critical thinking and problem-solving skills. The 21st-century skills of critical thinking and problem-solving can be addressed through the implementation of the Computational Thinking framework, which serves as the foundation for developing teaching methods in science, technology, engineering, arts, and math (STEAM). 21st-century skills have made Computational Thinking a subject of primary importance, as it is increasingly recognized as a fundamental competence for the computer-driven world of today (Tenzin Doleck, 2017). Computational Thinking (CT) is a foundational skill that facilitates learning in computer science (Barr *et al*., 2011). However, CT does not mean thinking like a computer; rather, it involves human thinking processes for problem-solving, system design, and understanding human behavior. Possessing CT skills in the present century is a necessity for everyone, as computational thinking trains the brain to think logically, systematically, creatively, and helps individuals grasp technology around them more quickly (Soleimani, 2019). Characteristics of Computational Thinking (CT) identify problems by breaking down the problem into smaller, more solvable segments (see https://www.kompasiana.com/fathur_rachim/55e06cc71593736c0a109023/computational-thinkingcomputer-science). In a seminar held by the International Society for Technology in Education (ISTE), CT is a problem-solving methodology that can be applied across subjects. This reshapes the perception that these foundational skills are distinct and cannot be substituted with other basics like reading, writing, and arithmetic. If teaching of this ability is widely implemented among students, it will establish a new discipline of skills for students, enabling them to conceptualize, analyze, and solve problems more innovatively, thus supporting every aspect of life in the 21st century.

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Quoted from a detiknews article written by Zahid in 2020, the Ministry of Education and Culture (Kemendikbud) issued Ministerial Regulation No. 35, 36, and 37 of 2018, designating informatics as an elective subject at the junior high school (SMP) and senior high school (SMA) levels, to be taught starting from the academic year 2019/2020. It is in the attachment of Ministerial Regulation No. 37 where the term "Computational Thinking" is formally included as one of the fundamental competencies studied within the informatics subject (see https://news.detik.com/kolom/d-4922046/computational-thinking-menyongsong-pisa-2021). However, there is no harm in implementing Computational Thinking education at the elementary school level as well, to prepare more competent and technologically literate human resources. Additionally, this initiative aims to prepare elementary school students who will later progress to junior high school, as outlined in the Ministerial Regulation. Similar to the approach taken by the United Kingdom, which introduced programming content into the elementary school curriculum in 2014, the goal is to acquaint children/students with Computational Thinking from an early age (Lee *et al*., 2014). By introducing and integrating Computational Thinking from elementary school, students will become accustomed to it and will be better prepared to study informatics at the junior high school level. Moreover, the Bebras Indonesia book (2018) emphasizes that in the field of informatics, the cognitive skill required from early education is computational thinking. This is because Computational Thinking itself can aid in problem-solving. Hence, the present research aims to produce software in the form of a Computational Thinking educational tool for elementary school students. This learning tool employs the concepts and skills of Computational Thinking through problem-based exercises.

Therefore, this study aims to develop an instructional media using the Computational Thinking strategy that involves four aspects: decomposition, pattern recognition, abstraction, and algorithm, for elementary school students. The developed instructional media consists of various question categories, namely story problems, visual problems, color-based challenges, and mathematical problems. Each of these four question categories encompasses elements of Computational Thinking.

2. METHODS

The research design utilized in this study is a descriptive qualitative research design. The steps employed in this research begin with a literature review and culminate in the analysis of research findings. This process is illustrated in the following **Figure 1**.

1. Concept

In this preliminary research, a literature study was conducted. Initially, a literature review was carried out with the aim of gathering theoretical data that could assist in the research. The sources used in this literature study included books, journals, as well as reliable websites on the internet. The literature study encompassed topics related to the concept of Computational Thinking, examples of Computational Thinking application, and software for creating educational media, such as Unity.

Next, a field study was conducted, involving the collection of information through field surveys, utilizing unstructured interviews with subject teachers. The interviews were not limited to subject teachers; rather, several students were also interviewed. This activity took place at SDIT 'Alamy Subang, located at Jalan Ki Hajar Dewantara No.1b, Dangdeur, Subang District, Subang Regency, West Java 41211. The purpose was to determine the extent to which students learn ICT (Information and Communication Technology) at school, the

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methods and media used during the learning process, and whether Computational Thinking has been taught or introduced to the students in the school.

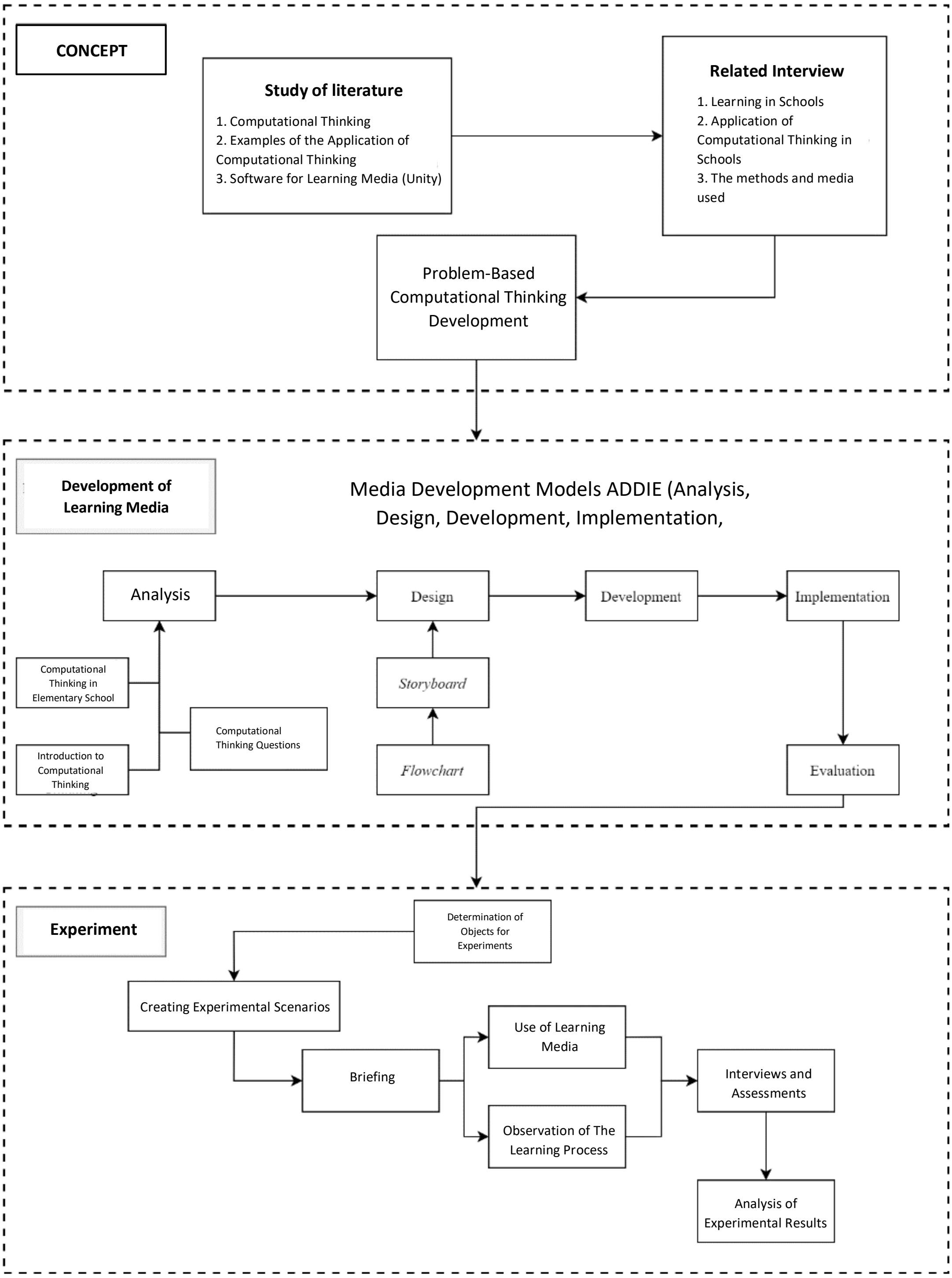

Figure 1. Research procedure flowchart.

2. Development of Learning Media

This study employs a development model with five stages derived from the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation) developed by Reiser and Mollenda in the 1990s. This model was chosen because the objective of this research is to create a Computational Thinking learning media product for elementary school students.

Another rationale for selecting this model is its suitability for developing targeted, effective, and dynamic instructional/learning products. It greatly assists in instructional development for educators. Moreover, this model can be applied to various forms of product development, with one such example being multimedia-based learning. In the analysis phase, software and hardware requirements needed for developing the learning media are determined based on the analysis of literature study and field research outcomes. The development of problem-based Computational Thinking is analyzed during this phase.

The questions are assessed for their inclusion of Computational Thinking elements and how these questions will be integrated into the media. In the design phase, flowcharts and storyboards are created to facilitate the subsequent development process. This phase focuses on translating the design concepts into a tangible product. Asset creation for the learning media starts here, aligning with the designs made earlier. CorelDraw is used to produce the required assets. This design is developed into a complete learning media using the Unity application. After development, the product undergoes blackbox testing for validation before implementation. In the implementation phase, the media is directly tested. It is used and validated by two experts: a Computer Science Education lecturer from Universitas Pendidikan Indonesia and a TIK (Information and Communication Technology) teacher from SDIT 'Alamy Subang, who also serves as the school principal. The results of these tests serve as the basis for the evaluation phase. The evaluation phase aims to determine whether the media product is suitable for use based on validation from both experts, indicating whether improvements are necessary.

3. Experiment

After the development of the learning media, the next step involves creating an experimental scenario to ensure a focused and clear implementation of the research. Subsequently, the research is conducted in accordance with the scenario, involving the application of the created media. Following this, the learning media to be used by students is prepared. Once the learning media is ready, the students are provided with instructions on how to use it. In the subsequent phase, while students use the learning media, the researcher conducts observations to determine the students' Computational Thinking skills. These observations are recorded based on previously prepared observation sheets. Once the observation of students is complete, interviews are conducted. Interviews are carried out directly with the students after their use of the learning media. Additionally, questionnaires are distributed through the parents' WhatsApp group in the form of a link. However, parents are only responsible for assisting their children while they fill out the questionnaire. From this research, obtained results will be analyzed and processed using qualitative methods, leading to conclusions drawn from the analyzed outcomes. Subsequently, a draft of the research is created after collecting all the data. This draft serves as physical evidence of the research process, accessible to all and serving as a reference for future research development.

2.1. Population dan Sample

The population consists of sixth-grade students at SDIT 'Alamy Subang. The research focuses on a portion of this population, not the entire group, which is referred to as the sample. To determine the sample, this study employs purposive sampling, where the selection is based on specific considerations. The selection is based on high, moderate, and low-ability sixth-grade students from Class 6A. Two students are selected from the high-ability group, two from the moderate-ability group, and two from the low-ability group. These six

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students are chosen based on their Semester Final Assessment (PAS) results in fifth grade, teacher recommendations, and the constraints posed by the Covid-19 pandemic.

2.2. Research Instruments

The instruments employed in this research include a field study instrument in the form of unstructured interviews conducted with subject teachers. Additionally, a media validation instrument is used, specifically the Multimedia Mania 2003 - Judge's Rubric from North Carolina State University. Observation sheets, assessment and feedback instruments used by the students include the Multimedia Mania - Student Checklist and interviews.

2.3. Instrument Analysis

The data analysis obtained from the field study results and student feedback can be directly described as they are outcomes of interviews. Data analysis stemming from the observation sheets is also described based on the direct activities conducted. Furthermore, the level of validation of the learning media by experts and the assessment of the learning media by students in this research are categorized into four levels using a scale, as depicted in **Figure 2**.

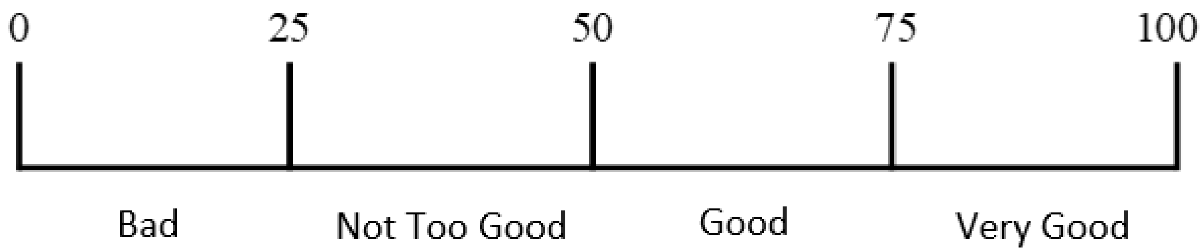

Figure 2. Interval categories of expert validation and student assessment.

3. RESULTS AND DISCUSSION

3.1. Question-Based Computational Thinking Development

In this research, the aim is to teach Computational Thinking to elementary school students using questions that encompass Computational Thinking components: decomposition, pattern recognition, abstraction, and algorithm. Alongside the available questions, there is also material providing information about Computational Thinking itself. Subsequently, these questions are integrated into the created learning media. The learning media contains a total of 17 questions, categorized into four types: story, visual, color-based, and mathematical. Categorized as story questions, they predominantly involve stories related to the questions to be solved, and similar characteristics apply to the other categories. Specifically, in the story category, there are four drag-and-drop questions. In the visual category, five questions exist, with one requiring text-based answers and the other four being of the drag-and-drop type.

The color-based category contains four questions, all requiring drag-and-drop actions. Finally, the mathematical category consists of one text-based answer question and three drag-and-drop questions. An illustrative example of a question containing Computational Thinking components can be found in the mathematical category. It prompts students to solve the calculation 6 x 3 + 2 : 2. This question incorporates decomposition, abstraction, and algorithm. Decomposition is applied as the complete problem is broken down into smaller components and solved step by step.

According to the order of operations, multiplication and division are performed first, and their results are then added. Abstraction involves disregarding incorrect choices that do not

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contribute to problem-solving. Algorithm is manifested as students are required to arrange available choices and place them in answer boxes according to their sequential order to successfully solve the question. This task is based on the previously undertaken decomposition activity, involving selecting the necessary options to complete the question. Moreover, within the story category, there are questions depicting the daily life of an individual named Danu.

These questions incorporate five icon images: sound, temperature, light, button, and screen. These images relate to Danu's daily experiences. In these questions, students are tasked with identifying words from the story, connecting them with the corresponding icon images, and then writing these words in the provided boxes. This process involves decomposition and abstraction techniques. Decomposition is applied as students implicitly break down the overall story into relevant words and connect them with the icon images. Abstraction is utilized to eliminate words from the story that do not conform to the applicable rules, disregarding words that are irrelevant or not connected to the icon images. Additionally, there are three questions instructing students to select animal characteristics based on images. These questions involve abstraction and pattern recognition. Abstraction arises as there are choices that do not correspond with the visual images. Pattern recognition is present in these questions as they encompass images that can be solved by selecting common characteristics from the images of animals.

3.2. Design and Development of Learning Media

Referring to the development of problem-based Computational Thinking as explained in section 3.1 above, the next step involves the design and development of learning media using the four stages of the ADDIE development model (analysis, design, development, implementation, evaluation).

3.2.1. Analysis Phase

The initial phase of developing this instructional media involves literature review and field study. The field study is conducted by conducting unstructured interviews with subject teachers to determine what solutions need to be developed or discovered. The results of these interviews indicate that the teaching methods and media used in the school still rely on lecture-style teaching and slide presentations using projectors. Furthermore, the teaching specifically for the ICT subject only covers the use of basic tools and applications such as Microsoft Word, Excel, PowerPoint, and CorelDraw. Computational Thinking has not been taught or introduced to students, and teachers are also unaware of the students' Computational Thinking abilities.

Based on these results, it is evident that there is a need to teach and introduce Computational Thinking to elementary school students through instructional media containing problems or challenges that involve Computational Thinking.

3.2.2. Design Phase

In this design phase, a flowchart is created to illustrate the process flow of the media from beginning to end. Below is the **Figure 3** of the instructional media's flowchart. Once the flowchart is created, the next step is to create a storyboard. The storyboard is designed to facilitate the implementation process in the subsequent phase. The storyboard is used to create visual representations that will simplify and display the instructional content aligned with the intended objectives.

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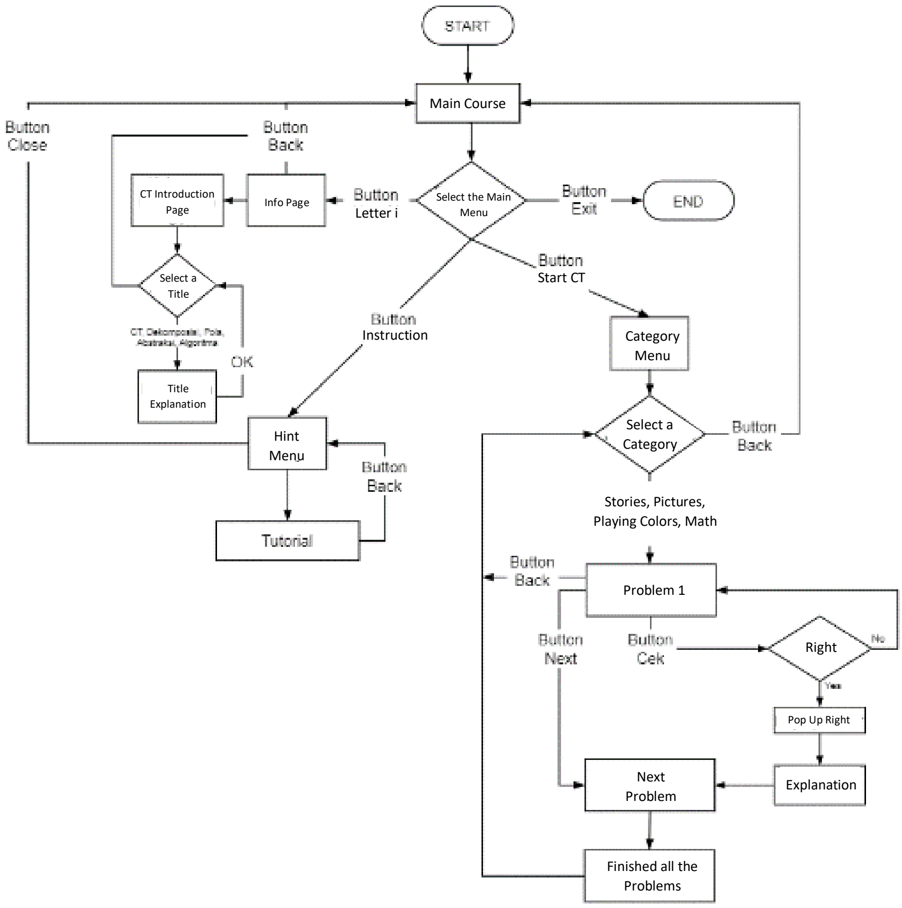

Figure 3. Instructional media flowchart.

3.2.3. Development phase

In the development phase, the instructional media interface is created based on the flowchart and storyboard.

3.2.3.1. Interface - home page

On this page, students press the "START" button to begin (see **Figure 4**).

Figure 4. Interface - home page.

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p- ISSN xxxx-xxxx e- ISSN 2774-7891

3.2.3.2. Interface - Main Page

This page contains the main menu of the instructional media, offering several options for selection: Instructions, "i" for information, Start CT, and Exit. The Instructions menu is explained in section 3, the "i" icon in section 4, and Start CT comprises the question categories as detailed in section 5 (see **Figure 5**).

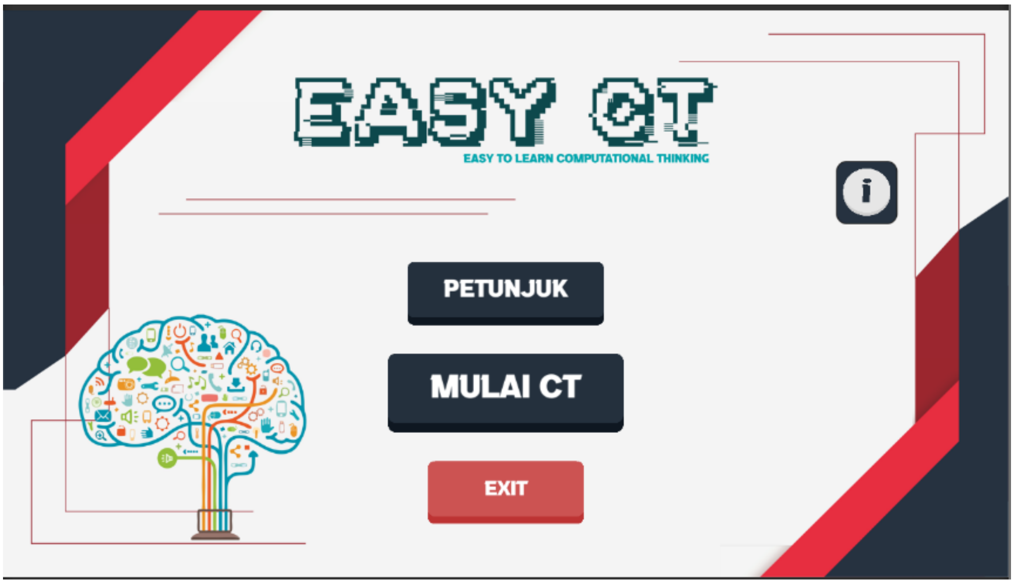

Figure 5. Interface - main page.

3.2.3.3. Interface - Instructions Page

This page presents the flow of the instructional media and provides guidelines for using the educational tool. It includes a step-by-step breakdown of the media's features and activities. A "Next" button is provided to proceed to the tutorial page, which contains instructions for completing drag-and-drop and fill-in-the-blank exercises on the media (see **Figure 6**).

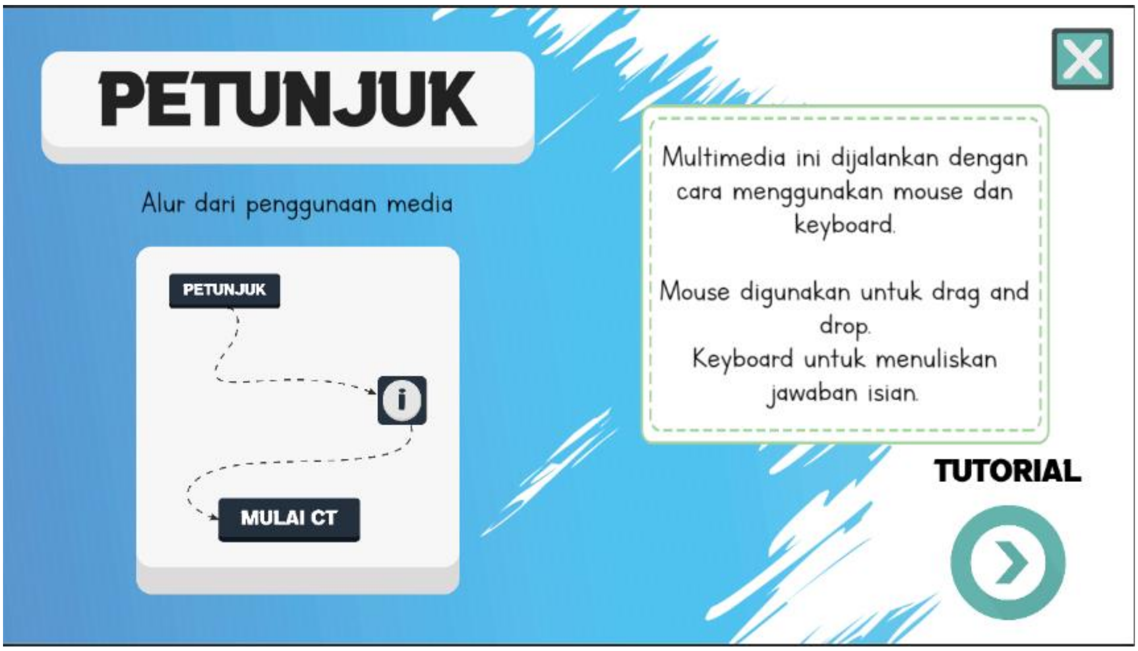

Figure 6. Interface - instructions page.

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3.2.3.4. Interface - Information Page

The info page contains information about the creator of the instructional media, an explanation of the instructional media, and the sources used in developing this instructional media. There is a "Next" button available to proceed to the page with information about Computational Thinking, and a "Back" button to return to the main page (see **Figure 7**).

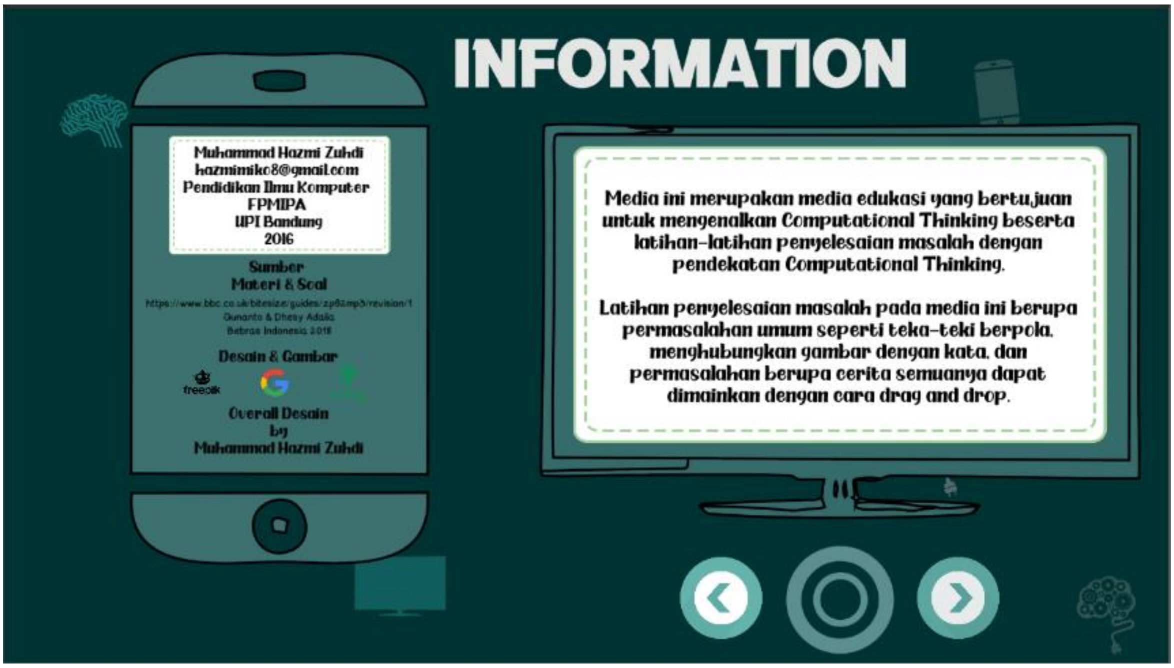

Figure 7. Interface - information page.

3.2.3.5. Interface of the Category Page

Contains 4 buttons on this category page, these 4 buttons are Story, Picture, Color Play, and Mathematics. These four buttons can be selected according to the user's preference. This page will appear when the user presses the "Start CT" button on the main page (see **Figure 8**).

Figure 8. Interface of the category page.

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3.2.3.6. Interface for Category-specific Question Page

This page contains problems or questions that need to be solved one by one. However, if you choose not to work on a particular question, there are "Next" and "Back" buttons available. In **Figures 9** to **11**, there are interfaces for question pages with drag and drop instructions, while **Figure 12** is an interface for a question page with fill-in-the-blank instructions.

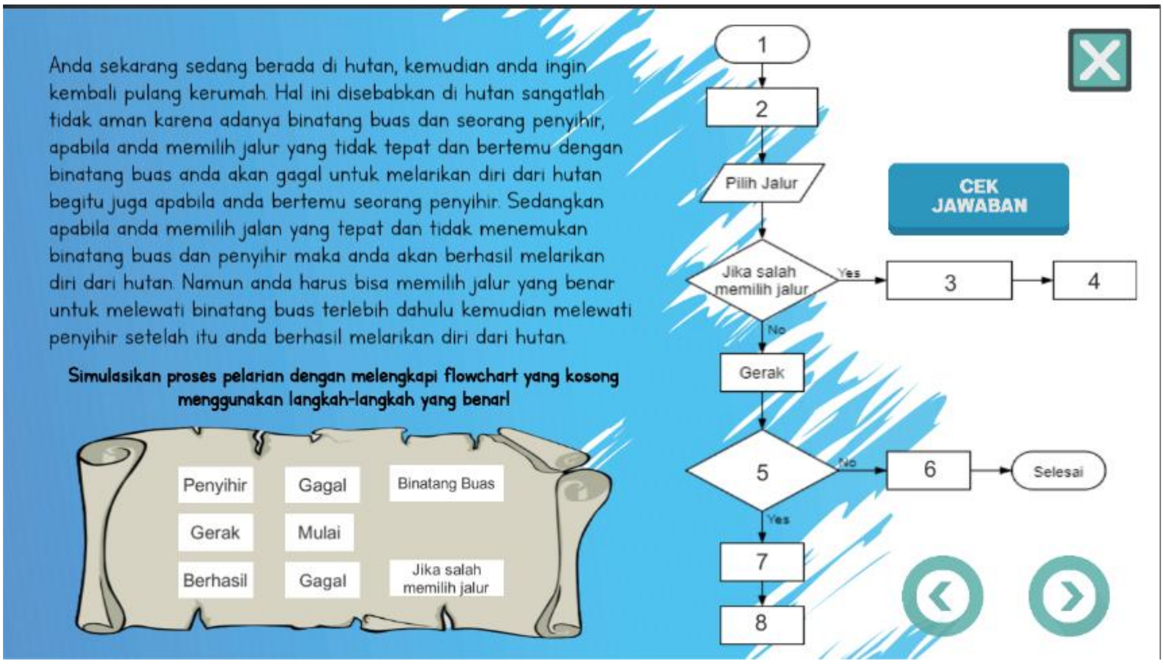

Figure 9. Interface for category-specific question page.

Figure 10. Interface for image category.

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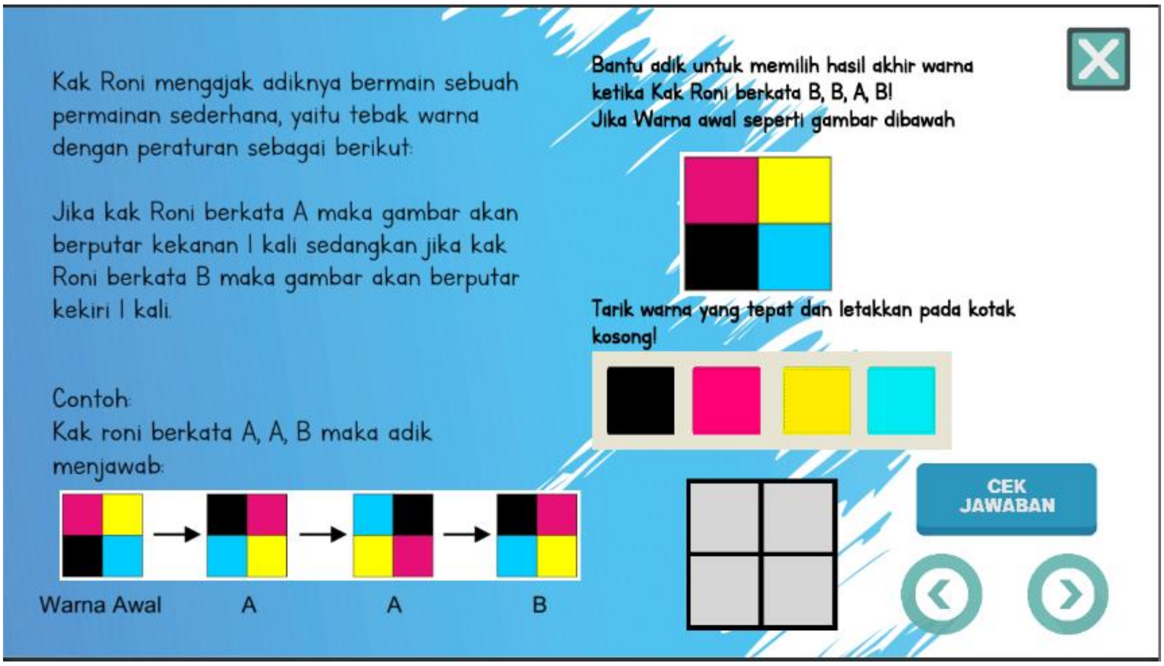

Figure 11. Interface for color play category.

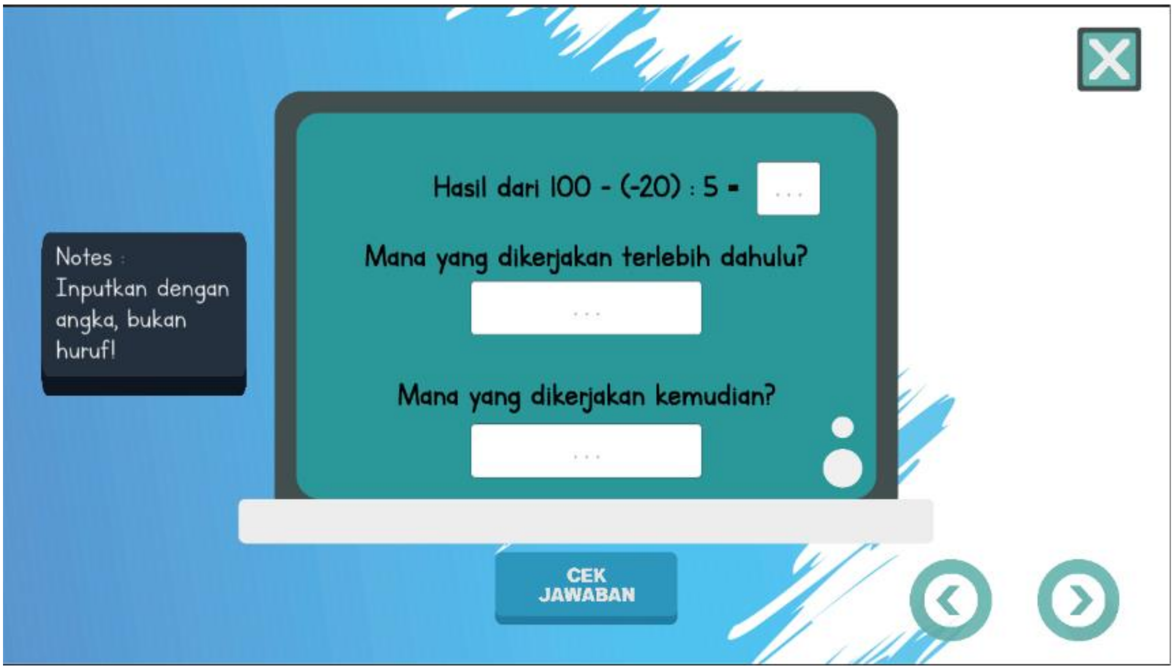

Figure 12. Interface for mathematical category.

3.2.3.7. Interface for Knowledge Page

The knowledge page will appear when students successfully answer each problem or question (see **Figure 13**).

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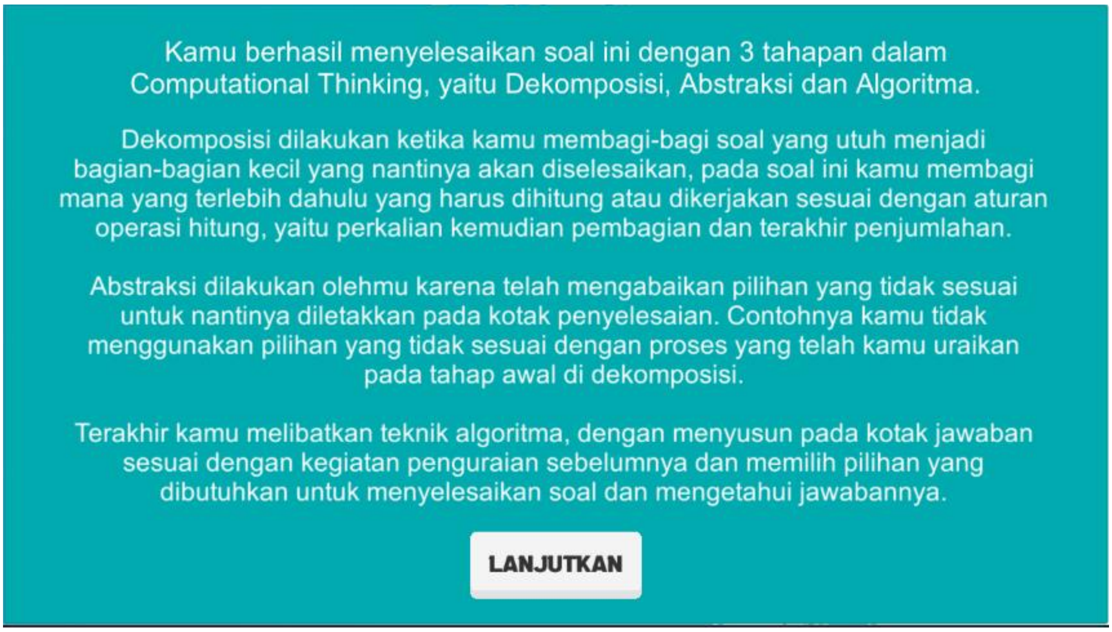

Figure 13. Knowledge page interface.

3.2.4. Implementation Phase

The media was implemented with two experts: one lecturer from the Department of Computer Science Education at the University of Education Indonesia and one teacher from the respective school. They were provided with supporting instruments, namely assessment sheets based on the Multimedia Mania 2003 - Judge's Rubric North Carolina State University. The implementation phase was carried out in two ways. First, by providing a Google Drive link to the media and a Google Form link for the assessment sheet to one expert. Second, by personally visiting one expert so that they could directly interact with the media, and they were given the assessment sheet. The results from the assessment sheets will be used for the evaluation of the developed learning media.

3.2.5. Evaluation phase

The evaluation phase is conducted after going through the implementation stage or applying the learning media to the two experts. The results from the conducted implementation are then processed and evaluated in this stage. This evaluation indicates that the learning media is suitable for use with some improvements to make it more effective for students. The improvements at this stage include refining the question texts and information to make them visually distinct, as well as ensuring that all text is clear in terms of font style and font size.

3.2.6. Expert validation results

This expert validation refers to the Multimedia Mania 2003 – Judge's Rubric from North Carolina State University. This stage serves to assess the appropriateness of the developed instructional media. The outcomes of the media evaluation by the media expert are presented in the following **Table 1.**

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p- ISSN xxxx-xxxx e- ISSN 2774-7891

Table 1. Expert validation results.

No	Assessment Aspect	Number of Testers	Number of Items	Ideal Score	Score Acquisition	Presentase (%)
1.	Mechanism	2	4	32	31.6	98,75%
2.	Multimedia Element	2	2	16	14.7	91,75%
3.	Information Structure	2	2	32	31	96,87%
4.	Dokumentation	2	2	16	15.1	94,37%
5.	Content Quality	2	3	72	68.4	96,15%
		2	2	32	31.6	
	TOTAL					**96,19%**
	CATEGORY					**Very Good**

3.2.7. Results of Observation Sheet Assessment

Observation results at this stage are based on observations of students while they solve problems within the instructional media, using the observation sheets previously prepared. This aims to assess the students' skills in solving the problems presented in the instructional media, based on the Computational Thinking skill indicators. Here are the observation results obtained from observing 6 students.

3.2.7.1. Student 1

Student 1 is academically proficient and exhibited good Computational Thinking skills, albeit specifically in certain categories of problems. They were able to solve all the problems within a duration of 1 hour.

3.2.7.2. Student 2

Student 2 has moderate academic abilities. Their Computational Thinking skills were not very proficient as they often asked questions and struggled to effectively utilize the steps of Computational Thinking. However, they showed a notable skill in recognizing patterns or similarities within problem categories like story and color-play problems. Additionally, they could formulate solution steps in the picture and math problem categories. Student 2 completed all the problems within 1 hour and 30 minutes.

3.2.7.3. Student 3

Based on the results, Student 3 exhibited poor Computational Thinking skills, bordering on very poor. They frequently asked for guidance and struggled significantly in solving problems within the instructional media. However, they did demonstrate some Computational Thinking skills in specific problem categories due to prior experience in dealing with similar problems. Student 3 completed all the problems within 1 hour and 30 minutes.

3.2.7.4. Student 4

Student 4, academically proficient, demonstrated relatively good Computational Thinking skills. Although not perfect, they were able to engage in Computational Thinking activities to solve problems, with occasional errors that they managed to rectify independently. Student 4 completed all the problems within 1 hour.

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p- ISSN xxxx-xxxx e- ISSN 2774-7891

3.2.7.5. Student 5

Student 5, academically struggling, displayed inadequate Computational Thinking skills. They asked many questions, exhibited hesitancy, and sought assistance frequently. Despite this, they showcased some Computational Thinking skills, albeit limited to specific problem categories. Student 5 completed all the problems within 1 hour and 35 minutes.

3.2.7.6. Student 6

Student 6 has moderate academic abilities. During observation, they exhibited strong Computational Thinking skills in the picture and story problem categories, but their skills were lacking in the color-play and math problem categories. Student 6 completed all the problems within 1 hour and 30 minutes.

3.5. Results of Assessment and Student Responses

Assessment and feedback from students are conducted to identify the strengths and weaknesses of the developed instructional media. This process helps to make adjustments and provide insights for further development. The evaluation is carried out by students through their responses, utilizing the Multimedia Mania – Student Checklist, and also through interviews. The assessment results can be seen in **Table 3**.

The students' responses to the instructional media, as gathered from interviews, reveal that the students were enthusiastic upon learning that they would be part of the research, as they were going to use an instructional media application that they hadn't tried before. The developed instructional media was perceived positively as it sharpened their minds and encouraged deeper thinking. Although some questions were challenging and required substantial thinking, students enjoyed learning through the instructional media. They were able to acquire new knowledge in Computational Thinking. However, some difficulties were encountered while using the media, particularly with certain questions that were not fully understood. Students found the mathematical category challenging, possibly due to a lack of interest, and the color-based activities were described as causing confusion.

Table 3. Results of Assessment and Student Responses

No	Assessment Aspect	Ideal Score	Score Acquisition	Presentase (%)
1.	Mechanism	24	21	87,5%
2.	Multimedia Element	12	11	91,66%
3.	Information Structure	24	20	83,33%
4.	Dokumentation	12	10	83,33%
5.	Content Quality	54 24	48 22	89,74%
	TOTAL			**87,11%**
	CATEGORY			**Very Good**

3.6. Discussion

3.6.1. Development of computational thinking instructional media

The design and development of Computational Thinking instructional media were carried out using the ADDIE development model, which consists of five stages: analysis, design, development, implementation, and assessment. Before entering the development stage of instructional media, a preliminary search was conducted from various sources such as journals and books. Subsequently, problems or scenarios containing Computational Thinking

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were created. The result of this process yielded 17 problems categorized into four different types: story-based problems, visual problems, color-based problems, and mathematical problems. All the compiled problems encompassed the four components of Computational Thinking: decomposition, pattern recognition, abstraction, and algorithmic thinking. These problems were then organized and integrated into the instructional media format.

After successfully creating the instructional media, the next step involves validation by experts. The average assessment score for the instructional media was 96.19%, indicating that the created media falls into the "excellent" category, as shown in Table 1. The table illustrates that the expert assessment covers five aspects. The Mechanism aspect received a score of 98.75%, meaning that technically, navigation, spelling, grammar, and problem-solving within the instructional media are categorized as excellent. The Multimedia Elements aspect received a score of 91.75%, signifying that the interface design, content, images, videos, audios, and other additional elements in the instructional media are effectively utilized. The Information Structure aspect obtained a score of 96.87%, indicating that the arrangement of information is logical and intuitive, and the media includes distinct branching paths that are well-categorized. The Documentation aspect scored 94.37%, reflecting that all sources are correctly cited, proper permissions for asset usage are obtained, and copyright information for assets is provided within the instructional media. The Content Quality aspect scored 96.15%, indicating that the media demonstrates significant originality in its development and all content supports the intended learning objectives, appropriately aligned with the media's purpose.

3.6.2. Development of computational thinking instructional media

After conducting observations on students, the results of the observations revealed varying levels of Computational Thinking skills among the students. When observed individually, the Computational Thinking skills cannot be categorized solely based on high, medium, or low academic abilities. Due to the diverse outcomes of the observations, each student exhibits distinct strengths in different aspects of Computational Thinking skills.

Furthermore, each student demonstrates varying abilities in each question category within the instructional media, and they also encounter different levels of difficulty. Differences are noticeable in the duration taken to complete the questions within the instructional media; students with higher academic abilities tend to finish faster compared to students with medium or low academic abilities.

3.6.3. Development of computational thinking instructional media

Assessments and student feedback indicate an "excellent" category for the instructional media, with an average score of 87.11%, as shown in Table 3. The student assessment covers five aspects: mechanism, multimedia elements, information structure, documentation, and content quality. The Mechanism aspect scored 87.5%, indicating that navigation, spelling, grammar, and problem-solving within the instructional media are categorized as excellent. The Multimedia Elements aspect scored 91.66%, implying that the design interface, content, images, videos, audios, and other additional elements within the instructional media are effectively utilized.

The Information Structure aspect scored 83.33%, meaning that the logical and intuitive arrangement of information, along with distinct branching paths in the media, can be considered excellent. The Documentation aspect scored 83.33%, signifying that all sources are correctly cited, proper permissions for asset usage are obtained, and copyright information for assets is provided within the instructional media. The Content Quality aspect scored 89.74%, indicating that the media demonstrates significant originality in its development and all content supports the intended learning objectives, appropriately aligned with the media's purpose.

Additional student feedback during interviews after using the instructional media indicates that students are pleased with the opportunity to learn something new. They also find learning through this media to be engaging and exciting, as opposed to traditional lecture-based methods. Furthermore, students provided suggestions for improvement, suggesting that the font size in the media should be enlarged for clarity, and the images within the media should be more visually appealing.

3.6.4. Development of computational thinking instructional media

In **Table 4**, differences and similarities are observed with the conducted research, such as the type of media used. In this research, instructional media based on questions is used. However, the objectives align with Langga and Soleimani's research, aimed at elementary school students. The research subjects in this study share similarity with Soleimani's work, focusing on sixth-grade elementary school students, whereas Langga's research targeted fourth and fifth-grade elementary students. The description clarifies that the conducted research is in line with Langga's study, aiming to introduce Computational Thinking, albeit with differences in the method of delivery.

Table 4. Comparison with Similar Studies

No	Researcher's Name	Title	Media Type	Object of Research	Information
1.	Soleimani *et al.* (2019)	CyberPLAYce—A tangible, interactive learning tool fostering children's computational thinking through storytelling	The learning media is in the form of a kit called CyberPLAYce	11 students of grade VI Elementary School (11-12 years old)	Improve Computational Thinking skills through storytelling and using CyberPLAYce tools. Located in the USA
2.	Muhammad Hazmi Zuhdi (2020)	Development of Computational Thinking Learning Media for Elementary School Students	Question-based Learning Media	6 Elementary School Students class VI	Introducing Computational Thinking with 4 categories of questions that contain 4 Computational Thinking components (decomposition, pattern recognition, abstraction, and algorithms)

4. CONCLUSION

The Computational Thinking instructional media for elementary school students has been successfully designed, resulting in a question-based Computational Thinking instructional media comprising four distinct question categories. The development process followed the stages outlined in the ADDIE media development model (Analysis, Design, Develop,

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Implementation, Evaluation). After the instructional media was developed, it underwent evaluation and validation by experts to determine whether it was ready for use or required further improvement. The instructional media was assessed for its suitability by two experts, achieving a percentage score of 96.19%, which indicates that it is fit for use and falls within the "Excellent" category.

The research findings indicated that students' Computational Thinking skills varied and couldn't be categorized solely based on high, medium, or low academic abilities. Each student exhibited distinct abilities in different question categories and faced varying levels of difficulty. The only distinguishing factor was the time duration of completion. This conclusion was drawn from the observation assessment sheets of Computational Thinking skills. It is reasonable given that in interviews with students, they were not yet familiar with Computational Thinking, and teachers had not introduced or taught it to them.

Student feedback on the instructional media was overwhelmingly positive. This assessment was based on the analysis of the participants' feedback on the instructional media, yielding an average percentage score of 87.11%, categorizing it as "Excellent." Additional student feedback from interviews revealed that students enjoyed learning something new and appreciated the quality of the instructional media. They also didn't feel bored after using it.

To enhance the content of the instructional media, more questions should be added to ensure students become more accustomed to and proficient in Computational Thinking. Additionally, transforming textual content into videos or animations could make the content more engaging. Moreover, expanding the categories would be beneficial. Lastly, efforts should be directed towards adapting the media for other platforms, particularly smartphones, to enable usage anywhere and anytime.

5. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism.

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