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Interactive Learning Media for Final Assignment Problem-Solving Programming Projects in Students' Computational Thinking Training Using Scratch

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ABSTRACT

Background. The use of teaching materials is very important for getting students more interested and helping them to understand the things they are being taught. But so far, no one's done any research on making interactive teaching materials for computational thinking using Scratch programming in a project-based way and block-based programming ideas, especially for students training to be primary teachers (PGSD).

Purpose. Thus, the objective of this investigation is to formulate authentic and functional interactive educational materials for computational thinking programming instruction for PGSD pupils as a concluding endeavour, whilst additionally evaluating their proficiency in resolving programming project issues using the Scratch application.

Method. The ADDIE model-based Research and Development (R&D) method was used in this study, with 40 education students in Sumatra taking part. Data collection was conducted through observation. It was also conducted through interviews. Another method was artifact analysis. Another method was questionnaires. The primary instrument was a Likert-scale questionnaire.

Results. The results show that the interactive teaching tools we made for computational thinking programming got a "highly valid" rating, with a 100% score from subject matter and media experts, and an 86% score for how practical the product is.

Conclusion. The media is regarded as being eminently suitable for use, given its intermediate level of difficulty. It has been demonstrated to efficaciously assist students in the construction of their programs.

KEYWORDS

Computational Thinking, Learning Media, Problem-Solving

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INTRODUCTION

Achievement of optimal progress is dependent on demonstration of a high level of responsiveness to shifting times by the national education system. This demands the ability to proactively adapt to various global demands. It also demands the ability to adapt to the rapid pace of technological advancement. These are the characteristics of the current era. By making these changes, schools can do more than just teach they can also help to make sure that

the people trained are ready for the jobs of today and tomorrow (Satria, 2016; Sudarsana et al., 2020). Significant impacts have been caused on various aspects of human life, including the education sector, by the rapid development of science and technology in the twenty-first century. Scientific reasoning and critical thinking are fundamental to this progress, with a series of investigations and new discoveries made by scientists providing the necessary support. This approach means that science and technology can solve real-world problems. Ultimately, they aim to improve people's lives (Wikandaru et al., 2020; Satria & Widodo, 2020; Satria & Sopandi, 2019; Satria, 2018; Zulkifli et al., 2022; Sugiarto Maulana et al., 2021; Ichsan et al., 2023).

The education sector has seen big improvements thanks to fast progress in science and technology, especially in how we learn. This has ultimately resulted in a transformation and evolution in education that is progressively speedy and changeable in responding to the requirements of the current age (Satria, 2015; Sudarsana et al., 2019; Satria & Sopandi, 2022), The education sector is currently experiencing the implementation of a wide range of reforms. These far-reaching initiatives are chiefly conceived to augment the calibre of the educational experience and the extent of educational opportunities available to the general populace. The end goal of these efforts is to create an educational ecosystem that is more inclusive and equitable. This ecosystem will be able to meet the evolving demands of society without compromising the academic standards provided to students (Suharyat, et al., 2022; Satria et al., 2023; Haniko et al., 2023). Achieving a comprehensive improvement in the quality of education will require a number of strategic breakthroughs that address several fundamental aspects. Renewing the curriculum, integrating instructional innovations and using cutting-edge educational technology are all included. Moreover, it is vital to have the right facilities and infrastructure for education if the environment is to be optimised and learning outcomes improved (Rahmat et al., 2021; Maruf et al., 2022; Satria, et al., 2023; Satria et al., 2024; Winarto et al., 2026).

The majority of learning activities moved to online platforms when the global COVD-19 pandemic hit. This state of affairs forced schools, teachers and pupils to get used to new ways of teaching quickly by using computers and the internet. These efforts were made to make sure that teaching and learning could continue despite restrictions on physical interaction. At the same time, these efforts also marked a major change in how academic content was delivered around the world (Ichsan et al., 2022), The modern educational landscape has been fundamentally transformed by the rapid advancement of digital and online learning technologies. The integration of these innovative tools into teaching frameworks is now essential for educational institutions, given their rapid evolution. It's not just an optional extra anymore, it's a must to make sure that students in the digital age still have a good learning experience (Sudarmo, Rasmita, 2021; Manullang & Satria, 2020; Sudarsana, et al., 2019; Suharyat et al., 2022). During the pandemic, it has become vital for educators and learners to be digitally proficient. Ensuring the smooth operation of remote learning is something this capability is vital for, and not just something it supports. So, adapting to different digital devices and platforms is not just an optional extra; it is a basic requirement for making sure education continues and maintains its quality, even when there are limits on physical interaction (Wahyuningtyas et al., 2022; Satria et al., 2023; Satria, et al., 2024). In today's world, teachers need to use technology and digital learning materials in their teaching. Pedagogical approaches must now be aligned with technological advancements by instructors at all levels of education. This step is essential. It is essential for creating a learning ecosystem.

This ecosystem must be more effective. It must be more interactive. It must be more relevant to the needs of today's learners (Satria, 2021; Sudarsana, et al., 2019; Arifin et al., 2023). In today's schools, teachers have a big job. They must choose the right tools and media for their

students' different learning needs. It is very important for teachers and teachers to think carefully about which digital tools and ways of teaching can make difficult ideas easier to understand. This will help students to learn more easily. By making considered and knowledgeable choices about the incorporation of technology into their everyday teaching methods, teachers can encourage a more captivating and inclusive learning atmosphere. In the end, this intentional strategy for picking media and tech not only improves the overall quality of teaching but also helps students to understand more deeply and remember more of what they learn at all levels of education (Satria, 2017; Nurdin et al., 2019; Abidin et al., 2023). Essentially, teaching materials are tactical tools that support the whole learning process. The function of these tools is twofold: as aids for the delivery of content and as a crucial bridge for the connection of educators and learners. Consequently, academic interaction is optimised and students absorb knowledge and skills far more effectively (Satria & Sari, 2018; Satria et al., 2022).

From an academic standpoint, media can be regarded as any instrument, resource, or go-between deliberately employed to stimulate learners' reflections, sentiments, and focus, as well as to nurture the growth of their capabilities and competencies. The main purpose of these tools is to promote and enable the educational process, making it more productive, engaging, and valuable. Therefore, media is not just a means of sharing information, but also an interactive component that can enhance the learning journey and facilitate the overall success of educational objectives (Abdullah et al., 2019; Satria, et al., 2023; Satria, et al., 2023). This scope is both extensive and exhaustive, incorporating an awareness of various learning materials, ecological circumstances, personal functions, and the techniques used to accomplish learning goals. This method provides a thorough viewpoint on how the learning process can be perceived in a comprehensive way through various elements that work together and are interconnected (Satria, 2019; Suharyat, et al., 2022). This includes all kinds of ways to send and receive information, like newspapers, pictures, and music. All of this is supported by technology, like computers and programs. The way in which technology effectively facilitates access to and the overall experience of the exchange process is also a key factor in the information exchange process, as well as the method of message delivery (Sudrajat et al., 2018; Kurniasih et al., 2019; Sudarsana, et al., 2019; Morales-Obod et al., 2020; Satria, et al., 2022).

The successful completion of learning goals is greatly impacted by the thoughtful choice of suitable learning materials and tech. When teachers pick teaching materials that match the exact requirements and attributes of their pupils, the procedure of transferring knowledge becomes far more productive and significant. As a result, the incorporation of suitable educational resources and tech is not just an extra component, but a crucial underlying element in attaining ideal and long-lasting learning results (Egline & Satria, 2014; Har et al., 2018; Sudarsana, et al., 2019). The right way to learn is one that is right for the people learning and what they are learning. Ensuring that learning objectives are optimally achieved relies on there being a crucial foundation of alignment among the medium, the needs of the students, and the substance of the material. Therefore, the choice of a medium should not be based exclusively on the complexity of its form or technology; instead, it must consider the degree to which the medium supports student comprehension and contributes to the overall success of the educational process (Satria, 2018; Agustin et al., 2019). As a result, teachers and lecturers are responsible for choosing suitable learning materials to effectively support the educational process. The crucial nature of these instructional tools lies in their adaptability and close alignment with the local cultural context of the students. By incorporating regional cultural components into the educational resources, teachers can cultivate a more welcoming, understandable and productive scholarly setting for their students (Sudarsana, et al.,

2020; Sudarsana, Suyanta, et al., 2020).

Instructing students in computational thinking through computer programming can effectively facilitate the process of them developing digital media. By having coding integrated into the educational curriculum, essential analytical skills are not only acquired by learners, but the technical proficiency required to design and produce their own media projects is also gained. This teaching method connects the theoretical side of logic with the practical side of using it, and in the end it makes students able to create in a digital world in an active and innovative way (Brennan & Resnick, 2012). Computational thinking is a way of thinking about problems and solutions. It is a step-by-step process. In simple terms, it means to break down complicated issues into smaller, easier-to-understand parts. Then, you need to arrange the suggested solutions in a clear, step-by-step way. The way it's set up makes it easy for computers or algorithms to understand and use the solutions. By linking human logic with computer implementation, this cognitive structure allows for more efficient, extendable, and accurate problem solving in a range of academic and real-world scenarios (Wing, 2011).

The existence of computational thinking as a fundamental cognitive process is independent of any specific technology. It is not just a technical skill. It is a way of solving problems that is easy to follow. This approach is deliberately crafted to be carried out by people, machines, or a combination of both, depending on the type of problem being tackled. By centring on the fundamental reasoning and the methodical decomposition of intricate concerns, computational thinking offers a multifaceted structure that improves judgement and creativity across a wide range of scholarly and occupational domains (Akbar & Satria, 2019; Rahim et al., 2019; Maseleno et al., 2021). Intricate challenges can be addressed effectively by operating within a framework of four fundamental principles of computational thinking. The methodology commences with decomposition, which involves the segmentation of extensive systems into more compact and highly manageable components. Then, experts look for patterns to find the things that are the same in different situations. Abstraction is the third most important part. It helps scholars to focus only on the important information and forget about the things that are not important. The process concludes with the creation of a set of rules in a clear and step-by-step order that is necessary to successfully solve the main problem (Satria et al., 2023). It is very important to start teaching computational thinking at primary school, because this helps young learners to understand how to solve problems in the real world and in school. The development of these foundational skills by students results in an encouragement of more critical and creative thinking. This way of thinking helps them solve problems in their school books that teachers give them, and also helps them make digital media that has a lot of meaning. The ability to learn and innovate throughout life is best supported by nurturing computational thinking from a young age (Natali, 2022).

Preliminary findings suggest that students have not yet been introduced to the development of animated educational materials using block programming and computational thinking. At the moment, PowerPoint and similar software is used extensively by both lecturers and students. The instructional approach is largely passive and unidirectional, although there is occasional incorporation of downloaded internet resources such as videos and images. As a result, learners simply watch and listen without taking an active part in the academic material. This boring way of learning often makes students lose interest. Many students stop listening to lectures or presentations and use their phones for social media or games. To deal with these teaching problems, it is important to teach people how to think like a computer and use block programming through training that is designed for this. Students can learn to create their own interactive and moving educational materials by looking at clear examples of programming projects. This project is especially

important for students on teacher training courses at primary school level. As Physics is habitually regarded as a challenging and uninspiring discipline, it is imperative to furnish these prospective pedagogues with the competencies to devise captivating visual materials, thereby substantially elevating the pedagogy of scientific concepts. The ultimate result of this approach will be an increase in the accessibility, enjoyment and comprehensibility of Physics for young learners in elementary classrooms (Lusiani et al., 2021). It is vital to innovate in education if we want to make teaching scientific concepts more engaging and enjoyable for students.

This aim can be accomplished by creating multimedia resources that are interactive and combine text, images, videos and audio in a smooth way. Ensuring broad accessibility for these materials is dependent on full compatibility with both smartphones and laptops. Moreover, simple visual programming blocks should be utilised in the development process, allowing these interactive tools to be easily constructed by even novice programmers without advanced technical expertise being needed (Iskandar et al., 2019; Fatah et al., 2019; Saddhono et al., 2019). A variety of digital tools have been used by numerous researchers to explore the development of interactive media in their studies. For example, a number of research projects have used easy-to-use software such as Microsoft PowerPoint or Powtoon (Handayani & Dahlia, 2022; Chaerun et al., 2023). Some have chosen to use more specialised software, such as Macromedia Flash, to create their interactive content (Syaflin, 2022; Sidik et al., 2020). And on top of that, visual programming and development platforms like Construct 2 (Megawaty et al., 2021; Widyastuti & Puspita, 2020) and App Inventor (Hanif, 2021; Firdaus & Hamdu, 2020), have also been used a lot in similar academic research. The variety of ways in which technology is being used shows a growing trend of incorporating interactive and captivating media into educational and scholarly projects.

This research is different from other studies because it uses a new way of doing things. This new way is called Scratch and it is used to make things that you can interact with. These things are made up of blocks that are designed to help solve problems. The project is for students who are learning to be teachers at primary school. This plan is to make people better at thinking using computers. It does this by teaching them important ideas about computer programming. These ideas include events, sequences, loops, parallelism, conditionals, operators, and data processing. This is an area that has not been explored in Indonesian schools. To make sure the study is valid, it looks at how well this training material works in practice. The project's main aim is to create a practical and highly valid media project based on the Scratch application. This is in response to the lack of interactive programming tools for computational thinking that currently exist. The project will foster strong programming competencies. At the end of the day, this interactive platform is not only a first-class final task for training in computational thinking but also a trustworthy source for implementing these programming principles, empowering future teachers to create teaching materials for a range of subjects, including Basic Physics.

RESEARCH METHODOLOGY

The systematic and methodological approach of research and development is how scholars design, test and refine innovative products. Within this academic framework, there is no reliance on theoretical assumptions by researchers. Alternatively, they proactively collect and examine real-world information during the whole developmental cycle. The integration of quantitative metrics and qualitative feedback ensures the rigorous validation of newly created models against practical evidence by these professionals. The bridging of the gap between abstract concepts and highly effective solutions is ultimately guided by concrete data in this process (Gall et al., 1996). The research and development (R&D) approach is chiefly used to develop a physical product, which in

this particular situation refers to educational learning materials. Subsequent to the preliminary design and development phases, the freshly minted media is subjected to a methodical evaluation process. This next testing stage is very important to see if the media can be used to teach people and if it works well. By doing these trials, researchers can collect real data to show that the product is easy to use. This makes sure that the learning media really achieves its teaching goals in the real world (Dick et al., 2015). This study uses the ADDIE growth model to develop interactive educational resources that meet recognised teaching standards. The ADDIE framework is made up of five stages which are ordered systematically. Analysis, Design, Development, Implementation and Evaluation. When they are looking at the problem, the people doing the study find out what is already wrong with the way people learn, and what the people learning need. The next step is the design phase, where the focus is on creating the product's structure through storyboards, layouts and interactive interface designs. The development stage is initiated with the construction of the media utilising the Scratch application, subsequently accompanied by meticulous testing and debugging to ensure optimal functionality and alignment with the stipulated objectives. The implementation phase follows the refinement stage and involves introducing the finalised media to the target users in a real learning context. Finally, the review stage checks every step of the process and the final product to make sure it is the same as the quality specifications that were decided before.

The study looked at a group of people, including two people who know a lot about materials, two people who know a lot about media, and forty students training to be elementary school teachers from private universities in Sumatra. In order to amass exhaustive insights, the researchers employed a combination of quantitative and qualitative data collection methodologies, with a particular focus on observations, interviews, Likert-scale questionnaires, and artifact analysis. This dynamic educational resource was custom-made to function as a hands-on guide for final projects, encouraging computational thinking and problem-solving exercises within scientific courses. A thorough, reliable and well-rounded assessment of the educational effectiveness of the developed media is ensured by the study's integration of robust and varied data collection techniques (Sudarmo, Muharlisiani, et al., 2021; Latief et al., 2025). Researchers used a customized questionnaire for this. It was based on a Likert scale with four distinct response options. This was to gather comprehensive evaluation data. This data was for the interactive media currently under development. The survey instrument offered participants specific alternatives. This allowed it to effectively capture quantitative feedback. The feedback was regarding the quality and usability of the digital tool. This made sure that the information collected was a true picture of what the media was like (Likert, 1932). The researchers used special validation questionnaires. These were tailored for material and media experts. This was to gather the necessary data for the study. Tables 1 and 2 provide a clear and comprehensive framework for the evaluation process by systematically detailing these essential data collection instruments.

Table 1. Material Expert Questionnaire

Aspect	Indicator	Number of Items
Learning	Competency compatibility	3
	Providing Motivation	3
	Assessment	2
Material Content	Material Quality	3
	Material Selection	2
Videos	Material Suitability	2
Total	15	

Table 1 presents the material expert questionnaire, which consists of two main aspects: learning and material content, with a total of 15 assessment items. The learning aspect covers three indicators, namely competency compatibility, providing motivation, and assessment, consisting of 3, 3, and 2 items, respectively. Meanwhile, the material content aspect includes three indicators: material quality, material selection, and material suitability, comprising 3, 2, and 2 items, respectively. These indicators are designed to evaluate the quality, relevance, and appropriateness of the learning materials in supporting the achievement of learning objectives. The questionnaire serves as an evaluation instrument for material experts to determine whether the developed learning materials meet the expected standards and are suitable for use in the learning process.

Table 2. Media Expert Questionnaire

Aspect	Indicator	Number of Items
Media Quality	Easy to use	**Number of Items**
	Background selection music/sound	3
Media Visual	Image quality	2
	Layout	3
	Suitability of illustration	2
Videos	Suitability of videos to material	1
Total		1

Two distinct questionnaires were given to a panel of subject matter experts during the development phase of the computational thinking interactive media product. The information collected from material specialists, media experts, and end users was reviewed using a structured four-point rating scale, where a score of four reflects very good, three indicates good, two denotes fair, and one means not good. The Gregory formula was used to rigorously assess the validity of the research instruments to ensure the robustness and reliability of the collected data (Gregory, 2014). The numbers given for each statement are turned into a percentage. This is done by getting the actual score and dividing it by the highest possible score. Then the result is multiplied by one hundred. These average scores are then put into four groups: very good or very useful, good or useful, not good or not useful, and not good or not useful. Dr. Scratch, an open-source web application, is used to evaluate the developed programming artefacts.

This computer program looks at the Scratch code that is made and gives scores for how well the program does these things: problem separation and breakdown, things happening at the same time, logical thinking, keeping things in order, how the user interacts with the program, and how data is shown (Moreno-León et al., 2015). The overall Computational Thinking (CT) score is decided by combining the separate partial scores allocated to each distinct CT concept. This data is then used to put projects into three groups based on how good they are. This makes it easier to evaluate them in a clear and organised way. In particular, schemes that attain a maximum rating of 7 points are categorised as displaying a rudimentary level of computational thinking. In addition, people who get a score between 8 and 14 points are considered to be working on projects that show a medium level of skill development. At last, initiatives that rack up over 15 points are officially acknowledged as sophisticated, demonstrating a high level of proficiency and a thorough grasp of computational thinking tenets.

RESULT AND DISCUSSION

This section presents the research results and discussions to answer the research questions.

Analysis Stage

At the start of the project to train people in computational thinking, we found out what the specific problems were when it came to making interactive animation media. For novice programmers, the required programming curriculum is important. This is particularly so for students in elementary school teacher education. The curriculum encompasses several core modules. These include getting to know the Scratch application skills, how to make things move and draw things for sequencing, visual and audio effects, variables involving operators and data, making decisions based on conditions, and loop repetitions. It is notable that this specific curriculum has never previously been introduced to these teacher candidates. The selection of the Scratch platform was due to its significantly more accessible visual block programming interface in comparison to traditional text coding. This is a good way to learn for kids in primary school and students training to be teachers at university who have never learned about computer languages before. Significant gaps in the current educational environment have been revealed by recent observations and interview data. Specifically, the abilities to think in a computational way through Scratch programming are not imparted at all, and the teaching materials that are available are extremely restricted to wearisome PowerPoint presentations. This has led to students finding it difficult to understand the concepts, which has resulted in lecturers having to repeatedly explain them. Additionally, students are facing a shortage of adequate reference materials. In addition, educators have reported that students often lack motivation and are frequently distracted by mobile phones, social media, and gaming. A significant challenge confronting the lecturers themselves pertains to their incapacity to engineer interactive animated simulations for intricate concepts. To deal with these problems, it is very important to use teaching materials that clearly present information, include videos to explain things, and provide practice questions to help people understand and remember what they have learned. The end goal is to create an interactive platform that will allow students to study independently at home. The development of this platform will be a joint effort between lecturers and students, who will work together to create it through the use of computational thinking training in Scratch.

Design Stage

This investigation created programming project tasks that incorporate fundamental computational thinking principles, particularly sequences, loops, conditionals, operators, and data, to assist learners in developing interactive animation media. During the design phase, the team created a number of documents to help plan the game. These included flowcharts, scene layouts and storyboards. They also produced detailed interface designs. As demonstrated in Figure 1, the complete flowchart acts as the essential framework for the learning medium. The launch of the interactive project within the Scratch application by users results in their first experience being a welcome image for the computational thinking lecture on the cover page. A main menu is displayed to users when they click the start button, with four distinct sections. The material segment provides the fundamental components of the topic, while the video segment presents animated material intended to enhance the comprehension of the four cornerstones of computational thinking. Additionally, a pool of 20 randomly selected questions is used in the practice section to ensure a diverse assessment experience and avoid exact repetitions. At last, a special page has been added that tells you exactly how to use the interactive learning application.

Development Stage

The development stage is a very important part of how a product is made. It is when the results of the earlier analysis and design processes are changed into a product that works. In this specific investigation, the creation and design of the product were carried out using Scratch software as the main programming platform. As shown in Figures 2, 3, 4 and 5, the development process resulted in interactive animation media that was specifically designed to support computational thinking instruction. During this step, the design and programming of the media deliberately included all four main computational thinking skills, which are making things simpler, breaking things down, seeing patterns, and thinking about algorithms. These abilities were interwoven with essential programming principles that learners generally come across during training in computational thinking, with the primary aim of enhancing their capacity to tackle and resolve programming challenges in a methodical and rational way.

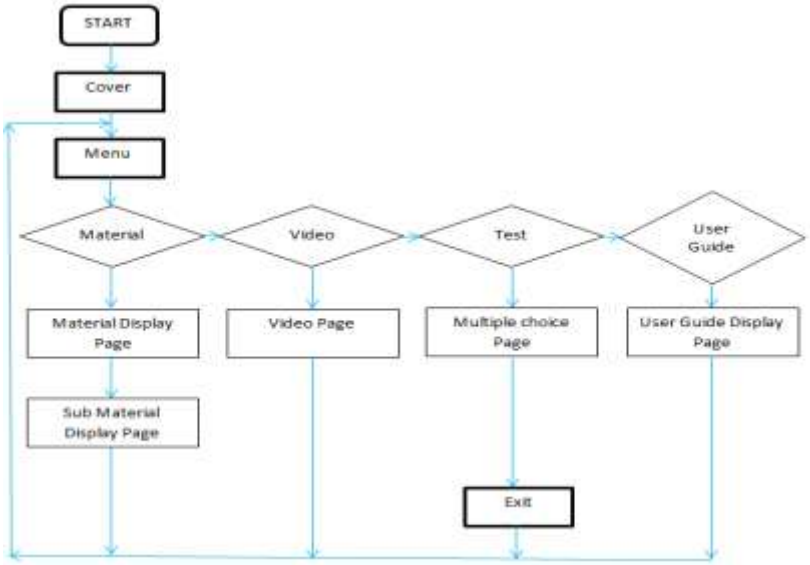


Figure 1. Media flow diagram

The flowchart illustrates the navigation flow of an educational or learning application starting from the Start stage and moving to the Cover, followed by the Menu, which provides access to four main sections: Material (leading to the Material Display Page and Sub Material Display Page), Video (leading to the Video Page), Test (leading to a Multiple Choice Page and then to Exit), and User Guide (leading to the User Guide Display Page), with return paths allowing users to navigate back to the Menu across the flow.



Figure 2. Computational thinking cover and menu material page



Figure 3. Computational thinking material page



Figure 4. Question practice page and block programming form in Scratch (which contains the concepts of events, sequences, parallelism, conditional, and looks)



Figure 5. User guide and video animation material page

The created learning materials were subjected to a thorough verification procedure involving two material specialists, two media specialists, and six learners. The learning media was categorised as highly valid (i.e. perfect validity score of 100%) by material and media experts, as shown in Table 3. Several targeted enhancements were implemented to optimise the design, guided by constructive feedback from the experts. These improvements included adding interesting and suitable picture examples, improving the button layout and how things look, making the practice questions more varied in how hard they are, and creating more useful programming projects that fully cover all the ideas about computational thinking that are taught. After making these changes, the updated learning materials were tested with a group of six students. The helpful comments and suggestions from these students were then used to make more improvements to the educational media.

Table 3. Experts Assessment Results

Expert Validation	Value	Description
Material	1 (100 %)	Very Valid. Can be tested in the field
Media	1 (100 %)	Very Valid. Can be tested in the field
Average Score	1 (100 %)	Very Valid. Can be tested in the field

After experts in materials and media did some detailed tests, and some students gave their early thoughts, the new interactive animation for computational thinking was approved and is ready to be tested with research subjects. The Dr. Scratch evaluation tool was used to assess the difficulty level of the Scratch programming project that was created. There is a necessity to make the following observation: the process was subject to system errors resulting in the unavailability of automated web-based checking. The online version of Dr. Scratch is still being tested, so it has some problems and still has to fix some bugs. These technical limitations mean that the tool needs to be improved in the future to make sure it works as well as possible and provides useful feedback to help with further programming enhancements. Notwithstanding these provisional limitations, the assessment was concluded successfully, and the precise difficulty ratings for the devised Scratch programming initiative are specified in Table 4.

Table 4. Results of the Scratch project points assessed by Dr. Scratch rubric

No	CT Concept	Competence Score
1	Abstraction and problem decomposition	1
2	Paralelism	3
3	Logical thinking	2
4	Synchronization	3
5	Flow Control	2
6	User Interactivity	2
7	Data representation	1
Total point	14	

Table 4 presents the computational thinking (CT) assessment results of a Scratch project evaluated using the Dr. Scratch rubric, earning a total score of 14 points across seven concepts. The project achieved the highest competence scores of 3 in parallelism and synchronization, followed by scores of 2 in logical thinking, flow control, and user interactivity, while abstraction and problem decomposition and data representation each received a score of 1.

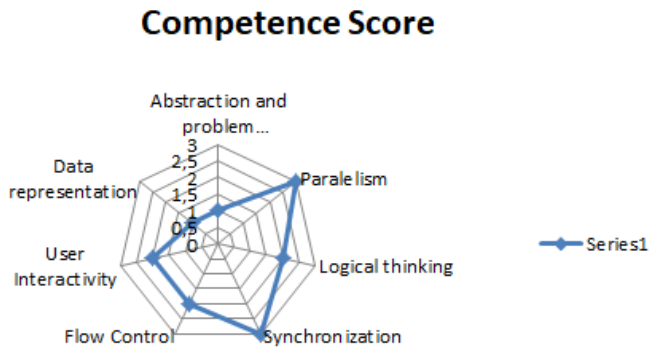


Figure 6. Results of the Scratch project points assessed by Dr. Scratch rubric

Pursuant to the evaluation undertaken with the Dr. Scratch assessment instrument, the media programming project attained a cumulative total of 14 points out of a maximum of 21, thereby categorising it within the Developing or Medium echelon of difficulty. For how it is separated into parts and for how it is put together, the project got 1 point because the game plan was made using more than one script given to one sprite, showing not much organisation. The idea of running two different processes at the same time got 3 points, as the project used two different scripts that were

triggered by "when the backdrop switches to" and "when the button is pressed" events. This shows that it can run different processes at the same time. The project was awarded 2 points for logical thinking due to the incorporation of an if-else command block within one of the sprites, which demonstrates a fundamental understanding of conditional reasoning. The idea of making sure everything is in time also got 3 points, because there was a "broadcast" and a "when backdrop switches to" command block in one of the sprite scripts, showing that different parts of the program can work well together. Two points were awarded to Flow Control because specific sprites employed "repeat" and "forever" command blocks to regulate iterative processes within the media. The project was awarded two points in the area of user interactivity because it contained sprites with scripts that used the "clicked sprite" command block to allow users to interact with it. Ultimately, the data representation was awarded a single point, given that the sprite media comprised solely adjustments to visual attributes, with no profound data manipulation. In sum, these results indicate that while the project evinces a satisfactory basis in a number of computational thinking concepts, there is still scope for enhancement, in particular with regard to abstraction, problem decomposition and data representation.

Implementation Stage

The evolution of interactive Scratch programming media for computational thinking underwent a rigorous and systematic process. Initially, the prototype was validated by experts and trialled by small groups, which informed the necessary revisions to create the final product. A cohort of 40 students then evaluated this final application for practicality. To make it easy for people to get the information, the researchers shared the links to the information in WhatsApp groups. This way, all students could easily use the learning application on their own laptops or phones using a normal internet connection. At last, the research team meticulously documented the usage feedback from these participants to guarantee ongoing enhancements and make sure the educational resource stays extremely effective.

Evaluation Stage

At every stage of the development process, activities are carried out to evaluate the product. This allows for continuous refinement before the final implementation stage. An essential stage in this review is to improve the interactive learning materials following in-depth evaluations by media specialists, subject matter experts, and small focus groups. Feedback received during this stage is used to revise the interactive learning media for this stage, which is used to develop the final product, the quality of which is to be improved. For example, they said that it would be good to include animated videos with simpler, more relatable examples of computational thinking ideas, and to provide more practice questions to help students understand. In the final analysis, the user feedback evaluated the created Scratch-based interactive learning media as "Very Practical," attaining an impressive score of 86%, as delineated in Table 5. It is indicated by this quantitative data that computational thinking training and problem-solving programming projects are effectively supported by the application. Also, the media can be used in many ways. It can be used in the classroom and on its own. It can be used on Android phones and laptops.

Table 5. Practicality Assessment of Computational Thinking Interactive Media

Aspect	Value	Description
Aspects of CT programming concepts	85 %	Very Practical
CT learning aspects	85 %	Very Practical
Visual aspects of media	85 %	Very Practical
Aspect level of programming problem-solving questions	85 %	Very Practical
Aspects of the benefits of CT materials and skills	90 %	Very Practical

Average Score	86 %	Very Practical

When it comes to computer programming education, most students (85%) think these projects are very easy to understand and manage. Moreover, they are of the conviction that the provided illustrations can be readily adapted for utilisation in other academic disciplines. In addition, the employment of the Scratch application renders the mastery of rudimentary programming concepts remarkably uncomplicated. The findings are based on data analysis. They also take into account the development of interactive media projects. These projects focus on computational thinking. They are developed through Scratch. The findings indicate that these educational tools are highly feasible. They are also practical for classroom implementation. This matches what other studies have found, which says that interactive media is a good way to help students learn (Wulandari et al., 2017; Sugiyarto et al., 2021; Satria et al., 2024). More studies show the same results. They show that interactive media can be used at all levels of education. They also show that interactive media can be a useful learning tool in the classroom (Ketut Sinta et al., 2021; Kurnia et al., 2023; Satria, Sa'ud, Riyana, et al., 2024; Satria et al., 2024). The cognitive understanding abilities of students are also significantly boosted by the integration of such media (Suwiantini et al., 2021). Student learning outcomes are positively impacted by the use of high-quality instructional materials. These tools do more than just help educators deliver course content; they also make it easier for learners to absorb knowledge (Satria & Sari, 2018; Satria et al., 2023; Satria, Gusmaweti, Har, et al., 2024; Abidin et al., 2026; Satria et al., 2024).

Furthermore, the judicious exploitation of media by educators engenders favourable student evaluations of their instructors, thereby acknowledging those who demonstrate excellence in pedagogical practices (Abdullah, Hartono, et al., 2019). At last, a thorough analysis of different pieces of research shows that the clever use of teaching materials can reliably boost the progress of pupils' overall academic success (Satria, 2013; Satria, 2015; Satria, 2020; Satria, 2019; Morales-Obod et al., 2020). Additionally, the creation of this interactive animated media project successfully refines students' computational thinking abilities as they comprehend essential programming principles, including events, sequences, parallelism, loops, conditionals, operators, and data. This educational resource is intended for use by learners and instructors to pinpoint and nurture the four primary elements of computational thinking: abstraction, decomposition, pattern recognition, and algorithms (Satria & Sopandi, 2022). Additionally, the media functions as a hands-on learning tool, especially by serving as a complete illustration of a final assignment for resolving a variety of programming challenges.

CONCLUSION

From the data analysis of research and development results carried out on the development of an interactive learning media project for computational thinking programming with Scratch software as an example of a final problem-solving assignment in computational thinking training for elementary school teacher education students, it can be concluded that the programming project application created is very valid with a score of 100 % and very practical with a score of 86% so it is suitable for learning computational thinking programming material after validation by material experts, media and user trials. The difficulty level of the programming projects created is at the medium level, so it is not too difficult for students to create them. The interactive media created can help students understand the material and computational thinking programming concepts taught. The interactive media created can also be modified (remixing) and used for independent learning to develop students' computational thinking skills. For future research, it is recommended to use

programming concepts at a higher or more difficult level by using programming command blocks such as create clone, logic operation, and list.

DECLARATION OF AI AND AI ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

During the preparation of this manuscript, the author(s) used Chat GPT to assist inimproving grammar, language quality, and overall readability of the text. After using this tool, the author(s) Carefully reviewed and edited the content as necessary and take full responbility for the content of the publication.

AUTHORS' CONTRIBUTION

Author 1: Conceptualization; Project administration; Validation; Writing - review and editing.
Author 2: Conceptualization; Data curation; In-vestigation.
Author 3: Data curation; Investigation.
Author 4: Formal analysis; Methodology; Writing - original draft.
Author 5: Supervision; Validation.

DECLARATION OF COMPETING INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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