

<https://research.adra.ac.id/index.php/jete/>

P - ISSN: 3025-0668

E - ISSN: 3025-0676



## Development of Interactive Learning Media as a Final Problem-Solving Project to Improve Computational Thinking Abilities of PGSD Students with Scratch

Erwinsyah Satria<sup>1</sup>, Gusmawetti<sup>2</sup>, Enjoni<sup>3</sup>, Melati Suci<sup>4</sup>, Zafara Khairul Nissa<sup>5</sup>

<sup>1</sup> Universitas Bung Hatta, Indonesia

<sup>2</sup> Universitas Bung Hatta, Indonesia

<sup>3</sup> Universitas Bung Hatta, Indonesia

<sup>4</sup> Universitas Bung Hatta, Indonesia

<sup>5</sup> Universitas Bung Hatta, Indonesia

### ABSTRACT

**Background.** The background of this research is the challenges faced in teaching abstract concepts in elementary school material learning to make it easier to understand and interesting for elementary school children.

**Purpose.** The purpose of this research is to explore students' abilities in creating interactive learning media with the Scratch application so that the level of students' computational thinking abilities in lectures can be known.

**Method.** The method used in this research is the ADDIE model. The research participants were 40 students of a private university in West Sumatra. Data were collected using observation, interview, artifact analysis, and questionnaire techniques.

**Results.** The research instrument was a questionnaire with a Likert scale filled out by material experts and media experts. Analysis of the research results was carried out descriptively and qualitatively. From the development research conducted, it was found that the interactive learning media programming problem-solving project for computational thinking developed by PGSD students as a problem-solving assignment obtained a very valid value with a score of 93.75% from the validation of material and media experts and was feasible to use and made it easier for students to create their programs because the difficulty was at an intermediate level.

**Conclusion.** In conclusion, the application of computational thinking through the Scratch programming problem-solving project assignment in creating elementary school learning material media in lectures will add more interesting learning innovations and be suitable for PGSD students.

### KEYWORDS

Computational Thinking, Interactive Learning Media, Problem Solving

**Citation:** Satria, E., Gusmawetti, Gusmawetti., Enjoni, Enjoni., Suci, M & Nissa, K, Z. (2026). Development of Interactive Learning Media as a Final Problem-Solving Project to Improve Computational Thinking Abilities of PGSD Students with Scratch. *Journal Emerging Technologies in Education*, 4(5), 411–429. <https://doi.org/10.70177/jete.v4i5.4462>

### Correspondence:

Erwinsyah Satria,  
[erwinsyah.satria@bunghatta.ac.id](mailto:erwinsyah.satria@bunghatta.ac.id)

**Received:** April 12, 2026

**Accepted:** September 15, 2026

**Published:** October 16, 2026



### INTRODUCTION

National education that wants to advance must be responsive to the demands and progress of the times and technology of this century globally (Satria, 2016; Sudarsana et al., 2020). The progress of science and technology in the 21st century is so rapid that all aspects of human life, including the world of education, are affected by its existence. Science and technology are

based on scientific thinking, critical thinking, and the conduct of new investigations and discoveries by scientists in solving problems to simplify and improve the quality of human life (Wikandaru et al., 2020; Satria & Widodo, 2020; Satria & Sopandi, 2019; Satria, 2018; Zulkifli et al., 2022; Maulana et al., 2021; Ichsan et al., 2023). With the advancements in science and technology that can be applied to education and the learning process, the world of education is currently growing (Satria, 2015; Sudarsana et al., 2019; Satria & Sopandi, 2022), various reforms continue to be carried out to improve the quality and quantity of education (Suharyat et al., 2022; Satria et al., 2023; Haniko et al., 2023). Various breakthroughs in curriculum development, learning innovation, learning technology, and the provision of educational facilities and infrastructure are urgently needed to improve the quality of education (Rahmat et al., 2021; Maruf et al., 2022; Satria, Efendi, et al., 2023; Satria et al., 2024). During the global COVID-19 pandemic, much learning took place online (Ichsan et al., 2022). Digital and online learning technologies developed rapidly, and the education sector was required to utilize them (Sudarmo et al., 2021; Manullang & Satria, 2020; Sudarsana, Armaeni, et al., 2019; Suharyat, Ichsan, Satria, & Santosa, 2022). Mastery of digital technology has become a necessity for teachers and students during the pandemic (Wahyuningtyas et al., 2022; Satria et al., 2023; Satria, Sa'ud, Riyana, Sopandi, & Rahmiani, 2024).

Integrating technology and digital learning media is an absolute requirement for teachers and lecturers today (Satria, 2021; Sudarsana, Mulyaningsih, et al., 2019; Arifin et al., 2023). Lecturers or teachers must be able to choose technology and media that can help students or students more easily understand the material being taught (Satria, 2017; Nurdin et al., 2019; Abidin et al., 2023). Learning media in general is a tool in the teaching and learning process (Satria & Sari, 2018; Satria et al., 2022). Anything that can be used to stimulate thoughts, feelings, attention, and learning abilities or skills to encourage the teaching and learning process can be called media (Abdullah et al., 2019; Satria, Suseno, et al., 2023, Satria, Hendrizal, et al., 2023). The definition is quite broad and in-depth, including the understanding of sources, environment, people, and methods used for learning purposes (Satria, 2019; Suharyat, Supriyadi, Satria, & Santosa, 2022). This includes communication tools such as print, visual, and audio media, as well as hardware and software technology (Sudrajat et al., 2018; Kurniasih et al., 2019; Sudarsana, Armaeni, et al., 2019; Morales-Obod et al., 2020; Satria, Sa'ud, et al., 2022).

Factors supporting the achievement of learning objectives include selecting appropriate learning media and technology (Egline & Satria, 2014; Har et al., 2018; Sudarsana et al., 2019). Appropriate learning media is defined as how it can create learning that is appropriate to student characteristics and learning materials to achieve learning objectives (Satria, 2018; Agustin et al., 2019). Therefore, a teacher or lecturer must be able to select appropriate learning media to support the learning process and adapt to their local culture (Sudarsana et al., 2020; Sudarsana, Suyanta, et al., 2020). Students can create media by teaching computational thinking skills through computer programming (Brennan & Resnick, 2012).

Computational thinking skills are important for students to learn even in elementary school to solve various problems related to the subject matter or everyday life. Computational thinking skills can encourage students to think critically and creatively (Natali, 2022) in finding solutions to problems in the learning material presented by teachers or lecturers, as well as in creating media.

Based on initial observations conducted by researchers, information was obtained that creating animated learning media using block programming that applies computational

thinking concepts had never been taught to students. Furthermore, lecturers and students in science or learning media when delivering lecture material only used PowerPoint and Canva applications, which do not require complex thinking or programming skills and are less interactive even though they have downloaded materials, videos, images, and learning media from the internet. This learning process seems one-way, with students simply watching and listening to the material being presented, and it does not allow for active, direct interaction with the material being presented. Furthermore, based on observations regarding the teaching process, which does not require higher-order thinking skills (HOTS) and is less creative, it is evident that many students pay less attention to lecturers while teaching because they are busy looking at their phones, social media, or playing more interesting games.

One way to address this issue is to introduce computational thinking materials and concepts using block programming through lectures by providing examples of programming projects in the form of interactive media that students can create so that they can later be used to create animated media in their lectures, especially for elementary school material. This will make the process of delivering lecture material more interesting, enjoyable, and easy to understand, especially for elementary school teacher education students who will teach elementary school material, where science and media lecture materials are less interesting in their presentation and the concepts are somewhat difficult to understand (Lusiani et al., 2021). Therefore, teaching innovation is needed to make learning science concepts or other subject concepts more interesting and enjoyable to learn, namely by developing interactive learning multimedia containing text, images, videos, and sounds that can be run and opened on mobile phones and laptops (Iskandar et al., 2019; Fatah et al., 2019; Saddhono et al., 2019) which are easy to create with simple block-based programming that can also be created by novice programmers.

Many other researchers have conducted research using interactive media creation, including using PowerPoint or Powtoon applications (Handayani & Dahlia, 2022; Chaerun et al., 2023), Macromedia Flash (Syafliin, 2022; Sidik et al., 2020), Construct2 (Megawaty et al., 2021; Widyastuti & Puspita, 2020) or App Inventor (Hanif, 2021; Firdaus & Hamdu, 2020). Different from these researchers, the researcher offers the creation of interactive learning media in lectures using block-based Scratch application programming as a final project assignment for problem-solving for elementary school teacher education students for computational thinking programming training materials that hone programming concepts such as events, sequences, loops, parallelism, conditionals, operators & data, which have not been studied by other researchers in Indonesia.

## LITERATURE REVIEW

Daryanto (2015) explains that learning media is anything used by a message sender (teacher) to a message recipient (student) to increase students' interest and enthusiasm in learning a particular subject. Learning media are various tools that assist teachers in delivering learning materials so that they are more easily understood by students.

Computational thinking is the thought process involved in formulating problems and solutions so that these solutions are represented in a form that can be effectively implemented by information processing agents (Wing, 2011). Therefore, computational thinking is a thought process independent of technology, and computational thinking is a problem-solving method designed to be solved and carried out by humans, computers, or both (Akbar & Satria, 2019; Rahim et al., 2019; Maselena et al., 2021). There are four main techniques (foundations) of

computational thinking as a problem-solving strategy (Satria et al., 2023): decomposition - breaking down a complex problem or system into smaller, more manageable parts; Pattern recognition - finding similarities between and within problems; abstraction - focusing only on essential information, ignoring irrelevant details; algorithms - developing a step-by-step solution to a problem or a set of rules to follow to solve it.

One programming tool used to develop students' computational thinking (BK) abilities or skills is the block-based programming program Scratch (Berland & Wilensky, 2015; Brennan & Resnick, 2012), which can also be used to develop digital competencies and 21st-century skills (Zhang & Nouri, 2019). Furthermore, Scratch offers particular advantages for young learners because it provides "very basic" programming features, allowing children to get started early (Maloney et al., 2010).

Based on the theory proposed by Maloney et al. (2010), the block-based Scratch software can be considered an attractive tool for acquiring computational thinking skills because it provides students and teachers with the opportunity to learn by doing (Tan & Kim, 2015; Cárdenas et al., 2014). The block-based graphical programming environment is relatively easy to use and allows early experiences to focus on design and construction. It can also avoid programming syntax issues for students from kindergarten through high school or non-computer science majors (Ma et al., 2021). Furthermore, using the Scratch application can teach students to master computational thinking skills and train them in programming (Lye & Koh, 2014).

Scratch will become an environment where computational thinking is transferred and applied. Brennan & Resnick (2012) created a framework that identifies seven computational thinking concepts inherent in coding: sequences, loops, events, parallelism, conditionals, operators, and data. These concepts are not limited to Scratch and can emerge in other programming contexts.

In connection with the explanation of the background of the problem, because there is no lecture on making interactive learning media for computational thinking with block programming, this study aims to develop interactive learning media for computational thinking using the Scratch application which is valid and practical and has a good level of programming competence which is useful as a final assignment for solving programming problems in media lectures or basic science concepts for elementary school teacher education students. The development of teaching materials to make this interactive learning media is also useful as a reference for applying the concept of computational thinking programming learned in lectures and can later be used to make media for lecture materials for elementary school or learning materials for elementary school students. pelatihan pemrograman berpikir komputasional yang mengasah konsep-konsep pemrograman seperti events, sequences, parallelism, loops, conditionals, operator & data, yang belum diteliti oleh peneliti lainnya di Indonesia.

## RESEARCH METHODOLOGY

### Type and Design

Research and development (R&D) (Gall et al., 1996) is used as one type of development research conducted by researchers. Research and development is used to develop a product, in this case in the form of media and learning materials, and then after the design and development process, the process of testing the practicality or effectiveness of the teaching materials or media as a product is carried out (Dick et al., 2015). The development model used in the research is the ADDIE model which consists of five process stages to produce interactive

learning media products that comply with standards, namely: (1) Analyze, (2) Design, (3) Development, (4) Implement, (5) Evaluation. The analysis stage is related to the analysis activity or identifying any problems found in a particular environment so that ideas or thoughts emerge in determining the product to be developed. Analysis is carried out to determine user needs supported by the specifications/characteristics of the media or learning materials being developed. Design is the stage for designing a product according to the needs or analysis that has been carried out previously. Includes activities to create the content of the teaching materials or storyboard, layout, and design the interface of the interactive media being created. The third stage is development, which involves creating media or teaching materials using the Scratch application, testing the developed media, and revising or debugging them to ensure they run smoothly and meet the desired requirements. In the implementation stage, the media or teaching materials are ready for use by research subjects as users. Next, the fifth and final stage of the ADDIE model is evaluation, which involves evaluating and assessing each step taken to achieve a product that meets the specified specifications. The goal is to measure the quality of the developed product.

#### Data and Data Sources

The participants in the study were two subject matter experts, two media experts, and 40 elementary school teacher education students from a private university in Sumatra. Quantitative and qualitative data were collected through observation, Likert scales, artifacts, and interviews. This interactive learning media was used as an example of a problem-solving project assignment for computational thinking learning and for science courses.

#### Data Collection Technique

Quantitative and qualitative data were collected through observation, Likert scales, artifacts, and interviews. Data collection techniques used were observation, interviews, and questionnaires (Sudarmo, Muharlisiani, et al., 2021). To obtain data regarding the assessment of the interactive media developed, a Likert scale questionnaire (Likert, 1932) was used with four types of choices for the validation of the material expert questionnaire (Table 1) and the validity of the media expert questionnaire (Table 2).

**Table 1.** Subject Matter Expert Questionnaire

| No    | Aspect           | Indicator                | Number of Items |
|-------|------------------|--------------------------|-----------------|
| 1     | Learning         | Competency Compatibility | 3               |
|       |                  | Motivation               | 3               |
|       |                  | Assessment               | 2               |
| 2     | Material Content | Content Quality          | 3               |
|       |                  | Material Selection       | 2               |
|       |                  | Material Suitability     | 2               |
| Total |                  |                          | 15              |

The questionnaires from material experts and media experts were distributed to experts at the development stage of interactive computational thinking learning problem-solving media products.

**Table 2.** Media Expert Questionnaire

| No | Aspect               | Indicator   | Number of Items |
|----|----------------------|-------------|-----------------|
| 1  | Media Quality        | Ease of use | 3               |
|    | Background selection | 2           |                 |
|    | Music/sound          |             |                 |

|   |                    |                          |           |
|---|--------------------|--------------------------|-----------|
| 2 | Media Presentation | Image quality            | 3         |
|   |                    | Layout                   | 2         |
|   |                    | Illustration suitability | 1         |
| 3 | Video              | Video suitability        | 1         |
|   |                    | to the material          |           |
|   |                    | <b>Total</b>             | <b>12</b> |

### Data Analysis

Data were obtained from questionnaires administered to subject matter experts, media experts, and users with scale options of strongly agree (4), agree (3), somewhat disagree (2), and disagree (1). The validity test in this study used Gregory's formula (Gregory, 2014). The results of each statement were divided by the maximum score and multiplied by 100 percent. The average percentage score was then categorized into four categories: very valid or very practical, valid or practical, less valid or less practical, and invalid or impractical.

To assess the artifacts or products of the programming projects created, the free and open-source web application, Dr. Scratch (<http://www.drscratch.org/>), was used to automatically analyze the Scratch code projects the researchers created and assign CT scores to the projects based on abstraction and problem decomposition, parallelism, logical reasoning, synchronization, flow control, user interactivity, and data representation (Moreno-León et al., 2015). The total CT score was calculated by summing the partial scores for each CT concept. Projects with scores up to 7 points are considered to demonstrate a basic CT level, projects with scores between 8 and 14 points are evaluated as developing projects, and projects with more than 15 points are marked as advanced.

### RESULT AND DISCUSSION

This section presents the research results and discussions to answer the research questions, where in this media development research the presentation starts from the analysis stage, continues to the design stage, development stage, implementation stage, and evaluation stage.

At the analysis stage, learning issues were identified for the computational thinking problem-solving project assignment, which can be used to create animated learning media for the motion of objects and animated media for evaluation questions on Physics learning materials. Programming materials that students as beginner programmers need to learn to create interactive learning media include: How to get started using the Scratch application, Motion & Sequences, Looks & Sound, Variables (Operators & Data), Decision Making (Conditionals), and Loops. These materials have not been taught to elementary school teacher education students in the 2024 intake. Scratch programming was chosen because its block-based programming format is less complex than text-based programs, easier to learn, and suitable for elementary school children and elementary school teacher education students unfamiliar with programming languages.

Observations and interviews revealed that computational thinking skills through programming with the Scratch application have not been recognized and taught to students. Problems with the quality of learning media are still limited to PowerPoint slides, which are still less engaging. Furthermore, the media used lacks variety and is less enjoyable. Judging from the students' situation, the material is difficult to understand, requiring lecturers to repeat the material and struggling to find references. Meanwhile, challenges faced by lecturers in the

classroom include students being distracted by cell phones, social media, and games, lacking motivation to learn due to difficult-to-understand material, and not paying attention or taking the lessons seriously. Science lecturers have not yet been able to create interactive animated teaching materials that can simulate the concepts being taught.

Therefore, media is needed to capture students' interest and attention while providing clear materials, such as storytelling and practice problems, to enhance understanding and test retention of the material covered. This media is also expected to be used for independent learning at home. Lecturers and students can create this interactive media through computational thinking programming problem-solving assignments using the Scratch application. Furthermore, the use of information technology in the classroom can help increase student engagement, and evidence shows that IT use enables a richer and more engaging learning environment (Satria et al., 2024).

On design stage, researcher Designing sample programming project problem-solving assignment materials containing computational thinking concepts such as sequences, loops, conditionals, operators, and data that can be used to create interactive animated media. The results of the media design stage include a storyboard with a template design plan, flowcharts, and layouts for each scene that explain the sequence and structure of the learning media, as well as a carefully planned user interface and environment (Trecene et al., 2022). The resulting flowchart (in computational thinking, this is called an abstraction component) is then used as a learning tool, as illustrated in Figure 1.

In the initial stage of opening and displaying or playing an interactive media programming project in the Scratch application, the user will enter a cover page containing an image of the main character or student sprite with stage 1 background. Next, after the user clicks the start button for the greeting or introduction of the main character in the story/student, the user is then directed to enter the second stage background, then the main character in the story will introduce the place where he studies, then the first character moves to the second stage background and tells what is in the facilities or atmosphere there, finally the main character moves to the third backdrop and says goodbye and wants to return home.

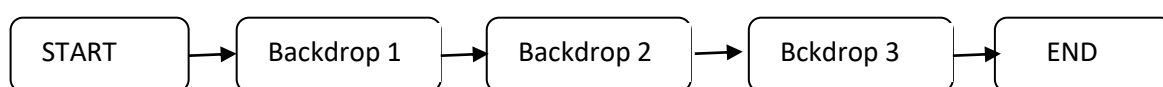


**Figure 1.** Story Telling Programming Project Flowchart

In the computational thinking problem-solving programming media, the two students were asked to create evaluation questions for elementary school physics material. Ten questions on the practice questions page relate to science content.

Development is the product testing and development phase where the final product is produced from the analysis and design results. The crucial or fundamental stage in creating an educational product is called development (Dick et al., 2015). The product development and design phases created using Scratch software are listed below. The following (the decomposition section) shows the results of the product development and the programming project form for the storytelling project and the evaluation questions that have been created (Figures 2, 3, and 4). In this development phase, all computational thinking skills, such as abstraction, decomposition, pattern recognition, and algorithms, are applied along with all programming concepts learned by students in computational thinking training to programming problem-solving tasks.

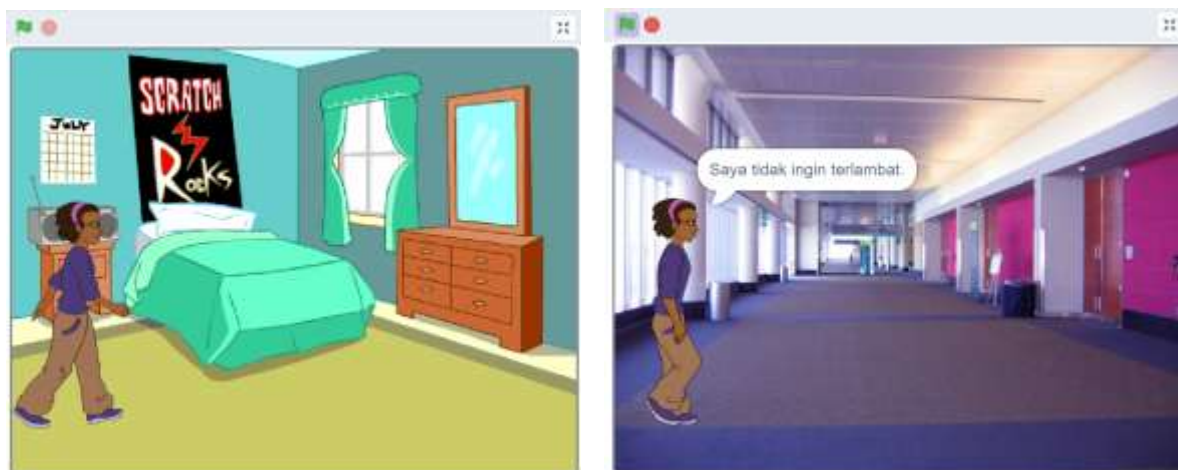


**Figure 2.** The first and second backdrop pages of the storytelling problem-solving programming project.



**Figure 3.** Backdrop page of programming problem solving project, evaluation questions and questions and their scores.

Evaluation by material and media experts: one material expert and one media expert validated the results of the computational thinking learning programming project media design. As seen in Table 3, the results of the material and media experts indicate that the designed learning media is in the very valid category with a score of 93.75%.

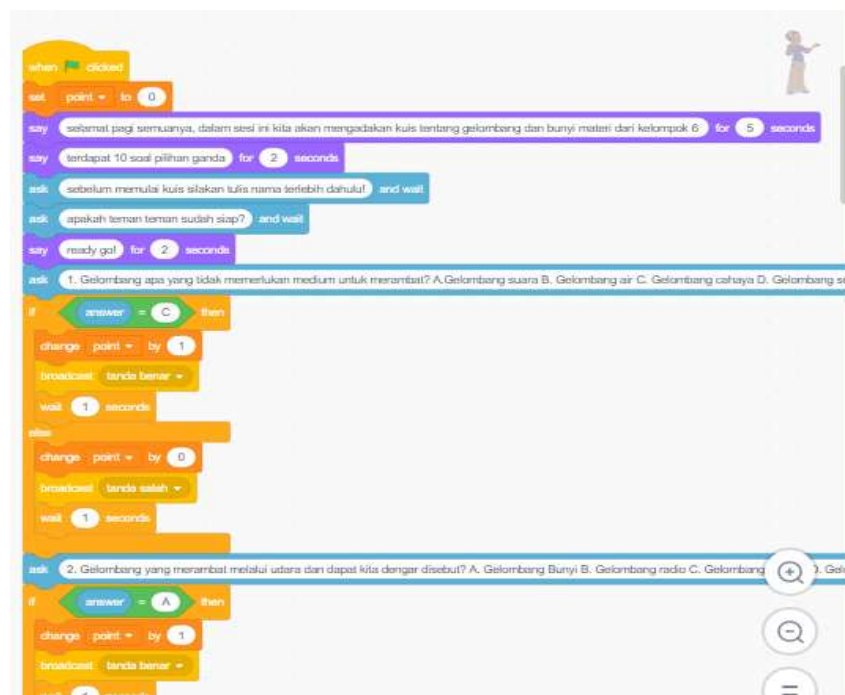


**Figure 4.** The programming block format in Scratch which contains the concepts of events, sequences, parallelism, and looks.

**Table 3.** Expert Assessment Results

| No                   | Validate | Value      | Description                             |
|----------------------|----------|------------|-----------------------------------------|
| 1                    | Material | 1 (91,67%) | Very valid. Can be applied in the field |
| 2                    | Media    | 1 (95,83%) | Very valid. Can be applied in the field |
| <b>Average value</b> |          | 1 (93,75%) | Very valid. Can be applied in the field |

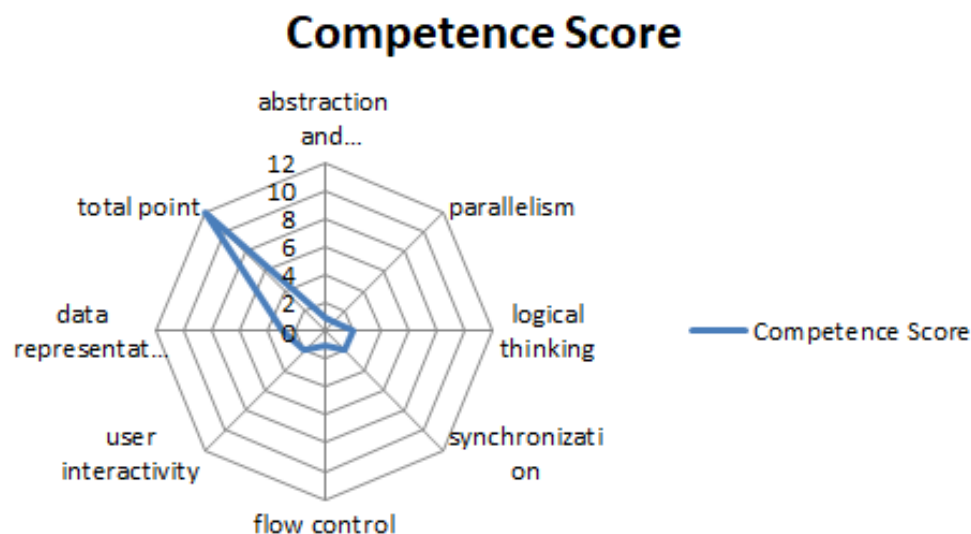
Based on the assessment of material and media experts, the interactive animation media for computational thinking that was developed is very valid and can be applied to research subjects.

The design of this learning media was refined with suggestions and comments from media and content experts. These included the addition of attractive backdrop images or sprites related to each concept being studied, button layout, improvements to the media design and video examples of evaluation questions, evaluation questions with varying levels of difficulty, and more practical programming projects that encompass all the computational thinking concepts taught. Furthermore, additional material explaining computational thinking and its concepts is needed. Based on the assessment of content and media experts, the developed interactive problem-solving animation learning media is valid and can be tested on research subjects.

The difficulty score for the created Scratch programming projects was assessed using the Dr. Scratch application, which can automatically examine web pages or programming files. The online Dr. Scratch system shared is still in beta, or being tested, and is therefore not yet perfect. Many bugs need to be fixed for proper operation, and the application provides feedback to improve the programming products created by students. The difficulty score results for the created Scratch programming projects and the radar chart for the computational thinking concept competency ranking are shown in Table 4 and Figure 5.

Table 4. Scratch project point results assessed based on the Dr. Scratch rubric.

| CT Concept                            | Competence Score |
|---------------------------------------|------------------|
| abstraction and problem decomposition | 1                |
| Parallelism                           | 1                |
| logical thinking                      | 2                |
| Synchronization                       | 2                |
| flow control                          | 1                |
| user interactivity                    | 2                |
| data representation                   | 3                |
| total point                           | 12/21            |

**Figure 5.** Results of the Scratch project point assessment using the Dr. Scratch rubric.

The result of the computational thinking programming media assessment for the concept of abstraction and problem decomposition is one because the learning media programming script created uses more than one script and more than one sprite. The idea of parallelism gets 1 point because the media programming project contains one script when the program receives a start message. The concept of logical thinking, gets 2 points because, in the media program, there is an if-else command block in several sprites. The synchronization concept gets 2 points where there is a broadcast in one of the media sprite scripts, when the program receives a message, stop all command blocks. The flow control concept also gets 1 point because, in the media, there is a sprite with a script that uses a sequence command block. User interactivity gets 2 points because the media contains a sprite with a script that uses a button pressed, sprite clicked, ask and wait command block. Data representation gets 3 points in computational thinking because in the media sprite operates on a list. So, the total score obtained from Dr. Scratch's assessment is 12/21 or is classified as a developing or developing level of difficulty for the programming project created. The difficulty level of this program is caused by the problem-solving program created, which is related to question and answer material using the ask...and wait block command.

The implementation phase involves testing the actual computational thinking problem-solving programming project for the intended users. This interactive media for computational

thinking programming with Scratch was refined to the final version, which was then tested on 2 students to see its practicality, after going through a small group trial and expert validation process. The interactive media link for the computational thinking problem-solving programming project and the video of the creation process were shared through the WhatsApp group. The interactive media for the computational thinking problem-solving programming project in this application can be accessed via the internet by 40 students via laptop or mobile phone so that each student can view and imitate it to create their own programming project. The implementation of the programming project creation task by students was carried out in three meetings, 2.5 hours each meeting, 13 groups, meeting once a week in the lecture schedule. The students' usage responses to the programming projects they created were recorded for further learning improvement processes.

Evaluation activities are conducted at each stage. Before the finished product is widely used, evaluation aims to improve it (Hess & Greer, 2016). Refinement of the interactive learning programming problem-solving project resulting from the development stage, particularly after testing by media experts and content experts, is one of the evaluation stages. At this stage, the interactive learning programming problem-solving project material is revised based on the feedback received to refine the final product. Some recommendations for improvement include creating animations with physics examples that are easier for students to understand and supplemented with practice questions that are more understandable. Students suggested creating a game with two or three levels for the next project.

The results of the data analysis and development of the interactive computational thinking programming problem-solving project using Scratch programming met the criteria of being feasible or very valid. These results align with research indicating that interactive computational thinking learning media projects are suitable for use as learning media and can improve student learning quality (Wulandari et al., 2017; Sugiyarto et al., 2021; Satria et al., 2024). The results of this study are supported by other studies, which state that interactive media programming projects are suitable for use at all levels of education and can be an alternative learning resource in the classroom (Ketut Sinta et al., 2021; Kurnia et al., 2023; Satria et al., 2024). Interactive media can improve students' comprehension skills (Suwiantini et al., 2021). The use of appropriate and good learning media will affect student learning outcomes; In addition to assisting teachers or lecturers in delivering material, learning media also makes it easier for students to receive the material presented by teachers or lecturers (Satria & Sari, 2018; Satria et al., 2023; Satria et al., 2024) while adding good assessment criteria from students towards the best teachers in teaching (Abdullah, Hartono, et al., 2019). The results of several studies conducted by (Satria, 2013; Satria, 2015; Satria, 2020; Satria, 2019; Morales-Obod et al., 2020) also show that the use of interactive learning media computational thinking problem-solving programming projects can help improve student learning outcomes. In addition, the development of this interactive learning media project computational thinking problem-solving hones students' computational thinking skills in developing programming concepts such as events, series, parallelism, loops, conditionals, operators & data, and can be used by students and lecturers to recognize and develop computational thinking skills in the components of abstraction, decomposition, pattern recognition, and algorithms (Satria & Sopandi, 2022; Satria et.al, 2024; Satria et.al, 2024; Satria et.al, 2024; Satria et.al, 2024; Winarto et.al, 2026) in computational thinking course assignments as an example of a final assignment for student programming problem solving.

## CONCLUSION

From the analysis of research and development data conducted on the development of computational thinking programming problem-solving assignment projects with Scratch, it can be concluded that the application created is valid, very practical and worthy of being used as an example of programming problem-solving assignments for elementary school teacher education students in terms of computational thinking that can hone their programming concepts and can be used for learning Physics material after validation by material experts, media experts, and user trials. The level of difficulty or computational thinking competency of the programming project created is at the intermediate/developing level, so it is quite challenging for students to develop it. The interactive animation media created is interesting and can help students understand Physics material. The interactive media created can also be modified (remixed) by users and used for independent learning to develop computational thinking skills and student creativity. For further research, it is recommended to use programming concepts at a higher or more difficult level by using programming command blocks such as logical operations, operations on variables, and lists.

## DECLARATION OF AI AND AI ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

In the course of preparing this work, the author employed Google Assisted assistance for language refinement, academic paraphrasing, and plagiarism detection to ensure that the content was original and free from duplication. Following the use of this tool, the author conducted a thorough review and revision of the material, thereby accepting full responsibility for the accuracy, integrity, and authenticity of the publication.

## AUTHORS' CONTRIBUTION

Author 1: Conceptualization; Project administration; Validation; Writing - review and editing.

Author 2: Conceptualization; Data curation; Investigation.

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.

## REFERENCES

- Abdullah, D., Erliana, C. I., Irwansyah, D., Rahayu, S., Khairani, N., Moelyaningrum, A. D., Vebrianto, R., Wiliani, N., Maifizar, A., Mukarromah, N., Satria, E., Jefri, R., & Sudarsana, I. K. (2019). Body Height Detection System Using Russel & Rao Method. *Journal of Physics: Conference Series*, 1363(1), 012070. <https://doi.org/10.1088/1742-6596/1363/1/012070>
- Abdullah, D., Hartono, H., Saddhono, K., Kurniasih, N., Iskandar, A., Rianita, D., Purwarno, Setyawasih, R., Satria, E., Nuryanto, T., Herawati, L., Sujinah, & Sudarsana, I. K. (2019). HFLTS-TOPSIS with Pseudo-distance in Determining the Best Lecturers. *Journal of Physics: Conference Series*, 1363(1), 012073. <https://doi.org/10.1088/1742-6596/1363/1/012073>

- Abidin, D., Mayasari, N., Muamar, A., Satria, E., & Aziz, F. (2023). Development of Android- Based Interactive Mobile Learning to Learn 2D Animation Practice. *Jurnal Scientia*, 12(1), 138–142. <https://doi.org/10.58471/scientia.v12i01.1058>
- Agustin, M., Handayani, H., Imran, E., Adi, Y. K., Suryana, N., Hilmawan, H., Prayogi, A. G., Jumanto, Ikhsan, H., Maulani, S., Puspita, A. M. I., Satria, E., & Ninawati, M. (2019). 42 *Aktivitas Pengembangan Kecerdasan Jamak (Multiple Intetligences) Anak SD* (R. D. Putra (ed.)). <https://doi.org/https://doi.org/10.31219/osf.io/raudy>
- Akbar, S. A., & Satria, E. (2019). UV-VIS Study On Polyaniline Degradation At Different pHs And The Potential Application For Acid-Base Indicator. *Rasayan Journal of Chemistry*, 12(03), 1212–1218. <https://doi.org/10.31788/RJC.2019.1235370>
- Arifin, Mashuri, M. T., Lestari, N. C., Satria, E., & Dewantara, R. (2023). Application of Interactive Learning Games in Stimulating Knowledge About Object Recognition in Early Childhood. *Educenter : Jurnal Ilmiah Pendidikan*, 2(1), 1–6.
- Brennan, K., & Resnick, M. (2012). New frameworks for studying and assessing the development of computational thinking. *Proceedings of the 2012 Annual Meeting of the American Educational Research Association*, 1, 1–25. [https://doi.org/10.1007/978-3-319-64051-8\\_9](https://doi.org/10.1007/978-3-319-64051-8_9)
- Chaerun, F., Teti, N. R., Zen, D. S., Pakuan, U., Pakuan, U., & Pakuan, U. (2023). Pengembangan Media Video Animasi Berbasis Powtoon Pada Subtema 3 Usaha Pelestarian Lingkungan Sebagai Sumber Pembelajaran Di Sekolah Dasar. *Jurnal Elementaria Edukasia Volume*, 6(4), 2101–2116. <https://doi.org/10.31949/jee.v6i4.7406>
- Dick, W., Carey, L., & Carey, J. O. (2015). *The Systematic Design of Instruction* (8th ed.). Pearson.
- Egline, M., & Satria, E. (2014). Peningkatan Kemampuan Mengamati Dalam Proses Belajar Mengajar Tema X Rekreasi Dengan Menggunakan Media Visual Siswa Kelas II-A Di SD Negeri 49 Kuranji. *Jurnal CERDAS Proklamator*, 2(2), 165–175. <https://ejurnal.bunghatta.ac.id/index.php/JCP-PGSD/article/view/7544>
- Fatah, A., Arif, I., Farchan, F., Varbi Sununianti, V., Amalia Madi, R., Satria, E., Fourianalistyawati, E., Bempah, I., Ermayanti Susilo, D., Ridho Kismawadi, E., Nopriadi, Sumiati, R., Novita Sari, I., Kusnadi Kusumah Putra, F., Fajrin, H., Danius, E. E., Subekti, P., Noviyanty, Y., Siregar, N., ... Puspita Dewi, S. (2019). Application of knuth-morris-pratt algorithm on web based document search. *Journal of Physics: Conference Series*, 1175, 012117. <https://doi.org/10.1088/1742-6596/1175/1/012117>
- Firdaus, S., & Hamdu, G. (2020). Pengembangan Mobile Learning Video Pembelajaran Berbasis STEM (Science, Technology, Engineering And Mathematics) Di Sekolah Dasar. *JINOTEP (Jurnal Inovasi Dan Teknologi Pembelajaran): Kajian Dan Riset Dalam Teknologi Pembelajaran*, 7(2), 66–75. <https://doi.org/10.17977/um031v7i22020p066>
- Gall, M. D., Borg, W. R., & Gall, J. P. (1996). *Educational research: An introduction* (6th ed.). Longman Publishing.
- Gregory, R. J. (2014). Psychological testing: History, principles, and applications Boston, MA: Pearson. In *Psychological Testing* (Seventh Ed). Pearson Education Limited.
- Handayani, S. L., & Dahlia, I. (2022). ANIMA-LIE: Android-Based Learning Media on Animal Life Cycles Materials for Elementary School. *Jurnal Ilmiah Sekolah Dasar*, 6(2), 287–294. <https://doi.org/10.23887/jisd.v6i2.45359>
- Hanif, A. (2021). Pengembangan Aplikasi Belajar Pengetahuan Alam Tingkat Sekolah Dasar Berbasis Android Menggunakan Model Waterfall. *Journal of Informatics, Information System, Software Engineering and Applications (INISTA)*, 4(1), 47–57. <https://doi.org/10.20895/inista.v4i1.394>
- Haniko, P., Sarumaha, Y. A., Satria, E., Hs, N., & Anas. (2023). Building Students ' Critical Thinking Skill through Problem- Based Learning Model. *WIDYA ACCARYA: Jurnal*

- Kajian Pendidikan*, 14(1), 92–98.  
<http://ejournal.undwi.ac.id/index.php/widyaaccarya/index>
- Har, E., Sari, R. T., Gusmaweti, Hendri, W., Azrita, Dewati, L., Muhar, N., Perdana, R. P., Seftriawan, D., Setriadi, & Mulyani, V. (2018). Peningkatan Kompetensi Guru IPA Biologi Sekolah Menengah Pertama Melalui Pelatihan Dan Pembekalan Materi Di Laboratorium Kabupaten Pesisir Selatan. *Journal of Character Education Society*, 1(1), 94–99. <http://112.78.38.8/index.php/JCES/article/view/1637>
- Ichsan, I., Satria, E., Santosa, T. A., & Yulianti, S. (2022). Implementation of Blended Learning in Improving Science Literacy Of SMA / MA in Indonesia : A Meta-Analysis. *International Journal of Education and Literature*, 1(2), 58–67.
- Ichsan, I., Suharyat, Y., Santosa, T. A., & Satria, E. (2023). The Effectiveness of STEM-Based Learning in Teaching 21 st Century Skills in Generation Z Student in Science Learning : A Meta-Analysis. *Jurnal Penelitian Pendidikan IPA*, 9(1), 150–166. <https://doi.org/10.29303/jppipa.v9i1.2517>
- Iskandar, A., Dwiyanto Tobi Sogen, M., Chin, J., Satria, E., & Dijaya, R. (2019). Mobile Based Android Application Pharmaceutical Dictionary with Direct Search as Searching Process. *International Journal of Scientific and Technology Research*, 8(06), 44–46.
- Ketut Sinta, N. A., Gede Astawan, I., & Made Suarjana, I. (2021). Belajar Subtema 3 Lingkungan dan Manfaatnya dengan Media Pembelajaran Interaktif Berbasis Articulate Storyline 3. *MIMBAR PGSD Undiksha*, 9(2), 211. <https://doi.org/10.23887/jjpgsd.v9i2.35919>
- Kurnia, L. A., Syaflin, S. L., & Sholeh, K. (2023). Pengembangan Media Pembelajaran Siklus Air Berbasis Digital Siswa Kelas V Sekolah Dasar. *Jurnal Elementaria Edukasia*, 6(2), 350–359. <https://doi.org/10.31949/jee.v6i2.5352>
- Kurniasih, N., Kurniawati, N., Sujito, Rizal, E., Sudirman, A., Mesran, Alif, M., Sugiarto Maulana, Y., Sari Faradiba, S., & Satria, E. (2019). Analysis of the implementation of Unpad Library Management System using the Technology Acceptance Model: librarian perspective. *Journal of Physics: Conference Series*, 1175(1), 012228. <https://doi.org/10.1088/1742-6596/1175/1/012228>
- Likert, R. (1932). A technique for the measurement of attitudes. *Archives of Psychology*, 22(140), 55.
- Lusiani, Muliawan, A., Ratnadewi, Satria, E., Taba, H. H. T., Tanwir, Yani, J. S. A., Nugraha, A. S. A., & Widyastuti, H. (2021). *Fisika Terapan* (D. U. Sutiksno & R. Ratnadewi (eds.); Cetakan 1). Zahir Publishing. [https://books.google.co.id/books?hl=id&lr=&id=sGtgEAAQBAJ&oi=fnd&pg=PA3&dq=Lusiani,+Fisika+Terapan+&ots=cOuZswRuZd&sig=d4Iad2dlw3KpjXFKJDHXxu3VTEM&redir\\_esc=y#v=onepage&q=Lusiani%2C+Fisika+Terapan&f=false](https://books.google.co.id/books?hl=id&lr=&id=sGtgEAAQBAJ&oi=fnd&pg=PA3&dq=Lusiani,+Fisika+Terapan+&ots=cOuZswRuZd&sig=d4Iad2dlw3KpjXFKJDHXxu3VTEM&redir_esc=y#v=onepage&q=Lusiani%2C+Fisika+Terapan&f=false)
- Manullang, S. O., & Satria, E. (2020). The Review of the International Voices on the Responses of the Worldwide School Closures Policy Searching during Covid-19 Pandemic. *Jurnal Iqra' : Kajian Ilmu Pendidikan*, 5(2), 1–13. <https://doi.org/10.25217/ji.v5i2.1036>
- Maruf, I. R., Nugroho, B. S., Kurniawan, A., Musiafa, Z., & Satria, E. (2022). Virtual Learning Apps: Best Instructional Leadership Practices in the Digital Age Efforts to Improve Student Learning Outcomes. *Jurnal Iqra': Kajian Ilmu Pendidikan*, 7(1), 32–43. <https://doi.org/10.25217/ji.v7i1.2187>
- Maseleno, A., Abdullah, D., Satria, E., Souisa, F. N. J., & Rahim, R. (2021). An Intelligent Intrusion Detection for Smart Cities Application Based on Random Optimization with Recurrent Network. In M. Elhoseny et al. (Ed.), *Artificial Intelligence Applications for*

- Smart Societies: Recent Advances* (pp. 119–133). Cham: Springer International Publishing. [https://doi.org/10.1007/978-3-030-63068-3\\_8](https://doi.org/10.1007/978-3-030-63068-3_8)
- Maulana, Y. S., Sundari, C., Abdurrohim, Ekasari, S., Nurjanah, D. S., Sudirman, A., Anisah, H. U., Syah, S., Saputra, D. H., & Satria, E. (2021). *Operations Management* (D. U. Sutiksno & Ratnadewi (eds.); I). Zahir Publishing. [https://books.google.co.id/books?hl=id&lr=&id=3GtgEAAQBAJ&oi=fnd&pg=PA51&dq=Sugiarto+Maulana,+Y.,+Sundari,+C.,+Abdurrohim,+Ekasari,+S.,+Nurjanah,+D.+S.,+Sudirman,+A.,+Anisah,+H.+U.,+Syah,+S.,+Saputra,+D.+H.,+%26+Satria,+E.+\(2021\).+Operations+Management&ot](https://books.google.co.id/books?hl=id&lr=&id=3GtgEAAQBAJ&oi=fnd&pg=PA51&dq=Sugiarto+Maulana,+Y.,+Sundari,+C.,+Abdurrohim,+Ekasari,+S.,+Nurjanah,+D.+S.,+Sudirman,+A.,+Anisah,+H.+U.,+Syah,+S.,+Saputra,+D.+H.,+%26+Satria,+E.+(2021).+Operations+Management&ot)
- Megawaty, D. A., Damayanti, D., Assubhi, Z. S., & Assuja, M. A. (2021). Aplikasi Permainan Sebagai Media Pembelajaran Peta Dan Budaya Sumatera Untuk Siswa Sekolah Dasar. *Jurnal Komputasi*, 9(1), 58–66. <https://doi.org/10.23960/komputasi.v9i1.2779>
- Morales-Obod, M., Valdez Ramirez, M. N., Satria, E., & Indriani, D. E. (2020). Effectiveness on the use of mother tongue in teaching the concepts of fraction among second grade of elementary school pupils. *Journal for the Education of Gifted Young Scientists*, 8(1), 291–304. <https://doi.org/10.17478/JEGYS.637002>
- Moreno-León, J., Robles, G., & Román-González, M. (2015). Dr. Scratch: Análisis Automático de Proyectos Scratch para Evaluar y Fomentar el Pensamiento Computacional. *Revista de Educación a Distancia (RED)*, 46. <https://doi.org/10.6018/red/46/10>
- Natali, V. (2022). *Computational Thinking Mata Kuliah Pilihan*. Direktorat Pendidikan Profesi Guru Direktorat Jenderal Guru dan Tenaga Kependidikan Kementerian Pendidikan, Kebudayaan, Riset dan Teknologi.
- Nurdin, Abdullah, D., Putri, O. C., Satria, E., Rianita, D., Liantoni, F., Yuliwati, Wijayanti, A., Sujinah, Madinah, Rosiska, E., Erwinsyah, A., Syahputra, H., & Sudarsana, I. K. (2019). Detection System of Aceh Ethnic Music Types Based on Sound Using the Hubbard Stratonovich Transformation Method. *Journal of Physics: Conference Series*, 1363(1), 012076. <https://doi.org/10.1088/1742-6596/1363/1/012076>
- Rahim, R., Iskandar, A., Aziz, F., Satria, E., Muttaqin, W. M., Sujito, S., Laumal, F. E., Suryaningsih, D. R., Susantinah, N., Suradi, A., & Ikhwan, A. (2019). Hashing Variable Length application for message security communication. *ARPN Journal of Engineering and Applied Sciences*, 14(1), 259–264.
- Rahmat, A., Syakhrani, A. W., & Satria, E. (2021). Promising online learning and teaching in digital age: Systematic review analysis. *International Research Journal of Engineering, IT & Scientific Research*, 7(4), 126–135. <https://doi.org/10.21744/irjeis.v7n4.1578>
- Saddhono, K., Satria, E., Erwinsyah, A., & Abdullah, D. (2019). Designing SwiSH Max Learning Software Based of Multimedia. *Journal of Physics: Conference Series*, 1364(1), 012032. <https://doi.org/10.1088/1742-6596/1364/1/012032>
- Satria, E. (2013). Peningkatan Proses Dan Hasil Belajar Kognitif Pembelajaran IPA Peserta Didik Dengan Pendekatan Rational Inquiry Di Kelas III SD Pembangunan Air Tawar UNP Padang. *Jurnal CERDAS Proklamator*, 1(1), 31–43. <https://ejurnal.bunghatta.ac.id/index.php/JCP-PGSD/article/view/2270>
- Satria, E. (2018a). Pendekatan Lingkungan Dengan KIT IPA Seqip Untuk Peningkatan Keterampilan Proses Ilmiah Dan Hasil Belajar Kognitif Siswa. *Jurnal Akrib Juara*, 3(1), 40–60.
- Satria, E. (2018b). Projects for the implementation of science technology society approach in basic concept of natural science course as application of optical and electrical instruments' material. *Journal of Physics: Conference Series*, 983(1), 012049. <https://doi.org/10.1088/1742-6596/983/1/012049>

- Satria, E. (2019). Problem Based Learning Approach With Science Kit Seqip To Enhancing Students' Scientific Process Skills And Cognitive Learning Outcomes. *Jurnal Akrab Juara*, 4(2), 100–114.
- Satria, E. (2020). Improving Students' Scientific Skills, Cognitive Learning Outcomes, and Learning Interest in Natural Science in Class IV by Using Brain Based Learning Approach with Science Kit at SD Negeri 34 Kuranji Padang. *Prosiding International Conference on Mathematics, Science and Education (ICMSE)*, GE10-20. <https://doi.org/10.31219/osf.io/9fj6e>
- Satria, E. (2015). Improving Students' Activities and Learning Outcomes In Natural Science In Class V By Using Somatic Auditory Visual Intellectual (SAVI) with Science KIT Seqip in SD Negeri 25 Seroja Lintau. *Prosiding International Conference on Mathematics, Science, Education and Technology (ICOMSET)*, 458–464.
- Satria, E. (2017). NHT Model to Enhancing Students' Scientific Skills and Learning Outcome. *Prosiding International Conference on Global Education (ICGE) V*, 2086–2100. [https://www.researchgate.net/profile/Erwinsyah-Satria/publication/337386336\\_NHT\\_MODEL\\_TO\\_ENHANCING\\_STUDENTS'\\_SCIENTIFIC\\_SKILLS\\_AND\\_LEARNING\\_OUTCOMES/links/5dd4aaa9299b11ec8628aeb/NHT-MODEL-TO-ENHANCING-STUDENTS-SCIENTIFIC-SKILLS-AND-LEARNING-OUTCOMES.pdf](https://www.researchgate.net/profile/Erwinsyah-Satria/publication/337386336_NHT_MODEL_TO_ENHANCING_STUDENTS'_SCIENTIFIC_SKILLS_AND_LEARNING_OUTCOMES/links/5dd4aaa9299b11ec8628aeb/NHT-MODEL-TO-ENHANCING-STUDENTS-SCIENTIFIC-SKILLS-AND-LEARNING-OUTCOMES.pdf)
- Satria, E. (2016). Strategies for Developing Pre Service Teachers' Scientific Skills Towards a Resourceful Teaching of Primary Science in Facing AEC. *Prosiding Seminar Nasional Pendidikan (SEMEDIK)*, 126–134. <https://doi.org/10.31219/osf.io/gzdaq>
- Satria, E., & Sari, S. G. (2018). Penggunaan Alat Peraga Dan Kit IPA Oleh Guru Dalam Pembelajaran Di Beberapa Sekolah Dasar Di Kecamatan Padang Utara Dan Nanggalo Kota Padang. *Ikraith-Humaniora*, 2(2), 1–8. <https://journals.upi-yai.ac.id/index.php/ikraith-humaniora/article/view/109>
- Satria, E., & Sopandi, W. (2019). Applying RADEC model in science learning to promoting students' critical thinking in elementary school. *Journal of Physics: Conference Series*, 1321(3), 032102. <https://doi.org/10.1088/1742-6596/1321/3/032102>
- Satria, E., & Widodo, A. (2020). View of teachers and students understanding' of the nature of science at elementary schools in Padang city Indonesia. *Journal of Physics: Conference Series*, 1567(3), 032066. <https://doi.org/10.1088/1742-6596/1567/3/032066>
- Satria, Erwinsyah. (2019). Environment Approach with Science Kit Seqip to Enhancing Students' Scientific Process Skills, Learning Motivation, and Cognitive Learning Outcomes. *Prosiding of International Conference on Education Research and Development (ICERD)*, 832–843. <https://doi.org/10.31227/osf.io/3aejn>
- Satria, Erwinsyah. (2021). Problem Based Learning Model With Science Props To Enhancing Students' Science Process Skills And Cognitive Learning Outcome. *International Conference on Mathematics and Science Education (ICMSE) 2016*, 91–100. <https://doi.org/10.31219/osf.io/w62gs>
- Satria, Erwinsyah. (2015). The Implementation of STM Approach in Natural Science I Course in Designing Simple Technology in The Form of Electricity Media. *Proceeding of International Seminar on Science Education*, 1, 109–114. <https://repository.bbg.ac.id/bitstream/426/1/ISSE-2015.pdf#page=115>
- Satria, Erwinsyah, Efendi, G., Makmur, Z., Sofarina, S., & Daswarman, D. (2023). Pengembangan Media Interaktif Pemograman Berpikir Komputasional. *Journal on Teacher Education*, 4(3), 660–671. <https://doi.org/10.31004/jote.v4i3.12554>
- Satria, E., Sa'ud, U. S., Riyana, C., Sopandi, W., Al Aflah, R. R., & Sari, R. T. (2024). ENERGIA: learning media programming project as a problem solving task for students' computational thinking training with scratch. *Educational Administration: Theory and Practice*, 30(4), 4270–4282.

- Satria, E., Sa'ud, U. S., Riyana, C., Sopandi, W., Nora, Y., Jusar, I. R., ... & Rusli, R. (2024, May). The development of computational thinking skills-based interactive learning media for PGSD students' problem solving task with scratch programming. In AIP Conference Proceedings (Vol. 3116, No. 1, p. 040016). AIP Publishing LLC.
- Satria, E., Sa'ud, U. S., Riyana, C., Sopandi, W., & Rahmiani, N. (2024). Pengembangan proyek pemrograman media pembelajaran interaktif untuk tugas pemecahan masalah pelatihan berpikir komputasional mahasiswa dengan scratch. *Jurnal Elementaria Edukasia*, 7(1), 2320-2337.
- Satria, Erwinsyah, Gusmaweti, G., Har, E., Nursi, M., & Darwianis, D. (2024). Training on The Use of The Electrical Physics Kit to Improve The Competency of Science Teacher. *JMM (Jurnal Masyarakat Mandiri)*, 8(1), 418-435. <https://doi.org/10.31764/jmm.v8i1.20069>
- Satria, Erwinsyah, Gusmaweti, G., Sari, R. T., & Har, E. (2024). Pelatihan Pengenalan Penggunaan KIT Listrik Untuk Peningkatan Kompetensi Guru IPA di Laboratorium Dasar Universitas Bung Hatta. *Jurnal Ikraith-Abdimas*, 8(1), 1-13. <https://doi.org/10.37817/ikraithabdimas.v8i1.3064>
- Satria, Erwinsyah, Har, E., Yuza, A., Gusmaweti, & Anwar, V. N. (2024). Pengembangan Media Pembelajaran Interaktif Magnet ( MANIAKNET ) Untuk Pengembangan Keterampilan Pemecahan Masalah Berpikir Komputasional Dan Berpikir Kreatif Dengan Blok Programming. *Ikraith-Informatika*, 8(2), 209-221. <https://doi.org/10.37817/ikraith-informatika.v8i2.3045>
- Satria, E. (2024). Pengembangan Model Pelatihan Pemrograman Berbasis RADEC Untuk Meningkatkan Kemampuan Berpikir Komputasional Mahasiswa PGSD. Disertasi pada PPS UPI: diterbitkan.
- Satria, Erwinsyah, Hendrizal, Daswarman, Nora, Y., & Jusar, I. R. (2023). Pelatihan Pemograman Dengan Aplikasi Scratch Untuk Mengenalkan Keterampilan Berpikir Komputasional Bagi Guru- Guru SD di Gugus III Kecamatan Tilatang Kamang. *Jurnal Ikraith-Abdimas*, 7(3), 91-103. <https://doi.org/10.37817/ikraithabdimas.v7i3.2990>
- Satria, Erwinsyah, Hendrizal, H., Daswarman, D., & Jusar, I. R. (2023). Pelatihan Keterampilan Computational Thinking Bagi Guru SD di Nagari Kapau Kabupaten Agam Sumatera Barat. *Jurnal Ikraith-Abdimas*, 6(2), 45-52. <https://doi.org/10.37817/ikraithabdimas.v6i2.2405>
- Satria, Erwinsyah, Musthan, Z., Cakranegara, P., Arifin, A., & Trinova, Z. (2022). Development of based learning media with App Inventor. *Sinkron : Jurnal Dan Penelitian Teknik Informatika*, 7(4), 2400-2407. <https://doi.org/10.33395/sinkron.v7i4.11611>
- Satria, Erwinsyah, Sa'ud, U. S., Sopandi, W., Tursinawati, Rahayu, A. H., & Anggraeni, P. (2022). Pengembangan Media Animasi Interaktif Dengan Pemograman Scratch Untuk Mengenalkan Keterampilan Berpikir Komputasional. *Jurnal Cerdas Proklamator*, 10(2), 116-127. <https://doi.org/10.37301/cerdas.v10i2.169>
- Satria, Erwinsyah, & Sopandi, W. (2022). Creating Science Online Learning Media Using Scratch App Block Programming. *KnE Social Sciences*, 2022, 372-384. <https://doi.org/10.18502/kss.v7i6.10639>
- Satria, Erwinsyah, Suseno, D., Hikariantara, I. P., Wijayanti, A. I., & Pane, A. F. (2023). Pengembangan Media Interaktif Perpindahan Panas (Minterinas) dengan Game Menggunakan Pemrograman Berbasis Blok Scratch untuk Mahasiswa. *Jurnal Basicedu*, 7(4), 2396-2405. <https://doi.org/10.31004/basicedu.v7i4.5200>
- Sidik, G. T., Kelana, J. B., Altaftazani, D. H., & Firdaus, A. R. (2020). the Effect of Macromedia Flash Based Learning Media To Improve the Ability To Calculate of Students in Elementary School. *PrimaryEdu - Journal of Primary Education*, 4(2), 241. <https://doi.org/10.22460/pej.v4i2.1805>

- Sudarmo, Rasmita, E. S. (2021). Investigation of best digital technological practices in millennial classroom innovation : critical review study. *International Journal of Social Sciences*, 4(1), 98–105.
- Sudarmo, S., Muharlisiani, L. T., Manullang, S. O., Satria, E., & Sari, Y. A. (2021). How Research Skills Affect Indonesian Postgraduate Students Writing Outcomes: Publication Review. *Jurnal Iqra' : Kajian Ilmu Pendidikan*, 6(1), 224–234. <https://doi.org/10.25217/ji.v6i1.1406>
- Sudarsana, I. K., Anam, F., Rianita, D., Wikansari, R., Namok Nahak, M., Setyawasih, R., Wirta, I. W., Satria, E., & Sukabawa, I. W. (2020). *Culture as Indonesia Educational Base to Form Competitiveness and National Character*. 3–6. <https://doi.org/10.4108/eai.20-6-2020.2300608>
- Sudarsana, I. K., Anam, F., Triyana, I. G., Dharmawan, I. M., Wikansari, R., GS, A., Indahingwati, A., Satria, E., & Nora, Y. (2020). *Education In Community Views In The Globalization Era*. <https://doi.org/10.4108/eai.20-6-2020.2300610>
- Sudarsana, I. K., Armaeni, K. W. A., Sudrajat, D., Abdullah, D., Satria, E., Saddhono, K., Samsiarni, Setyawasih, R., Meldra, D., & Ekalestari, S. (2019). The Implementation of the E-Learning Concept in Education. *Journal of Physics: Conference Series*, 1363(1), 012063. <https://doi.org/10.1088/1742-6596/1363/1/012063>
- Sudarsana, I. K., Mulyaningsih, I., Kurniasih, N., Haimah, Wulandari, Y. O., Ramon, H., Satria, E., Saddhono, K., Nasution, F., & Abdullah, D. (2019). Integrating Technology and Media in Learning Process. *Journal of Physics: Conference Series*, 1363(1), 012060. <https://doi.org/10.1088/1742-6596/1363/1/012060>
- Sudarsana, I. K., Nakayanti, A. R., Sapta, A., Haimah, Satria, E., Saddhono, K., Achmad Daengs, G. S., Putut, E., Helda, T., & Mursalin, M. (2019). Technology Application in Education and Learning Process. *Journal of Physics: Conference Series*, 1363(1), 012061. <https://doi.org/10.1088/1742-6596/1363/1/012061>
- Sudarsana, I. K., Suyanta, I. W., Pramesti Dasih, I. G., Permana, E., Rianita, D., Satria, E., Suleman, A., & Iskandar, A. (2020). *Implementation of Cultural Education In Elementary School*. <https://doi.org/10.4108/eai.20-6-2020.2300634>
- Sudrajat, D., Achmad Daengs, G. S., Satria, E., Nurawati, N., Iskandar, A., Khasanah, K., Sururi, A., & Rahim, R. (2018). Expert system application for identifying formalin and borax in foods using the certainty factor method. *Eurasian Journal of Analytical Chemistry*, 13(6), 321–325.
- Sugiyarto, U. S., Wulandari, Y., & Casworo, A. (2021). Media Pembelajaran Powerpoint Interaktif Dalam Pembelajaran Daring Di Sekolah Dasar. *Jurnal Cerdas Proklamator*, 8(2), 118–123. <https://doi.org/10.37301/jcp.v0i0.44>
- Suharyat, Y., Ichsan, I., Satria, E., & Santosa, T. A. (2022). Meta-Analysis : The Effectiveness Of Learning The Effectiveness Of Problem Solving-Based STEM Learning On 21 st Century Skills Of High School Students In Indonesia. *International Journal of Education and Literature (IJEL)*, 1(3), 6–14.
- Suharyat, Y., Ichsan, Satria, E., Santosa, T. A., & Amalia, K. N. (2022). Meta-Analisis Penerapan Model Pembelajaran Problem Based Learning Untuk Meningkatkan Keterampilan Abad-21 Siswa Dalam Pembelajaran IPA. *Jurnal Pendidikan Dan Konseling*, 4(5), 5081–5088. <https://doi.org/10.31004/jpdk.v4i5.7455>
- Suharyat, Y., Supriyadi, A., Satria, E., & Santosa, T. A. (2022). Analisis Pembelajaran daring dalam pembelajaran IPA di SMA/MA di Indonesia Pasca Pandemi COVID-19: Sebuah Literatur Review. *Jurnal Pendidikan Dan Konseling*, 4(5), 1860–1865. <https://doi.org/10.31004/jpdk.v4i5.7311>
- Suwiantini, L. A., Jampel, I. N., & Astawan, I. G. (2021). Learn Energy Sources with Interactive Learning Multimedia. *Jurnal Ilmiah Sekolah Dasar*, 5(1), 119. <https://doi.org/10.23887/jisd.v5i1.35000>

- Syaflin, S. L. (2022). Pengembangan Multimedia Interaktif Berbasis Macromedia Flash Pada Materi IPA Sekolah Dasar. *Jurnal Cakrawala Pendas*, 8(4), 1516–1525. <https://doi.org/http://dx.doi.org/10.31949/jcp.v8i2.3003>
- Wahyuningtyas, D. P., Mayasari, N., Rohmah, S., Satria, E., & Rinovian, R. (2022). Adaptation of ICT Learning in The 2013 Curriculum in Improving Understanding Student's of Digital Literacy. *Jurnal Scientia*, 11(2), 211–218. <http://infor.seaninstitute.org/index.php/pendidikan/article/view/828>
- Widyastuti, R., & Puspita, L. S. (2020). Pengembangan Media Pembelajaran Berbasis Game Edukasi Pada MatPel IPA Tematik Kebersihan Lingkungan. *Paradigma - Jurnal Komputer Dan Informatika*, 22(1), 95–100. <https://doi.org/10.31294/p.v22i1.7084>
- Wikandaru, R., Cathrin, S., Satria, E., & Rianita, D. (2020). Critical Analysis of Javanese Epistemology and Its Relevance to Science Development in Indonesia. *Jurnal Humaniora*, 32(3), 206–216. <https://doi.org/10.22146/jh.49065>
- Winarto, Misbah, Ariyatun, Satria, E., Widiyati, E., Jumini, S., Parameswari, P., & Shidiq, G. A. (2026). Integrating mobile technology in inquiry-based instruction for sustainable and innovative learning in higher education. *European Journal of STEM Education*, 11(1), article 26. <https://doi.org/10.20897/ejsteme/18304>
- Wing, J. (2011). Research notebook: Computational thinking What and why? *The Link Magazine*, June 23, 2015. <http://www.cs.cmu.edu/link/research-notebook-computational-thinking-what-and-why>
- Wulandari, R., Susilo, H., & Kuswandi, D. (2017). Penggunaan multimedia interaktif bermuatan game edukasi untuk siswa sekolah dasar. *Jurnal Pendidikan: Teori, Penelitian Dan Pengembangan*, 2(8), 1024–1029. <https://doi.org/10.17977/jptpp.v2i8.9759>
- Zulkifli, Z., Satria, E., Supriyadi, A., & Santosa, T. A. (2022). Meta-analysis: The effectiveness of the integrated STEM technology pedagogical content knowledge learning model on the 21st century skills of high school students in the science department. *Psychology, Evaluation, and Technology in Educational Research*, 5(1), 32–42. <https://doi.org/10.33292/petier.v5i1.144>

---

**Copyright Holder :**

© Erwinsyah Satria et al. (2026).

**First Publication Right :**

© Journal Emerging Technologies in Education

**This article is under:**

