# Development of Scratch-Based Educational Games Media to Enhance Natural Sciences and Social Sciences (IPAS) Learning Outcomes in Elementary School

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**Abstract:** This study aims to develop scratch-based educational game media to enhance Natural Sciences and Social Sciences (IPAS) Learning Outcomes in Elementary School. The research uses a Research and Development method with the ADDIE model, which has five stages, namely Analyze, Design, Development, Implement, and Evaluate. The subject of this study were fourth-grade elementary school students. Data were collected through questionnaires containing questions and interviews for teachers and students, and observation of learning. The results of this study showed that scratch-based educational game media can significantly increase student learning outcomes, especially in elementary school IPAS learning. This is evidenced by statistical analysis through a paired sample t-test shows a significant result of 0.000, because the significant result is below 0.05. The development of scratch-based education game media is considered to provide a different learning experience because students can explore learning directly. With the increased participation of students, the learning outcomes obtained will also increase. The practicality of using scratch-based educational game media obtained a score of 86.5%, which indicates that it is very feasible and practical to use.

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## Introduction

Education is an important aspect of developing individual potential and preparing the younger generation to face opportunities and challenges in the future. In an era of the Industrial Revolution 5.0, education is experiencing significant adjustments that certainly affect the reconstruction of the education curriculum in a country and increase the urgency of education personnel in the role of educators and technology-based education facilities (Sukasih, 2021). In 2024, the education curriculum in Indonesia was officially implemented by the Merdeka Belajar Curriculum. The Merdeka Belajar Curriculum has characteristics, namely (project-based learning) which aims to develop soft skills and 8 good characters (Pancasila Student Profile), focus on essential material so that it can focus on exploring the basic competencies of literacy and numeracy, provide flexibility to facilitate learning following the abilities of students (teaching at the right level) and the context of local content (Permendikbudristek Nomor 21 Tahun 2022)

In the new curriculum, there is a new subject that integrates Natural Sciences (IPA) and Social Sciences (IPS), known as IPAS. (Permendikbudristek Nomor 12 Tahun 2024, 2024). The student will learn several subjects there are Natural and Human Resource, And The Interaction of Both; Basic Concepts of Energy, Force, and Motion; and Introduce Earth's Place In The Universe. While in the subject of Social Science, the students will study History, Culture and Society, Geography And The Environment; Concepts of Citizenship, Society, Economics, and Technology (Fitri et al., 2023). Besides the essential materials, IPAS

learning in the Merdeka Belajar Curriculum also has basic methodological principles that are expected to be achieved in learning. The fundamental concepts indicate that IPAS learning can cultivate scientific mindsets, enhancing curiosity, critical thinking abilities, analytical skills, and the capacity to reach accurate conclusions. This way, students nurture a sense of wisdom within themselves (Habbah & Sari, 2023).

To reach the learning objectives of IPAS in elementary school education, the implementation of suitable learning media is required.  Learning media is a set of tools to help deliver the content of learning materials in a way that captures the attention of students. Learning media is anything that can be utilized to convey messages (learning materials) so that it can invigorate the attention, interface, considerations, and sentiments of students in learning exercises (Rozie & Pratikno, 2023). Learning media refers to any device used by educators as an intermediary to convey learning content to people who will learn it correctly and effectively. In this case, learning media with educational game models can help teachers improve learning outcomes according to the basic objectives of IPAS learning in elementary schools (Pagarra et al., 2022).

In the 21st century, learning media is often a challenging task for educators because the media applied must be technology-based and forces educators to design teaching and learning activities in such a way as to fulfill the needs and knowledge while still considering the environmental conditions of students (Wahyuni & Solfema, 2020). There is often a gap between the technology infrastructure owned and the human resources capable of applying technology, making learning less effective (Nkosi & Ramaligela, 2025). Yet behind it, Innovative technologies such as collaborative platforms, interactive learning media, and tools provide opportunities for students to stimulate creativity, critical thinking, and problem-solving. The direct interaction or activity associated with the media being studied will certainly have an impact on increasing student participation during learning (Yusuf, 2023). In this case, educational game media can be a solution to increase student participation and make it easier for students to understand learning materials. Educational games are games that are deliberately designed with learning content or subject matter so that users can improve their abilities and get new fun experiences, and can absorb the material well (Wibawanto, 2020).

Educational game media have been proven effective in improving student learning outcomes in elementary schools. A study by (Zakiyah et al., 2021) found that using the ASEAN Smart Pinwheel Educational Game Media through Online Learning can increase motivation and student learning outcomes, which can be seen from the learning outcomes of students in the implementation class, 94.12% reached a score ≥ 75, and affective learning outcomes 91.18% reached good criteria. Additionally, (Mufidah & Lestari, 2022) stated that educational game media was able to increase students' understanding, with the acquisition of an average score which was initially only 55.6, and increasing to 85.6. As well as (Hakim & Kasiyun, 2024). This is indicated by an increase in the percentage of success indicators. Cycle 1 value data shows 38% of students are declared complete, while Cycle 2 value data shows 100% of students are complete.

Based on the results of interviews with students and teachers at SD Negeri Sampangan 01 Semarang, there are several problems experienced in the learning process, including (1) students still have difficulty understanding IPAS learning, especially on local wisdom material. (2) The media used in delivering the material is not interactive. This is concluded from the results of the formative assessment of class IV SD Negeri Sampangan 01 in the mid-semester of the 2024/2025 school year. The minimum value that applies is 65,

with a total of students is 27 students. However, there are only 10 students who get scores above the minimum score. In addition, students find it difficult to understand the material on cultural and local wisdom due to the very large content coverage, as well as the lack of time allotted to the teacher to develop learning media that can provide comprehensive materials but still be interesting and interactive. Researchers also observed learning activities and distributed surveys to students and teachers. Researchers found that learning Natural and Social Sciences in Class IV still uses conventional methods (lecturing), and the use of technology-based media only utilizes PowerPoint to display material and images on the projector.

Many educational games have been designed and declared effective in improving student learning outcomes such as research by Zakiyah, A., Riyanto, Y., & Jacky, M. (2021) which uses the Adobe Flash Media platform to develop learning media for online learning and shows that student learning outcomes in the implementation class 94.12% reached a score $\geq$ 75, affective learning outcomes 91.18% reached good criteria. In addition, research by Mufidah, E., & Lestari, P. D. (2022), who developed educational game media with the Smart Apps Creative platform, was able to increase students' understanding with the acquisition of an average score, which was 55.6, increased to 85.6 after applying the educational game media. As well as research by Juhaeni, J., Cahyani, E. I., Utami, F. A. M., & Safaruddin, S. (2023), who developed educational game media assisted by Canva and Quiz Whizzer, showed an increase in student math learning outcomes of 84%. Based on previous research, the application of learning media focuses on the use of smartwatches. Meanwhile, with technological advances, the smartwatches used by students are increasingly diverse in the software used. So, often learning media cannot be used on certain devices. In addition, several educational game media, especially quiz themes, require a strong internet connection. This becomes an obstacle if the network at the school is unstable.

This research is expected to be an alternative solution to the above problems. Researchers will develop learning media that will help improve student learning outcomes but with more multifunctional devices. The devices can be used with smartphones or Chromebooks, with screen adjustments that are acceptable on both devices, and a universal HTML file format. In addition, this media does not require an internet connection to access it, so the internet network will not hinder learning. In creating an educational media game, teachers can use the Scratch platform. Scratch is a platform that teachers can use to create creative and interactive content that can develop students' critical thinking skills. The results or media products produced from Scratch can be accessed by students without any restrictions on place and time. So that students can review the subject matter again (Maola & Irianto, 2023). Scratch-based educational game learning media can produce flexible learning media where users can use computers and Android devices without depending on the signal.

**Research Method**

This study used a Research and Development (R&D) method with the aim of creating products based on findings and experiments in the field, which are then reviewed (Rayanto, 2020).Development research is a research method that creates an output in a particular field of expertise, followed by certain side outputs, and has the effectiveness of these outputs (Saputro, 2021). Researchers want to develop a product, namely Scratch-based Educational Game Learning Media, with a focus on Cultural Diversity and Local Wisdom of Class IV Elementary Schools. The sample in this study was fourth-grade elementary school students, with a total of 27 students. This research uses the ADDIE model. Gustafon & Powell stated

that the ADDIE model is a guiding development. There are 5 elements in the ADDIE model, namely Analyze, Design, Development, Implement, and Evaluate (Gustafon et al., 2002)
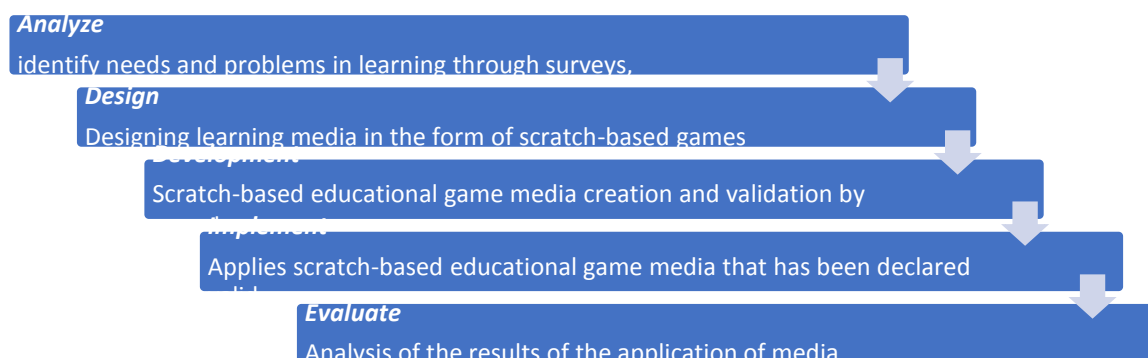


**Analyze**
identify needs and problems in learning through surveys,

**Design**
Designing learning media in the form of scratch-based games

**Development**
Scratch-based educational game media creation and validation by

**Implement**
Applies scratch-based educational game media that has been declared

**Evaluate**
Analysis of the results of the application of media

**Figure 1. ADDIE Model Steps**

Data in this study were used by researchers to measure the level of validity, practicality, and effectiveness of scratch-based educational game-learning media. To degree the legitimacy of the appraisal obtained from media specialists and fabric specialists concerning the achievability of fabric content, design, and show quality of the created item. To measure practicality data, researchers obtained the results of the assessment or responses of teachers and students to the ease and appearance of the products developed. Then, to measure the effectiveness of data, namely the learning outcomes of students, through the results of pretest and posttest assessments. The information sources in this ponder are fabric specialists who evaluate the substance and precision of the fabric contained, media specialists who evaluate the plan, appearance, and utilization of media, principals, instructors, and students of SDN Sampangan 01. The media feasibility category is like the following Table 1

**Table 1. Media Feasibility Category (Mulyani et al., 2024).**

| Percentage (%) | Category |
|---|---|
| 76% - 100% | Very Feasible |
| 51% - 75% | Worth |
| 26% - 50% | Decent Enough |
| 0% - 25% | Less Feasible |

In small-scale and large-scale testing, researchers applied a pretest-posttest evaluation aimed at measuring the effectiveness and reliability of the product, namely scratch-based educational games for elementary school IPAS learning. To measure the low and high increase in the N-Gain score, you can see Table 2. While the level of effectiveness of its application can be seen in Table 3.

**Table 2. N-Gain Value Criteria (Sukarelawan et al., 2024)**

| N-Gain Value | Criteria |
|---|---|
| $0,70 \leq g \leq 100$ | High |
| $0,30 \leq g < 70$ | Medium |
| $0,00 \ g < 0,30$ | Low |
| $g = 0,00$ | Invariable |
| $-1,00 \leq g < 0,00$ | Lowering |

**Table 3. Effectiveness Category(Sukarelawan et al., 2024)**

| Percentage (%) | Criteria |
|---|---|
| < 40 | Not Effective |
| 40 – 55 | Less Effective |
| 56 – 75 | Quite Effective |
| > 76 | Effective |

**Results and Discussion**

In the initial stage, namely analysis, researchers sought information about the learning problems through three stages. The first is direct observation of learning and creating a conceptual picture of the problems that occur (Hafni Sahir, 2021). Then, interviews with various parties, namely the principal, teachers, and students using interview instruments. Asking students to fill out a questionnaire about the learning that has taken place so far. And finally, documentation. In carrying out the documentation method, researchers investigate written objects such as learning resources used, student assessment data, and documentation in the form of pictures of IPAS learning activities in class IV.

Based on the observation, it is known that learning tends to be teacher-centered, where the teacher is the main source of learning and is supported by written books, blackboards, and PowerPoint presentations that present material to be memorized and understood by students. In the results of interviews, students considered that the learning media that had been used had used technology, but was limited to PowerPoint to present material and videos explaining material through the YouTube platform. Meanwhile, most of the content provided on PowerPoint and YouTube is relatively the same as the information in the student's book, which students must then memorize simply by looking at the content (Kudsiyah & Harmanto, 2017). So that students do not explore learning. This results in a lack of participation, so learning outcomes are less than optimal. This is shown by the documentation of the 1st midterm assessment with an average score of 60. So, researchers develop scratch-based educational game media with the ADDIE development model, with the content of "Cultural Diversity and Local Wisdom" material that can be applied in Tables 4 and 5.

At the design stage, researchers design media by creating a storyboard that serves to provide an overview of the series of media displays to be made. The storyboard components of the scratch-based educational game media with the content of "Cultural Diversity and Local Wisdom" can be seen in Figure 2.
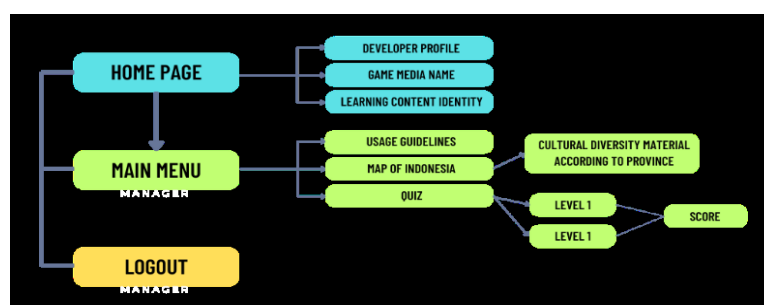


**Figure 2. The Storyboard Components Media**

The next stage is Development. At this stage, researchers began to make products in the Educational Game Media, assisted by the Scratch platform, with the results of the product made in the form of HTML, which was converted into an application format (.html). This

product will later be installed on the school's Chromebook. The steps for making the product begin with creating a basic screen display for each menu. The screen attachment applied in this application has a 4:3 ratio according to the size of the Chromebook used. After the basic screen display is ready, the researcher makes buttons and icons that will be used in the learning media application. The results of the development media can be seen in Figure 3.



**Figure 3. Documentation of some screen displays on the developed product**

After that, the researcher entered the material on cultural diversity and local wisdom of 38 provinces into the "Map of Indonesia" menu. As well as compiling questions for quizzes that have been adjusted to the Learning Outcomes and Learning Objectives of IPAS Class IV Elementary School. After all menu displays have been input into Scratch. Researchers submitted validity tests to material experts, media experts, and supervisors. The results of the media validity assessment can be seen in Table 4 below.

**Table 4. Results of Media Expert Validation**

| Aspect | Percentage (%) | Category |
|---|---|---|
| Media Indicators | 75% | Worth |
| Display Indicators | 75% | Worth |
| Usage Indicators | 75% | Worth |
| Usability Indicators | 75% | Worth |
| Average Number of Validations | 75% | Worth |

The media feasibility test assessment for media experts has 4 indicators, which are accumulated with a percentage. The result of the media expert feasibility test assessment is 75%, which can be categorized as "feasible" to be applied in research

**Table 5. Results of Material Expert Validation**

| Aspect | Percentage (%) | Category |
|---|---|---|
| Appropriateness of Material | 100% | Very Feasible |
| Appropriate to the Level of Thinking | 87,5% | Very Feasible |
| Support for Learning Content | 87,5% | Very Feasible |
| Suitability to Linguistic Aspects | 100% | Very Feasible |
| Accuracy and Usefulness | 87,5% | Very Feasible |
| Average Number of Validations | 92,5% | Very Feasible |

As for the material feasibility test for material experts, there are 5 indicators that are accumulated with a percentage. The result of the feasibility test assessment by the material expert is 92.5% and falls into the "very feasible" category to be applied to research. Based on

the results of the experts' validity assessment, the products that have been developed are declared feasible to be tested in the field.

Furthermore, at the implementation stage, researchers tested the application of products that had been feasible by the experts in the study group of Class IV elementary school students. Implementation of scratch-based educational games is carried out in small-scale and large-scale study groups. The small-scale study group consisted of 7 students and a large-scale group of 20 students, as shown in Figures 4 and 5.



**Figure 4. Documentation of product use in small-scale groups**



**Figure 5. Documentation of product use in large-scale groups**

After the implementation was carried out, the researchers asked teachers and students to fill out a questionnaire regarding the practicality and feasibility of scratch-based educational game media in improving the learning outcomes of IPAS grade IV elementary schools. In the instrument, there are six aspects of concern, namely the attractiveness of the media display, the ease of the media, the accuracy and usefulness of the media, the accuracy of the material, the breadth and clarity of the material, and the aspects of the use of language and writing. The results of the questionnaire are expressed in the form of percentages and eligibility categories, which can be seen in Table 6.

**Table 6. Average Number of Validation Media**

| Respondent | Percentage (%) | Category |
|---|---|---|
| Students | 78% | Very Feasible |
| Teacher | 95% | Very Feasible |
| **Average Number of Validations** | **86,5%** | **Very Feasible** |

Furthermore, to assess in general whether there is an increase in learning outcomes after the trial use of scratch-based educational game media for IPAS learning, the researchers analyzed the effectiveness through the average difference and paired sample T-Test. Through the average difference, it will be seen whether there is an increase in the average value descriptively. Meanwhile, to prove whether the increase in value is significant through statistics can use the T-Test method. The results of the effectiveness analysis of Scratch-based Educational Game Media can be seen in the table 7,8, and 9.

**Table 7. Value analysis on a small scale**

| The Test | Average | Average Difference |
|---|---|---|
| Pretest | 45 | 35 |
| Posttest | 80 | |

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**Table 8. Value analysis on a large scale**

| The Test | Average | Average Difference |
|---|---|---|
| Pretest | 53,684 | 30,526 |
| Posttest | 84,211 | |

**Table 9. Results of Paired Sample T-Test Scratch-Based Educational Game Media**

| The Test | Average | Average Difference |
|---|---|---|
| Small Group Trial | 0,000 | Significant Changes |
| Large Group Trial | 0,000 | |

The media effectiveness test is carried out by analyzing the N-Gain score through the results of the pretest and posttest assessments that have been done by students. The results of the N-Gain score analysis are expressed in percentages and categorized into several criteria. The results of the effectiveness test of scratch-based educational game media can be seen in Table 10.

**Table 10. Results of the N-Gain Test Scratch-Based Educational Game Media**

| The Test | N-Gain Score (%) | Category |
|---|---|---|
| Small Group Trial | 65,48 | Effective Enough |
| Large Group Trial | 67,48 | |

This study confirms that the scratch-based educational game media developed is quite effective in efforts to improve student learning outcomes. Evidenced by the score obtained on a small scale of 65.48% and a large scale of 64.411%. So the learning media can be a solution to the problem of student learning outcomes, especially in IPAS subjects.

In general, this study aims to assess the validity, practicality, and effectiveness of learning media in the form of educational games based on Scratch to improve primary school IPAS learning outcomes. The validity test was carried out through assessment by media experts and material experts. The material expert assessment has four aspects assessed, namely Media Indicators, Display Indicators, Display Indicators, Usage Indicators, and Usability Indicators. While the material experts assessed the Appropriateness of the Material, Appropriate to the Level of Thinking, Support for Learning Content, Suitability to Linguistic Aspects, Accuracy, and Usefulness.

The result of the media expert feasibility test assessment is 75%, which can be categorized as "feasible". Meanwhile, the result of the feasibility test assessment by the material expert is 92.5% and falls into the "very feasible" category. These results confirm that the learning media developed have a high level of validity and are very feasible to be applied in IPAS learning in elementary schools. Similarly, research conducted by (Juhaeni et al., 2023) who developed educational games on mathematics learning with addition and subtraction material and successfully showed the feasibility test of media experts with a value of 90% and the feasibility test of material experts with a value of 87%, (Mufidah & Lestari, 2022) who developed educational game media on science learning with energy source material and its utilization obtained the percentage results of media expert validation of 82%, material expert validation of 88%.

The questionnaire instrument, assessed by students and teachers, obtained a score of 95%, which indicates that it is very feasible and practical to use. Based on the assessment of students obtained the score of 78%, which means that the media is very feasible and practical to use. As in the research of (Hidayah & Prasetyo, 2022) who developed thematic educational game media theme 3 subtheme 1 grade 4 and showed the results of the analysis of teacher and

student limited test respondents, namely 84% of students and 90% obtained from the limited test of class teachers, so it can be said to be effective with a very high category.

Assessment of the effectiveness of the learning media is obtained from the results of the pretest-posttest assessment that students have conducted. In small-scale implementation, the average pretest score of students was 45, while the average score on the posttest increased to 80 after applying Scratch-Based Educational Game media. Then, in the large-scale implementation, the average pretest of students was 53.684, and the value increased in the posttest to 84.211. Statistical analysis through a paired sample t-test shows a significant result of 0.000, because the significant result is below 0.05, it can be concluded that the application of learning media using scratch-based educational game media shows a significant increase.

The development in this study focuses on the development of educational game media with the help of the Scratch platform on IPAS learning in elementary schools. In the media, students can learn the material of cultural diversity and local wisdom throughout Indonesia in a fun way. In addition, there is a quiz menu to test the extent to which students understand the material well. This educational game media is made in the format of the product in the form of an application without requiring the internet. This application can be downloaded via Chromebook or a smartphone. This research aims to provide solutions to learning problems that are common in the 21st century. Where applicable, learning must emphasize the use of technology.

## Conclusion

This study shows that scratch-based educational game media can significantly increase student learning outcomes, especially in elementary school IPAS learning. This is evidenced by statistical analysis through a paired sample t-test shows a significant result of 0.000, because the significant result is below 0.05. The development of scratch-based education game media is considered to provide a different learning experience because students can explore learning directly. With the increased participation of students, the learning outcomes obtained will also increase. The practicality of using scratch-based educational game media obtained a score of 86.5%, which indicates that it is very feasible and practical to use.

## Recommendation

Based on the learning challenges identified, especially in the Merdeka Belajar curriculum learning that emphasizes technology and the development of student abilities, researchers recommend. The first is that the lesson content needs to be narrowed so that students can explore the lesson according to the predetermined learning time. The second school policy, where there is training of teachers' skills in making technology-based media, will have a significant impact on the quality of learning. Schools can also apply technology-based learning media, such as this research product. Although this media development research shows positive results, some things become limitations, such as the absence of varied audio related to the material, yet available by AI, Virtual Reality, or Augmented Reality. The next researcher can improve media development by paying attention to that.

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