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Development of Interactive Learning Media My Indonesia is Rich in Culture INKAYA Based on Unity to Improve Science Learning Outcomes of Grade IV Elementary School Students

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Abstract: Based on pre-research data at SDN Tambangan 01 Semarang, the problem of the lack of interesting and IT-based learning media was found. This study aims to develop, assess the feasibility, and test the effectiveness of interactive learning media Inkaya based on Unity in the subject of science for grade IV. This type of research is Research and Development (R&D) with the Borg & Gall model involving 10 steps. The study population consisted of 28 grade IV students. Data collection techniques include tests, questionnaires, observations, interviews, and documentation, as well as data analysis using normality tests, t-tests, and N-gain tests. The results of the study showed that the Inkaya learning media based on Unity was feasible to use with a feasibility of 90% for presentation by media experts and feasibility of content by material experts. This media has also proven effective in improving student learning outcomes with a t-test value of 0.000 (significant) and an N-gain of 0.656 (moderate criteria). In conclusion, the Inkaya learning media based on Unity is effective and feasible to use in learning science for the material of Indonesian cultural wealth.

Keywords: Elementary school; Learning media; Science; Unity

Introduction

Education is very important for the progress and welfare of the nation. Advances in technology, information, and communication in education can increase the spread of knowledge (Mhlongo et al., 2023; Haleem et al., 2022). The use of digital technology in the contemporary era allows education to be in line with the fourth industrial revolution, thus producing quality and continuously developing human resources (Nursyifa, 2019). Education seeks to foster individual potential in knowledge, skills, and constructive attitudes (Deng, 2022; Ammar et al., 2024). Curriculum development continues to be carried out to improve the quality of education in Indonesia (Pakpahan et al., 2023). The curriculum in force in Indonesia is the Independent Curriculum. According to PP Number 4 of 2022, the curriculum is a systematic plan and organization of objectives, content, learning materials, and learning methods aimed at achieving educational goals. After the outbreak of Covid-19, the government through the Ministry of Education, Culture, Research, and Technology implemented a policy to advance the Independent Curriculum in order to rehabilitate the learning process. This curriculum is given to educational institutions as an alternative to facilitate learning recovery from 2022 to 2024 (Ariga, 2023).

The policy of the Ministry of Education, Culture, Research, and Technology on the national curriculum will be reviewed in 2024 after an evaluation of the learning recovery phase. The Independent Curriculum or Prototype Curriculum is adaptive and emphasizes

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basic material, character development, and student competencies. This curriculum uses interactive and collaborative learning techniques, thus offering greater flexibility for educators, students, and institutions in implementing education (Ferreira et al., 2024). Permendikbud No. 7 of 2022 concerning Content Standards stipulates that elementary school/MI education includes scientific disciplines, which integrate science and social studies content in the Independent Curriculum. The aim is to provide a comprehensive understanding of the surrounding environment.

Scientific material covers natural and social phenomena, with science focusing on natural conditions and social studies examining social relationships. Both materials are important to help students understand their existence (Sumarmi, 2023). Science is a discipline that focuses on understanding living things, inanimate objects, and their interactions in the world, as well as human existence as social beings. Science methodically synthesizes various information in a logical framework, which includes cause and effect analysis (Assazili et al., 2024; Reed et al., 2021; Partelow, 2023). Elementary school children can see and engage with natural and social phenomena in their environment (Alfatonah et al., 2023; Lanza et al., 2023). They are directed to observe and investigate, building an important foundation before a comprehensive examination of concepts and subjects in science and social studies. Science education is carried out practically. Comprehensive and real learning is in the independent curriculum, which also encourages students to collaborate in groups. Science education is an important component of the contemporary Independent Curriculum (Rahman & Fuad, 2023; Hofstein et al., 2011; Valladares, 2021).

In a preliminary study conducted on March 5, 2024 at SDN Tambangan 01, Mijen District, Semarang City, researchers identified several problems in the fourth grade science curriculum, including: lack of interesting IT-based learning media, limited learning resources that only rely on teacher and student textbooks without being supported by diverse teaching materials, the use of available facilities and infrastructure such as projectors, laptops, and speakers is not optimal, and the limited learning media used reduces student enthusiasm in learning that only uses images, videos, or powerpoints that only contain material.

Learning methods that encourage student involvement have not been applied to learning environments where learning is more teacher-centered, such as lectures and discussions. As a result, learning models that encourage student activity are still underdeveloped, so that student learning achievement in science subjects is still relatively low for some individuals. The results of the Final Assessment of Semester I of 2023/2024 for fourth grade social studies students at SDN Tambangan 01 Semarang showed achievements that were still below the Learning Target Achievement Criteria (KKTP). SDN Tambangan 01 Semarang has 28 fourth-grade students, consisting of 16 male students and 12 female students.

As many as 15 people (54%) do not meet the KKTP, while 13 people (46%) have met the KKTP requirements. The lack of interesting and technology-based educational resources is a significant problem. Media makes a significant contribution to education by enhancing learning activities and improving student performance. In addition, the integration of media into the educational environment facilitates the delivery of impactful content, increases student engagement and motivation, reduces boredom, and allows students to investigate knowledge independently. This is in line with Arsyad's statement that knowledge is easier to understand when it involves several senses, especially hearing and sight, for optimal retention (Jannah, 2020). Given the various problems mentioned above, researchers recognize the need to develop innovative educational media that utilize advances in technology, information, and communication, while still following current trends and using interesting pedagogical models to increase student enjoyment in the learning experience (Kraus et al., 2022; Kamalov et al., 2023). This study seeks to create interactive educational media that uses Unity, a game development software.

The goal is to develop educational content that integrates audio and visual components, provides additional learning games, and displays an engaging interface with audiovisual attributes. Furthermore, the media will have evaluative questions that encourage student participation, thereby increasing their engagement and aiding the understanding of social studies, with a special emphasis on the richness of Indonesian culture. Unity has the advantage of allowing the media to be customized to specific requirements, desires, and creative expressions. Furthermore, Unity can combine many media elements, including audio, text, and graphics, thereby engaging students in learning activities and reducing boredom through the presentation of engaging information.

Method

This study uses the Research and Development (RnD) methodology. That RnD functions to validate and refine products. Product validation indicates that the product already exists, and researchers only assess its effectiveness or validity. Product development broadly includes the improvement of existing products (to increase their practicality, effectiveness, and efficiency)

or the creation of completely new products outline ten phases of development. This approach includes prospective and problem phases, data acquisition, product design, design validation, design modification, usage trials, product revisions, and mass production; Researchers carry out all 10 steps in product development, which include:identifying potential and problems, data collection, product design, design validation, design modification, product testing, product refinement, usability testing, final product modification, and mass production; Identifying potential and problems, Researchers conducted observations and interviews with grade IV teachers of SDN Tambangan 01 Semarang to analyze potential and problems, equipped with supporting documentation. The results of data collection indicate that the use of IT-based learning media by educators is still limited. Educators only rely on instructional texts and student texts.

This can be seen from the learning outcomes that are still less than optimal, especially in science subjects, especially the subject of Indonesian Cultural Wealth; Data collection, involving researchers to collect information that will be the basis for product planning, including questionnaires about teacher and student needs and relevant documents. At this stage, researchers look for many supporting sources to be used as references in this study; Product design, creating interactive learning media products using Unity for the fourth grade science curriculum focused on "Indonesian Cultural Wealth". At this stage, researchers develop scripts, concepts, layouts, and accompanying animations for educational media to engage students and facilitate deeper understanding of the content through this interactive media; Design validation, by media and material experts involves assessing the product design to determine its efficacy based on rational evaluation rather than empirical evidence or field conditions.

In this step, the developed media is evaluated by professionals, especially media experts and content experts; Design modification, After evaluation by several experts in product validation, researchers can find weaknesses or deficiencies in the design revision. Learning media products can be refined or improved based on expert feedback. If the validation findings indicate that the product has met the requirements and received expert consensus, then the product does not require further revision and is ready for field application; Product trial, conducted with a small group at SDN Tambangan 01. The small group was identified using a purposive sampling method. The researcher selected 9 students to conduct a small-scale product trial: 3 with the highest ratings, 3 with average ratings, and 3 with the lowest ratings based on the knowledge criteria. This was done to ensure that the product testing was balanced and fair; Product Revision, After conducting testing on nine students, the researcher found product deficiencies based on their input. The input provided was used to improve and refine the product. After conducting revisions, validations, and initial trials, the product underwent testing to assess its efficacy; Product usage and trial tests involving all fourth-grade students at SDN Tambangan 01, Semarang.

The researcher used a saturated sampling method in product research. This stage was carried out with a design plan based on pre-experimental methodology, specifically using a one-group pre-test-post-test design model. The pre-test was conducted before the implementation of the product operation treatment, and the post-test was given after students engaged with the subject through the interactive learning media Prosispen, developed by the researcher on the Google site. The purpose of this design is to assess the comparative state and understanding of students before and during the treatment; Modification of the final product is carried out if there are deficiencies and benefits in the Prosispen learning media during actual improvement. During usability testing, product manufacturers consistently evaluate product performance in the working system; Mass production begins when the evaluated product is considered effective and feasible to be produced on a large scale.

Result and Discussion

Progress review of interactive educational media Project Inkaya, centered on Unity in Science, emphasizing the Cultural Wealth and Diversity of Indonesia for fourth grade students at SDN Tambangan 01 Semarang. Researchers are developing interactive educational media, Inkaya, which uses Unity in Science, emphasizing the cultural richness of Indonesia for fourth grade students, utilizing the Borg and Gall research and development approach as adapted by Sugiyono (Dwivedi et al., 2023; Yao et al., 2023; Nowell et al., 2017). The researchers' development model includes ten stages: identification of potential and problems; data collection; product design; design validation; product modification; product testing; product refinement; usability testing; final product modification; mass production.

During the problem identification and data collection phase, the lack of interesting IT-based learning media was noted. Educational institutions mostly rely on teacher and student texts, missing other materials that can enhance a more varied learning experience (Lee et al., 2024; Walter, 2024). The use of limited learning

media causes students' interest to decrease, because the educational approach relies more on textual information than including images, films, or PowerPoint presentations. The pedagogical methods used were largely teacher-centered, relying heavily on lectures and discussions, which negatively impacted students' overall academic performance in the science disciplines. Out of 28 students, 15 (54%) failed to meet the learning objectives (KKTP) set at 70, while 13 (46%) managed to achieve the KKTP.

After the potential and problems stage was completed, the next step involved data collection. The researcher conducted an analysis of the needs of teachers and students, which were collected through a questionnaire regarding the Inkaya interactive learning media product developed on the Unity platform. After obtaining the data needed for the development of the Inkaya interactive learning media, which is based on Unity material on the richness of Indonesian culture, the next stage involved formulating the product design (Raharja et al., 2020; Pratiwi et al., 2022). This educational material is an application that can be accessed by all individuals, regardless of their location. This educational media is provided by the Unity application. The integration of animation enhances the appeal of learning, consisting of a series of images featuring aesthetically created characters that display varied and clear graphics (Palioura & Dimoulas, 2022; Caella & Yulianto, 2024; Li et al., 2024).

The next phase requires design validation, where the Inkaya interactive learning media, created with Unity, is assessed by two specialists: a media expert and a content expert. The assessment of the feasibility of interactive learning media using Unity includes validation of the content and language assessment components by subject matter experts, in addition to validation of the presentation component by media specialists. Both professionals filled out the researcher's questionnaire using a Likert scale, which provided a check mark with comments and recommendations to improve the Unity-based Inkaya interactive learning media. The experts' evaluation scores were then analyzed quantitatively, producing the following product validation test results.

Table 1. Product validation results

Subject	Result (%)	Category
Media expert	90	Very worthy
Material expert	90	Very worthy

Table 1 is the result of the analysis of the validity test that has been conducted. The results of the validity test from media experts obtained a percentage of 90%. While the validity test by material experts obtained 90%. Both results were then adjusted to the predetermined table and obtained the result that the interactive media Inkaya based on Unity was very feasible. In addition, the experts also provided responses and suggestions. The following are details of the responses and suggestions from the experts.

Table 2. Suggestions for product improvement

Subject	Suggestions for improvement
Media expert	Providing the name of the development on the cover, complete with a bibliography, and instructions for use complete with button descriptions.
Material expert	Addition of cultural potential in the city of Semarang.

Table 2 shows the responses and suggestions for improvement in media development. The suggestions given were in the form of giving the developer's name on the cover, equipped with a bibliography, instructions for use with button descriptions, and adding cultural potential in the city of Semarang. The next stage involved modifying the design, after evaluation by media and material specialists from the Unity-based Inkaya interactive learning media, and combining their recommendations for improvement, the researcher revised the Unity-based Inkaya media once again. The next version of the Unity-based Inkaya interactive learning media has been revised according to expert recommendations.

Figure 1. Cover view

The cover section displays the media name, the logo of Semarang State University, and the name of the media developer.

Figure 2. Menu display on the media

The menu consists of a developer profile menu, a learning achievement and objectives menu, a usage instructions menu, a materials menu, a quiz menu, and a bibliography menu.

Figure 3. Developer profile view

This section presents the video developer's identification, including photo, developer name, student ID, faculty, and department.

Figure 4. Display of instructions for use

This section describes the functionality of the buttons present in the Unity-based Inkaya interactive media.

Figure 5. Display of the material menu

The material menu section presents three sub-materials: elements that contribute to the richness and diversity of Indonesian culture, Semarang local culture, and the richness and diversity of Indonesian culture.

Figure 6. Display of the first material menu

The initial part of the material menu provides an explanation of the elements that contribute to the richness and diversity of Indonesian culture.

Figure 7. Second material menu display

The second area of the material menu provides an overview of local cultural materials related to the city of Semarang.

Figure 8. Third material menu display

Figure 9. Third material menu display

Figure 10. Third material menu display

The third area of the material menu presents images of islands next to the names of provinces in Indonesia. It displays explanations of Indonesian cultural artifacts, including traditional houses, traditional clothing, dances, and musical instruments.

Figure 11. Initial view of the quiz menu

The quiz menu begins with eight numbered boxes displaying the quiz questions.

Figure 12. Quiz question display

The Quiz Question Area Provides Multiple Choice Questions by Selecting One of the Most Relevant Answers

The next stage includes product trials, product modifications, and usage assessments. This stage includes product trials in the field. Products developed and validated by media and material experts are then implemented or tested on students. This stage is carried out in two parts, namely the initial stage of small-scale trials and the next stage of large-scale trials. The small-scale product trial was conducted in class IV B using the purposive sampling technique, which is a sampling technique with certain considerations. The researcher selected 9 students heterogeneously based on class ranking, namely 3 top-ranking students, 3 middle-ranking students, and 3 bottom-ranking students. The implementation of the product trial began with a demonstration of the use of Inkaya interactive learning media based on Unity and then working on student and teacher response questionnaires.

The Inkaya interactive learning media response questionnaire based on Unity was given to 9 students and teachers of class IV SDN Tambangan 01 Semarang City. The teacher response questionnaire is a questionnaire given to teachers to obtain information and suggestions related to the Unity-based Inkaya interactive learning media. The teacher response questionnaire aims to be used as input for product improvement and refinement. The teacher response questionnaire consists of 20 questions. The questionnaire was given to teachers after the teachers conducted observations and the use of the Unity-based Inkaya interactive learning media in the product trial. The results of the teacher response questionnaire analysis can be seen in the following diagram.

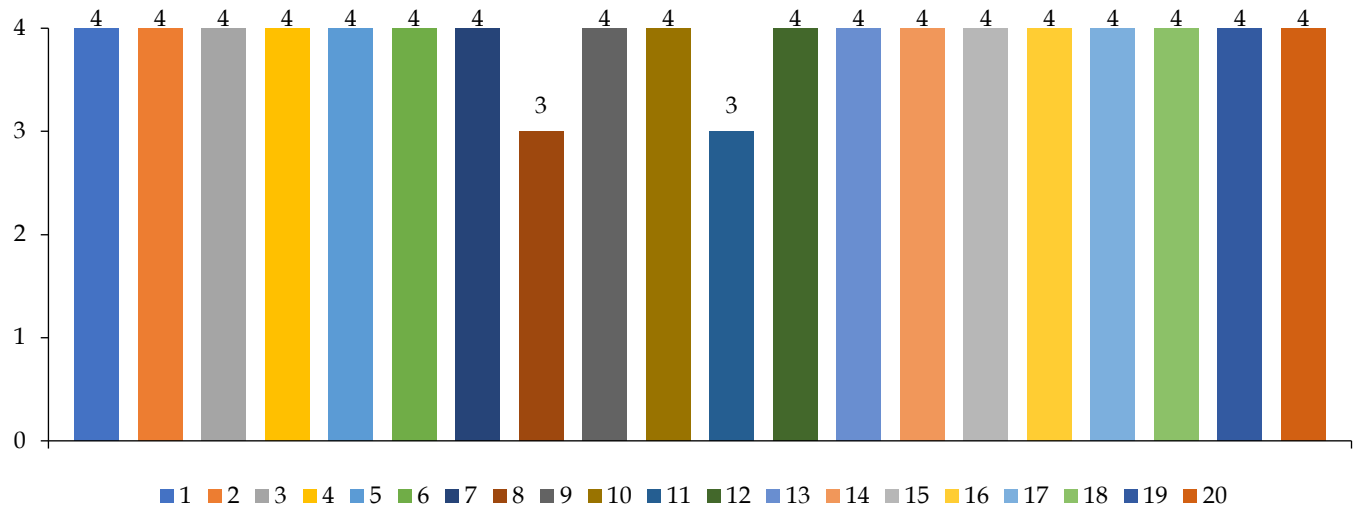

Figure 13. Teacher response questionnaire diagram

The teacher response questionnaire diagram regarding the Google Sites web-based interactive process media, consisting of 20 questions arranged as a Guttman scale, obtained a good response with a score of 78, resulting in a percentage of 97.5%, which is classified as very good for each aspect assessed. The student response questionnaire consisted of 10 indicators given to 9 students, using 3 ranking categories: top ranking, middle ranking, and worst ranking. The response questionnaire was given during product testing to collect information and feedback on the media in order to improve the product. The results of the student response questionnaire study during the product trial are depicted in the following diagram.

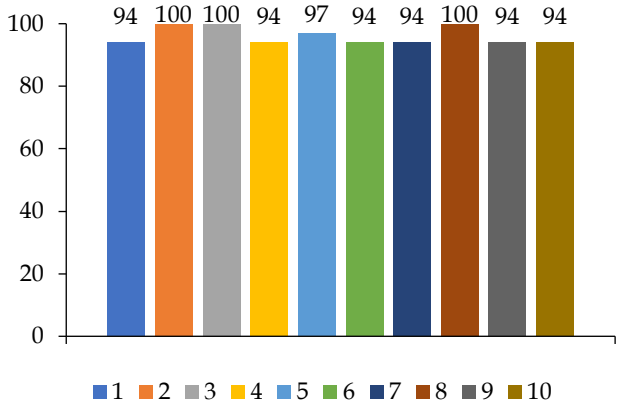

Figure 14. Student response questionnaire diagram

The diagram shows that 10 questions on the student response questionnaire of grade IV SDN Tambangan 01 Semarang in the small-scale product trial received a very good rating, with a percentage of 96%. Analysis of the results of the student response questionnaire showed that the Inkaya interactive learning media developed using Unity received a good response. The next stage is a comprehensive product trial conducted in class IV A, involving 28 students, using the Unity-based Inkaya interactive learning media response questionnaire, using the Guttman scale aimed at teachers and students. The sampling technique used is saturated sampling, where each member of the population is used as a sample. The purpose of the product trial which includes student and teacher response questionnaires is to evaluate the effectiveness of the Unity-based Inkaya learning media on the content of Indonesian cultural wealth. The comprehensive product trial was conducted in the learning session on Thursday, January 30, where the researcher distributed pre-test questions and then conducted learning using the Inkaya interactive learning media developed on the Unity platform, in accordance with the learning objectives. After learning, students worked on the post-test questions.

Learning in large-scale product trials was conducted by researchers. To test the effectiveness of Inkaya interactive learning media based on Unity. Student learning outcomes are seen from the pre-test and post-test scores (Verawati et al., 2024; Sari & Tyas, 2024). The pre-test score was recorded before students used the Inkaya interactive learning media developed on the Unity platform. The post-test score was obtained after learning using the Inkaya interactive learning media developed on the Unity platform. The average pre-test score was 35.46, while the average post-test score was 77.82. The difference between the pre-test and post-test scores was 42.36 on average. No students (0%) showed an increase in learning completeness during the pre-test, while 26 students (93%) showed learning completeness during the post-test. The data show that the learning outcomes of students in the field of social studies about the richness of Indonesian culture in grade

IV of SDN Tambangan 01 Semarang varied before and after the implementation of Inkaya learning media based on Unity. The pretest and posttest scores were then analyzed for normality, with results of 0.222 and 0.150. The normality test analysis is presented as follows.

Table 3. Results of the pretest and posttest normality tests

	Kolmogorov-Sminov			Shapiro- Wilk		
	Statistic	df	Sig	Statistic	df	Sig
Pretest	.180	28	.20	.952	28	.222
Posttest	.180	28	.20	.952	28	.150

Since both data produce values exceeding 0.05, the conclusion is that the data are regularly distributed. Paired Sample T-Test analysis was conducted to evaluate the efficacy of Inkaya interactive learning media on the integration of Indonesian cultural wealth material in educational activities. Paired Sample T-Test analysis produced the following results.

Table 4. Results of the pretest and posttest mean difference test

Paired Differences				Paired samples test		
95 % Confidence Interval of the Difference						
Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig (2-tailed)
9465	1.47	-45.37	-39.33	-28.75	27	.000

Based on the table of test results of the difference in the pretest and posttest averages assisted by the SPSS version 26 application, the sig. (2-tailed) value is 0.000. The paired sample t-test testing criteria are if the sig. (2-tailed) value < 0.05 then there is a significant difference between learning outcomes in the pretest and posttest data. Conversely, if the sig. (2-tailed) value > 0.05 then there is no significant difference between learning outcomes in the pretest and posttest data. The t-test results show that sig. (2-tailed) 0.000 < 0.05 so it can be concluded that there is a significant difference between the results of the pretest and posttest data. Furthermore, to determine the average increase in pretest and posttest scores, the average increase test is used (Pujiastuti & Fausan, 2024). The calculation of the average increase in pretest and posttest scores is calculated using the N-gain analysis. N-gain is the normalization of the gain obtained by comparing the difference in pretest and posttest scores with the difference in SMI scores and pretest scores. Gain shows an increase in the average learning outcomes on the material of Indonesian cultural wealth after using interactive learning media based on Inkaya (Afni & Bektiningsih, 2024; Hardika et al., 2024; Hasanah & Sudira, 2021; Sujarwo et al., 2024).

Table 5. Average test results (N-Gain)

Category	Mark
Pretest	35.46
Posttest	77.82
Average difference	42.36
N-Gain class	0.656
Criteria	Currently

Based on Table 5, the results of the average increase test (N-gain) show that fourth grade students of SDN Tambangan 01 Semarang obtained an average increase of 0.656 with an average difference of 42.36 which is included in the moderate category. The increase in pretest and posttest results using Inkaya interactive learning media based on Unity can be described by the following line diagram.

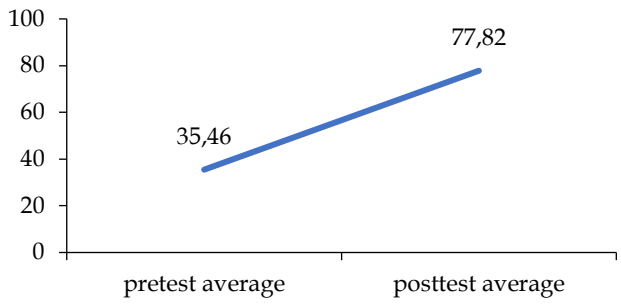

Figure 15. Line diagram of the increase in pretest and posttest learning outcomes

Figure 15 above shows an increase in pretest and posttest learning outcomes with an average difference of 42.36. The average increase shows that the implementation of Inkaya interactive learning media based on unity was successfully used for learning science content related to the richness of Indonesian culture for fourth grade students of SDN Tambangan 01 Semarang. This shows that Inkaya interactive learning media based on unity can improve student learning outcomes, but there are still some shortcomings such as students having difficulty operating the media and less conducive classroom conditions (Wang et al., 2022; Xu et

al., 2022; Ahmad et al., 2015). This is reflected in the n-gain value of 0.656 which is included in the moderate criteria.

Conclusion

The results of the study on the development of interactive learning media Inkaya utilizing Unity for the science curriculum on Indonesian cultural heritage for grade IV students of SDN Tambangan 01 Semarang resulted in the following conclusions: The researcher has developed an interactive learning media "inkaya" based on unity in the science subject on the material of Indonesian cultural heritage for grade IV of SDN Tambangan 01 Semarang with an attractive appearance including, the main menu consisting of, a menu of instructions on how to use the learning media; learning achievement menu; a material menu that presents material on Indonesian cultural riches, Semarang city culture, and factors causing the richness and diversity of Indonesian culture a quiz menu; a handout menu as a summary to make it easier for students to understand the lesson material; the closing menu contains references in compiling material on Indonesian cultural heritage and developer profiles; The interactive learning media Inkaya based on unity has been created after an evaluation of the feasibility of the content by media experts and material experts, with a high value of 90% for both the feasibility of presentation and the feasibility of content components; The use of interactive learning media Inkaya based on unity is effective for studying Indonesian cultural heritage in the context of science. This is indicated based on the results of students' cognitive learning in the pretest and posttest scores, there is an average difference of 42.36. The results of the test of the difference in average pretest and posttest values using the t-test calculation obtained an average increase with moderate criteria.

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Author Contributions
Collecting data, analyzing data, writing original drafts, methodology, data curation, visualization, Y.C.; review writing, S.S.A.

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The author declares no conflict of interest.

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