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Development of Interactive IPAS Teaching Material Based on the Inquiry Model Using the Powtoon Application for Fourth Grade Elementary School Students

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Abstract: This study aims to develop interactive teaching materials based on the inquiry model using the Powtoon application that are valid, practical, and effective for fourth-grade elementary school students. The background of this research includes the limited use of technology-based teaching materials, low student participation in science and social science learning, a lack of engaging instructional media, and the need for learning models that enhance critical thinking and problem-solving skills. The method used is Research and Development (R&D) with the 4D development model (Define, Design, Develop, and Disseminate). The validation results from subject matter experts, media experts, and language experts indicate that the developed teaching materials are highly valid, with a score of 90.04%. The materials include content aligned with the Competency Criteria and Learning Objectives, a systematic presentation following the inquiry model syntax, communicative language, and attractive visuals through Powtoon animations. In terms of practicality, both students and teachers rated the material as highly practical, with an average student response score of 86.98% and a teacher score of 92.67%. The effectiveness of the teaching material was evaluated through pretest and posttest, with an average N-Gain score of 0.79 (high category), showing a positive impact on student learning outcomes. These materials are proven to be valid, practical, and effective in improving student learning outcomes.

Keywords: Elementary school; Interactive teaching material; Inquiry model; IPAS; Powtoon

Introduction

The rapid development of information and communication technology has had a significant impact on various sectors of life, including in the field of education. The era of Industry 4.0 revolutionizes the role of technology, making it increasingly important in every aspect of life, especially in the education system. Educators are faced with the challenge of mastering information technology to ensure that they remain relevant and adaptable to ongoing changes. In the midst of this development, education must be able to keep up with technological advancements in order to provide effective learning for students (Barkati & Cahyadi, 2024; Fangestu, & Syahrizal, 2023; Utami et al., 2022).

Industry 4.0 marks an era where the use of information technology has rapidly developed, including in the education system. Information technology, which is increasingly affordable and advancing quickly, enables more efficient and widespread dissemination of information, even reaching remote areas that were previously difficult to access. The

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process of communication and information dissemination has become faster and more accessible, having a significant impact on education and the spread of knowledge in society. Therefore, it is important for educators to make optimal use of this technology (Akram et al., 2022; Anggriyani et al., 2024; Garzón Artacho et al., 2020; Spiteri & Chang Rundgren, 2020).

The Fourth Industrial Revolution also has a major impact on the education sector, which is a key pillar in the progress of a nation. Education not only serves as a means of imparting knowledge but also as a foundation for the development of national character. Therefore, education must be able to respond to technological advancements quickly and appropriately, using it as a tool to improve the quality of teaching and learning (Ajani, 2024; Bonfield et al., 2020; Oliveira et al., 2021). Technology and the internet, which were previously used solely as tools for information, now also function as instruments for living life and innovating in the field of education (Burbules et al., 2020; Haleem et al., 2022; Timotheou et al., 2023).

In the context of Indonesia, the use of technology in education is increasingly widespread. A survey conducted by the West Sumatra Provincial Statistics Agency shows a significant increase in internet usage among the population, including educators. In 2023, more than 62% of the population in Padang Pariaman Regency accessed the internet, indicating that technology and the internet are becoming an integral part of everyday life. This phenomenon opens opportunities for educators to develop their competencies in utilizing technology to enrich teaching materials and enhance the quality of learning (Ibarra-Vazquez et al., 2023; Mena-Guacas et al., 2025; Siyam et al., 2025).

However, despite the adoption of technology, student learning outcomes in Indonesia are still not optimal. The Program for International Student Assessment (PISA) conducted by the Organisation for Economic Co-operation and Development (OECD) shows that 35% of Indonesian students are still at a low competency level in the field of science (Hartono et al., 2022). This indicates a major challenge in improving the quality of education, particularly in the field of science, which remains relatively low. Therefore, further efforts are needed to enhance the quality of education in Indonesia (Madhakomala et al., 2022).

One of the factors contributing to the low learning outcomes of students is the teaching method that still relies on conventional approaches. Many students feel bored with teaching methods that tend to focus on memorization and do not actively involve them in the learning process. A more interactive and engaging learning model is needed to increase student involvement and develop their cognitive skills. One method that can be used is the inquiry-based learning model, which involves students in critical and analytical thinking activities to find answers to the problems posed (Kek & Huijser, 2011; Rahmi et al., 2019; Ramadani et al., 2021; Wale & Bishaw, 2020).

The use of technology-based learning media, such as Powtoon, has become one of the alternatives to improve the quality of education. Powtoon is an animation-based learning platform that allows educators to create learning materials that are more engaging and easier for students to understand. This media is very suitable for developing attractive teaching materials, as it has animation features that can capture students' interest and attention in understanding the content. Powtoon can be used to create interactive learning videos that combine animation and text, helping students to better grasp the material being taught (Istiqomah & Adi, 2024; Wanti et al., 2024; Widyawati & Kamaludin, 2024).

In addition to the use of digital media, the approach to the learning model is also crucial in supporting the success of education. The inquiry model, which emphasizes critical and analytical thinking processes, is highly suitable for science education at the elementary level. This model encourages students to actively investigate and solve problems, as well as develop higher-order thinking skills. As a result, students are not merely passive recipients of information, but are directly involved in the process of independently discovering knowledge (Ghaleb, 2024; Kumar Shah, 2019; Putri et al., 2024).

Based on a needs analysis conducted in several schools, it was found that educators still underutilize digital technology in the learning process. This is reflected in the low use of digital media and learning platforms in the classroom, despite the availability of technological facilities. Learning that relies on conventional methods and limited teaching materials makes students feel less engaged and find it difficult to understand the material effectively. Therefore, innovation is needed in the development of more engaging and effective teaching materials through the use of inquiry-based digital media (Lee, 2023; Nurhasanah et al., 2025; Sotiriou et al., 2020; Susilawati et al., 2024).

Based on the description above, the researcher is interested in developing Powtoon-based learning media combined with the inquiry model to improve student learning outcomes, particularly in Natural Science (IPAS) education. By using Powtoon based on inquiry, it is expected that learning will become more engaging, interactive, and enjoyable for students (Fahyudi et al., 2022; Hamid K et al., 2025). This learning model is expected to enhance students' critical thinking skills and encourage them to be more active in searching for and

investigating information, thereby significantly improving their learning outcomes (Aras et al., 2024; Dafrita & Nawawi, 2022; Jumhur et al., 2024; Liana et al., 2022; Maharani et al., 2024).

Method

This type of research is Research and Development (R&D) aimed at creating teaching materials based on the Inquiry model using the Powtoon application in IPAS learning for fourth-grade elementary school students. 4D model which includes four stages, namely: Define, Design, Develop, and Disseminate. (Abolhassani et al., 2025; Astarina et al., 2024; Fahru et al., 2024; Rosyidah et al., 2019) model 4D is very suitable for the development of teaching materials because it is time-efficient and facilitates the achievement of development goals in a structured manner. The practicality and appropriateness of this model also support the development process of Powtoon-based teaching materials, which are expected to enhance student engagement and learning outcomes in IPAS education (Harjanto et al., 2023; Wanti et al., 2024). The first stage, Define aims to identify the main issues that serve as the basis for developing inquiry-based teaching materials using the Powtoon application for fourth-grade students. Activities in this stage include three main steps: needs analysis, learner analysis, and curriculum analysis. In the Design stage, there are two important steps that need to be carried out: developing instruments and designing appropriate learning media. Next, in the Development stage, the steps involved include developing learning modules, developing media, and conducting validity testing, practicality testing, and effectiveness testing of the developed teaching materials. Finally, in the Disseminate stage, the main goal is to distribute the inquiry-based teaching materials using the Powtoon application to users or schools that need it, so that it can be widely used to enhance learning.

This development research was conducted in three elementary schools: Grade IV SDN 21 Surabayo, Lubuk Basung District, Agam Regency with 26 students; Grade IV SDN 23 Koto Baru, Tanjung Raya District, Agam Regency with 12 students; and Grade IV SDN 19 Koto Tinggi, Tanjung Raya District, Agam Regency with 20 students. The instruments used in this research include the Define Instrument, Validity Instrument, Practicality Instrument, and Effectiveness Instrument. The data collection techniques used were Preliminary Study, Validation Sheets, Questionnaires, and Tests, with data analysis conducted through the analysis of the validity of the learning media.

$$Vs = \frac{\sum x}{\sum y} \times 100\% \quad (1)$$

Description:
Vs = Validation score percentage
ΣX = Total score obtained
ΣY = Maximun Score

The criteria for interpreting the validity percentage of the validity calculation results can be seen in the table below (Nila & Mustika, 2022).

Table 1. Validity Interval Category

Interval	Validity category
81%-100%	Highly valid
61%-80%	valid
41%-60%	Suffiently valid
21%-40%	Less valid
0%-20%	not valid

Analysis of the Practicality of Learning Media

$$Vs = \frac{\sum x}{\sum y} \times 100\% \quad (2)$$

Vs = Validation score percentage
ΣX = Total score obtained
ΣY = Maximun Score

The practicality categories of the learning media based on the practicality score obtained can be observed in the table below (Nila & Mustika, 2022).

Table 2. Practicality Categories

Interval	Practicality categories
81%-100%	Very practical
61%-80%	Practical
41%-60%	Fairly practical
21%-40%	Less practical
0%-20%	Not practical

Analysis of the Effectiveness of Learning Media

To evaluate the effectiveness of inquiry-based learning media using the Powtoon application in improving student learning outcomes, the assessment is carried out through tests with objective question formats.

$$\text{Final score} = \frac{Score\ obtained\ by\ the\ student}{maximum\ score} \times 100 \quad (3)$$

To determine the improvement in student learning outcomes, the difference between the pre-test and post-test scores is calculated. The difference between the two tests is called the Gain. The formula for calculating the N-gain is as follow (Andini & Fitria, 2021):

$$N\text{-}Gain = \frac{Skor\ Posttest - Skor\ Pretest}{Skoir\ Ideal - Skor\ Pretest} \quad (4)$$

The next step, the results of the N-Gain calculation are presented using the following criteria:

Table 3. N-Gain Interpretation

N-gain value	Category
N-Gain > 0.7	High
0.3 < N-Gain < 0.7	Medium
N-Gain < 0.3	Low

To evaluate the criteria for media effectiveness, it can be seen from the students' IPAS learning outcomes obtained through the N-Gain score, which will be presented in the following table (Andini & Fitria, 2021):

Table 4. N-Gain Effectiveness Category

N-gain percentage interval	Effectiveness criteria
Percentage N-Gain < 40%	Ineffective
40% ≤ Percentage N-Gain <55%	Less effective
56% ≤ Percentage N-Gain ≤ 75%	Moderately effective
Percentage N-Gain < 76%	effective

Result and Discussion

Devine Stage

The needs analysis shows that educators have not optimally utilized digital platforms, even though the facilities at school are adequate, with learning media limited to images and videos. More than 60% of students have not met the Mastery Learning Criteria (KKTP) in the IPAS subject due to difficulties in understanding the material and monotonous teaching. The dominant learning style of students is visual, with an interest in learning media that is rich in colors and images, which can enhance their learning motivation. In addition, the Merdeka curriculum implemented at SDN 23 Koto Baru needs to be adjusted to the Learning Outcomes (CP) and the Flow of Learning Objectives (ATP) for the IPAS material in grade IV.

Design Stage

The development of the instruments involves validation by experts in content, media, and language to assess the appropriateness of the material, its alignment with the curriculum, and the accuracy of the concepts. A student response questionnaire is used to measure students' feedback on the trialed instructional materials, while an observation sheet monitors student participation, engagement, and inquiry activities during the use of the materials. Learning outcome tests are also used to assess the improvement in learning results after the use of inquiry-based teaching materials. Based on the Define phase analysis and the needs of the fourth-grade students, the instructional materials were designed, including a Powtoon-based learning video, a teaching module, and Inquiry-Based Student Worksheets (LKPD) for the topic of Indonesian Cultural Diversity. The media design steps include the creation of a content framework that divides the "Indonesian Cultural Diversity" material into sections according to the inquiry model syntax, development of storyboards with narratives, images, animations, and trigger questions following the inquiry steps, and the selection of the Powtoon application to create interactive animated video-based instructional materials. The visual design uses bright colors, contextual illustrations, and animated characters to capture attention and enhance students' enjoyment.

Development Stage

The initial product is an interactive IPAS learning video with an inquiry model. The topic presented is "Indonesian Cultural Diversity," delivered in the form of an animated video using Powtoon.

Figure 1. Video title section display

Figure 2. Orientation section view

Figure 3. Problem formulation section view

Figure 5. Data collection section view

Validity Test

The teaching materials were validated by three validators, consisting of a content expert, a media expert,and a language expert. The results of the validity assessment can be seen from the validation sheets filled out by the validators.

Table 5. The Results of the Validation of Teaching Materials by Experts

Validator	Validation Score	Category
Content Expert	83.45%	Highly Valid
Media Expert	86.67%	Highly Valid
Language Expert	100%	Highly Valid
Overall Validity Score	90.04%	Highly Valid

Based on Table 5 it can be seen that the validity results of the interactive teaching materials for the topic "Indonesian Cultural Diversity" in grade IV SD have an average score of 90.04% with a highly valid category. This indicates that the developed teaching materials are valid for all aspects assessed, such as content feasibility, presentation feasibility, language feasibility, and are ready to be used in the classroom for the learning process.

Practicality Test

The practicality test was conducted by gathering responses from students and teachers to assess how practical the designed teaching materials are, based on the data collected.

Individual Trial

This trial was conducted on three fourth grade students at SDN 21 Surabaya. Based on the table above, it can be seen that the practicality score obtained is 80.66% with a highly practical category.

Small Group Trial

Small group trials were conducted on six fourth grade students at SDN 23 Koto Baru.

Table 6. Student Practicality Questionnaire Results (Individual Trial)

Assessed aspect	Practicality score (%)	Category
Practicality of using interactive teaching materials	86.66	Highly practical
Highly practical	73.33	Practical
Appropriateness of illustrations	83.33	Highly practical
Language	73.33	Practical
Evaluation	86.67	Highly practical
Average	80.66	Highly practical

Table 7. Student Practicality Questionnaire Results (Small Group Test)

Assessed aspect	Practicality score (%)	Category
Practicality of using interactive teaching materials	90	Highly practical
Highly practical	77. 78	Practical
appropriateness of illustrations	85	Highly practical
Language	80	Highly practical
Evaluation	90	Highly practical
Average	84.33	Highly practical

Small Group Trial

Small group trials were cinducted on six fourth grade students at SDN 23 Koto Baru.

Table 8. Student Practicality Questionaire Results (Small Group Test)

Assessed aspect	Practicality score (%)	Category
Practicality of using interactive teaching materials	90	Highly practical
Highly practical	77.78	Practical
Appropriateness of illustrations	85	Highly practical
Language	80	Highly practical
Evaluation	90	Highly practical
Average	84.33	Highly practical

Limited Large Group Trial

A limited large group trial was cinducted at SDN 19 Koto Tinggi with 26 students in grade IV. Based on the table 9, it can be seen that the practicality score obtained in the large group trial is 86.98% with a highly practical category. It can be concluded that the developed teaching materials are ready to be used in the learning process on a larger scale and can be tested for their effectiveness. The practicality questionnaire was also given to the teacher to assess their response to the developed teaching materials.

In Table 10, it can be seen that the practicality score of the teaching materials by the teacher is 92.67% with a

highly practical category. Overall, the respondents assessed that the teaching materials for the topic of cultural diversity in Indonesia for the IPAS subject in grade IV can be used effectively.

Table. 9 Results of the Student Practicality Questionnaire (Limited Large Group Test)

Assessed aspect	Practicality score (%)	Category
Practicality of using interactive teaching materials	90.51	Highly practical
Highly practical	77.43	Practical
Appropriateness of illustrations	88.84	Highly practical
Language	88.84	Highly practical
Evaluation	90.76	Highly practical
Average	86.98	Highly practical

Table 10. Results of the Practicality Questionnaire (Teacher)

Assessed aspect	Practicality score (%)	Category
Practicality of using interactive teaching materials	95.55	Highly practical
Highly practical	88.88	Highly practical
Appropriateness of illustrations	90	Highly practical
Language	100	Highly practical
Evaluation	93.33	Highly practical
Average	92.67	Highly practical

Effectiveness Stage

The effectiveness test of the interactive teaching materials based on Inquiry using the Powtoon application in improving student learning outcomes was conducted through a test with objective-type questions. The purpose of the pre-test is to assess the initial abilities of the students before the learning process is conducted using the developed interactive teaching materials. Before starting the main activity, students were first given the pre-test questions. The goal of the pre-test is to measure the students' initial abilities before they engage in the learning process with the balanced interactive teaching materials.

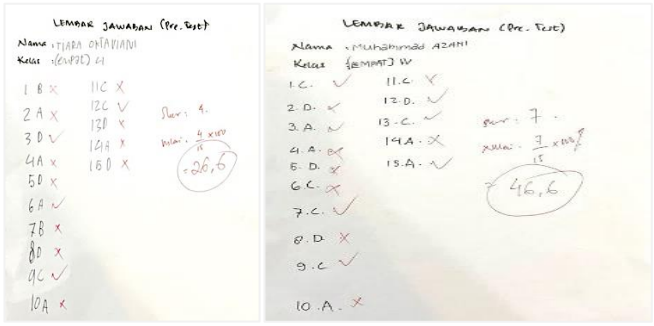

Figure 6. Result of the student's pretest

It can be seen that many of the answers provided by the students were still incorrect. Only a small portion of them were able to give correct answers, and the scores obtained were still far from the mastery criteria. After the pre-test was given, learning was conducted using the developed interactive teaching materials. The learning activities were carried out in 3 sessions.

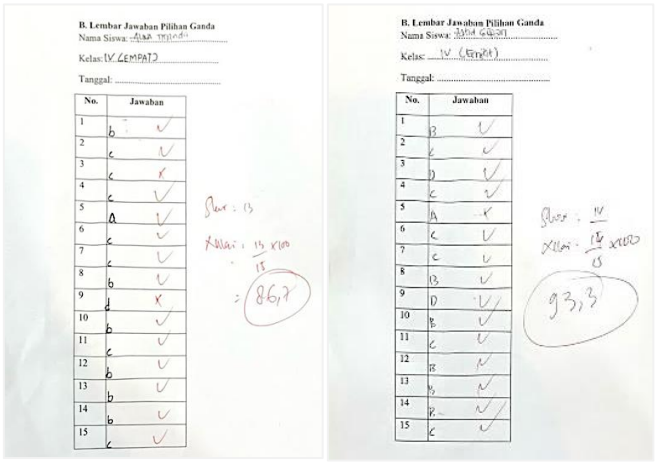

Figure 7. Result of the student's posttest

After the learning session using the interactive teaching materials, students were given a posttest to observe the difference in learning outcomes before and after the learning process. To assess the effectiveness of the inquiry-based interactive teaching materials, the N-Gain values were analyzed and calculated.

Table 11. Result of the Gain Score Measurement

Trial activity	Average score	Average n-gain (<g>)	Criteria
Pretest	29.74	0.79	High
Posttest	84.87		

Based on the results of the N-Gain calculation in Table 11, it can be concluded that the inquiry-based interactive teaching materials are effective, as they have a high N-Gain with an average N-Gain score of 0.79.

Disseminate Stage

After the trial is completed, the next stage is dissemination. The goal of this stage is to spread the inquiry-based teaching materials using the Powtoon application. In this study, the dissemination is carried out on a limited scale, by promoting the final product of the Powtoon-based teaching materials through the Teacher Working Group (KKG) for grade IV in Tanjung Raya District, Agam Regency. In addition, the developed Powtoon learning video can also be accessed on the researcher's YouTube channel via the provided link.

Conclusion

Based on the findings and data obtained in this study, it can be concluded that the interactive IPAS teaching materials, designed using the inquiry model and Powtoon application for the topic of Indonesian Cultural Diversity in grade IV, have been validated in several aspects. These materials are deemed valid in terms of content feasibility, presentation, graphics, and language. Additionally, the materials are practical, as evidenced by their ease of use, time efficiency, appropriate illustrations, clear language, and effective evaluation components. Furthermore, the interactive IPAS teaching materials have proven to be effective in enhancing students' learning outcomes, confirming their potential for improving the overall learning experience in the classroom.

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Conceptualization, M., U. methodology, M., U.; software, M.; validation, R., A., and M.; formal analysis, M.,U.; investigation, M.; resources, M.; data curation, M.; writing—original draft preparation, M., U.; writing—review and editing, M.; visualization, M.; supervision, M.,U.; project administration, M.; funding acquisition, M.

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