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Development of media EDUMEDIG with the model problem-based learning to improve science understanding

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Abstract. This Research and Development (R&D) study was conducted to evaluate the feasibility (validity and practicality) and efficacy of the Problem-Based learning Interactive Game Educational Media (EDUMEDIG) in enhancing the understanding of Science and Social Sciences among fifth-grade elementary students. The core problem addressed was the limited use of interactive conventional media, which contributed to student passivity, lack of enthusiasm, and difficulties in grasping Science material. The ADDIE model (*Analysis, Design, Development, Implementation, Evaluation*) guided the development process. Using a quasi-experimental Pretest-Posttest Control Group Design, the study's population comprised all fifth-grade students. Sampling was carried out using a purposive sampling technique, selecting 31 students from SD N Sambiroto as the experimental group and 30 students from SD N 2 Mojosari as the control group. Data collection techniques involved written tests (pre-test and post-test) to measure effectiveness, and questionnaires (expert validation, teacher, and student responses) served as the research instruments to assess feasibility. The findings demonstrate that the EDUMEDIG media has excellent validity (Media Experts: 95%; Material Experts: 92.5%) and very high practicality (Teachers: 98.3%; Students: 100%). Crucially, the media proved highly effective, as confirmed by a T-Test result of 0.000 (<0.05), indicating a significant difference in mean scores between the two groups. This effectiveness was further underscored by the experimental class's N-Gain score of 0.71 (High category), which was substantially higher than the control group's score of 0.257 (Low category). In conclusion, the EDUMEDIG media successfully serves as a valid, practical, and effective innovative solution. It is recommended that this EDUMEDIG media be implemented as a proven tool to enhance students' motivation, engagement, and conceptual understanding in IPAS (Integrated Science and Social Sciences) subjects.

Introduction

Science learning is an important pillar in developing a generation with strong critical thinking skills and scientific literacy, which are essential in the digital era and the demands of the 21st century (Dianti & Indarini, 2025). Science, as a knowledge, not only requires mastery of theoretical concepts, but also the ability to solve contextual problems that are relevant to everyday life (Safrida & Kistian, 2020). However, conventional learning processes are often dominated by lectures, making abstract science material difficult to understand and leading to boredom for students.

Therefore, innovative learning strategies and media are needed to engage students and bridge the gap between theory and reality (Widana et al., 2024).

The Problem-Based Learning (PBL) learning model is recognized as having great potential to achieve these goals because of its characteristics, which place students in real problem situations as a trigger for learning (Windiari, 2024). PBL encourages students to actively identify, explore, and solve problems through investigation, thereby building deeper conceptual understanding and problem-solving skills. However, the implementation of PBL is often hampered by students' lack of interest in learning or a tendency to be passive when asked to try new challenges (Fauzi et al., 2023). The gap arises when the PBL model, which should be effective in solving real-world problems, fails to spark students' initial motivation due to the presentation of problems that are less engaging and irrelevant to their world. As a result, students' scientific understanding does not reach its optimal level.

Based on the observations of the learning process and interviews with fifth-grade teachers at SD Negeri Sambiroto, it was found that the use of learning media by teachers is very limited and not interactive. Teachers predominantly use the lecture method (ceramah), which is a one-way, oral delivery of material, ultimately leading to boredom and a lack of student participation. Although the school has received assistance of 15 Chromebook units, the utilization of these interactive digital tools is not yet optimal among the teachers. Consequently, due to the teachers' lack of initiative to be creative and innovative in using media, student learning outcomes in the cognitive domain are categorized as low. This is substantiated by the data from the average score of the final semester assessment (PAS) for the Science subject in the fifth grade for the 2024/2025 academic year, which was only 70. This data indicates that 78% (18 students) scored below the KKM (Minimum Completeness Criteria), while only 12% (5 students) scored above it. This situation suggests that the students' understanding of science and social concepts is declining , and the media used by teachers is not in line with the current need for interactive media.

To address the gap between the strong potential of PBL and students' low motivation and understanding, the integration of interactive media technology, particularly in the form of educational games, is a highly relevant and urgent solution. Interactive games are able to leverage the stimulating and enjoyable nature of games to significantly increase student engagement and interest in learning (Kumalasari et al., 2024). When educational games are developed based on the PBL model, the media not only present material interactively but also guide students through systematic problem-solving stages within the gameplay. Previous research has shown that PBL-based multimedia development and educational game integration are effective in enhancing various aspects of learning (Ridwan et al., 2021). The development of interactive game media that explicitly integrates the syntax of the Problem-Based Learning (PBL) model represents a distinctive strength and contribution of this study in addressing methodological gaps in science education.

According to findings by Andani (2022), the use of interactive learning media such as educational games, instructional videos, and interactive applications can significantly enhance students' learning motivation. Learners become more engaged, enthusiastic, and participative during lessons, as the learning process becomes more enjoyable and stimulating. In addition, teachers also perceive improved teaching effectiveness when employing such interactive tools. This is reinforced by the experimental research conducted on fourth-grade students, which revealed a positive and significant influence of implementing the Problem-Based Learning (PBL) model on science learning outcomes (Ernawati et al., 2024). The results showed that the experimental class achieved a notably higher mean score (75.96) compared to the control class (65.08). This difference was statistically verified ($t_{count} > t_{critical}$ with $p < 0.05$), confirming that PBL is an effective pedagogical approach to enhance students' cognitive achievement in science.

While numerous prior studies, such as the findings reported by Fauzi et al. (2023), Dianti & Indarini (2025), and Ridwan et al. (2021) have generally established the effectiveness of interactive learning media in significantly enhancing student comprehension and learning outcomes across various subjects, a specific research gap remains. These earlier studies predominantly concentrated on interactive media without systematically integrating a specific pedagogical approach. The novelty of the current research lies in the development of the EDUMEDIG product, which represents a unique synergy between a digital interactive game and the Problem-Based Learning (PBL) model. This media is explicitly designed for the integrated Science and Social Sciences (IPAS) subject under the *Merdeka Curriculum*. This distinct combination ensures that the developed media is not only technologically interactive but also fosters a secure, engaging, and child-centered learning environment consistent with PBL principles. Consequently, this development specifically addresses the critical need for innovative media that is highly compatible with the characteristics of the integrated IPAS subject and the concrete thinking stage of elementary school students.

Drawing from the identified problem background, the urgency for interactive media, and the analysis of the study's unique contribution, this research and development project addresses the following key issues, structured as the Research Questions: (1) What is the feasibility level (in terms of validity and practicality) of the EDUMEDIG media, which integrates the Problem-Based Learning (PBL) Model, for fifth-grade IPAS subjects? (2) Is the Problem-Based Learning EDUMEDIG media effective in improving the Science understanding of fifth-grade students? Consequently, the Research Objectives are defined as: (1) To examine the feasibility (validity and practicality) of the EDUMEDIG media, and (2) To empirically test its effectiveness in enhancing students' Science understanding. Finally, the proposed Research Hypothesis posits that the development of the EDUMEDIG media utilizing the Problem-Based Learning (PBL) Model is (a) appropriate (feasible) and (b) effective when implemented in IPAS content to significantly increase the Science understanding of fifth-grade elementary students.

Method

Research Method and Design

This study employed a Research and Development (R&D) approach adopting the ADDIE framework, which includes the phases of *Analysis, Design, Development, Implementation,* and *Evaluation*. The primary goal was to design and develop EDUMEDIG, an educational interactive game media based on Problem-Based Learning principles for science education. Relevant adjustments were made during the *Implementation* phase through the application of a quasi-experimental design, specifically the *Pretest–Posttest Control Group Design*, to evaluate the product's effectiveness. The researcher served as the key instrument, actively participating in each process from conceptual design to field implementation and subsequent evaluation. This methodological choice aligns with the experimental framework aimed at testing hypotheses regarding comparative differences in students' learning outcomes (Faiza Nafaul & Wardhani Setyo, 2024).

Participants and Sampling Technique

The population and sample of the study consisted of fifth-grade elementary school students. Participants were divided into two groups during the implementation and evaluation stages: the experimental group, comprising 31 fifth-grade students from Sambiroto Elementary School, and the control group, consisting of 30 fifth-grade students from Mojosari 2 Elementary School. Both research sites were purposively selected based on their contextual relevance to the study's focus on digital learning media needs and challenges.

Research Setting and Timeline

This development research was conducted at SD N Sambiroto and SD N 2 Mojosari. The selection of these locations was based on the research focus regarding the application of interactive learning methods within the context of basic education. The research execution period spanned six months, commencing in April 2025 and concluding in September 2025. Specifically, the analysis phase was scheduled from April 29th to May 20th, 2025; the design and development phases were conducted from June 2nd to July 30th, 2025; the product implementation phase took place from August 2nd to August 29th, 2025; and finally, the evaluation phase was set for September 4th to September 30th, 2025.

Research Procedures

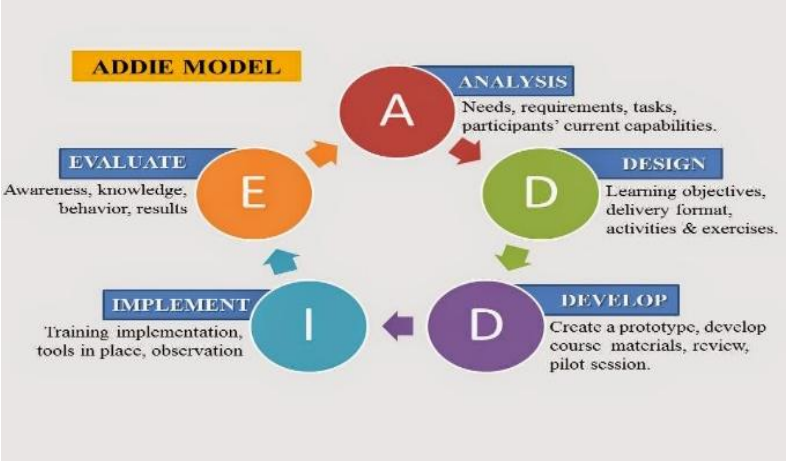

Image 1. The ADDIE model

The research procedure is detailed, following the five stages of the ADDIE model, supported by references to development theory. The initial analysis stage includes analyzing media performance and needs through interview and observation guidelines. The design stage includes designing the EDUMEDIG media concept and developing test and non-test instruments. The development stage is the product realization, followed by validation by media, materials, and learning experts using an expert validation questionnaire to ensure validity. Furthermore, the implementation stage involves product testing with a pretest-posttest design on the experimental group. Finally, the Evaluation stage is conducted comprehensively to analyze the validity, practicality, and effectiveness of the developed product (Vivien Pitriani et al., 2021).

Data Collection Techniques and Research Instruments

Data collection techniques in this development research are executed sequentially, tailored to the requirements of each phase within the ADDIE model. During the Analysis phase, initial data is gathered through structured Observation and Interviews, utilizing pre-designed guidelines. These techniques aim to identify learning media needs and existing problems in the field. Subsequently, in the Development phase, the primary instrument employed is the Expert Validation Questionnaire given to media, material, and instructional experts to determine the product's validity before testing. Furthermore, a Practicality Sheet or Feedback Form is utilized during the Media Trial to gather feedback from students and assess the effectiveness and level of engagement in a real classroom setting. For the Implementation and Evaluation phases, Test instruments (in the form of multiple-choice *pre-test* and *post-test* questions) are used to measure the students' cognitive achievement in science and social understanding. The Evaluation phase is also reinforced by the Student Response Questionnaire and the Teacher Response Questionnaire, which measure the

overall quality, acceptance, and effectiveness of the EDUMEDIG media. The entire research process and its results are documented using the Documentation technique, which includes student grade lists and photographs of the learning activities (Sugiyono, 2020).

Data Analysis Techniques and Criteria

Data analysis in this research is divided into two main focuses: product feasibility and effectiveness. The feasibility analysis of the EDUMEDIG media uses quantitative descriptive analysis, in which data are obtained from validation questionnaires completed by experts using a Likert scale. The media is declared feasible if the percentage of achievement results falls within the Good qualification (61-80%) or the Very Good qualification (81-100%). Meanwhile, the effectiveness analysis is conducted by comparing pre-test and post-test scores using a one-group pretest-posttest design. Before measuring the comparison, Normality Testing (Kolmogorov-Smirnov) and Homogeneity Testing are performed. Hypothesis testing to determine the difference in science and social understanding uses the T-test (paired samples t-test). In contrast, the level of improvement in understanding is measured with the N-Gain test. The product is considered adequate if the N-Gain score in the experimental class is $g \geq 0.30$ (Moderate or High criterion).

Product Specifications

The product developed in this research is EDUMEDIG (Educational Digital Media Game). This media is an interactive multimedia product specifically designed to enhance students' understanding of science and social studies in the IPAS (Science and Social Studies) subject. Specifically, the media is developed by integrating the Problem-Based Learning (PBL) Model, with its content and game features structured to encourage students to think critically and solve problems. This interactive digital media is created using platforms such as Google Sites and further developed in Canva, making it easily accessible and visually engaging. The EDUMEDIG media delivers interactive IPAS learning materials and provides an evaluation packaged in a fun game format. The key success indicators for this media are that it must be proven valid and practical (meeting the feasibility criteria set by experts and user responses), and practical (achieving an N-gain score of $g \geq 0.30$ in improving students' science and social understanding.

Results and Discussion

Research results are systematically presented by following the procedural order of the ADDIE development model (Analysis, Design, Development, Implementation, and Evaluation). This flow begins with identifying problems and needs in the Analysis stage, followed by product feasibility validation by experts in the Development stage. Finally, all findings are summarized with evidence of the product's practicality and effectiveness from field trials and statistical analysis conducted in the Implementation and Evaluation stages, which are the primary focus of the discussion.

The analysis phase confirmed the initial findings: fifth-grade teachers at SD Negeri Sambiroto predominantly use conventional learning media. The resulting needs assessment, conducted through interviews and observations, highlighted significant issues, specifically student boredom and documented difficulties in comprehending science (IPA/IPAS) material. This critical gap between current teaching practices and student learning needs strongly indicates the necessity for an innovative solution. Consequently, the analysis established an urgent need to develop a child-friendly, game-based digital learning medium that effectively boosts student engagement and comprehension while fully complying with the pedagogical standards of the Merdeka Curriculum.

The Design phase successfully yielded the conceptual blueprint for the EDUMEDIG medium, which was detailed across eight main components. This comprehensive design incorporated the Main Menu and three interactive quiz game sessions structured explicitly around the stages of

Problem-Based Learning (PBL). Ultimately, this robust conceptual framework will serve as the foundational guide for the subsequent production and development of the learning media.

Based on these findings, the Design stage developed the media concept and content, consisting of eight components: the Cover, the Main Menu (containing Learning Objectives, Materials, Instructions for Use, and Games), and three interactive multiple-choice quiz game sessions. The Development stage involves creating a product according to the design, which results in an attractive and interactive media interface, as shown in the following displays: 1) The EDUMEDIG media homepage displays an animal-themed cover with a PLAY button.

Image 2. Menu display play

2) The Homepage provides navigation to all media content, facilitating dynamic two-way interaction.

Image 3. Homepage

3) The Game menu, titled "Harmonious Adventures in the Ecosystem," consists of three engaging quiz games, complete with answer confirmation for student evaluation.

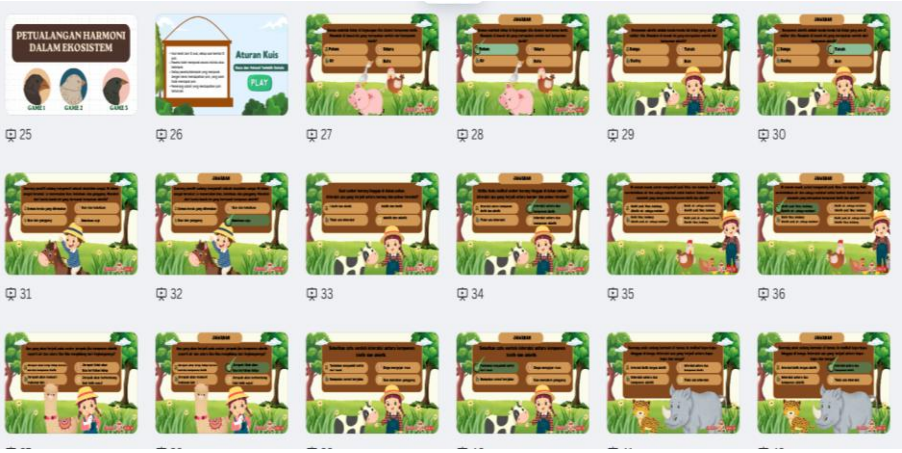

Image 4. The Game menu

The design media encourages independent navigation, ensuring students can choose from a variety of learning options (materials) and test their understanding (quizzes), in line with the principles of Problem-Based Learning. After going through the Development stage, the EDUMEDIG media was then validated by experts and received a Very Valid category, ready for implementation and evaluation. These results align with previous research by Asyri et al. (2024), who stated that interactive learning media based on Canva have good qualifications, are feasible, and effective for use in the learning process by integrating HOTS. This finding is supported by Okra (2023), who found that educational science learning games for elementary school children are highly suitable for fifth-grade students, as evidenced by fifth-grade students' assessments of this media, which indicated that it was very effective.

The Development phase involved the product realization process of EDUMEDIG, where the conceptual design was transformed into a functional, game-based digital application. Once the media prototype was completed, the crucial next step was Expert Validation. During this process, the medium was assessed by material, media/design, and pedagogical experts to ensure content accuracy, technical feasibility, and didactic suitability with the principles of the Merdeka Curriculum and the Problem-Based Learning (PBL) model, before proceeding to field trials.

Table 1. Recapitulation of the Validity Results of the EDUMEDIG Product

Expert	Average Score	Persentase	Category
Media	95	95%	Very Valid
Material	92.5	93%	Very Valid
Overal Average	93.75	94%	Very Valid

The validation results of the EDUMEDIG (Educational Interactive Game Media) learning media product based on Problem-Based Learning showed a very high level of feasibility. The validity test was conducted by two Media Experts and two Material Experts. The level of reliability (consistency) between validators also showed strong results: Media Expert Reliability: 97.4% (Reliable because ≥75%) and Material Expert Reliability: 97% (Reliable because ≥75%). The practicality test was conducted by measuring the responses of Grade V teachers and students at Sambiroto State Elementary School.

The Implementation stage focused on evaluating the practical usability of the EDUMEDIG digital product within its intended educational context. This vital trial took place at SD Negeri Sambiroto and involved the active participation of both class teachers and students. To gauge its practicality, relevant data were gathered directly through the distribution of feedback questionnaires to the

product's users. The insights derived from these responses are crucial for determining the media's user-friendliness, instructional manageability, and overall acceptance by the school community.

Table 2. Practicality Test Results

Respondenents	Persentase	Category
Teacher Respondenents	98%	Very Practical
Student Respondenents	100%	Very Practical

The practicality test results indicate that the EDUMEDIG medium achieved a Highly Practical rating, as evidenced by exceptionally high acceptance rates (100% from students and 98% from teachers). Teachers reported that the medium effectively facilitated content delivery and was highly suitable for implementation under the Merdeka Curriculum. Furthermore, students demonstrated remarkable enthusiasm during its use. These findings underscore EDUMEDIG's success in cultivating an enjoyable learning environment, thus supporting the concept of Problem-Based Learning.

The Evaluation phase was designed to measure the effectiveness of the EDUMEDIG medium in improving student learning outcomes. This effectiveness was quantified using a Quasi-Experimental method with a two-group pretest-posttest design. The study compared learning outcomes between the experimental class (which used the EDUMEDIG medium) and the control class (which used conventional instruction), thereby allowing a quantitative assessment of the medium's positive impact on comprehension of science material.

These results indicate that the EDUMEDIG media is very easy to use, with clear, interesting, fun, and relevant steps to the science subject "Harmony in Ecosystems". The effectiveness test was conducted using a quasi-experimental design with an experimental class (EDUMEDIG media) and a control class (without EDUMEDIG media). The prerequisite test was:

Table 3. Tests of Normality

Class	Test	Uji Shapiro-Wilk	Description
Control	Pretest	Sig. = 0.799	Normally Distributed (Sig. > 0.05)
Control	Posttest	Sig. = 0.075	Normally Distributed (Sig. > 0.05)
Experimental	Pretest	Sig. = 0.136	Normally Distributed (Sig. > 0.05)
Experimental	Posttest	Sig. = 0.098	Normally Distributed (Sig. > 0.05)

In the pretest and post-test normality test in the experimental class, the sig. 0.136 and 0.098 were obtained. Meanwhile, the pretest and post-test normality test in the control class obtained sig. 0.799 and 0.075. The results of the normality test for both classes showed a significance value (p-value) > 0.05.

Table 4. Test of Homogeneity of Variance

Test	Levene Statistic	Sig.	Description
Based on Mean	0.319	0.574	Homogeneous (Sig. > 0.05)

The analysis of variance homogeneity test, conducted using Levene's test, confirmed that the post-test scores in both the experimental and control groups exhibited comparable variance. Specifically, the Levene Statistic was recorded at 0.319, yielding a high significance value (Sig.) of 0.574. Since this significance value is markedly above the conventional threshold of 0.05, the variance between the two groups' data is definitively considered homogeneous. Satisfying this assumption of homogeneity is crucial for subsequent statistical inference. Therefore, with both the normality and

homogeneity assumptions met, the data is deemed suitable for further analysis using the parametric independent samples t-test.

Tabel 5. Independent Samples Test

Test	F	Sig. (Levene)	T	df	Sig. (2-tailed)	Mean Difference
Equal variances assumed	0.319	0.574	-14.240	58	0.000	-23.467

The comparative statistical analysis, specifically the independent samples t-test, yielded a highly significant probability value (Sig.) of 0.000. Given that this significance level (0.000) is far less than the established alpha level of 0.05, the null hypothesis of no difference was firmly rejected. Consequently, the research definitively concluded that a statistically significant disparity exists in the average learning outcomes between the two observed groups. Students who utilized the EDUMEDIG medium exhibited notably superior academic results compared to their counterparts in the control class. This robust finding substantiates that the EDUMEDIG digital game medium is highly effective as an instructional tool. Furthermore, it validates the strategy of integrating this media to improve student learning achievement substantially. These results are in line with the findings of Wulandari & Sari (2024) in the *Indonesian Journal of Educational Development (IJED)*, which demonstrated that the PBL approach can significantly increase critical thinking and conceptual understanding in elementary science education.

Table 6 Pretest Posttest Results

Class	Average Pretest Score	Average post-test Score	Improvement (N-Gain)	N-Gain Category
Experiment (with EDUMEDIG)	50.37	85.2	0.710	High
Control (without EDUMEDIG)	48.67	61.87	0.257	Low

The results of the effectiveness analysis clearly reveal a substantial difference in learning progress between the two instructional groups. Students in the experimental class, who engaged with the EDUMEDIG-based learning intervention, demonstrated a remarkable improvement in performance, with their mean score rising from 50.37 in the pretest to 85.2 in the posttest, yielding an N-gain value of 0.710, categorized as high. This improvement was considerably greater than that of the control group, which recorded an N-gain of 0.257, categorized as low, despite starting with comparable pretest scores. The dramatically higher N-gain observed in the experimental group unequivocally confirms that the utilization of the EDUMEDIG medium, integrated with PBL, is highly effective in enhancing students' IPAS comprehension. Ardiansyah & Buchori (2023) further emphasize in their *IJED* study that interactive learning media designed under PBL frameworks can substantially elevate conceptual mastery and cognitive outcomes at the elementary level. This outcome aligns with existing research indicating that interactive digital media imparts a distinct and significant positive effect on student learning outcomes.

A preliminary study showed that fifth-grade teachers at Sambiroto Public Elementary School were still using conventional media. Interviews and analysis of teacher and student needs indicated that EDUMEDIG media, based on Problem-Based Learning, was urgently needed to address student learning difficulties and boredom in understanding science material. Similar results were reported by Rahmadani & Sumarno (2023) in *IJED*, where integrating PBL with Canva-based media increased student engagement and motivation in classroom learning.

The EDUMEDIG media, developed under the problem-based learning approach, was found to be highly valid and practical for implementation in science learning. Results from the validity evaluation showed 95% from media experts and 92.5% from material experts, placing the product in the "very valid" category. The practicality aspect was strongly supported by user feedback, with teacher responses reaching 98.3% and student responses achieving 100%, indicating excellent usability and acceptance. The effectiveness analysis was carried out by comparing pretest and posttest results between the experimental group utilizing EDUMEDIG and the control group using conventional media. These findings are in line with Hidayat and Lestari (2024), whose *IJED* study highlighted that digital game-based learning environments enhance student engagement and lead to significant improvements in learning performance.

The EDUMEDIG media validity level of 94% (Very Valid) confirms that this product is theoretically and substantially feasible to use. This development adopted the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). The Analysis stage identified a significant problem: the use of conventional media (textbooks) made it difficult for students to understand the material, causing boredom and a lack of enthusiasm/activity. Teachers and students agreed that game-based, problem-based Learning, and interactive media were essential. The results of this analysis triggered the design of Canva-based interactive media with a scientific approach.

High validity from the Material Expert (93%) indicates that the Science content of the "Harmony in Ecosystems" material is presented accurately, contextually, and integrates the principles of Child-Friendly Learning (CLE). The CLE aspect is supported by simple, non-discriminatory language and a design that emphasizes independent exploration. Validity from the Media Expert (95%) indicates that the EDUMEDIG media interface design is intuitive and user-friendly, with a combination of bright colors and easy-to-read typography, very suitable for the psychological characteristics of elementary school students. Previous research conducted by Andani (2022). This ergonomic design is important for supporting independent learning and ensuring smooth navigation.

The practicality level, reaching 98% (Teacher Response) and 100% (Student Response), demonstrates that EDUMEDIG media is highly functional and well-received in the real learning process. Teachers consider this media practical for achieving learning objectives and for facilitating diverse learning needs (differentiation). The 100% response rate among students who answered "Yes" across all aspects of practicality shows that EDUMEDIG media has succeeded in changing the learning atmosphere. In the aspect of Increasing Engagement and Motivation, students feel more enthusiastic, not bored, and active. In the aspect of Increasing Understanding, students feel they understand the material better by using this media. Interactive media, especially game-based media, inherently increase the appeal and motivation for learning, which aligns with EDUMEDIG's design.

Preliminary testing through normality and homogeneity analyses confirmed that the data met the required statistical assumptions. The normality test results for the experimental group's pretest and posttest significance values (sig.) of 0.136 and 0.098, while the control class obtained sig. 0.799 and 0.075. Since all sig. values >0.05, the data were declared normally distributed. After that, a homogeneity test was conducted, which produced a sig. value of 0.574 (>0.05), concluding that the samples from both classes were homogeneous. Descriptively, the average of the experimental class (85.2) was much higher than the control class (61.7). The effectiveness of EDUMEDIG media based on Problem-Based Learning will be tested using a t-test between the experimental class at elementary school Sambiroto (using EDUMEDIG) and the control class at elementary school

Mojosari 2 (without media). Learning success was measured by students' test results and engagement levels, aligning with Nursella's (2024) and Widana & Laksitasari's (2023) opinion.

A significant improvement in the experimental group's learning performance was observed. Their mean pretest score of 50.37 increased sharply to 85.2 in the posttest, while the control group only improved to 61.87. The N-gain value for the experimental class was 0.710 (medium category), notably higher than the control group's 0.257 (low category). A t-test yielded a significance value (Sig.) of 0.000, well below the 0.05 threshold, confirming a statistically significant difference between the two groups. Thus, the superior N-gain demonstrates that the use of EDUMEDIG media significantly improves students' comprehension of science content.

Furthermore, the N-gain analysis was utilized to assess the effectiveness of learning improvement independently of initial achievement levels. The experimental group attained an N-gain of 0.659, classified as medium based on Hake's (1999) criteria ($0.30 \leq g < 0.70$), while the control group achieved an N-gain of 0.257, falling within the low category ($g < 0.30$). The marked difference between the two groups (0.659 vs. 0.257) demonstrates that exposure to EDUMEDIG media yielded a greater learning impact than the traditional teaching method.

The core finding of the statistical comparison is revealed by the t-test results, which generated a high significance value (Sig.) of 0.000. Because this probability value is substantially smaller than the 0.05 threshold, the analysis clearly indicates that the disparity in average learning outcomes between the two classes is statistically meaningful. This robust evidence leads directly to the acceptance of the alternative hypothesis Ha. Accepting Ha confirms that the treatment administered using the EDUMEDIG medium had a genuine effect on student performance. In practical terms, this demonstrates a reliable difference in achievement favoring the experimental group. Consequently, the research substantiates that the EDUMEDIG intervention is a potent factor in boosting student scores. Thus, the data conclusively support the effectiveness of the developed digital learning media.

The results of the overall effectiveness test indicate that the EDUMEDIG (Educational Digital Game Media) media, integrated with model problem-based learning, has been proven effective in improving understanding of natural and social sciences among fifth-grade elementary school students. The unique characteristics of the EDUMEDIG media strongly support this significant improvement. In particular, its design as an interactive game makes it highly relevant and aligned with technological developments in the digital era. This alignment significantly increases intrinsic motivation and active student engagement. This conclusion aligns with the findings of Putri & Indarini (2025), who found that problem-based learning multimedia environments in *IJED* significantly enhance learning motivation and comprehension in science subjects. In addition, this media facilitates active and student-centered learning, while presenting dynamic visualizations that help them build a deeper conceptual understanding of complex material. This result is in line with the findings of other studies, as reported by Mardiyana & Febryansyah (2021), which states that "the application of multimedia can improve the activities and learning outcomes of Cooling System Material for Class XI TKRO Students of SMK Negeri 1 Calang" with evidence of a significant increase in average achievement of up to 94.44%.

The developed media encourages independent navigation, ensuring students can choose from a variety of learning options (materials) and test their understanding (quizzes), in line with the principles of Problem-Based Learning. After the Development stage, the EDUMEDIG media was validated by experts and received a Very Valid rating, ready for implementation and evaluation. These results align with previous research by Asyri et al. (2024), who stated that interactive learning media based on Canva have good qualifications, are feasible, and effective for use in the learning

process by integrating HOTS. This finding is supported by Okra (2023), who found that educational science learning games for elementary school children are highly suitable for fifth-grade students, as evidenced by fifth-grade students' assessments of this media, which indicated that it was very effective.

The results of this research are consistent with previous studies (Aeni et al., 2024) reported that the SAHIH application, developed using Smart Apps Creator (SAC**)**, serves as an Android-based digital learning tool applicable in Islamic Religious Education (PAI). Similarly, Raharjo et al. (2022) demonstrated that integrating interactive learning media effectively enhances student motivation and academic achievement in both affective and cognitive domains. This improvement occurs because students engage through multiple sensory modalities, auditory, visual, and kinesthetic, facilitating better comprehension. Consequently, DELIKAN learning materials are considered a viable alternative for implementing technology-based, innovative learning at the elementary level.

This outcome aligns with the findings of Julianti et al. (2025), who highlighted that the strength of interactive multimedia lies in enabling students to regulate their own learning pace and sequence, thereby increasing autonomy and control over learning outcomes. The findings are further corroborated by previous studies conducted by Shahzad & Nadeem (2021), Susilo et al. (2023), Diyana et al. (2023), and Safitri et al. (2025), all of which concluded that interactive learning media substantially boost student motivation and academic results in both cognitive and affective domains. Hence, it can be asserted that the Problem-Based Learning EDUMEDIG media effectively enhances fifth-grade students' understanding of science and social studies. This effectiveness is supported by the characteristics of EDUMEDIG media, namely Game Interactivity. Interactive media functions as an interesting evaluation tool, using multiple-choice quizzes with answer confirmation. This game element creates a fun learning experience (learning while playing), which is the core of Child-Friendly Learning. The suitability of the Material is presented in an easy-to-digest format and complemented by attractive visuals.

A study by Rahmawati and Sanoto (2025) is highly relevant, highlighting the effectiveness of the Problem-Based Learning (PBL) model combined with Powtoon media to improve student engagement and learning outcomes. Using a quantitative method with a quasi-experimental design (non-equivalent control group design), this study on fourth-grade elementary school students yielded significant findings. The T-test results showed a value of 0.000 <0.05, confirming a significant difference between the experimental class and the control (conventional) class in both aspects studied. Furthermore, the N-Gain results of the experimental class reached 61% (quite an effective category), much higher than the control class, which was only 43% (less effective category). These findings firmly conclude that the combination of the PBL model and Powtoon media is proven to be effective in improving student engagement and learning outcomes.

Consistent with previous evidence, this study affirms that integrating interactive learning media significantly enhances students' scientific and social understanding. Therefore, the Problem-Based Learning EDUMEDIG media demonstrates considerable positive impact on student learning outcomes. It is empirically validated as a valid, practical, and effective digital learning innovation to address classroom challenges such as low motivation and learning fatigue in science education. This achievement establishes EDUMEDIG as a proven and reliable instructional tool for improving learning quality and fostering meaningful engagement in the elementary school context.

The primary novelty of this research lies in the convergence of the ADDIE development model with the Problem-Based Learning (PBL) framework and its principles, all realized through a digital game-based medium on the Canva platform. This unique contribution delivers a digital media prototype that is simple and low-cost yet has been empirically proven to be valid, practical, and

effective. Furthermore, this innovation provides a readily replicable solution for educators in schools with limited technological resources. Crucially, this novelty surpasses merely presentational digital media by offering an active, game-based, and student-centered learning environment.

These findings are consistent with the established academic literature. The high levels of validity and practicality align well with the work of (Asyri et al., 2024), who reported that Canva-based media possesses excellent feasibility, and with (Raharjo et al., 2022), who showed that interactive media effectively boosts motivation. Moreover, the demonstrated effectiveness (Sig. 0.000) is strongly supported by previous research, such as (Wulandari & Sari, 2024) and (Rahmadani & Sumarno, 2023). Both of those studies similarly concluded that integrating the PBL approach with digital media significantly enhances conceptual mastery and student engagement at the elementary school level.

The results of this study yield a significant impact, both theoretically and practically, within the field of education. Theoretically, the research strengthens the scholarly framework for synthesizing the ADDIE and Problem-Based Learning (PBL) models in the context of digital media creation. The finding that the EDUMEDIG medium, grounded in the PBL stages, significantly improves science comprehension affirms that integrating problem-based instructional design with interactive technology is a valid and effective model for optimizing students' cognitive processes at the elementary level. Practically, the success of the EDUMEDIG product makes a tangible contribution as an innovative solution to the challenges of boredom and difficulty in understanding science concepts. This product serves as a primary alternative learning medium for teachers to foster a more active, problem-based learning classroom atmosphere aligned with the characteristics of 21st-century students, thereby directly supporting improvements in student learning quality and efficiency.

Although the product proved effective, this study has inherent limitations that must be acknowledged. First, the effectiveness test was conducted at only one school with a limited sample, which limits the generalizability of the findings and necessitates further trials across different contexts and educational levels. Second, the intervention duration was relatively brief, preventing the measurement of long-term retention. Third, the medium remains web-link-based (Canva link), which requires a stable internet connection for optimal operation, thus restricting implementation in areas with inadequate internet access.

Based on the valid, practical, and effective findings and the identified research limitations, three main recommendations are proposed. First, teachers and schools are encouraged to adopt the EDUMEDIG medium as an innovative primary solution for science instruction and to organize internal training to ensure the continuous integration of digital technology within the school environment. Second, for developers, it is suggested that innovation continue by converting the product into a standalone mobile application and expanding its content coverage to other subjects to enhance accessibility and ease of use. Third, future researchers should conduct comparative studies with other educational game media and perform trials across diverse educational levels or school contexts to reinforce product generalization and measure its long-term impact, especially on the development of students' critical thinking skills.

Conclusion

This research found that the Digital Interactive Learning Media (EDUMEDIG), developed using the Problem-Based Learning (PBL) model, proved to be Very Valid and Highly Practical for use and Significantly Effective in enhancing fifth-grade students' science understanding compared to conventional methods. Based on these findings, it is recommended that teachers adopt

EDUMEDIG as a primary learning medium for innovative, problem-based science instruction. Furthermore, it is suggested that future researchers expand the product development into a mobile application format and test its impact on students' critical thinking skills within a broader educational context. Based on the research findings and the success of the EDUMEDIG product, the following recommendations are put forward: Teachers and schools are urged to adopt the EDUMEDIG media as the primary innovative solution for science learning and immediately conduct training to ensure the sustainable integration of this technology. Developers are advised to continue innovation by converting the product into a mobile application format and expanding its content coverage to other subjects to enhance user accessibility. Future researchers should conduct comparative studies and trials in diverse educational contexts to strengthen the generalization of the product's effectiveness and measure its impact on students' critical thinking skills.

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