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Development of Interactive Multimedia Based on Problem Based Learning and Liveworksheets to Improve IPAS Learning Outcomes

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A B S T R A C T

Teachers have not yet fully utilized technology-based media and innovative learning approaches, which has contributed to low student achievement. This study aimed to develop, validate, and evaluate the effectiveness of interactive multimedia designed with a Problem-Based Learning approach and enhanced by Liveworksheets to improve fifth-grade students' IPAS learning outcomes. The research applied a Research and Development (R&D) method using the ADDIE model as the framework. The participants were 21 fifth-grade students from State Elementary School (SDN) 1 Bawu Jepara. Data were collected through tests and non-test techniques, including observation, interviews, questionnaires, and documentation. The findings revealed that: (1) the developed multimedia included a main menu, user guide, learning materials, games, Liveworksheets-based assessments, and references; (2) its feasibility was rated very high by experts, teachers, and students; and (3) the product was proven effective in improving students' engagement and learning outcomes. Therefore, the interactive multimedia developed in this study is both feasible and effective as a tool to enhance IPAS learning for elementary school students.

1. Introduction

Education serves as a foundation for both individual development and societal progress. It is not only about transferring knowledge but also about nurturing skills, values, and attitudes that prepare students to face twenty-first-century challenges. Government Regulation No. 57 of 2021 defines education as a purposeful and systematic process designed to help learners develop potential, including intelligence, character, and moral values. Within this framework, the curriculum acts as the backbone of the educational process, guiding teachers in designing meaningful instruction. Recently, Indonesia introduced the Merdeka Curriculum as part of learning recovery initiatives. This curriculum emphasizes flexibility and

student competencies beyond memorization. Based on Minister of Education and Culture Decree No. 56 of 2022, its implementation ensures learning becomes both informative and transformative. At the elementary level, outcomes are divided into three phases—Phase A, Phase B, and Phase C—structuring student learning from grades I through VI. The alignment of curriculum with educational needs is essential for effective implementation and contributes to achieving national education goals (Martin & Simanjorang, 2022).

The Learning Outcomes (Capaian Pembelajaran) in the Merdeka Curriculum are narrative descriptions of competencies that integrate knowledge, skills, and values. These outcomes are detailed in the Decree of the Head of BSKAP No. 8 of 2022, covering early childhood through secondary education. At the elementary stage, outcomes are arranged progressively so that students achieve appropriate knowledge and skills in each phase. For Natural and Social Sciences (Ilmu Pengetahuan Alam dan Sosial, IPAS), the goal is to cultivate scientific ways of thinking, working, and behaving. IPAS also trains students to understand the universe and its relation to human life, laying the foundation for advanced scientific study. According to Agustina et al. (2022), IPAS is not limited to factual recall but aims to foster inquiry, curiosity, and problem-solving. This makes IPAS vital because it combines science concepts with social context while supporting the integration of local wisdom in the Merdeka Curriculum (Hasanah et al., 2023).

Despite its importance, IPAS learning still faces challenges. Many students struggle with abstract concepts, and teaching often lacks engagement. One factor is the limited use of technology. Teachers rely on printed texts or static images, which are less interactive. Studies show contextual approaches such as ethnomathematics help simplify concepts by linking them to real contexts (Ajmain et al., 2020). Juniari and Putra (2021) highlight that underuse of digital media reduces motivation and achievement. Arisanti and Adnan (2021) note that limited instructional variety hinders critical thinking.

Lestari et al. (2020) found audiovisual media effective during the pandemic when in-person learning was restricted. These issues appear in fifth-grade IPAS classes at State Elementary School (SDN) 1 Bawu, Jepara, where teacher-centered methods dominate and 62 percent of students fail to meet minimum mastery. Innovation is urgently needed. Educational awareness also determines how effectively teachers use new media (Nasrah & Elihami, 2021). Research further shows multimedia interventions significantly enhance motivation and achievement in science learning (Qistina et al., 2019).

To address these issues, this study developed interactive multimedia using a Problem-Based Learning (PBL) approach with Liveworksheets. Multimedia combines text, audio, images, animation, and video into a single platform that accommodates diverse learning needs. Donna et al. (2021) and Nazhiroh et al. (2021) emphasize that multimedia increases engagement by encouraging interaction with material. Integrated with Liveworksheets, students can complete tasks, receive feedback, and practice independently. Features such as menus, learning materials, games, and interactive assessments create a more active learning

experience. This design allows teachers to move beyond conventional methods and build lessons that appeal to modern learners.

The PBL model itself is a student-centered strategy emphasizing learning through problem solving. Instead of passively receiving information, students face real-world problems to analyze, discuss, and solve collaboratively. Rahmadani and Taufina (2020) note that PBL fosters critical and creative thinking while strengthening collaboration. In IPAS, PBL can be applied to topics such as the human movement system, where students explore how muscles and bones work, identify problems, and propose solutions. Integrating PBL into interactive multimedia transforms lessons into meaningful experiences that connect directly to real life. This approach also builds lifelong skills such as inquiry, reflection, and collaboration, aligning with the aims of the Merdeka Curriculum.

The multimedia development followed the ADDIE model, consisting of Analysis, Design, Development, Implementation, and Evaluation. The analysis stage identified problems in IPAS learning at SDN 1 Bawu. The design stage planned features such as materials, interactive tasks, and assessments. Development used Canva and Liveworksheets to create the product. Implementation involved classroom use in fifth grade, and evaluation included expert, teacher, and student reviews. The product was rated feasible, practical, and effective in improving learning outcomes.

In conclusion, interactive multimedia based on PBL and supported by Liveworksheets provides an effective solution for improving IPAS learning in elementary schools. This innovation addresses limitations of traditional methods, increases engagement, and supports mastery of complex concepts. It aligns with the Merdeka Curriculum, which prioritizes student-centered learning and competency development. Adopting multimedia-based and innovative approaches is important not only to improve IPAS achievement but also to contribute to broader reforms aimed at creating independent, critical, and creative learners.

2. Methodology

This study used the Research and Development (R&D) method, which is a step-by-step way to create, produce, and check educational tools (Sugiyono, 2022). To develop interactive multimedia based on Problem-Based Learning and Liveworksheets, the researchers followed the ADDIE model. This model has five stages: (1) Analysis, where the problems and needs are identified; (2) Design, where the learning media is planned; (3) Development, where the multimedia is created; (4) Implementation, where it is tried out in the classroom; and (5) Evaluation, where its effectiveness and suitability are checked. The whole process of the research is shown in Figure 1.

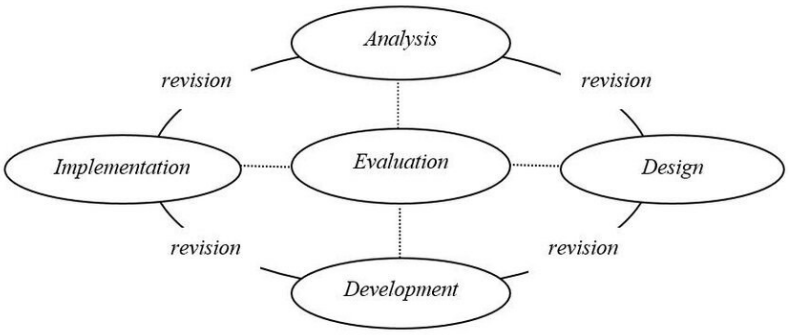


Figure 1. Stages of ADDIE Development Model (Sa'adah & Wahyu, 2021)

The participants in this study were 21 fifth-grade students and their teachers at SDN 1 Bawu Jepara. Data collection used both test and non-test methods to obtain comprehensive findings. Pretests and posttests were administered to measure learning outcomes quantitatively. Observations, interviews, questionnaires, and documentation were employed to gather qualitative insights. Normality and homogeneity tests were carried out to check data assumptions. T-tests were then used to determine differences between pretest and posttest scores. N-gain analysis was applied to measure the effectiveness of interactive multimedia. This procedure provided a reliable basis for evaluating its impact.

3. Results and Discussion

Development of Interactive Multimedia based on Problem Based Learning and Liveworksheets

Analysis

Observations revealed that in IPAS learning, teachers relied mainly on visual media, with little to no integration of technology-based resources, and innovative models had not been applied effectively, resulting in low science learning outcomes. Interviews with fifth-grade teachers confirmed that the school had already adopted the Merdeka Curriculum, and to further explore the needs, questionnaires were distributed to both teachers and students regarding the types of media required. The collected data indicated that existing media were not sufficiently engaging to capture students' attention or stimulate motivation, while teachers expressed the need for technology-based tools to enrich students' understanding of the human movement system. Therefore, learning media should be developed in alignment with subject matter and student characteristics, using concise and accessible language to ensure comprehension (Wijayanti et al., 2022).

Both teachers and students agreed on the inclusion of visual and video elements to facilitate better understanding, which emphasizes the importance of interactive and appealing content. To address these challenges, interactive multimedia was identified as the most suitable solution, since it can integrate various formats such as images, audio, video, animation, and games to enhance learning outcomes

(Patricia & Zamzam, 2021; Rulismi et al., 2023). In addition, observations confirmed that the school possesses adequate facilities to support technology-based learning, including LCD projectors, Wi-Fi, and speakers, all of which can be utilized effectively in classroom activities. Based on these findings, this study focuses on developing interactive multimedia for IPAS learning, designed around the Problem-Based Learning model and integrated with Liveworksheets.

Product Design

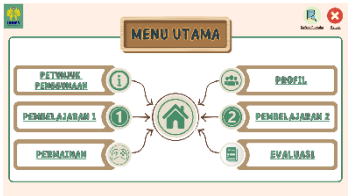
The interactive multimedia, developed around the principles of Problem-Based Learning (PBL) and enhanced with Liveworksheets, was created using Canva and made available to students via an online link. It integrates multiple media types, including text, images, animation, audio, and instructional videos. The multimedia package features a cover page, main menu, user instructions, developer profile, concept maps, learning outcomes and objectives, linked games and assessments, as well as content on the human movement system presented through text, audio, images, animation, videos, and student worksheets (LKPD), all structured according to the Problem-Based Learning (PBL) framework. A bibliography is also provided.

In this multimedia, the Problem-Based Learning (PBL) approach is applied through a series of steps designed to actively engage students. First, students are introduced to the problem to spark curiosity. Next, they are organized for collaborative learning and guided through individual and group investigations. They then develop and present their solutions, followed by a reflection phase where they analyze and evaluate the problem-solving process (Agustin & Razi, 2023; Syawaludin et al., 2019). This structured sequence ensures that students not only gain conceptual understanding but also develop critical thinking, communication, and collaboration skills essential for 21st-century learning.

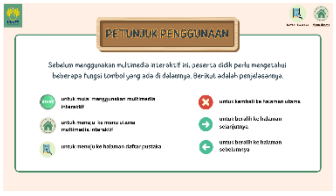
Product Development

Following the design phase, the interactive multimedia based on Problem-Based Learning was successfully developed into a functional educational tool. To ensure its quality and suitability for learning, it was subjected to validation by media and content experts. Using a standardized questionnaire, the multimedia was assessed on aspects such as content accuracy, design, usability, and technical functionality. Material experts rated it at 93.7%, while media experts gave a score of 85.9%, both classified as “very feasible” and not requiring further adjustments. Figure 2 presents the final form of the interactive multimedia, ready to support student learning.

Interactive Multimedia Cover



Game menu



Instructions for Use

Problem Based Learning Syntax

Liveworksheets and Wordwall-based evaluation using barcodes and links

Figure 2. Design of Interactive multimedia based on Problem Based Learning and Liveworksheets

Implementation

After successfully passing validation by media and content experts, the interactive multimedia based on Problem-Based Learning was put into practice through both small-scale and large-scale classroom trials. The small-scale trial involved six fifth-grade students at SDN 1 Bawu, selected heterogeneously according to ability: two low-achieving, two medium-achieving, and two high-achieving students. Following the trial, teachers and students completed response questionnaires to evaluate their perceptions of the interactive multimedia for the IPAS topic on the human movement system. The results indicated positive feedback, and no revisions to the product were deemed necessary. Following the small-scale trial, a large-scale trial was carried out involving 15 fifth-grade students at SDN 1 Bawu.

Feasibility of Interactive Multimedia based on Problem Based Learning and Liveworksheets

Evaluation

To test the feasibility of the interactive multimedia, validation was carried out by material experts, media experts, teachers, and students. Their assessments focused on content accuracy, media design, and practicality for classroom use. Feedback was collected using structured questionnaires provided in this study. Teachers gave input on how the multimedia supported teaching, while students shared their experiences using it. Expert validation ensured that the materials were scientifically accurate and visually clear. Student responses highlighted its attractiveness and ease

of use. Overall, the evaluations showed that the multimedia was feasible and effective for learning. The complete results of this validation process are summarized in Table 1.

Table 1. Validity Test Results of Material Experts and Media Experts

No	Validator	Valuation Percentage (%)	Criteria
1	Media Experts	85.9%	Very feasible
2	Material Experts	93.7%	Very feasible

As presented in Table 1, the interactive multimedia based on Problem-Based Learning and Liveworksheets earned a validity score of 85.9% from media experts, placing it in the "very feasible" category. Their evaluation focused on four key aspects: the quality of content and learning objectives, clarity of usage instructions, technical information, and overall visual design. Material experts rated the multimedia even higher, with a score of 93.7%, also falling into the "very feasible" category. Their assessment emphasized the alignment of learning objectives, appropriateness for students' cognitive levels, quality and accuracy of multimedia content, inclusion of motivational elements, and correctness of facts, concepts, principles, and generalizations. These findings are further reinforced by teacher and student response questionnaires, summarized in Table 2.

Table 2. Results of Teacher and Student Response Questionnaires

No	Validator	Valuation Percentage (%)	Criteria
1	Teacher	91.25%	Very feasible
2	Students	90.53%	Very feasible

The feasibility assessment revealed that the interactive multimedia developed using PBL and Liveworksheets is robust and ready for integration into teaching. Media experts assigned a score of 85.9%, evaluating content quality, learning objectives, instructions, technical information, and visual design, which placed the multimedia in the "very feasible" category. Material experts gave an even higher score of 93.7%, considering the alignment of learning objectives, suitability for students' cognitive level, quality of multimedia content, motivational stimuli, and accuracy of learning content, including facts, concepts, principles, and generalizations. These results indicate that the multimedia meets high standards for both content and presentation.

Reinforcing these results, analysis of teacher and student questionnaires revealed overwhelmingly positive responses to the multimedia. Teachers gave it a score of 91.25%, while students rated it at 90.53%, with both falling into the "very feasible" category. These evaluations considered aspects such as content quality, presentation, and ease of use. Taken together with the assessments from material and media experts, it is clear that the interactive multimedia based on Problem-Based Learning and Liveworksheets is highly suitable and effective for enhancing learning.

The Efficacy of Interactive Multimedia Based on Problem Based Learning

To see how well the interactive multimedia based on Problem-Based Learning worked for teaching the human movement system, the researchers looked closely at the students' pretest and posttest scores. By comparing these scores, it became clear how much the students' understanding had grown after using the multimedia in class. The analysis also included statistical tests to ensure that the improvements were significant and not due to chance. Table 3 shows the results in detail, giving a clear picture of the improvements in their learning and how this interactive approach made a real difference in the classroom.

Table 3. Pretest dan Posttest results

No	Aspect	Pretest score	Posttest score
1	Average	47.46	83.49
2	Highest score	73.33	100
3	Lowest score	23.33	66.67

Table 3 illustrates a notable improvement in students' learning outcomes, with the average score increasing by 36.03 points, from 47.46 in the pretest to 83.33 in the posttest. This considerable gain demonstrates the positive effect of implementing interactive multimedia based on Problem-Based Learning and Liveworksheets on students' mastery of the subject matter. To make sense of the students' learning progress, the researchers turned to SPSS 25 for their analysis. They started by checking the basics, whether the data followed a normal pattern and whether the variations were consistent, so that the statistical tests they planned to use would be valid. Using the Shapiro-Wilk method, they confirmed the data were normally distributed, with the detailed results shown in Table 4. Once the data were ready, they moved on to see the real impact of the interactive multimedia. By running the t-test and the N-gain test, they were able to measure both the significance of the improvements and the overall gain in student learning after using the Problem-Based Learning multimedia.

Table 4. The normality test results

Tests of Normality						
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pretest	.152	21	.200*	.928	21	.126
Posttest	.203	21	.024	.926	21	.114

Before diving into the main analysis, the researchers first checked whether the data behaved as expected. They started with a normality test to see if the pretest and posttest scores followed a normal distribution. The guideline was that a significance value (2-tailed) above 0.05 would indicate normal distribution, while a value below 0.05 would mean the data were not normally distributed. According to Table 4, the Shapiro-Wilk test showed 0.126 for the pretest and 0.114 for the posttest. Since both values are above 0.05, it confirmed that the data were normally distributed. Next, they ran a homogeneity test to determine whether the data came from populations with similar variances. Ensuring homogeneity is important for fair comparisons between groups. This test was also conducted using SPSS 25, and the findings are summarized in Table 5.

Table 5. The homogeneity test results

	Levene Statistic	df1	df2	Sig.
Based on Mean	7.452	1	40	.009

Looking at Table 5, the significance value (Sig.) calculated from the mean is 0.009, which is above the threshold of 0.005. This result indicates that the data variances are equal, meaning the data are homogeneous. Combined with the earlier normality test results, we can conclude that the research data meet the key assumptions required for parametric analysis. Once the normality and homogeneity checks were confirmed, the researchers went ahead with a Paired T-test using SPSS 25 to see if the interactive multimedia based on Problem-Based Learning really made a difference in students' learning outcomes. This analysis allowed them to measure the impact of the multimedia on students' understanding and performance. The results of this test, which reveal how effective the multimedia was in enhancing learning, are summarized in Table 6.

Table 6. The results of the Paired T-test

Paired Samples Test									
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
					Lower	Upper			
Pair 1	Pretest - Posttest	-36.031	15.549	3.393	-43.110	-28.953	-10.619	20	.000

In a Paired T-test, the 2-tailed significance value is used to determine whether the difference between pretest and posttest scores is meaningful. A significance value below 0.05 indicates that the change is statistically significant, showing clear improvement in students' learning. Conversely, a value above 0.05 suggests that the difference between the scores is not significant, implying that the learning intervention did not produce a noticeable effect. According to Table 6, the 2-tailed significance value is 0.000, which falls well below the 0.05 threshold. This confirms that students' scores improved significantly, with an average gain of 36.03% between the pretest and posttest. The pattern of this improvement is visually presented in Figure 3.

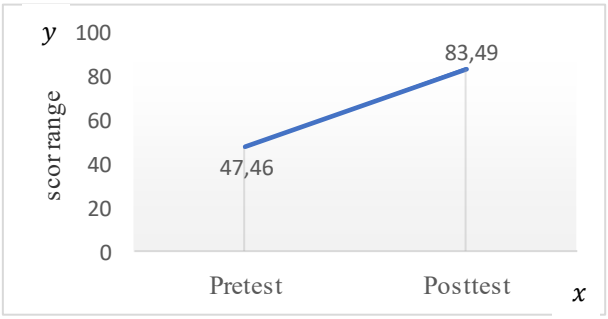


Figure 3. The Increase in Pretest and Posttest Results

The findings from the study paint a clear picture: using interactive multimedia designed around Problem-Based Learning really helped students improve their understanding of science, especially in the area of the human movement system. It wasn't just about the scores; the multimedia seemed to engage students, guide them through the material, and make abstract concepts easier to grasp. To better understand the magnitude of this improvement, the researchers turned to an N-Gain analysis using SPSS version 25. This analysis allowed them to quantify how much students had grown in their learning from the pretest to the posttest. The results, summarized in Table 7, provide a concrete measure of the progress, showing the real impact of integrating interactive multimedia into the learning process.

Table 7. The N-Gain test results

No	Action	Average	Average Difference	N-gain	Category
1	Pretest	47.46	36.03	0.67	Moderate
2	Posttest	83.49			

Table 7 shows that the IPAS learning outcomes of fifth-grade students at SDN 1 Bawu Jepara experienced notable improvement after using interactive multimedia based on Problem-Based Learning for the human movement system topic. The average N-Gain score was 0.67, which falls into the medium category. Although the learning gains are considered moderate, the multimedia product itself was rated very highly in terms of feasibility by material experts, media experts, and both teachers and students. This gap can be explained by differences in students' learning readiness, study habits, and learning styles, which all play a role in shaping academic performance.

These findings are consistent with previous research showing that both learning readiness and learning style significantly affect students' outcomes (Oktafiani et al., 2020; Sulaiha et al., 2018). Students who maintain strong study habits, actively participating in class, asking questions, and seeking help when needed, tend to perform better academically (Priya, 2023). Likewise, learning styles strongly influence student behavior and engagement, which in turn has a substantial impact on their overall learning achievement (Razali et al., 2023; Zhang, 2023; Zhao et al., 2021). In summary, the findings indicate that interactive multimedia developed with a Problem-Based Learning approach and complemented by Liveworksheets proves to be a highly effective tool for enhancing students' IPAS learning outcomes. This is particularly evident in the human movement system topic, where the multimedia not only supported students in understanding the material more clearly but also helped make the learning process more engaging and interactive.

4. Conclusion

This study focused on developing interactive multimedia for IPAS learning, specifically on the human movement system, using a Problem-Based Learning approach combined with Liveworksheets through the Research and Development method. The multimedia, created with Canva and Liveworksheets, includes a cover,

main menu, user instructions, learning materials, games, Liveworksheets-based assessments, and references. The feasibility of the interactive multimedia was confirmed by validation from both material and media experts, along with enthusiastic feedback from teachers and students, all of whom rated it as highly feasible. Its effectiveness was evident from the clear improvements observed between pretest and posttest results, which showed that students gained a better understanding of the material and were more actively engaged in the learning process. Altogether, these findings suggest that the interactive multimedia was successfully developed, is highly practical for classroom use, and can meaningfully enhance the IPAS learning outcomes of fifth-grade students at State Elementary School (SDN) 1 Bawu Jepara.

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