

Development of PBL-Based Interactive Multimedia to Improve Learning Outcomes on Human Digestive System Material

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ABSTRACT

This research is based on the fact that teachers are not yet optimal in presenting technology-based learning media, resulting in low learning outcomes on the human digestive system material. This study aims to describe the development design, test the feasibility, and effectiveness of PBL-based Interactive Multimedia to improve learning outcomes of human digestive system material. The type of research is R&D with the ADDIE model including analysis, design, development, implementation, and evaluation. The research subjects were 20 fifth grade students. Data collection techniques were non-tests (observation, interviews, questionnaires, documentation) and tests (pre-test and post-test). Data analysis techniques were normality tests, t-tests, and N-Gain tests. The PBL-based interactive multimedia development design used Canva to design integrated PBL syntax starting with a video stimulus and equipped with simple experiments. The feasibility of interactive multimedia was shown by the results of the material validator of 91.07% and the media of 91.07% supported by the results of the analysis of teacher responses of 100% and students of 89.37% in the very feasible category. The effectiveness of PBL-based Interactive Multimedia is shown to increase learning outcomes by 24.28%, supported by the results of a significance analysis of 0.000 and an N-Gain of 0.631 in the moderate category. The conclusion of the study, PBL-based interactive multimedia on the human digestive system material was successfully developed, very feasible, and effective in improving the learning outcomes of fifth-grade students at SDN Karanganyar Gunung 01, Semarang City.

Keywords: Interactive Multimedia; PBL; Learning Outcomes; Human Digestive System

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INTRODUCTION

21st-century learning focuses on leveraging digital technologies to accommodate the unique characteristics of each student. Rapid technological advancements require the world of education to adapt and transform by integrating these technological advancements into the teaching and learning process (Novela et al., 2024). This aims to develop students with advanced IT knowledge. In accordance with Government Regulation Number 4 of 2022 concerning National Education Standards, educational standards are established that are student-centered, take into account the characteristics and developmental stages of children, and utilize advances in science and technology. This serves as the primary legal basis for the implementation of education in elementary schools. Students are highly curious and have limited concentration. Several subjects implement essential concepts at the elementary school level, including science.

Science is a subject that a group of people systematically uses to investigate natural phenomena, the laws governing nature, and cause-and-effect relationships in the surrounding environment. Science has two main elements: conceptual understanding and process skills. Conceptual understanding of science is the comprehensive ability to grasp scientific ideas, formulate ways to work on or solve problems, apply simple calculations, and be able to apply these skills in everyday life (Zuleni & Marfilinda, 2022). Science as a process skill includes observation activities, time relationships, hypotheses, classification, measurement, research, communication, control variables, and data interpretation (Fitra, 2022). Science subjects facilitate students to think critically, work in groups, and discuss the application of essential concepts in the scope of science.

The scope of science learning is very broad and encompasses various disciplines. Natural Sciences (IPA) learning is learning that relates to concepts in the subjects of Biology, Chemistry, and Physics (Mufida &

Widodo, 2021). One of them at the elementary school level is the human body's organ system which is related to how to maintain body health. The scope of the human body's organ system studies material about the various organ systems in the body along with their functions and how they work. An organ system is a collection of organs that work together so that the body can function properly, such as the digestive, respiratory, and circulatory systems. In studying this material, students will learn the structure and function of each organ system, for example how the digestive system processes food into energy, or how the respiratory system takes in oxygen and releases carbon dioxide. In the scope of science learning, students cannot always see or witness the human body's organ system in real life, for example in the material "The Human Digestive System". Hence, interactive multimedia is considered necessary in order to facilitate a more accessible understanding among students of the digestive system's essential, yet abstract, concept.

As a learning medium that integrates diverse media formats, interactive multimedia combines technological elements with principles of active learning, thus facilitating a more effective and engaging comprehension of the material among students (Irawan, E., Kusumah, Y. S., & Saputri, 2023). The main components of interactive multimedia include text, which plays a role in conveying information systematically and clearly, while images and animations help visualize abstract concepts, making them easier for students to understand. Audio and video provide additional stimulation that increases the appeal of learning and supports the fulfillment of various learning styles, especially auditory and visual. Interactive elements make students actively involved during the learning process, for example by answering questions, navigating buttons to display information, or conducting simulations, so that the learning process becomes more participatory and meaningful. In line with (Rahmadhani & Manalu, 2022). The components involved in multimedia include: (1) an opening menu (intro), (2) a main menu containing instructions for use, competencies, materials, evaluations, and development profiles. (3) navigation buttons that function to operate interactive multimedia so that it can be used independently by students. In addition, interactive multimedia facilitates problem-solving skills, so that it can increase understanding more deeply by presenting situations or simulations that require students to analyze, evaluate, and find solutions through the PBL learning process.

Problem-based learning (PBL) is a learning model that places students in complex situations, requiring them to use their existing knowledge and skills to solve them. Furthermore, this approach shifts the focus from memorization to practical application of knowledge, enabling students to understand and integrate concepts more effectively across various aspects of real life (Rachman et al., 2025). This finding is consistent with previous studies suggesting that the stages involved in problem-based learning can foster greater student engagement in the process of problem-solving (Ariani et al., 2025). Students will apply the knowledge they have or try to find out the knowledge they need (Novelni & Sukma, 2021). Students do not get bored easily and have a higher sense of curiosity because they implement various interesting learning elements, thus increasing students' motivation and interest in participating in the learning process.

Based on the results of a preliminary study conducted through observation, interviews, and the distribution of a needs assessment questionnaire to 20 fifth-grade students at SDN Karanganyar Gunung 01 in Semarang, it was found that the learning problems encountered were caused by teachers' suboptimal use of technology-based learning media. Teachers implement teacher-centered learning, using textbooks and PowerPoint presentations. This leads to a lack of interest in learning, which impacts student learning outcomes. According to (Lisnasari, 2021) The impact of the TCL learning system is that teachers under-develop learning materials and tend to use them as is (monotonous). Teachers have not optimally varied interactive learning media. This is evident in students' behavior, who easily become bored during the learning process, lose focus, and prefer to talk to their deskmates (RimahDani, D. E., Shaleh, S., & Nurlaeli, 2023) states that, to achieve maximum or optimal learning outcomes, an educator needs to determine appropriate media to support the learning process. By adding game elements to teaching and learning activities where students can play an active role, this can help improve students' cognitive development (Hidayati, 2021).

Teachers have not yet optimally implemented the Problem Based Learning model, as seen in the implementation of syntaxes 2, 3, and 4. In the first and fifth syntaxes, the teacher has been optimal in its implementation. The teacher has introduced the learning topic and presented relevant problems to arouse students' curiosity and provide evaluations, provide reinforcement for students' work results, and conclude the learning. In the second syntax, grouping is still general and has not been adjusted to students' potential, so that interaction within the group is less than optimal and tends to work individually. In the third syntax, the teacher

has not actively facilitated student exploration by providing sufficient guidance to solve problems. In the fourth syntax, students have not optimally presented ideas in depth. Student activeness is also influenced by the use of learning media. This is because the function of learning media extends beyond serving as a mere teaching aid, functioning also as one of the means by which students can become more actively engaged in the classroom teaching and learning process (Mukarromah, A., & Andriana, 2022). The development and implementation of learning media should therefore be tailored to both the characteristics of students and the prevailing advancements in technology (Sari & Harjono, 2021).

The learning outcomes of fifth-grade students at SDN Karanganyar Gunung 01, Semarang City, on the Human Digestive System topic show that 65% (13 students) scored below the minimum competency criteria (KKTP), while 35% (7 students) scored above the KKTP. This can be concluded that the Human Digestive System material has not been running optimally. Several inaccuracies remain evident in the identification of the parts of the human digestive system and their respective functions. Therefore, learning media are needed that are appropriate for learning and can visualize the material for easy understanding.

Learning under these conditions therefore requires the development of technology-based learning media capable of presenting abstract scientific concepts in a more concrete manner. Learning media are any form of tool, tool, or material used to convey learning messages and information. Learning media can be used to stimulate thoughts, feelings, attention, and learning abilities or skills, thereby encouraging a more effective learning process (Pujiyanti, U., & Sartika, 2021). Learning media has the characteristics of being a tool to help teachers achieve learning objectives, motivate them, and be able to be adapted to the characteristics of students. The principal function of learning media lies in creating conditions that enable students to acquire knowledge accurately and thoroughly, while also fostering cognitive development and shaping students' character (Saleh, MS, Syahrudin, S., Saleh, M., & Azis, 2023). The supporting learning media is interactive multimedia.

Interactive multimedia offers a range of benefits within the learning process (Nata & Putra, 2021) this medium holds certain advantages over other forms of media, as it integrates various elements such as photos, animation, audio, and video. Its use in the classroom can enhance student engagement by encouraging direct involvement through material exploration, simulations, and interactions designed to stimulate students' curiosity and attention. This view is reinforced by (Wedayanti & Wiarta, 2022) who note that interactive multimedia contributes to increased student activity by directly involving them in its operation, making the learning process more engaging and enjoyable, offering new learning experiences, supporting students' comprehension of the material, and fostering greater interest and motivation that ultimately influences learning outcomes. Furthermore, the integration of interactive multimedia within a problem-based learning framework has proven effective in supporting problem-solving, thereby contributing to improved student learning achievement.

Research that supports this research, namely (Ulfa et al., 2022) entitled "Development of Interactive Multimedia on Problem Based Learning Theme 3 Healthy Food Subtheme 1 How the Body Processes Food Grade V SDN Sidomulyo 2 Demak" The results of the development of Interactive Multimedia in the form of videos based on Problem Based Learning on Theme 3 Healthy Food Subtheme 1 How the Body Processes Food. The results of the assessment of Interactive Multimedia on Problem Based Learning were declared practical and useful. This is evidenced by the results of teacher responses of 91% and from student responses of 90%.

Research that supports this research, namely (Sinaga, 2025) entitled "Development of Interactive Multimedia Based on Problem Based Learning on the Topic of Me and My Needs in Class IV of Budi Murni 1 Elementary School, Medan". The findings of this study indicate that the developed product is effective in improving student learning outcomes, as reflected in the percentage of classical completion, which reached 80% in the first trial with an average gain value of 0.5, and increased to 100% in the second trial with an average gain value of 0.8.

Based on the background description above, the researcher will conduct a development research entitled "Development of Interactive Multimedia Based on Problem Based Learning to Improve Student Learning Outcomes on the Human Digestive System Material for Class V of Karanganyar Gunung 01 Elementary School, Semarang City".

METHOD

This study employed a research and development (R&D) approach using the ADDIE model. The stages are as follows:

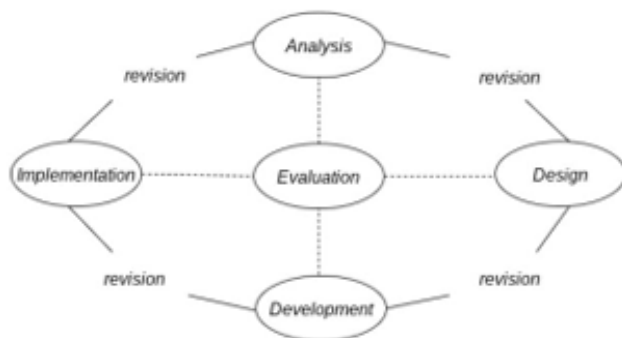


Figure 1. Stages of the ADDIE Model (Rahayu, 2025)

This research was carried out through five interconnected phases under the ADDIE model. The process began with Analysis, during which observations, interviews, questionnaires, and documentation were employed as means of gathering data, allowing the researcher to pinpoint existing problems, learning needs, student characteristics, and the broader instructional context. Building upon these findings, the Design phase followed, in which a product blueprint—together with its specifications—was formulated; this involved constructing the framework for a Problem-Based Learning (PBL)–oriented interactive multimedia product and arranging the presentation of its content through Canva, with the design itself shaped largely by insights drawn from the prior needs questionnaire. Once the design had taken shape, the Development phase commenced, wherein the PBL-based interactive multimedia was produced and subsequently examined by material and media validators to determine its feasibility; only after receiving validation was the product considered ready for use among fifth-grade students. Attention then turned to Implementation, a phase concerned with observing how the product performed in practice—particularly student responses, as well as the product's overall efficiency and effectiveness. The research process concluded with Evaluation, through which the product's quality was assessed by examining feedback gathered from questionnaires completed by both teachers and students.

The subjects of this study involved material validators, media validators, fifth-grade homeroom teachers, and fifth-grade students of Karanganyar Gunung 01 Elementary School, Semarang City. There were 20 fifth-grade students, consisting of 9 boys and 11 girls. Data in this study were gathered through two main approaches: non-test techniques, encompassing observation, interviews, questionnaires, and documentation, and test techniques, consisting of pre-tests and post-tests. To examine the effectiveness of the PBL-based Interactive Multimedia, the resulting data were then analyzed using normality testing, the t-test, and the N-Gain test. Normality test is an important step in data analysis because it serves as a prerequisite for determining whether parametric statistical methods can be applied or not (Sianturi, 2025). The t test functions to find out whether there is a significant difference before and after using the media and the N-Gain test functions to measure the increase in learning outcomes after being implemented.

RESULTS AND DISCUSSION

This study aims to describe the design, test the feasibility, and test the effectiveness of the development of PBL-based Interactive Multimedia on the Human Digestive System material. The ADDIE model applied in the study includes five interrelated stages in the development process, as follows;

Interactive Multimedia Development Design

The first phase, analysis, is directed at uncovering problems that arise within the learning process while also laying the groundwork for selecting and planning the subject matter to be taught (Hidayati, 2021). Preliminary research conducted through observation, interviews, and needs questionnaires among fifth-grade students at Karanganyar Gunung 01 Elementary School, Semarang City, revealed that this problem originates largely from teachers' limited optimization of technology-based learning materials. Learning in the classroom remains predominantly teacher-centered, relying mainly on textbooks and PowerPoint presentations. Such

conditions have contributed to a decline in students' interest in learning, which in turn has affected the learning outcomes achieved. Teachers have yet to diversify interactive learning media in ways that effectively present contextual problems or incorporate educational games into instruction. This is reflected in student behavior during lessons, where boredom, loss of focus, and a tendency to converse with deskmates are commonly observed (RimahDani, D. E., Shaleh, S., & Nurlaeli, 2023) achieving optimal learning outcomes requires educators to carefully select media that are appropriate to support the learning process.

The learning outcomes of fifth grade students of Karanganyar Gunung 01 Elementary School, Semarang City on the Human Digestive System material 2025/2026 are low. Based on the results of the Human Digestive System material, it shows that 65% of 13 students got scores below the KKTP, while 35% of 7 students got scores above the KKTP. The KKTP at Karanganyar Gunung 01 Elementary School, Semarang City in the science subject is 70. It can be concluded that the Human Digestive System material has not run optimally. In the formative assessment analysis, there are still several errors in the parts of the human digestive system and their functions. Therefore, learning media are needed that are appropriate to learning and can visualize the material so that it is easy to understand.

The second stage is design, this stageThe learning designer begins to design appropriate solutions based on the results of the previous analysis (Torang Siregar, 2025) This interactive multimedia was created using Canva and includes a start button, a button to return to the previous or next page, a button to activate/deactivate the audio explanation of the material, a cross button to end the interactive multimedia, and instructions. Furthermore, the interactive multimedia is equipped with learning outcomes and learning objectives to be achieved. This wordwall-based edugame aims to increase students' interest in learning while playing.

The design of this PBL-based interactive multimedia was tailored to suit the characteristics of upper-grade students, who are generally at the concrete operational stage and thus capable of logical reasoning and applying clear rules to resolve problems (Hidayatulloh et al., 2023)The characteristics of learning in elementary schools in the upper classes show that in addition to requiring high levels of student activity, students' abilities in carrying out learning activities such as carrying out stages of investigation, solving problems and so on are also required.

The third stage of development,the designs that have been made in the previous stage begin to be realized into real products (Torang Siregar, 2025). This stage is the assembly of interactive multimedia by combining all materials such as covers, usage instructions, learning objectives, lesson materials, images, learning videos, and edugames by facilitating 5 learning syntaxes based on Problem Based Learning.

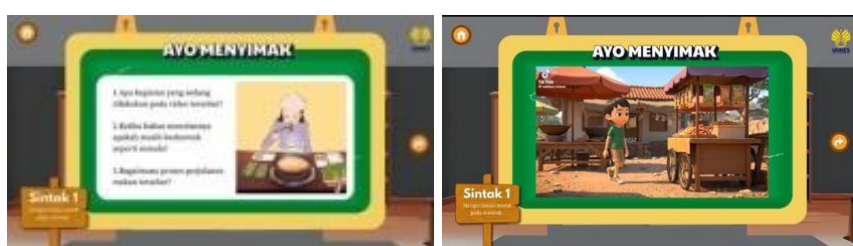


Figure 2.Orienting Students to Problems

Syntax 1 orients students to the problem, the teacher raises the problem, conveys the learning objectives, material topics and apperception (Ekayanti, 2021). In this stage, in lessons one and two, students are given a video stimulus that will spark curiosity and problem-solving by providing several probing questions. Students are challenged to think critically, trained to analyze problems, identify information, and find solutions.



Figure 3.Organizing Students for Learning

The 2nd syntax organizes students to learn, namely forming groups and distributing assignments. In this session, the teacher will organize or focus the students' participation in completing the assigned tasks (Liska et al., 2024).



Figure 4. Guiding Individual or Group Inquiries

In the 3rd syntax guiding individual or group investigations, In this session, the teacher will guide the students to deliver the data that has been obtained from each person to their group members and the teacher will guide them in determining the solution to the case that was given first (Liska et al., 2024). At this stage, the teacher acts as a facilitator, with students working on a student worksheet (LKM) as directed by the teacher. In the second lesson, the teacher conducts a simple experiment, assisted by the students, to test foods containing carbohydrates. This third syntax is one of the strengths of PBL-based interactive multimedia because the teacher facilitates simple experiments that help students broaden their knowledge.



Figure 5. Developing and Presenting Results

The 4th syntax is developing and presenting results, after working on the LKM in lessons 1 and 2, students present the results of their group work confidently in front of the class. In this session, the teacher gives other groups the opportunity to share their assumptions regarding the results of the statements submitted (Liska et al., 2024).



Figure 6. Analyzing and Evaluating Problem Solving

The 5th syntax analyzes and evaluates problem solving, where at this stage reflection is carried out to determine the extent to which students understand the learning and reinforcement of concepts by the teacher by helping to straighten or summarize this material in the human digestive system. The teacher carries out reflection or perfects the learning summary, and guides students in compiling a summary of learning outcomes (Liska et al., 2024). In lesson 1, students were given reinforcement on the digestive tract, digestive glands, types of digestion, and their functions, using engaging visuals. In the second lesson, students received reinforcement on disorders of the digestive system as well as strategies for maintaining its health. Following the completion of the five learning syntaxes, students engaged in a quiz conducted through Word Wall prior to working on the evaluation questions.

The fourth stage of implementation, the stage where the learning products that have been developed begin to be applied in real learning situations (Torang Siregar, 2025). At this stage, they were divided into two groups. The small group test involved six fifth-grade students of SDN Karanganyar Gunung 01, Semarang City, selected based on their varying levels of cognitive ability, namely two students with high cognitive ability, two students

with medium cognitive ability, and two students with moderate cognitive ability. At this stage, the researcher used pretest and posttest questions to identify the initial level of understanding and measure the improvement in learning outcomes after using the product. A large group of 14 students was conducted using a test consisting of pretest and posttest questions. This test was conducted with the aim of drawing conclusions regarding the extent to which science instruction on the human digestive system proved effective when delivered through the Problem-Based Learning-oriented Interactive Multimedia developed by the researcher.

The fifth stage of evaluation, conducted to assess the effectiveness and efficiency of learning products as a whole (Torang Siregar, 2025). The evaluation stage is aimed at identifying the outcomes of teacher and student response questionnaires following the use of PBL-based Interactive Multimedia.

Feasibility of Interactive Multimedia

After the PBL-based Interactive Multimedia is developed, the researcher will then validate the product by involving material validators, such as lecturers in the field of Natural Sciences from the Elementary School Teacher Education department and media expert validators who have suitable qualifications, including lecturers from the Elementary School Teacher Education study program to assess the feasibility of the product. After conducting validation with material and media experts, suggestions are given regarding the product developed by the researcher, so that the researcher can revise the product that has been developed and obtain results.

Table 1. Results of the Material Validator Test

Expert Validation	Percentage	Category
Material	91.07%	Very Worthy

Evaluation by the material experts yielded a score of 86 percent prior to revision, which subsequently rose to 91.01 percent once revisions had been incorporated. This assessment was carried out using a 14-item validation instrument covering three key dimensions: how well the material aligned with the learning objectives, the extent to which it reinforced the overall learning content, and its capacity to provide stimuli that aid comprehension. The experts characterized both the instrument and the accompanying COBQ test items as highly satisfactory, though they recommended expanding the scope of the multimedia content—originally limited to the digestive tract—to also incorporate material on the digestive glands. Among the notable strengths identified was the product's ability to deliver stimuli that support understanding, earning a score of 4 in this regard, given that well-designed stimuli are capable of eliciting the intended response from learners while simultaneously enabling effective feedback that reinforces the learning process (Islamiati Ade, Yanti Fitria, 2024).

Table 2. Media Validator Test Results

Expert Validation	Percentage	Category
Media	91.07%	Very Worthy

The test results from the media validator yielded a score of 91.07%, placing it within the "very appropriate" category. The media validation questionnaire contained 14 questions covering two aspects: content quality and objectives, and instructional aspects. Several suggestions from media experts included adding a logo to the interactive multimedia and including a website URL. Other components were excellent. The advantage of this interactive multimedia is its ease of use by students. Easy-to-use digital learning media allows students to focus on the learning material rather than being distracted by technical complexities (Murdianti, 2024).

In addition, researchers developed teacher and student questionnaires to determine responses after using PBL-based interactive multimedia in learning. These questionnaires were completed by teachers and 20 fifth-grade students at SDN Karanganyar Gunung 01, Semarang City.

Table 3. Results of the Teacher and Student Response Questionnaire for Grade V

Response	Significance	Category
Teacher	100%	Very Worthy
Student	89.37%	Very Worthy

The table shows that the teacher's response to the use of Interactive Multimedia based on Problem Based Learning in the trial was Very Appropriate, with a percentage of 100%, and from 20 students, an average

percentage of 89.37% was obtained with the criteria of Very Appropriate. Taken together, these findings demonstrate that both teachers and students responded favorably to the PBL-based Interactive Multimedia throughout its trial implementation, with feedback consistently falling within the "very appropriate" category. The difference of 10.63% was due to students not being fully able to provide real examples and problems that are relevant to everyday life.

Research that supports this research, namely (Ridwan et al., 2023) entitled "Interactive Multimedia Based on Problem Based Learning on the Material of Characteristics of Living Things for Elementary School Students" Interactive Multimedia Based on Problem Based Learning Science Learning Characteristics of Living Things for Class III SDN Kepatihan Purworejo Academic Year 2021/2022 is suitable for use as an Elementary School learning media (Rohman et al., 2021) entitled "Development of PBL-Based Interactive Multimedia on Parabolic Motion Material to Improve Student Learning Outcomes"

It may therefore be concluded that the PBL-based interactive multimedia developed in this study is appropriate for application in science instruction on the topic of the human digestive system among fifth-grade students at SDN Karanganyar Gunung 01, Semarang City.

Effectiveness of Interactive Multimedia

Determining whether the PBL-based interactive multimedia achieved its intended effectiveness involved a three-pronged statistical approach, encompassing a normality test, a paired-sample t-test, and an N-gain test, with effectiveness gauged through the comparison of students' pretest and posttest scores. Once the data had satisfied the necessary statistical assumptions, further analysis was undertaken to examine the differences in learning outcomes recorded before and after fifth-grade students at SDN Karanganyar Gunung 01, Semarang City, made use of the multimedia in question.

Table 4. Pre-test and Post-test Results

Aspect	Percentage
Pre-test	61.07%
Post-test	85.35%

In the large-group trial stage, pretest and posttest instruments were administered to determine students' initial level of understanding and to gauge the extent to which learning outcomes improved following the use of the product, with results showing an increase of 24.28%.

OnThe normality test was carried out using the Shapiro Wilk test because the subjects or respondents in this study were 14 students where <50 (Moch. Bahak Udin, Arifin, M.Pd.I. Aunillah, 2021).

Table 5. Normality Test Results

Aspect	Significance	Information
Pre-test	0.109	Normal
Post-test	0.249	Normal

The Shapiro-Wilk normality test produced significance values of 0.109 for the pretest and 0.249 for the posttest, both of which exceed the 0.05 threshold, indicating that the distribution of each dataset satisfies the assumption of normality. Since both the pretest and posttest results from the initial trial met this criterion, the data were considered normally distributed and thus eligible for further analysis using the paired-sample t-test, a parametric statistical procedure.

Table 6. Paired Samples t-Test Results

Aspect	Mean	Correlation	Significance 2 (tailed)
Pre-test	61.07	.883	0,000
Post-test	85.35	.883	0,000

Based on the results of the Paired Samples Test, it shows that the average pre-test score of the initial trial is 61.07 and the average post-test score of the initial trial is 85.35 so there is an increase of 24.28. So there is an increase in student learning outcomes after using Interactive Multimedia based on Problem-Based Learning. The Paired Samples Correlation table shows a correlation of 0.883, indicating a positive relationship. Based on the

Paired Samples Test, the significance value (2 tailed) is 0.000 which based on the criteria, is below 0.05. Because the sig value (2-tailed) is 0.000 < 0.05, then H_0 is rejected and H_a is accepted. There is a significant difference before and after using Interactive Multimedia based on Problem Based Learning—furthermore, the effectiveness of improving learning outcomes using N-Gain.

Table 7. N-Gain Test Results

Aspect	Mean	Category
N-Gain Score	0.631	Currently

The N-Gain test conducted during the trial phase produced a mean value of 0.631, a figure that falls within the moderate category according to established interpretive criteria. This outcome reflects the magnitude of improvement observed between the large group's pretest and posttest scores, which likewise corresponds to a moderate level of gain. Taken together, these findings present a layered picture of the product's performance: while the increase in learning outcomes registered at a moderate level, both the material and media validation results pointed to a very adequate standard, a conclusion mirrored in the equally favorable responses given by teachers and students alike.

One reason for the moderate N-gain results is that students are just trying to use interactive learning media, so student learning readiness is one factor that influences the learning outcomes achieved. In line with (Insani et al., 2023) that learning readiness influences the interest and learning style factors of students in achieving improved learning outcomes. Readiness to learn is one of the conditions that students must have, because students who have good readiness to learn will make it easier for them to receive and understand the material (Nuraisyah & Nuryadin, 2022).

Furthermore, the presence of school facilities supportive of interactive multimedia use enabled the researcher to deliver the material on the digestive system with greater ease, given that facilities conducive to student learning tend to make the learning process more enjoyable and effective in achieving its intended objectives (Dila et al., 2024). A similar pattern emerges in the work of (Septianingsih et al., 2023) whose findings revealed a 92.2% positive response among students toward interactive multimedia. Taken together, these results affirm that PBL-based Interactive Multimedia on the topic of the Human Digestive System is effective in enhancing the learning outcomes of fifth-grade students at Karanganyar Gunung 01 Elementary School, Semarang City.

CONCLUSION

Taken as a whole, the findings of this study point toward a single overarching conclusion: the Canva-developed, PBL-based interactive multimedia on the Human Digestive System—featuring learning objectives, instructional content, videos, quizzes, simple experiments, a developer profile, and a bibliography—stands as both a highly suitable and genuinely effective learning resource. Its suitability is borne out by the validation results obtained from subject matter and media experts, complemented by favorable feedback from teachers and students alike. Its effectiveness, meanwhile, is evidenced through multiple lines of data: an upward shift between pretest and posttest scores, a statistically significant difference confirmed through paired-samples t-test analysis, and an N-Gain score falling within the moderate category. On these grounds, the PBL-based interactive multimedia developed in this study may be regarded as a suitable and effective means of improving the learning outcomes of fifth-grade students at SDN Karanganyar Gunung 01, Semarang City.

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