Development of interactive multimedia based on problem-based learning in grade V elementary school

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ABSTRACT

The use of media plays a crucial role in the learning process to achieve learning objectives. However, the utilization of instructional media is still not optimal because it often overlooks the characteristics and needs of learners. Leveraging digital technology can be one of the solutions to address this issue. This research aims to produce interactive multimedia based on problem-based learning on the human digestive system in class V elementary school. The research method used is Research and Development (R&D) with research procedures using the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation). The subjects used were class V students for the 2023/2024 academic year, totaling 20 students. The data collection techniques used were interviews, validation sheets, and questionnaires. The data obtained was analyzed quantitatively and descriptively. The results of research through a validation process by material experts, media experts, and practitioners show that interactive multimedia based on problem-based learning is very suitable for use in the learning process in elementary schools. The results of field trials show that interactive multimedia based on problem-based learning is very practical to use as a learning medium to convey material on the human digestive system in elementary schools. The conclusion of this research is that the resulting PBL-based interactive multimedia product is very feasible and practical for learning in class V elementary schools.

1. Introduction

Entering the 21st century, the development of information, technology, and knowledge has experienced rapid growth, especially in the field of education. Digital technology is now being utilized in educational institutions as a supportive tool for learning [1]. It has become a significant demand for educators to develop mastery of technology and learning media skills. Children encounter difficulties in the learning process without assistance or the provision of objects used to represent the intended material in the learning materials [2]. The use of media plays a crucial role in elementary school children's learning, serving as a mediator in delivering learning materials. In order to achieve learning objectives, learning media in elementary schools must be tailored to the characteristics of students, especially in primary schools [3]. Observing the situation in the field, the use of learning media has not yet ideally integrated into the learning process [4]. During the delivery of materials, teachers often overlook the characteristics of their students and assume that simply relying on books and teacher explanations will make students understand the material. In reality, students experience boredom during learning due to less engaging lessons, making it difficult for them to understand the taught concepts and affecting learning outcomes. This boredom is caused by teachers' inadequate provision of opportunities for. Furthermore, when selecting instructional media, it is also necessary to tailor them to the needs of the learners. Education cannot be separated from the curriculum that has been

designed, organized, and determined [5]. The Merdeka Curriculum is a curriculum whose implementation will be adjusted according to the needs, environmental conditions, and competency achievements that are the main goals [6]. One of the skills expected to be possessed by learners in the Merdeka Curriculum is critical thinking skills. Learning activities in the modern era, such as today, not only teach learners to understand various fields of knowledge but also teach them to think critically, systematically, and be able to solve various problems [7]. It is crucial for learners to be trained in critical thinking skills to solve problems and easily adapt to life in the future. The low level of critical thinking among Indonesian learners, based on the Programme for International Student Assessment 2018 data, necessitates the training of critical thinking skills. Critical thinking is a thinking habit that should be instilled from an early age, and every elementary school learner has the potential and ability to become a proficient critical thinker [8]. To develop learners' thinking skills, teachers can implement learning processes that emphasize direct experience. In the Merdeka Curriculum, learning through direct experience can be incorporated through Natural Sciences and Social Sciences (IPAS) learning.

To create effective, enjoyable, student-centered learning that also trains students' critical thinking skills in solving problems, teachers are required to be skilled in innovation and use creative learning media according to students' characteristics and needs [9]. One effort that can be made to address existing problems is the development of learning media that utilizes digital technology [10]. One such effort is interactive multimedia oriented towards the Problem-Based Learning (PBL) model. Interactive Multimedia is one of the learning media that combines two or more elements consisting of text, images, graphics, photos, audio, video, and animations that are integrated [11]. Interactive Multimedia has characteristics that can directly involve students in its operation during the learning process, making students more active in learning [12]. Through the use of interactive multimedia in learning, students can easily understand abstract concepts more concretely [13]. This interactive multimedia can be developed with the assistance of Articulate Storyline 3, which is one of the software used in creating interactive learning media. Through the support of multimedia formats such as video, images, and timelines, we can create good presentations without having to spend much time and effort [14]. Furthermore, the development of this interactive multimedia can be oriented towards a learning model that is suitable for students' characteristics and needs. Teachers should also use a more innovative and creative learning model, especially in the IPAS material learning process, which is complex and requires relevant learning methods. One of the recommended learning models to be applied in learning in the Merdeka Curriculum is the Problem-Based Learning (PBL) model. PBL learning can create student-centered learning that prioritizes the process in learning [15]. The Problem-Based Learning (PBL) model can enhance students' critical thinking skills to solve real problems in students' lives, increase students' activeness in seeking and exploring information to solve problems both individually and in groups [16].

Research on the use of interactive media has been conducted by previous researchers, such as Ridwan & Zuhdi [17], who discussed Articulate Storyline learning media Using the Think Pair Share Model in Grade IV Elementary School. In addition, research on the use of the Problem-Based Learning (PBL) model has been conducted by previous researchers, such as Putu, *et al*. [18], who discussed E-Comic media based on Problem-Based Learning. Although research on the development of interactive media and research on the development of the Problem-Based Learning model has been widely conducted, research on development that combines or collaborates both has not been done before. The aim of this research is to produce interactive multimedia oriented towards the Problem-Based Learning model that is valid and suitable for use in the human digestive system material in Grade V Elementary School. The implication of the development research of interactive multimedia oriented towards the Problem-Based Learning model is to encourage teachers to be more creative in developing media by utilizing technological advances to create quality education. Furthermore, through this media, students' interest can be stimulated, their active participation encouraged, and their critical thinking skills trained in learning.

2. Method

This research is a type of Research and Development (R&D) study. The research model used is the ADDIE model, consisting of several stages: analysis, design, development, implementation, and evaluation [19]. The Analysis stage involves interviewing fifth-grade teachers to obtain needs analysis information, which includes analyzing the characteristics of students, analyzing the material, and analyzing the needs of students and teachers. The Design stage involves planning the creation of media

with the selection of media and material, followed by designing the layout of the produced product, which includes flowcharts and storyboard layouts. The Development stage involves creating and validating the product. After the product is completed and validated by experts, the Implementation stage involves product testing, including small and large group testing. The Evaluation stage involves formative evaluation aimed at assessing the developed learning media. The subjects selected for this study were 20 fifth-grade students who supported data collection at one of the State Elementary Schools in the Tanjung Batu sub-district, Ogan Ilir district. The data collection techniques used by the researcher include interviews, validation sheets, and questionnaires. The types of data used are qualitative and quantitative data. Qualitative data are obtained from data collection techniques such as interviews with fifth-grade teachers to obtain needs analysis data. Then, quantitative data are obtained from the scores of validation sheets assessed by expert validators and practicality questionnaires given to students. The validation sheets are presented in Likert scale 1-5, and the student questionnaires are presented in Guttman scale. The results of the validation sheets and questionnaires are presented in tabular form, and the average values are calculated using the equation:

$$P = \frac{\sum R}{N} \times 100 \tag{1}$$

P is Final score, $\sum R$ is Sum of assessment scores, N is total maximum scores. The final score obtained is then converted into validity categories in the following Table 1.

Table 1.   Validity Categories

Percentage (%)	Validation Criteria
76-100	Valid (no revision needed)
56-75	Fairly Valid (no revision needed)
40-55	Less Valid (revision required)
0-39	Not Valid (revision required)

The final score obtained is then converted into practicality categories in the following Table 2.

Table 2.   Practicality Categories

Percentage (%)	Validation Criteria
0-20	Not Practical
21-60	Less Practical
61-80	Practical
81-100	Very Practical

3. Results and Discussion

The development of interactive multimedia based on problem-based learning for the human digestive system material in elementary school was conducted in 5 stages: analysis, design, analysis was conducted to determine the needs for developing interactive multimedia based on problem-based learning. This involved identifying the characteristics of students, analyzing the material, and assessing the needs of both students and teachers.

3.1. Analysis of Student Characteristics

During the analysis of student characteristics, it was found that students are interested in things that are concrete in nature. This is in line with Piaget's theory, where fifth-grade elementary school students, who are usually aged 6-12 years old, fall into the concrete operational stage, meaning their cognitive development is still closely related to concrete objects that can be perceived by the senses [20]. It is also known that students are very enthusiastic, interested, and happy when they receive or try new things, enjoy using technology, enjoy playing, and quickly get bored. This is consistent with the opinion of Thangjai & Worapun that elementary school students have characteristics such as getting bored quickly, being meaning-oriented, enjoying discovering things, liking concrete activities, being more egocentric, imaginative, and imitative [21].

3.2. Analysis of Material

In the material analysis phase, it was found that one of the IPAS lessons that students find difficult to understand is the human digestive system material because it is abstract and extensive, making it difficult to explain without the use of instructional media. According to Saputra *et al*. [22], the human digestive system material is difficult for students to understand because it contains abstract concepts

that make students' understanding of this concept still suboptimal. In this material analysis, researchers also assessed the achievement and learning objectives of the human digestive system material.

3.3. Analysis of Teacher and Student Needs

In the analysis of the needs of students and teachers, it was found that students are passive in the learning process and have not yet developed good critical thinking skills. The use of instructional media and the implementation of instructional models used by teachers in the classroom have not been able to accommodate all the characteristics and needs of students, especially in making students interested, active, and training students' critical thinking skills. According to Rahmadayanti & Hartoyo [23], in choosing instructional media, it is also important to adjust to the characteristics and needs of students. Based on the above analysis results, researchers aim to develop an interactive multimedia articulate storyline based on problem-based learning in fifth-grade elementary school, particularly on the human digestive system material according to the characteristics and needs of students. This problem-based learning-based interactive multimedia is expected to attract interest, encourage active student participation, and train critical thinking in learning.

3.4. Design Stage

The second stage is the design stage, where the researcher designs the product, including selecting the type of media, choosing the material, and designing the framework of the media to be developed. The researcher chose Articulate Storyline as the tool for developing interactive multimedia based on PBL. Articulate Storyline is equipped with more features that can increase student interaction, and slides can be designed attractively to provide stimulus for understanding to students [24]. After that, the researcher selected the human digestive system material in the IPAS subject because of its abstract nature, requiring learning media. The human digestive system material is difficult for students to understand due to its abstract concepts, hindering optimal understanding [25]. After selecting the application and material, the researcher then designed the framework of the interactive multimedia based on PBL in the form of a flowchart, which can be seen in Fig. 1.
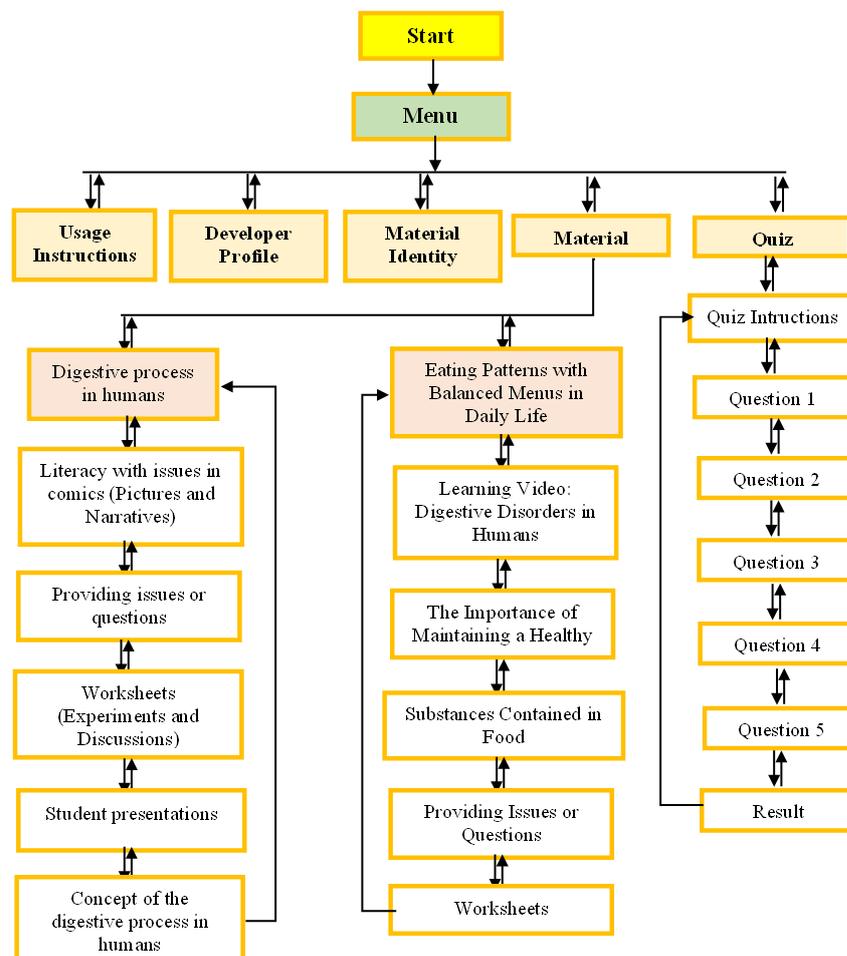

Fig. 1. Flowchart of Problem-Based Learning Based Interactive Multimedia

3.3. Development Stage

The third stage is the development stage, where the activity involves creating and validating the developed product. In this stage, the researcher creates interactive multimedia based on PBL that is adapted to the design made in the previous stage. After the product is completed, the next step is to validate the product by subject matter experts, media experts, and practitioners. Each validator will provide feedback and suggestions for improving the product to become a prototype suitable for testing. The results of the expert validation questionnaire assessment can be seen in the following Table 3.

Table 3. Validation Results by Experts

Assessment Component	Obtained Score	Maximum Score	Percentage (%)	Category
Matter Expert	78	80	97.5	Very Valid
Media Expert	76	80	95	Very Valid
Practitioner Expert	89	90	98.8	Very Valid
Total	243	250	97.2	Very Valid

The results of the assessment by the validators show that the problem-based learning-based interactive multimedia obtained a score percentage of 97.2%, which falls into the category of "Very Valid." The validity of the developed product was achieved with several improvements or inputs from the validators. The material validator suggested improvements, such as adding learning outcomes (LO) and learning objective flow (LOF) to the material identity. This is in line with Gunawan's [26] opinion stating that "Learning outcomes, learning objectives, and learning goal references are three key elements that are interrelated and important. These three elements provide a clear and structured framework in designing, implementing, and evaluating the learning process." Additionally, the material validator suggested adding instructional videos, including an activity to choose healthy and unhealthy foods, and improving the last question in item three of the E-LKPD (Healthy eating patterns with a balanced menu in daily life), as well as improving the sentence structure in the activity steps of the E-LKPD (Human digestive process), which aligns with Gunawan & Asnil's [27] assertion that "Learning media should pay attention to the correct use of language rules and language ease for understanding." Furthermore, the media validator suggested improvements, such as using simple yet attention-grabbing sentences in the title of activity 2 in the E-LKPD (Human digestive process) and avoiding repetition of activity 2 titles in subsequent sheets. Additionally, the media validator also suggested providing students with the opportunity to repeat evaluations before reviewing the results, which is also in line with Olson, *et al* [27] statement that remedial is an educational service provided to students to improve their learning achievements to reach the set completion criteria. Based on the results of the expert validation, it can be concluded that problem-based learning-based interactive multimedia is highly suitable for use in the learning process. This research result is relevant to the studies conducted by Sari & Fauzan [28] and Styowati & Utami [29], which showed that interactive learning media based on Problem-Based Learning is suitable for use in learning activities. After obtaining the assessment results from the expert validators and making improvements to the learning media, the final product of problem-based learning-based interactive multimedia can be seen in Fig. 2.

Fig. 2. The final product is an interactive multimedia based on Problem Based Learning (PBL).

3.4. Implementation Stage

The fourth stage conducted by the researcher is the implementation stage. The product that has been validated and improved by the researcher according to the validator's suggestions will be piloted with the students to obtain results in the form of student responses. In this stage, the researcher conducted a trial of the problem-based learning-based interactive multimedia with fifth-grade students at one of the public elementary schools in the Tanjung Batu district, Ogan Ilir regency. This trial was divided into two stages: small group testing and large group testing. The results of the trial can be seen in the following Table 4. The results of the small group trial, involving 4 students, showed a score percentage of 100%, categorizing it as "Very Practical." Meanwhile, the large group trial, involving 16 students, obtained a score percentage of 96.87%, also falling into the "Very Practical" category. The overall average score from both trials was 97.5%, categorized as "Very Practical." These findings are consistent with the research conducted by Putu, *et al.* [18] titled "Interactive E-Comic Based on Problem-Based Learning for the Human Digestive System Material in Grade V Elementary School Science Subjects," which obtained a student response rate of 95.95% categorized as very practical. It is also in line with the research by Wedayanti & Wiarta [30] titled "Interactive Multimedia Based on Problem-Based Learning for Mathematics Material in Grade IV Elementary School," which achieved a student response rate of 93.60%, also categorized as very practical.

Table 4. Results of student trials

Assessment Component	Total Score	Percentage (%)	Category
Trial Phase I	40	100	Very Practical
Trial Phase II	155	96.87	Very Practical
Total	195	97.5	Very Practical

Based on the researcher's observations, both the small group and large group trials demonstrated smooth and effective learning processes using PBL-based interactive multimedia. The learning sessions proceeded orderly, and students did not encounter difficulties in using the media. When faced with challenges, they immediately asked questions or sought assistance. The students were observed to engage well in solving problems during the learning process, conducting experiments, engaging in discussions, and seeking answers collaboratively. Problem-focused learning that involves finding solutions can train students' critical thinking skills [16]. Moreover, they showed interest and enthusiasm in using the media and actively participated in the learning process. This is supported by the student response results, indicating that most students were interested, happy, and actively engaged in using the media. These findings are consistent with the idea that interactive multimedia tailored to students' needs can make learning activities more engaging, interactive, and enjoyable, thereby fostering students' enthusiasm for learning [27]. Additionally, interactive multimedia has the characteristic of directly involving students in the learning process, making them more active learners [31].

However, during the large group trial, there were some issues with using the media via smartphones, as there were signal disruptions causing delays in media response. However, this issue was short-lived as the signal returned to normal, and the media resumed functioning properly. Additionally, two students were found to be unable to use laptops/smartphones, but this issue was manageable and did not affect the learning process as the learning was conducted in groups, allowing them to be assisted by their groupmates. It's common for each learning media to have its own strengths and weaknesses [13]. Furthermore, in the second trial, some students were found to be less focused on the learning process. This behavior was attributed to the larger number of students in the second trial compared to the first, which resulted in less conducive learning conditions due to occasional chatting with their neighbors. However, despite a couple of students occasionally chatting, they remained attentive and enthusiastic in the learning process, being able to answer questions when asked. This demonstrates that PBL-based interactive multimedia can capture students' interest, motivation, and aid in understanding the learning material.

3.5. Evaluation Phase

In this phase, formative evaluation is conducted with the aim of assessing the developed learning media. The evaluation method used in this study is formative evaluation, which involves assessments from experts including subject matter experts, media experts, and practitioners. Additionally, evaluations are conducted from students through small group and large group trials. This formative evaluation describes the quality results of the developed product, indicating whether improvements were made or not [32]. The evaluation stage is also interpreted as the final revision stage of the product

developed by researchers, based on input, suggestions, criticisms received from expert validators, students, and researcher notes during the product implementation phase. This stage is carried out to ensure that the developed product can effectively benefit learning in schools [33].

4. Conclusion

Based on the findings presented in the previous research, it can be concluded that the results of the developed product, which is interactive multimedia oriented towards the Problem Based Learning model, are highly valid and very suitable for use in teaching the human digestive system in fifth-grade elementary school. The implications of the development of interactive multimedia oriented towards the Problem Based Learning model are to encourage teachers to be more creative in developing media by utilizing technological advancements to create quality education. Additionally, through this media, it can attract interest, encourage active student involvement, and train critical thinking in learning.

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