

Development of Digital-Based Learning Devices Using the Problem-Based Learning Model to Improve Learning Outcomes

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ABSTRACT: This study aims to develop digital-based learning devices on the topic of the human excretory system that are valid, practical, and effective in improving students' learning outcomes. This research is an experimental study conducted at SMP Negeri 22 Balikpapan using the ADDIE model. The implementation of the developed digital-based learning devices will be carried out in classes VIII C and VIII D at SMP Negeri 22 Balikpapan in the 2024/2025 academic year. The data collection techniques used in this study include expert validation, observation, tests, questionnaires, and interviews. The research results indicate that: (1) The validity of the digital-based learning devices from the material aspect is 73%, categorized as valid. The validity from the media aspect is 92%, categorized as highly valid. The validity from the language aspect is 92%, categorized as valid. (2) The students' questionnaire responses regarding the practicality of the module show a score of 88%, categorized as highly practical. (3) The effectiveness of the module in improving students' learning outcomes, based on normality and homogeneity tests, shows that all classes in the pretest and posttest have a significance value (sig.) > 0.05, indicating that the data is normally distributed and homogeneous. Based on the Independent Sample T-Test, the significance value is 0.000, meaning Ho is rejected, and Ha is accepted. The n-gain score is 0.66, with a percentage of 66%, categorized as moderately effective. Thus, it can be concluded that the development of digital-based learning devices is effective in improving students' learning outcomes on the human excretory system material at SMP Negeri 22 Balikpapan.

KEYWORDS: Digital-Based Learning Devices, Problem-Based Learning, Learning Outcomes, Excretory System, Smart Apps Creator

I. INTRODUCTION

Education is one of the main foundations for the development of a country. Education plays an important role in the process of improving the quality of human resources, reducing social disparities, and advancing a nation's economy. Efforts to improve the quality of education require various breakthroughs, both in curriculum development, increasing learning innovation, fulfilling educational facilities, and utilizing technology to provide high-quality education for the entire community. The government has made efforts to improve the quality of education. Currently, the education system in Indonesia has experienced significant development, one of which is the development of a curriculum known as the independent curriculum. The independent curriculum focuses on strengthening student independence and facilitating student-centered learning by emphasizing empowerment and development of 21st-century skills, especially in Natural Sciences (IPA) learning.Natural Science (IPA) learning in schools has a crucial role in shaping students' understanding of nature and the phenomena that occur in it. Through IPA learning, students can develop scientific attitudes such as curiosity, honesty, objectivity, criticality, openness, discipline, and thoroughness. Students are also expected to be able to ask questions about scientific phenomena, conduct experiments, record and present the results of investigations, draw conclusions, and report the results of investigations orally or in writing to answer these questions (Sujana, 2013).

In the SMP Negeri or State Junior High School curriculum, the excretory system material is one of the topics that must be mastered because it is directly related to everyday life. A deep understanding of the excretory system allows students to understand how the body excretes metabolic waste and the importance of maintaining the health of the excretory organs. However, in reality, many students still have difficulty understanding this concept. One of the main challenges faced in various schools is the low analytical skills of students in solving problems related to scientific phenomena, especially in more complex materials such as the excretory system.

This leads to students' inability to connect theory with practice in their lives. Many students are only able to memorize the functions of the excretory organs without really understanding how these processes occur in the body or what impact they have on their health (Simorangkir and Napitupulu, 2020). Based on the results of interviews with IPA teachers at schools that have implemented the Merdeka Curriculum, namely SMP Negeri 3 Balikpapan, SMP Negeri 19 Balikpapan, SMP Negeri 5 Balikpapan, SMP Negeri 7 Balikpapan, and SMP Negeri 22 Balikpapan, several obstacles were found that were faced by teachers when carrying out learning activities. One of the main obstacles found was the lack of understanding of teachers in using various types of learning platforms or applications. As a result, teachers more often rely on textbooks or PowerPoint presentations during teaching, which tend to contain long texts and are less interesting to students. This causes a lack of student involvement in the learning process because the material presented is unable to arouse their curiosity. In addition, many teachers still have difficulty in compiling learning objectives, teaching modules, teaching materials, Student Worksheets (LKPD), and learning outcome test instruments that are in accordance with the Merdeka Curriculum standards. This problem is caused by the challenges of adapting to significant changes from Curriculum 13 to the Merdeka Curriculum, which affects the way teachers compile and deliver learning tools. Another challenge faced is the lack of utilization of technology-based media, because many teachers do not have the skills to use the available learning applications or platforms. In fact, the use of digital devices has been proven to increase student engagement in learning (Nasution, et al., 2023).

Based on the results of observations conducted in one of the VIII grades at SMP Negeri 22 Balikpapan, it was found that the teaching and learning process in the IPA subject was still not running optimally. During the learning process, several students appeared to show passive behavior such as laying their heads on the table, looking unfocused, and not showing interest in the material being presented. Several students also appeared to have difficulty answering questions given by the teacher, were unable to express their opinions, and showed signs of not understanding the explanation given. This condition indicates problems both in terms of learning motivation and the learning approach used. In addition, another significant obstacle was also found, namely, the minimal use of learning media by teachers in teaching science materials in class. In fact, supporting facilities such as WiFi networks and Chromebook devices are already available in schools and can be used to support technology-based learning. Unfortunately, these facilities have not been utilized optimally. Teachers tend to still use lecture methods and conventional teaching materials, such as textbooks, which are less able to attract students' attention. This is ironic considering that the availability of technology should be able to open up opportunities for teachers to develop more interactive, visual, and contextual learning, so that it can increase student involvement and understanding of the material being taught.

Efforts to improve the quality of learning in schools can be done by encouraging teachers to design learning tools that can motivate and encourage students to be active in the learning process. Learning tools that are designed systematically and contextually, such as learning objective flows, teaching modules, teaching materials, student worksheets, and assessment instruments can help students understand the material better because they are following their learning needs. This is in line with Rahayu (2022), who stated that effective learning tools can increase student motivation, help them understand the material better, and build the skills needed for academic success. Selecting an appropriate learning model is one of the key factors in improving the quality of learning in schools. Student-centered learning models, such as Problem-Based Learning (PBL), have been proven effective in increasing student engagement and understanding of the material being taught. Through the PBL approach, students are encouraged to actively explore authentic problems, think critically, and develop problem-solving and decision-making skills. The application of the PBL model provides ample space for students to engage in learning actively and independently. This model also allows students to build their own knowledge through collaborative activities and reflection, so that the learning process becomes more meaningful and has a long-term impact (Sagala and Tambunan, 2022).

The rapid development of information and communication technology in the current digital era has significantly impacted various fields, including the world of education. Digital transformation requires educational institutions to adapt and integrate technology into the learning process to be more effective, efficient, and relevant to the demands of the times. One crucial form of adaptation is the preparation and utilization of digital-based learning tools as a strategic effort in presenting learning innovations that support the achievement of 21st-century competencies. Digital-based learning devices are a collection of learning components such as digital teaching modules, electronic teaching materials, interactive LKPD, multimedia-based learning media, to digital evaluation systems, which are systematically arranged and integrated in the educational technology ecosystem. These devices are designed to meet the needs of today's students who tend to have the characteristics of visual, independent learners and are accustomed to the digital environment.

According to Kurniawan & Prasetyo (2022), digital devices can increase students' interest in learning because they present content interactively and visually, which can stimulate students' curiosity and active involvement in the learning process. In relation to the background description, observation results, and findings from the questionnaire distributed to teachers, it is known that there are still various obstacles in the implementation of learning that have an impact on the low quality of student learning outcomes, especially at the junior high school level. Responding to these problems, an innovation is needed in the form of developing learning tools that are able to integrate digital technology with a student-centered learning approach. Therefore, researchers are interested in developing digital-based learning tools with the problem-based learning model to improve student learning outcomes in the human excretory system material at SMP Negeri 22 Balikpapan.

II. METHOD

The type of research used in this study is the Research and Development (R&D) method with the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) development model. Data collection techniques in this study were carried out using observation sheets, interviews, questionnaires, and tests (pre-test and post-test). Researchers conducted observations to directly witness and examine the problems that occurred at SMP Negeri 22 Balikpapan. Interviews were conducted to identify problems faced by teachers when implementing science learning activities in class VIII. Validity testing in this study was carried out by distributing questionnaires to media experts, language experts, material experts, and learning device experts in order to obtain an assessment of the digital-based learning devices developed. A practicality test was also conducted through questionnaires given to teachers and students to determine the level of practicality of digital-based learning devices to measure the extent to which digital-based learning devices can improve student learning outcomes on human excretory system material in class VIII of SMP Negeri 22 Balikpapan.

III. RESULTS AND DISCUSSION

This research produces digital-based learning tools that aim to improve the learning outcomes of grade VIII students on the excretory system material. This development research was conducted in the Odd Semester of the 2024/2025 Academic Year using the ADDIE (Analysis, Design, Development, Implementation, Evaluation) development model. This model applies a systematic approach in designing and developing learning products. This model consists of five main interrelated stages. The first stage in the ADDIE model is a needs analysis, which was conducted in five schools, namely SMP Negeri 3 Balikpapan, SMP Negeri 5 Balikpapan, SMP Negeri 7 Balikpapan, SMP Negeri 19 Balikpapan, and SMP Negeri 22 Balikpapan. Based on the results of the interviews, it was found that both teachers and students expected interesting and interactive learning tools to increase students' active participation in the learning process. This expectation arose because the media previously used were still limited, such as less interactive PowerPoint, and the use of images and concrete media that were less interesting to students.

The second stage is design, which includes determining the media and making initial designs in the form of screen designs, flowcharts, and storyboards. The product developed in this study is a digital-based learning device using Smart Apps Creator 3 software. At this stage, the researcher designs the media concept as a whole, including the background, theme, layout, content, color scheme, and font style. The visual design is supported by the Canva application to simplify the design process and produce an attractive and consistent media appearance. The third stage is to develop digital-based learning devices according to the design that was designed in the previous stage. After the digital-based learning devices are developed, validation tests are carried out by media experts, language experts, material experts, and learning device experts. The results of the validation test by media experts and language experts obtained a percentage of 92% with the category "very valid", and the results of the validation test by material experts obtained a percentage of 73% with the category "valid". Meanwhile, the results of the expert validation test of the learning device showed the following percentages: learning objective flow of 75% with a valid category, teaching modules of 83%, teaching materials of 80%, student worksheets of 96%, evaluation of 86% which is included in the very valid category. In addition to the expert validation test, a small-scale test was conducted by 10 students to determine student responses to the product developed before being tested on a large scale. The image of the product developed can be seen in Figures 1.1 and 1.2 below:



Figure 1.1 Initial View



Figure 1.2 Main Menu

The fourth stage in this study is implementation, where the developed product is applied in science learning for class VIII at SMP Negeri 22 Balikpapan. Class VIII-C is used as an experimental class that uses digital learning devices, while Class VIII-D is a control class that does not use them. A pre-test and post-test were conducted in both classes to measure the device's effectiveness. The pre-test and post-test scores in the control class and experimental class were then analyzed to see if there was an increase in learning outcomes.

Table 1. Normality Test				
Class	Sig	Category		
Control Class Pre-Test	0.354	Normal		
Control Class Post-Test	0.282	Normal		
Experiment Class Pre-Test	0.172	Normal		
Experiment Class				
Post-Test	0.064	Normal		

A normality test was conducted to determine whether the pre-test and post-test data were normally distributed, using the Shapiro-Wilk test. In the experimental class, the significance values for the pre-test and post-test were both greater than 0.05. Similar things were also found in the control class, where the significance values of both tests also exceeded 0.05. Based on the testing criteria, if the significance value is greater than 0.05, then the data is considered normally distributed. Thus, it can be concluded that the pre-test and post-test data from both experimental and control groups meet the normality assumptions.

	Sig	Category
Based on	0.093	Homogen
Mean		
Based on	0.108	Homogen
Median		

Based on the results of the homogeneity test, the Sig value obtained. Based On Mean of learning outcomes was 0.093, which is greater than 0.05. Therefore, it can be concluded that the variance of post-test learning outcome data for the experimental class and control class is homogeneous.

	Sig	Category
Equal variances assumed	0.000	Significant
Equal variances not assumed	0.000	Significant

 Table 3. Independent Sample T Test

Based on the results of the normality test and homogeneity test, the data are normally distributed and have homogeneous variance. Therefore, the independent sample t-test can be used to analyze the difference in posttest scores between the experimental class and the control class. Based on the results of the independent sample t-test in the table above, the Sig. (2-tailed) value is 0.000 < 0.05. This indicates that *Ho* is rejected and *Ha* is accepted, which means that there is a significant difference in learning outcomes between the experimental class and the control class.

Table 4. N-Gain Test

	Averag e Pre- Test	Averag e Post- Test	N- Gain
Contr ol Class	44.67	56.44	0.20
Expe riment Class	50.26	82.23	0.66

Based on the table above, the results of the N-Gain test of the experimental class showed a percentage of 66%, which is included in the category of "quite effective." Meanwhile, the results of the N-Gain test of the control class showed a percentage of 20%, which is included in the category of "ineffective". This shows that the use of digital-based learning devices in IPA learning is more effective in improving student learning outcomes in the excretory system material.

IV. CONCLUSION AND SUGGESTIONS

Based on the research results, it can be concluded that digital-based learning devices developed based on the ADDIE model stages obtained a media validation percentage of 92%, which is categorized as very valid. Validation by language experts was also 92%, categorized as very valid, while validation by material experts was 73%, which was categorized as valid. Meanwhile, the results of the validation test from learning device experts showed the following percentages: learning objective flow of 75% with a valid category, teaching modules of 83%, teaching materials of 80%, student worksheets of 96%, evaluations of 86%, which are included in the very valid category. The practicality level of digital-based learning devices is determined through teacher and student response questionnaires. The teacher response questionnaire shows a percentage of 86%, which is categorized as very practical, while the student response questionnaire shows a percentage of 88%, which is also categorized as very practical. The results of the effectiveness of digital-based learning devices based on the results of the N-Gain test of the experimental class using the developed digital-based learning devices obtained a percentage of 66%, with a fairly effective category. Therefore, it can be concluded that the use of digital-based learning devices using the Problem-Based Learning model can improve student learning outcomes in the excretion system material for grade 8 at SMP Negeri 22 Balikpapan.Suggestions for further researchers who intend to develop digital-based learning tools include continuing the development of digital-based learning tools for other science materials.

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