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Development of Interactive Multimedia Articulate Storyline Based on Problem-Based Learning in Science Subjects

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A B S T R A C T
The purpose of the study was to determine the level of feasibility of interactive multimedia articulate storyline based on PBL; to determine the level of practicality of interactive multimedia articulate storyline based on PBL; to determine the effectiveness of interactive multimedia articulate storyline based on PBL. The research and development method were research and development. The location of the study was SMPN 1 Lubuk Pakam IPA, Human Movement System material, class VIII. The results of the study showed: (1) interactive multimedia articulate storyline based on PBL is very valid; (2) interactive multimedia articulate storyline based on PBL is very practical; (3) the use of interactive multimedia articulate storyline based on PBL is more effective in improving student learning outcomes compared to PowerPoint based on PBL. The average score of students taught with interactive multimedia Articulate Storyline was 87, while with PowerPoint media it was 78.

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INTRODUCTION

The use of technology has had a revolutionary impact on the world of education, changing paradigms and expanding the accessibility of learning. The integration of technology in education opens the door to a more dynamic, interactive, and inclusive learning experience. One of the main positive impacts is the increased accessibility of information, where students can easily access a variety of learning resources from all over the world (Abdulrahaman et al., 2020).

The use of technology-based learning media, such as web platforms and interactive applications, has become a significant breakthrough in the world of modern education (Alti et al., 2022). One prominent example is the use of Articulate Storyline, an interactive multimedia development platform that allows teachers to create engaging and leveraged learning experiences (Muhammad et al., 2022). Articulate Storyline utilizes features such as text, images, audio, and video to present learning content dynamically (Husna & Fajar, 2022).

In the context of education, Articulate Storyline has proven its effectiveness as an innovative learning tool. This platform allows learning material creators to create interactive modules that can be customized to the needs of the curriculum and certain levels of difficulty. The main advantage of Articulate Storyline lies in its flexibility, allowing users to create adaptive and engaging learning experiences (Nissa et al., 2021).The use of Articulate Storyline in learning has brought about positive changes in teaching styles. Interactivity in learning modules can increase student engagement to actively participate in the learning process (Agustina, Irhasyuarna, & Sauqina, 2022). In addition, this platform allows for efficient formative assessment to monitor student progress. In addition, it also provides easy accessibility because learning modules can be accessed online (Sindu et al., 2021).

The use of Articulate Storyline as a technology-based learning medium makes a positive contribution to increasing the effectiveness of learning, adjusting students' learning styles, and creating a more interesting and inclusive learning environment (Rachmavita, 2020).

Learning outcomes at the junior high school level in this subject have a central role in assessing students' understanding of scientific concepts. Science as a discipline opens a window of knowledge about the universe, natural phenomena, and basic principles that explain the existence of everything. Science teaching in schools aims to form a solid understanding and scientific thinking skills in students. However, the phenomenon shows that some students have difficulty in achieving a deep understanding of science material (Dwipayana et al., 2020).

In the context of the use of multimedia by science teachers in junior high schools in Indonesia, data shows that its use is still less than 30%; this means that more than 70% of teachers in Indonesia still use conventional media in carrying out the science learning process in Indonesia (Ministry of National Education and Culture, 2020).

In the Strategic Plan of the Directorate General of Teachers and Education Personnel for 2020-2024, the use of interactive multimedia is seen as one of the strategic solutions to improve students' understanding of various science

materials. This can be a learning method that includes the use of interactive multimedia in the science teaching process at the junior high school level (Ministry of National Education and Culture, 2020). Research related to the use of multimedia-based learning media in science subjects at the junior high school level has been carried out quite a lot and has been spread across various scientific literature (Abdulrahaman et al., 2020).

Various studies have shown that the application of interactive multimedia technology in learning has succeeded in improving student learning outcomes. Developing an interesting learning process requires an approach that utilizes technology and innovation, such as the use of platforms such as Articulate Storyline (Sindu et al., 2021). Articulate Storyline opens the door to creating dynamic and interactive learning experiences. By utilizing multimedia features such as text, images, audio, and video, the development of science learning materials can be adjusted to the characteristics of junior high school students. The interactivity embedded in the learning modules not only creates a fun learning experience but also motivates students to be actively involved in exploring science concepts (Hadza, C., Sesrita, A., & Suherman, I., 2020).

Research on the development of interactive multimedia based on these platforms can contribute to improving the quality of learning and student learning outcomes (Huda & Ardi, 2021). Articulate Storyline has advantages that distinguish it from other multimedia development platforms, especially in the context of education (Alfan, 2023). One of its advantages lies in its high flexibility in creating interesting interactive content (Nadzif, M., Irhasyuarna, Y., & Sauqina, S. 2022). Articulate Storyline allows users to create rich learning experiences with various multimedia elements such as audio, video, images, and animations that can be customized according to learning needs (Husna & Fajar, 2022).

Through the use of Articulate Storyline, this study aims to create more interactive learning media in science learning because it will include text, audio, images, and evaluations. The flexibility of Articulate Storyline in publishing to various formats will allow students to access materials anytime and anywhere. Thus, the thesis research entitled "Development of Interactive Multimedia Articulate Storyline Based on PBL in Science Subjects at SMPN 1 Lubuk Pakam" was conducted to overcome the problems of science learning at SMPN 1 Lubuk Pakam.

LITERATURE REVIEW

Science Learning (Natural Sciences)

According to the Ministry of Education and Culture, in general, natural sciences (IPA) in junior high schools/Islamic junior high schools include the fields of study of energy and its changes, space, earth, living things and life processes, and the properties of matter, which actually play a very important role in helping students understand natural phenomena. The objectives of integrated science learning, according to Wulandari et al. (2020), are to increase the efficiency and effectiveness of learning, interest, and motivation so that basic competencies can be achieved.

In this study, the author limits the topic to the material on the Human Movement System with Basic Competencies, analyzing the organs that play a role in the human movement system and understanding various disorders of the human movement system. With the following learning objectives: (1) distinguishing the types and names of bones in the human movement system; (2) explaining the movement of joints and muscles in the human movement system; and (3) analyzing various diseases/disorders of the human movement system and efforts to prevent them.

The theoretical study of learning outcomes in natural sciences (IPA) has special relevance in the context of science education. Science is a subject that focuses on understanding the universe, natural phenomena, and fundamental scientific principles (Wisudawati & Sulistyowati, 2022). In science learning, learning outcomes include understanding scientific concepts, developing the ability to observe and explain natural phenomena, and the ability to design experiments and construct scientific arguments.

Learning outcomes in science are not only about the accumulation of knowledge but also about developing scientific understanding and in-depth scientific thinking skills (Pratiwi et al., 2019). In effective science teaching, educators play a role in helping students achieve learning outcomes that include in-depth understanding of science, critical thinking skills, and scientific skills needed to succeed in an increasingly scientific world.

Interactive Multimedia

According to Marjuni (2019), "multimedia is a combination of various media, that is, using audio, video, graphics, and others." In contrast, according to Robin and Linda (in Putri et al., 2018), multimedia is a software that possesses the capability to create dynamic and interactive presentations which combine text, graphics, animation, sound, and video (Huda & Ardi, 2021).

Interactive multimedia not only functions as a tool in delivering content but also as a way to increase students' active participation and involvement in the learning process (Beare & Slaughter, 2021). By combining various elements such as text, images, graphics, sound, and video, interactive multimedia can deliver learning materials in an interesting and easy-to-use format. This is in agreement with Richard Mayer's cognitive theory of multimedia that asserts learning via the combination of words and images is better than using words (Kamlin & Keong, 2020).

In addition, interactive multimedia also allows for direct feedback, which is very important in the learning process. This feedback can be in the form of automatic assessments, additional explanations, or hints that help students understand the material more deeply. Timely and specific feedback can correct misunderstandings and encourage more effective learning (Huda & Ardi, 2021).

In the context of computer-based learning, interactive multimedia allows personalization of learning according to the needs and learning pace of each student. This technology allows the development of adaptive learning modules, which can adjust the level of difficulty based on student performance. This is in

line with the principles of personalized learning, where each student gets a learning experience that suits their individual needs (Marjuni & Harun, 2019).

Thus, interactive multimedia is not only a visual and audio aid in learning but also a platform that allows deeper interaction between students and learning materials. The combination of multimedia elements with interactivity can create a richer, more engaging, and more effective learning environment for achieving educational goals. This shows the great potential of interactive multimedia in supporting the Independent Curriculum, which focuses on developing the potential and needs of individual students (Hutauruk et al., 2022).

Articulate Storyline

Articulate Storyline, as per Alfan et al. (2023), is software that may be utilized for making presentations and is software developed by the Articulate company dealing in e-learning and media software introduced in 2014. The software has the potential to merge slides, Flash (SWF), video, and animated characters into one. It can be accessed offline, and products developed using Articulate Storyline can be deployed on desktops, laptops, or cell phones. Articulate Storyline offers several quite cool templates so that creation time will be cut down. Its clean appearance will make it easier for teachers to use.

Articulate Storyline performs the same function as Microsoft PowerPoint. It has numerous advantages so that it can produce interactive learning media since it has a useful menu for adding quizzes and evaluations so that the students of the media can immediately test their understanding of the subject material being learned (Hadza, C., Sesrita, A., & Suherman, I., 2020). Articulate Storyline is a software that can aid learning designers ranging from beginner to expert level.

This software has the advantage of simple smart brainware with interactive tutorial procedures through templates that are publishable online or offline, making it easy for users to format it in personal web, CD, word processing, and Learning Management System (LMS).

Problem Based Learning (PBL)

Problem-Based Learning (PBL), or Problem-Based Learning, is a learning approach that positions students as real-world problem solvers. This approach is different from conventional methods that may emphasize more on providing information (Soraya et al., 2024). In PBL, students are faced with a complex problem or situation that requires a solution. This concept is rooted in the philosophy that effective learning involves deep understanding and the development of critical thinking skills.

Problem-based learning is an approach with a structured curriculum that confronts students with practical problems where stimuli are developed for learning. The problem-based learning model is a learning model that challenges students to learn and work cooperatively in groups to solve real-world problems. PBL prepares students to think critically and analytically and discover by using various sources. Problem-based learning is a learning strategy that emphasizes active learning and can also use lecture modules (Pawson, 2006). Usually a

learning model, problem-based learning has learning steps, or what is known as syntax.

PBL-Based Science Learning

PBL-based science learning is a pedagogical approach that emphasizes real-world problem solving as the primary method for learning scientific concepts. PBL in science learning aims to develop students' critical, analytical, and creative thinking skills in a more contextual and relevant way (Feng et al., 2024). Through PBL, students are faced with real problems that require them to apply scientific knowledge in finding solutions, so that the learning process becomes more meaningful and connected to real-world applications (Abuhassna et al., 2020).

In PBL, learning begins with the presentation of complex and unstructured problems, which require in-depth understanding and information retrieval. Students work in groups to analyze problems, formulate hypotheses, search for relevant information, and finally find solutions. This process involves not only understanding science concepts but also research, collaboration, and communication skills. Thus, PBL creates an active, collaborative, and student-centered learning environment, where students become active researchers and problem solvers, not just passive recipients of information (Pratiwi et al., 2019).

One of the main advantages of PBL-based science learning is the ability to develop high-level thinking skills in students. Through the problem-solving process, students learn to analyze situations, evaluate information, and make decisions based on evidence. This is very different from traditional teaching methods that tend to focus on memorizing and repeating information (Wahono et al., 2020). PBL requires students to think critically and creatively and to be able to connect scientific concepts to real contexts. This helps students not only understand the material but also be able to apply it in different situations (Lederman & Lederman, 2019).

The integration of PBL in science learning also helps students develop important interpersonal and intrapersonal skills. In working together to solve problems, students learn to appreciate the perspectives of others, negotiate, and work as part of a team. They also learn to manage time, set goals, and evaluate their own progress. These skills are essential in both professional and personal life, and PBL provides a valuable opportunity for students to hone these skills in a supportive context (Wilujeng, 2020).

Overall, the essence of PBL-based science learning is to create a deeper, more relevant, and more motivating learning experience for students. By placing students at the center of the learning process and engaging them in solving real problems, PBL helps students develop the critical, collaborative, and creative thinking skills needed for future success. This approach not only enhances students' understanding of scientific concepts but also prepares them to become effective problem solvers and responsible citizens (Firmadani, 2020).

METHODOLOGY

The type of research used is development research, known as research and development (R&D). The research was conducted during the odd semester of the

2024/2025 academic year. Meanwhile, the location of the research was SMPN 1 Lubuk Pakam on Jalan Kartini, Tj. Garbus Satu, Lubuk Pakam District, Deli Serdang Regency.

The subjects of this study were 150 students in grade VIII at SMPN 1 Lubuk Pakam spread across 5 classes. Determined based on cluster random sampling. Students in grade VIII-1 were the experimental class, and class VIII-2 was the control class, with 30 students in each class so that the total sample size was 60 students.

The development model refers to 4D (four-D) development (Muqdamien et al., 2021). This development model was first developed by Thiagarajan, Dorothy S. Semmel, and Melvyn L. (1974). This model was later updated by Muqdamien et al. (2021). The 4D model has four main stages that detail the steps in designing and developing learning materials, namely, define, design, develop, and disseminate.

Development Procedure

The development procedure begins with an analysis of the curriculum used in science learning at SMPN 1 Lubuk Pakam. Then continued with the analysis of students and concepts and entered the product design planning stage. Tests carried out on the product are validity tests, practicality tests, and effectiveness tests.

Data Collection Instruments

Data collecting instruments are tools that are meant to gather data. Sugiyono (2017) clarifying said research tools are those employed to measure phenomena that have been observed. Based on the research objectives to be achieved in this study, the data collecting tools utilized are.

A questionnaire is also one of the research data collection tools applied to get responses from respondents using questions that are systematically located with a specific intent. A questionnaire was utilized here as the main tool for collecting data on the validity and usability of the interactive learning media Articulate Storyline on the basis of PBL. The measurement scale employed in the assessment was a Likert scale that had a range of 1 to 5, with the lowest being 1 and the highest being 5. The range is calculated as the highest range of the scores minus the range of the lowest scores. Table 1 presents used validity criteria.

Table 1. Validity Criteria

Score	Criteria	Percentage (%)
5	Very Valid	81% ≤ X ≥ 100%
4	Valid	61% ≤ X ≥ 80%
3	Quite Valid	41% ≤ X ≥60%
2	Less Valid	21% ≤ X ≥ 40%
1	Very Less Valid	0% ≤ X ≥ 20%

(Source: Arikunto, 2010)

The effectiveness of using interactive multimedia based on Articulate Storyline that was developed wased to determine what treatment to be given. Then conduct an N-gain score test (normalized gain). The ideal score is the maximum value that can be obtained to determine the category of N-gain score acquisition. The effectiveness of the procedure and implementation of treatment and control with treatment assessment are in Table 2.

Table 2. Treatment Design

Learning Media	*Pretest*	Treatment	*Posttest*
Interactive Multimedia Articulate Storyline based on PBL	O_1	X_1	O_2
PowerPoint Media based on PBL	O_3	X_2	O_4

The t-test is used to determine the difference between the mean of two independent groups or populations. Sugiyono (2017) stated that the t-test was a temporary solution to the formulation of the problem, i.e., asking for the correlation between two variables or more. The hypothesis submission design is used to determine the correlation of the two research variables. Based on the t-test output results, the independent variable is said to have an effect if the significance value is less than 0.05. In comparison of t-count and t-table values, the following conclusions can be drawn:

If t_count < t_table and the value is 0.05, then H_0 is accepted and H_a is rejected

If t_count> t_table and the value is < 0.05, then H_0 is rejected and H_a is accepted

While N-gain is used to see the level of effectiveness of the multimedia used in Table 3.

$$\text{N} - \text{gain} = \frac{\text{Post} - \text{test Score} - \text{Pre} - \text{test Score}}{\text{Ideal Score} - \text{Pre} - \text{test Score}} \text{x } 100\%$$

Table 3. Interpretation Categories of N-Gain Effectiveness

Limits	Category
N-Gain score ≥ 0.7	High
0.3 ≤ N-Gain score ≤ 0.7	Medium
N-Gain score ≤ 0.3	Low

RESEARCH RESULT

Evidence of findings on the overall rating by material specialists, learning design specialists, and media specialists and trial individual, small group, and field for all items of the assessment is assessed based on the average score. The results of the test are then compared to ascertain whether the interactive multimedia Articulate Storyline developed from PBL on the Human Movement System content is valid or not. The average percentage of the test results of material specialists, design specialists, media specialists, individual tests, small groups, and fields are presented in Table 4.

Table 4. Average Percentage of Assessment Results for Interactive Multimedia Articulate Storyline based on PBL on the Human Movement System Material

No	Categorization	Percentage average score	Criteria
1.	Material Expert Validation	92%	very valid
2.	Learning Design Expert Validation	89%	very valid
3.	Media Expert Validation	87%	very valid
4.	Individual Trial	91%	very valid
5.	Small Group Trial	92%	very valid
6.	Field Trial	96%	very valid
Average		**91%**	**very valid**

Interactive multimedia Articulate Storyline based on PBL on the Human Movement System material from expert validation along with trials shows a percentage of 92% on material validation, 89% on learning design validation, 87% on media validation, 91% on individual trials, 92% on small group trials, and 96% on field trials. Overall, the average percentage is included in the "Very Valid" category, which means that the use of interactive multimedia based on Articulate Storyline on the human movement system material meets the needs of students.

The normality test was carried out on two sample groups using the Lilliefors test. A summary of the normality of the two samples can be seen in Table 5 below.

Table 5. Summary of Data Normality Test Results

Learning Media	Class	Number of samples	L_{count}	L_{table}	Conclusion
Learning with interactive multimedia Articulate Storyline	*Pre-test*	30	0,117	0,161	Normal
	Post-test	30	0,114	0,161	Normal
Learning with PowerPoint media	*Pre-test*	30	0,149	0,161	Normal
	Post-test	30	0,158	0,161	Normal

Homogeneity test to determine the variation of the homogeneous population or not of the research data with the F test formula. Through the F test, data on student learning outcomes were obtained who were taught with interactive multimedia based on Articulate Storyline and students who were taught with PowerPoint media. A summary of the homogeneity of the two samples can be seen in Table 6 below.

Table 6. Summary of Data Homogeneity Test Results

Group	$\sum Xi$	$\sum Xi^2$	$\sum nXi^2$	n(n-1)	S^2
Post Articulate	6786025	228525	6855750	870	80,14
Post PPT	6630625	2575	6686250	870	63,93
F_{count} Post test			1,25		
F table			1,61		

The learning achievement of students taught using Articulate Storyline interactive multimedia and PowerPoint media attained Fcount Post-test < Ftable at 0.05 significance level. The data above show that the two samples have equal variances, and it is concluded that H_0 is accepted and the two groups of research data have met the hypothesis testing requirements.

Effectiveness test is to identify if the utilization of interactive multimedia using Articulate Storyline can enhance the learning outcome of students or not. The hypothesis was tested using one-tail t-test, and it provided the t-test value of 0.00000337. And the t-table is 1.67. H_0 is rejected if the t-value with alpha (α) 0.05 is lower than the t-table. So that 0.00000337 < 1.67, then H0 is rejected and H1 is accepted. Therefore, the research hypothesis that the mean learning outcome of students learning through the use of PBL-based Articulate Storyline multimedia is higher than that of students learning through the use of PowerPoint media has been proven to be true. Hence, interactive multimedia using Articulate Storyline is found to be more effective compared to utilizing media from PowerPoint.

DISCUSSION

Validity Test of Articulate Storyline Interactive Multimedia Products

The findings of testing and verification indicate that this Articulate Storyline interactive multimedia is highly valid for learning use. The product has fulfilled the conditions in media design and learning material development.

The findings of the questionnaire distributed to the learning material experts achieved a score of 92%, indicating that the Articulate Storyline-based interactive multimedia is valid for use because it contains material and delivery standards that fulfill the requirements. The learning design practitioner marked a score of 89%, which shows that the PBL-based interactive multimedia Articulate Storyline qualifies to be utilized since it has been properly designed and achieved the learning design criteria. The learning media expert gave a score of 87%, meaning that PBL-based interactive multimedia Articulate Storyline is valid for use since it has met the principles and criteria for the development of learning media.

According to the criteria and the evaluation guidelines of Sugiyono (2017), it can be concluded that interactive multimedia Articulate Storyline PBL is very valid for use by students to learn science in grade VIII, especially in the Human Movement System material. This is definitely in accordance with previous research; in 2022, Alti et al. reported that the utilization of technology-based learning media, including web platforms and interactive apps, has been a notable advancement in the field of contemporary education.

The results of this study were also confirmed by Nissa et al. (2021), who found that with the flexibility of Articulate Storyline interactive multimedia, it allows its users to create adaptive and interesting learning experiences. And Husna & Fajar (2022) state that Articulate Storyline interactive multimedia utilizes features such as text, images, audio, and video to present learning content dynamically. This Articulate Storyline interactive multimedia can also help learning designers, including teachers from beginner to expert level.

Practicality Test of Articulate Storyline Interactive Multimedia Products

The results of the practicality test obtained from the questionnaire given to students and teachers showed that PBL-based Articulate Storyline interactive multimedia was very practical to use. The practicality test assessment included appearance, ease of use, presentation of materials, and usefulness. The average assessment score obtained was 95%. The results of this study are in line with Akbar's opinion (2016) that multimedia is said to be practical if users, both teachers and students, find it easy to use the media. Research on product practicality is an important step in measuring the extent to which a product can be implemented and provide real benefits in the context of its use. This is in accordance with the aspects of practicality considerations put forward by Sukardi (2008), namely (1) ease of use, (2) efficiency, (3) device appeal to student interests, (4) appearance, and (5) benefits.

According to Nieveen (1999), practicality criteria are categorized as practical if they meet two criteria, namely, practical in theory and practical in practice. In line with this opinion, there are several practical benefits of this PBL-based Articulate Storyline interactive multimedia, namely: (1) easy to use, (2) presentation of material supports various learning styles, (3) increases student involvement in learning, and (4) supports student independent learning. The results of this study are also transferable to research findings conducted by Jazuli, Arvyaty, Hasnawaty, and Ibrahim (2023), where learning media created with software-based Articulate Storyline have met practical demands. This is also consistent with research findings conducted by Putra and Zainil (2023), where the implementation of interactive multimedia learning media Articulate Storyline in accordance with PBL received a good response from students, i.e., the media can practically be utilized in the learning process. The practicability test assessment includes appearance, usability, presentation of materials, and usefulness. According to the guidelines and standards of Sugiyono (2017), the 95% value is categorized as very practical. Therefore, it can be said that interactive multimedia Articulate Storyline based on PBL is very practical to be used by students to study science in grade VIII, especially on the material of the Human Movement System.

Test of the Effectiveness of Articulate Storyline Interactive Multimedia Products

Based on the results of the study, there are differences in learning outcomes between students who use PBL-based Articulate Storyline interactive multimedia and students who use PBL-based PowerPoint media. Specifically, the average score of students taught with Articulate Storyline interactive multimedia is 87, while the average score of students taught using PowerPoint media is 78. These data prove that PBL-based Articulate Storyline interactive multimedia is effective for improving student learning outcomes in science learning. This is in line with Nieveen's opinion (1999) that the effectiveness of a learning medium is the ability of the medium to achieve the goals that have been set. One of the indicators of success used to measure the effectiveness of learning media is student interest in learning.

The results of this study are relevant to the results of research conducted by Hafiedz and Nurhamidah (2023), where PBL-based Articulate Storyline

learning media is very effective in supporting the science learning process. Because it is easy to use, efficient, precise, and useful. Furthermore, it contains animations, images, and audio, making the media interactive and effective. Anna, Ajizah, and Hafizah (2022) received good responses regarding the use of learning media using Articulate Storyline, and it is valid and practical to use for science learning for Class VII SMP/MTs. It is proven that the learning media developed can facilitate teachers in the learning process, and it is hoped that the media developed can help students understand and master integrated science learning more easily, especially in the solar system material.

Based on the explanation above, it can be concluded that the use of interactive multimedia Articulate Storyline based on PBL is effective in improving student learning outcomes in science learning for Class VIII, especially in the Human Movement System material. The use of interactive multimedia Articulate Storyline based on PBL can increase student activity in student learning interests and be sensitive to immediately solving problems that have an impact on increasing student learning outcomes.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Based on the results of the research and discussion, the research on the development of interactive multimedia Articulate Storyline based on PBL on the Human Movement System material that has been tested on class VIII students of SMPN 1 Lubuk Pakam, the following conclusions are drawn.

1. Interactive multimedia Articulate Storyline based on PBL on the Human Movement System material gets very valid results and is used on students.
2. Interactive multimedia Articulate Storyline, based on PBL on the Human Movement System material, gets very practical results for use on students.
3. The use of interactive multimedia Articulate Storyline based on PBL on the Human Movement System material is more effective in improving student learning outcomes compared to the use of PBL-based PowerPoint media.

Recommendations

1. For schools, interactive multimedia Articulate Storyline based on PBL can be used by students individually or in groups as a learning resource to improve learning outcomes.
2. Educators to use interactive multimedia Articulate Storyline based on PBL in other lessons in order to improve student learning outcomes.
3. For educators, interactive multimedia Articulate Storyline based on PBL is limited to only two basic competencies in science subjects; it is recommended to develop other learning materials. This can enrich students' learning experiences and expand the scope of learning that can be done.
4. For subsequent researchers, researchers can use other learning models besides PBL to motivate students to be actively involved in the learning

process. In addition, research with larger samples and more diverse variations is also recommended to strengthen the generalization of research results and provide deeper insights.

ADVANCED RESEARCH

This research and development still have limitations so that further development research is still needed by adding interactive learning media to this topic. Development of Interactive Multimedia Articulate Storyline Based on PBL in Science Subjects for Class VIII of SMP Negeri 1 Lubuk Pakam.

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