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Development of interactive manipulative motion learning media using adobe animate for elementary school students

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Abstract: Over the past few years, there has been a growing recognition of the importance of integrating technology into educational practices to engage students more effectively. Traditional PE methods and limited resources have hindered effective learning, necessitating new approaches. This research aimed to develop innovative, interactive learning media based on adobe animate to enhance elementary students' learning outcomes in manipulative movement skills—a crucial component of Physical Education (PE) that fosters physical, social, emotional, and cognitive development. Utilizing the research and development (R&D) method with Borg and Gall's ten-stage model, the study involved experts and participants from five elementary schools in Purwokerto City. Following a structured process of preliminary study, planning, development, field trials, product revisions, and large-scale testing, data were analyzed using SPSS software. Expert evaluations rated the media and material highly (91.25% and 87.50%, respectively), indicating strong acceptance and usability. Field trials showed increased student motivation and engagement, demonstrating the effectiveness of the interactive approach. Large-scale trials confirmed significant improvements in learning outcomes, with interactive media exhibiting greater efficacy compared to conventional methods. The paired sample t-tests revealed a statistically significant increase in learning outcomes, where Group A (utilizing interactive media) achieved a p-value of 0.001, whereas Group B (employing traditional methods) obtained a p-value of 0.040. The findings emphasize the critical role of incorporating innovative technologies like Adobe Animate in PE programs, offering a model for developing impactful learning media across diverse educational settings. Moreover, they stress the necessity for ongoing adaptation and feedback integration to sustain media relevance and effectiveness over time. Future research could investigate the long-term impacts of interactive media on varied subjects and learning environments, as well as explore possibilities for customizing instructional materials based on individual student needs.

Keywords: interactive media, learning media, manipulative movement, physical education

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INTRODUCTION

Physical Education (PE) in the primary school curriculum not only aims to develop physical skills, but also the social, emotional and cognitive aspects of children. The subject not only focuses on improving physical abilities such as running and the use of fitness equipment, but also involves the development of sprinting and accelerated running techniques (Liptak & Scholtzova, 2021). More than just physical activity, PE is seen as a progressive and inclusive learning experience, promoting children's holistic growth through activities that match their individual abilities (Drury et al., 2023). It encourages cognitive understanding within their own cultural context, as well as enhancing positive social-emotional skills.

Basic manipulative movement skills, such as throwing, catching, kicking and hitting, provide a crucial foundation for children's future complex motor development (Dewi and Verawati, 2022; Kiliç, Uyanik and Çağlak, 2022). Through this learning, children not only acquire important physical skills,

but also build a solid foundation for more complex motor abilities in later stages of development. Thus, PE in primary schools not only teaches physical skills, but also plays a vital role in preparing future generations by strengthening their cognitive, social and emotional aspects through a thorough and integrated learning experience (Cañabate et al., 2023).

In practice, PE teachers face a number of challenges that affect students' manipulative movement learning outcomes. Data shows that seven out of ten physical education teachers experience significant obstacles. One of the main problems is the low learning outcomes achieved, which is caused by the limited learning resources available and a lack of understanding in teaching manipulative movements to students. These limitations affect teachers' ability to provide diverse and adequate learning approaches. In addition, the traditional learning model is also a significant obstacle. These traditional approaches tend not to be supportive enough to effectively improve students' understanding and movement skills. This can hinder students' ability to develop basic movement skills that are important for their motor development. Therefore, to improve learning outcomes of manipulative movements in PE, efforts are needed to overcome the limitations of learning resources, improve teachers' understanding of teaching manipulative movements, and introduce more diverse and innovative learning models.

In the current era of digital technology, innovative media development plays a crucial role in improving the quality of learning at various levels of education (Rahmatullah et al., 2022). Technology-based innovative media such as digital applications, educational games, or video tutorials not only facilitate the delivery of material in a more engaging, but also interactive way for students (Yue, 2020). For example, the use of multimedia technologies has proven to be effective in addressing the challenges of teaching in higher education, promoting more even interaction between learners and teachers (Liptak & Scholtzova, 2021). Prior studies have demonstrated the beneficial effects of using interactive learning resources built around Adobe Animate on elementary students' comprehension of manipulative motion materials. (Festiawan et al., 2024; Korte et al., 2024) discovered that throughout class, students showed higher levels of motivation and active participation. According to (Dengel et al., 2022), the media successfully helped students understand the principles being taught by offering clearer visuals of manipulating movements. Furthermore, (Traboco et al., 2022) highlighted that Adobe Animate enhanced the visual appeal and interaction of the learning process in addition to improving students' academic performance, student learning outcomes increase after using the teaching material for interactive and effective multimedia -based explanatory texts (Syarah, M., Ritonga, M. U., & Syarifah, S, 2023).

The existence of these innovative media provides students with the opportunity to learn in a more enjoyable and effective way. Not only can they gain a deeper understanding of the learning material, but also develop relevant skills for their future lives (Zhou, 2021; Cañabate *et al.*, 2023). With the integration of technology in learning, teachers can create a more dynamic and adaptive learning environment, allowing personalization of learning according to each student's needs and learning style. This not only increases learning motivation, but also expands the potential learning outcomes that can be achieved by each individual in a modern educational environment (Winarto, Syahid and Saguni, 2020; Kwangmuang *et al.*, 2021).

This research aims to develop innovative media-based manipulative basic movements for PE learning in elementary school, with the hope of increasing students' understanding and mastery of manipulative basic movement skills more effectively. Innovative media such as interactive applications, educational games, and animations are expected to make learning materials more interesting and easily understood by students. In addition, the presence of this media is also expected to stimulate student learning motivation, enrich the teaching methods used by teachers, and facilitate more active interaction between students and subject matter (Suryanto & Fitrawan, 2023).

The use of interactive electronic teaching tools such as interactive games and animations also plays an important role in increasing students' cognitive activity and broadening their horizons of basic manipulative movement skills (Lazebna and Prykhodko, 2021; Syara *et al.*, 2020). Thus, the integration of innovative media in PE learning in primary schools not only aims to improve academic achievement, but also to develop students' full potential through engaging learning experiences that are relevant to current technological developments. Innovative media plays a crucial role in the transformation of education with significant benefits. In addition to helping students develop a deep understanding of subject matter and improve communication and presentation skills, they also support active learning approaches such as collaboration and peer learning, which are essential for building the critical thinking,

problem-solving and communication skills needed in the 21st century (Dosoftei & Alexa, 2024). Students' academic motivation can also be enhanced through the use of this innovative medium, as well as facilitating the integration of technology to improve the quality of learning (Ahmed et al., 2023). By using illustrations and visualizations, interactive media helps students internalize abstract concepts and improve their skills through instant and continuous feedback during the learning process (Patni et al., 2020). This innovative media development also shows its relevance in the context of education in Indonesia, where there is a strong push from the government to integrate Information and Communication Technology (ICT) in education. This aims to improve the quality of education and students' competitiveness at the global level, in line with the rapid development of technology in this digital era. The use of innovative media such as Adobe Animate offers an exciting approach to enhance the appeal and effectiveness of learning (Gula et al., 2023). Adobe Animate is software that allows content creators to create engaging animations and interactivity. By utilizing this technology, learning basic manipulative movements can be presented in an interesting visual form and easily understood by elementary school students. Animation can help clarify movement concepts, reduce misinterpretation, and facilitate better understanding (Traboco et al., 2022).

Specifically, this research will identify the needs and preferences of students and teachers in learning basic manipulative movements, because the concepts involved in manipulative motion materials are abstract and might be difficult for young pupils to understand through standard means like verbal explanations or static visuals, teaching them in elementary schools can provide issues. Low student engagement and subpar learning outcomes are the results of this. Innovative learning aids that use technology to improve comprehension are desperately needed in the digital age. With its interactive and visually appealing content, Adobe Animate is a potent tool for breaking down complicated motion ideas and boosting students' enthusiasm and understanding. As a result, creating interactive learning materials with an Adobe Animate foundation is essential to raising the standard of physical education and creating a more vibrant and productive learning atmosphere in elementary schools. Based on the results of this identification, innovative media will be developed in accordance with the needs and characteristics of elementary school students. This media is expected to be widely implemented in various elementary schools to support a more effective and interesting PE learning process

Thus, the development of manipulative basic movements based on this innovative media will not only make a significant contribution to improving the quality of PE learning in elementary schools, but also become a model that can be adopted for the development of learning media in other fields. Ultimately, this will support the achievement of national education goals in forming a healthy, intelligent, and competitive young generation in the era of globalization.

METHODS

The purpose and objective of this research is to develop interactive learning media for motor motion material, so the research method used in this research uses the research and development (RnD) method. In this study, researchers used adobe animate-based media on elementary school students to see an increase in learning outcomes of manipulative motion material. The design used in this study uses the model used by Borg and Gall which consists of 10 stages. The process of creating an educational product begins with understanding the specific challenges or gaps that need to be addressed. Once the problem is clear, research and information are gathered to help shape a solution. With these insights, an initial design of the product is developed. Before moving forward, experts review it to ensure it’s on the right track. After this, the product is tested with a small group to see how it works in practice, and feedback is collected to make improvements. Then, it’s time to put the revised product to the test in a real classroom, getting input from teachers and students who will use it. Based on their experience, final tweaks are made to ensure the product is as effective and user-friendly as possible. Once everything is polished, the product's impact is measured to make sure it achieves its goals. Finally, the completed product is shared with a broader audience, ready to make a positive difference in learning environments everywhere.

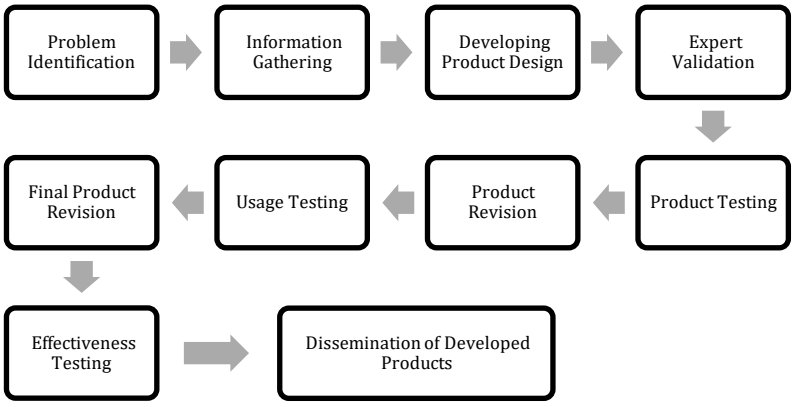

Figure 1. Research Flow

Participant

The study involved two main groups. First, the validator group consists of two experts: a material expert and a media expert, who are carefully selected based on competency criteria in their respective fields. They will provide valuable views and assessments for the development of manipulative motion learning media. The second group consists of physical education students and teachers from five elementary schools in Purwokerto City, including SDN 1, 2, and 3 Purwokerto Kulon. These three schools will be the subjects in the production and testing of this interactive learning multimedia.

Procedure

The research procedure consisted of ten stages that were structured in detail. The first stage began with a preliminary study that included problem identification and needs analysis, followed by information gathering through field observations at three schools, as well as the use of questionnaires and interviews with 15 research subjects from among students and teachers. The second stage involved planning which included drafting the basic manipulative movement development design and innovative media concept. The third stage focused on the development of initial products in the form of manipulative basic motion designs through a customized play approach, as well as the design of 3D animated images and innovative media as a development platform. The fourth stage involved an initial field trial with 5 models of manipulative movements and innovative media, which then analyzed the data results involving 20 research subjects. The fifth and sixth stages are the main product revision based on the evaluation of the initial field trial results, followed by the main product field test on a larger scale with 100 research subjects. The seventh and eighth stages are operational product revisions based on expert evaluation and field trials in accordance with the research objectives. The ninth stage is the final product revision to get perfect results. The tenth stage is the dissemination and implementation of effective final products to users such as students, teachers, and the community.

Statistical Analysis

Data from the measurement results were then processed and analyzed using statistical methods with the help of Statistical Product for Service Solutions (SPSS) software version 25. The following is data analysis using SPSS: The normality test used in this study is the Shapiro-Wilk Test with a significance level of 5% or 0.05. The homogeneity test used in this study is the Levane Statistical Test with a significance level of 5% or 0.05. Statistical techniques to find the effect of each variable using the Paired Sample t-test.

Procedures need to be outlined according to the type of research. How the research will be conducted and data obtained should be described in this section. For experimental research, the type of experimental design used should be stated in this section. The type of data, how the data is collected, with which instruments the data is collected, and how it is collected, should be clearly described in this section. How to interpret the data obtained, in relation to the problem and research objectives, needs to be clearly explained.

RESULT AND DISCUSSION

Planning Stage

The first stage begins with Research and Information Collecting. The initial step of this research successfully identified a number of problems and needs in physical education learning, especially related to basic manipulative movements in elementary schools. Through the analysis of current conditions, it was found that there is a significant gap between learning needs and the availability of effective media. The current learning media is considered inadequate in supporting the learning process of basic manipulative movements. Evaluation of media availability and effectiveness shows that many of the media used have not been able to meet the needs of physical education optimally. In addition, it was found that some of the existing learning media are not interactive enough and less engaging for students, thus reducing their motivation to learn. The identification of these shortcomings includes the need for more innovative and interactive media, which are able to increase student engagement and facilitate their understanding of basic manipulative movements. The results of this study confirm the need for the development of learning media that are more effective and in accordance with the needs of students in learning physical education in elementary schools.

The literature review successfully provided an in-depth understanding of the theories and best practices related to basic manipulative movements in physical education. Through the review of previous research, journal articles, textbooks and other relevant academic sources, a strong basis for the development of innovative learning media was obtained. The literature reviewed demonstrated the importance of using interactive learning media in improving student engagement and understanding. In addition, information was collected from various sources through field observations at three elementary schools to get a real picture of the conditions of learning basic manipulative movements. Questionnaires and interviews were also used to collect data from 15 research subjects consisting of students and teachers, covering their views, experiences and needs related to learning media for basic manipulative movements. Questionnaires and interviews with 15 research subjects, including students and teachers, revealed that the existing media for learning basic manipulative movements were less effective. Respondents voiced the need for media that are more interactive, interesting, and easy to integrate with the curriculum. Teachers highlighted the need for media that support flexible and independent learning, while students wanted better digital access. These findings confirm the importance of developing innovative learning media that support effective teaching of basic manipulative movements in primary schools.

The second stage is planning. Based on the information that has been collected, the next step is to develop a research and development plan. This plan includes the steps of developing learning media, taking into account the results of problem identification, needs, and literature review that have been conducted. Product specifications are also determined, including the features that will be included in the Adobe Animate-based innovative media. Adobe Animate product specifications for interactive learning media development include the ability to create attractive and dynamic animations with high-quality graphics. Adobe Animate allows the integration of interactive elements such as interactive buttons, navigation controls and responsive action-based animations. In addition, features such as support for various multimedia file formats, including audio, video, and images, enable the use of rich multimedia content in learning media. The platform also offers ease in setting up animation timelines, controlling frame-by-frame animation or tweening, as well as the ability to add smooth transition effects between scenes. With the combination of these features, Adobe Animate becomes an ideal choice for developing dynamic interactive learning media and supports a more engaging and effective learning experience for students.

Development Stage

The first stage in development is to create an initial draft or prototype of a manipulative basic motion learning media product using Adobe Animate. This prototype includes the initial design of the animation, interactivity, and content structure planned to be included in the final product.

Figure 2. Media Design

After completing the development of basic manipulative learning media, the product was assessed by media experts and material experts. The assessment results from media experts (91.25%) and material experts (87.50%) show that the manipulative basic motion learning media products developed have received very good category scores. Media experts appreciated the attractive animation design and the use of Adobe Animate technology that can enrich students' learning experience. Meanwhile, the material experts recognized that the learning content delivered through this media is relevant and in-depth, in accordance with the physical education curriculum standards in elementary schools. This positive feedback provides confirmation that the product not only meets, but also exceeds expectations in supporting the effective learning process of basic manipulative movements in a formal education environment.

Results from the field trial involving 15 primary school students (87.72%) and one PE teacher (91.00%) showed that the learning media for basic manipulative movements has successfully increased students' motivation in learning. Feedback received from the trial participants showed that the interesting and interactive animations and the use of Adobe Animate technology provided a more enjoyable and engaging learning experience. In addition, PE teachers reported increased student engagement in learning activities, which had a positive impact on their understanding of basic manipulative movements. Based on the feedback from this field trial, it was found that the addition of audio features in the learning media can further enrich students' learning experience, by providing a narrative that supports the visualization of movements more comprehensively. This feedback will be implemented in further development to ensure this learning media remains relevant and effective in supporting the objectives of physical education in primary schools.

Feedback from the field trial indicates that the addition of audio features in the manipulative basic movement learning media is predicted to have a significant positive impact on students' learning experience. This feedback provides encouragement to integrate audio more strategically in the development of this learning media, with the hope of maximizing the potential for effective learning in the primary school environment.

Figure 3. Product Revision

Figure 3. Product Revision is the part of the development process where we make changes based on what people said about earlier tests. Here, we look at what we learned from Product Testing and Expert Validation and make changes to improve the product's features, ease of use, or content quality. Before it is tried again in the real world, this iterative process helps the product change to better meet user needs. The ultimate goal is to make the product better so that it can be tested and used more.

Evaluation Stage

A wide-scale trial was conducted involving 100 students (93.36%) and 3 PE teachers (98.21%), which produced very satisfactory results. Feedback received from the trial participants showed an overall positive response to the manipulative basic movement learning media developed. Students reported increased motivation and engagement during the learning process, highlighting the clarity of animations and interactivity provided by the media. PE teachers also observed an increase in students' understanding of basic manipulative movements, as well as the ease of integrating this media in daily classroom learning. In all aspects of testing, only positive feedback was encountered, indicating that this learning media is effective in supporting the objectives of physical education in primary schools and achieving good acceptance from end users.

This study examined the effectiveness of interactive learning media in improving learning outcomes of manipulative movements through a series of statistical tests. For ease of mention in data analysis, the group using interactive media was given the initials “A” and the group using other learning media used the initials “B”. The normality test results showed that the data were normally distributed, while the variance homogeneity test showed similar results. The paired-sample t-test showed a significant increase in learning outcomes between the pre-test and post-test of method A greater than method B, confirming that the use of interactive media is effective in improving manipulative movement skills in elementary school students.

Table 1. Normality Test

Group	N	Asym. Sig (p-value)	Note
Pretest Group A	20	.059	Normal
Postest Group A	20	.457	Normal
Pretest Group B	20	.065	Normal
Postest Group B	20	.140	Normal

Table 1 shows that all data are normally distributed where the significance value is more than 0.05.

Table 2. Homogenity Test

Group	N	Asym. Sig (p-value)	Note
Pretest Group AB	40	0.059	Homogen
Postest Group AB	40	0.117	Homogen

Based on the Table 2, the combined variance or data homogeneity test results show that the P-value is > 0.05. This shows that the data has a homogeneous distribution.

Table 3. Paired sample T-Test

Group	t	Asym. Sig (p-value)
Postest – Pretest Group A	3.977	0.001
Postest – Pretest Group B	2.199	0.040

The data in Table 3 shows that both groups have a significant effect on student learning outcomes. Although both methods used by each group are effective, there is a difference in the level of significance between the two. Group A, which used interactive media as its learning method, showed a higher

significance value compared to group B which used the conventional method. This means that the interactive media used in learning in group A had a greater impact on improving student learning outcomes compared to the method used in group B. This finding emphasizes that the use of interactive technology can be more effective in improving students' understanding and skills in manipulative motion materials compared to traditional learning methods.

Discussion

Based on the results and research, it can be concluded that the stages of interactive media development consist of three main stages: planning, development, and evaluation. The results of the planning stage in this study are very important to design detailed learning scenarios, set learning objectives, and determine the tools and technology that will be used so that the learning media produced can be effective and in accordance with user needs. This result is also corroborated by research conducted by Korte *et al.* (2024) that the planning stage involves identifying learning needs and analyzing the content that will be delivered through interactive media. In addition, Khiatani *et al.* (2023) that this process aims to understand learning needs and identify areas of improvement and professional development. In the prototype lesson planning tool, the main issue was the mismatch between educational objectives and interface design, which required the adoption of a user perspective and the use of appropriate analytics to collect relevant data (Børte and Lillejord, 2024; Navío-Marco *et al.*, 2024). Interactive media have also been shown to facilitate the learning process (Demir, 2024).

The development stage is the process by which planned ideas are translated into tangible products. It involves the creation of visual and interactive content, such as animations, videos, and audio, which are used to explain basic motion concepts in a clear and engaging manner. In addition, best practices such as the use of digital technology and animation need to be adapted to explain basic motion concepts more effectively. This result is also in accordance with what was carried out by Kustyarini, Utami and Koesmijati (2020) that interactive media such as animation, video, and audio are effective media in delivering information in the learning process. This media combines images, sound, and text in the form of interesting and interactive animated videos. The advantages of interactive media include its ability to combine audio and visual, respond to users, and can be used independently. The application of video animation media has been shown to increase students' learning motivation, especially in complex subjects such as mathematics (Rachmavita, 2020; Barut Tugtekin and Dursun, 2022). This review emphasizes the importance of tailoring learning media to students' needs and the learning context in primary schools. Recommendations on features that need to be integrated in innovative learning media for physical education include the use of audio elements, interactivity and engaging visuals.

Multiple studies have validated the structure of a three-stage framework for planning, developing, and evaluating interactive media in physical education. This framework emphasizes the significance of user-centered design and the integration of multimedia elements to improve motivation and engagement. Nevertheless, it has drawbacks, such as a restricted emphasis on physical education, a possible over-reliance on technology, and a failure to adequately take into account the various requirements of learners. Its applicability to more educational contexts, the inclusion of learner feedback from a wider range, longitudinal studies to evaluate long-term effects, and the integration of interactive media with conventional teaching methods for a more well-rounded approach are some potential future improvements. By addressing these flaws and taking advantage of these chances, learning resources that are more inclusive and efficient can be created to meet the demands of all students.

The evaluation stage also showed that interactive media significantly improved learning outcomes. Another study also conducted by Novaliendry *et al.* (2020) emphasized the importance of this process in ensuring the effectiveness and acceptance of learning media, media is a determinant of instructional success because it enables students and teachers to communicate the subject matter in accordance with the objectives of the lesson (Ozdamli, F. & Ercag, E, 2018). Furthermore, an evaluation was conducted by comparing student test results before and after using interactive media, which also increased (Hardiansyah & Mulyadi, 2022).

The results of this literature review provide an important foundation in designing effective learning media that meet the objectives of physical education. Previous studies have shown that the use of interactive media can improve students' basic movement skills, but any new media development should still be based on the specific needs of the existing learning context. Thus, the development of interactive learning media should always consider factors such as student needs, technology availability,

and learning context. By summarizing all these findings, it is clear that the development of interactive learning media requires a systematic and evidence-based approach. Each stage of development, from planning to evaluation, must be carefully conducted to ensure that the resulting media is truly effective in improving student learning outcomes. Through the use of appropriate technology and a needs-based approach, interactive learning media can be an invaluable tool in physical education in primary schools.

Trial participants highlighted that the audio features in the interactive media significantly boost students' understanding of basic movement instructions and concepts. By adding audio, the media becomes more interactive and engaging, making it easier for students with different learning styles to connect with the material. This underscores the idea that effective interactive learning media should not only look good but also incorporate elements that cater to a variety of learning preferences. Effectiveness tests showed a strong positive impact on student learning outcomes, with expert evaluations indicating that the media performed very well. Numerous studies have confirmed that when media includes visual and interactive elements, it can greatly increase students' interest in learning.

The journey of developing this learning media involves several careful evaluation stages, including functional testing and feedback from media and subject matter experts. These evaluations are crucial for ensuring that the media functions properly and meets students' specific learning needs before it's rolled out widely. Expert feedback plays an essential role in refining the product, helping to ensure it supports the learning process effectively (Susanto et al., 2022). The evaluation phase has also demonstrated that interactive media can significantly enhance learning outcomes. Research, like that by Novaliendry *et al.* (2020), emphasizes the importance of this evaluation process for ensuring the media is both effective and well-received by students. Comparing test results before and after using the interactive media has shown notable improvements (Hardiansyah & Mulyadi, 2022).

These findings provide a solid foundation for designing effective learning tools that meet the goals of physical education. While previous studies have shown that interactive media can improve students' basic movement skills, it's important that any new media development considers the specific context and needs of the learners. This means that when developing interactive learning media, factors such as student needs, available technology, and the learning environment should always be considered. In summary, creating interactive learning media requires a thoughtful and evidence-based approach. Each phase of development from planning to evaluation needs careful attention to ensure that the resulting media genuinely enhances student learning. By using the right technology and focusing on what students need, interactive learning media can become a valuable resource in primary school physical education.

CONCLUSSION

Based on the research results, it can be concluded that the development of interactive learning media for manipulative motion consists of three main stages: planning, development and dissemination. The planning stage involves identifying learning needs and content analysis, while the development stage involves creating visual and interactive content using technologies such as Adobe Animate. Dissemination involves testing the effectiveness testing and also dessemination of developed product. The results showed that interactive media can significantly improve students' learning outcomes of manipulative movement skills. Therefore, it is recommended that educators and learning media developers focus more on using engaging and relevant interactive technologies to improve student learning outcomes in physical education. In addition, it is important to continuously adapt and update learning media based on feedback from students and teachers to ensure effectiveness and suitability to educational needs in primary schools.

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