



Development of Interactive Digital Learning Media To Improve Science Literacy and Learning outcomes of Elementary School Students In Natural And Social Sciences (IPAS) In Enrekang Regency

Saleha*, Baso Jabu, Nurhikmah H

Universitas Negeri Makassar

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*Correspondence: Saleha

Email: unimensaleha@gmail.com

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Abstract: This study aimed to develop an interactive digital learning medium based on Articulate Storyline that is valid, practical, and effective in improving scientific literacy and learning outcomes of fifth-grade elementary students in Enrekang Regency. The research employed a Research and Development design using the ADDIE model, which includes analysis, design, development, implementation, and evaluation stages. Research subjects consisted of teachers and fifth-grade students from several elementary schools representing different geographical conditions. Data were collected through expert validation, practicality questionnaires, and learning achievement tests, then analyzed using descriptive and inferential statistics, including paired sample t-tests and N-Gain analysis. The results show that the developed learning media achieved high validity according to expert assessments, demonstrated good practicality in classroom implementation, and effectively improved students' scientific literacy and learning outcomes. Thus, the interactive digital learning medium serves as an innovative instructional tool aligned with the Merdeka Curriculum, promoting active and meaningful science learning experiences for elementary

Keywords: Interactive Learning Media, Scientific Literacy, Learning Outcomes, IPAS, Elementary School

Introduction

Digital transformation in education is a logical consequence of the rapid development of information and communication technology in the era of Society 5.0. This change requires a paradigm shift in learning from a conventional teacher-centered approach to learner-centered, interactive, adaptive, and contextual learning. UNESCO emphasizes that the use of digital technology in education is no longer just an additional innovation, but a strategic necessity to prepare a generation with 21st-century competencies, such as critical thinking, creativity, collaboration, and digital literacy. In line with this, Indonesia's national education policy through the Merdeka Curriculum encourages educational units to integrate digital technology to create meaningful, flexible, and inclusive learning. In the context of basic education, the Natural and Social Sciences (IPAS) subject plays a strategic role in building the foundation of students' science literacy. IPAS aims not only to transfer factual knowledge but also to develop students' ability to understand natural and social phenomena scientifically, logically, and applicatively.

The Organisation for Economic Co-operation and Development (OECD) defines science literacy as an individual's ability to engage with science-related issues, explain phenomena scientifically, and use scientific evidence in everyday decision-making. Therefore, IPAS learning from the elementary school level is key to fostering sustainable scientific thinking. However, various national and international reports show that the level of science literacy among Indonesian students is still low. The results of the 2022/2023 Programme for International Student Assessment (PISA) placed Indonesia at the bottom of the rankings with science literacy scores well below the OECD average. These findings are reinforced by the results of the National Assessment, which show that most elementary school students are still in the basic skills category and need intervention, especially in understanding abstract scientific concepts. This condition indicates structural problems in the science learning process, particularly in terms of the methods, media, and learning approaches used in the classroom. One of the main problems identified in science learning is the dominant use of verbalistic lecture methods. Teachers are still the main source of information, while students play a passive role as recipients of knowledge. This learning pattern is not in line with the cognitive development characteristics of elementary school students who are in the concrete operational stage. According to cognitive development theory, elementary school-aged students need learning experiences that involve visualization, object manipulation, and direct interaction in order to understand abstract concepts meaningfully. When IPAS learning is only delivered through verbal explanations and textbooks, students tend to have difficulty constructing a complete conceptual understanding.

This problem becomes even more complex when linked to the limited use of digital learning media in elementary schools, especially in rural and mountainous areas. Enrekang Regency, as an area with mountainous geographical characteristics, faces its own challenges in implementing technology-based learning. Data from the Central Statistics Agency shows that most elementary schools in Enrekang Regency still have limited internet access, ICT facilities, and unstable electricity supply. This condition has an impact on the low utilization of digital learning media in the IPAS learning process. The results of observations and interviews conducted in various elementary schools in Enrekang Regency show that IPAS learning is still dominated by the use of textbooks and blackboards, with minimal support from visual or interactive media. Abstract material, such as energy and its changes, is one of the topics that is most difficult for students to understand. Students have difficulty imagining the process of energy conversion, how power plants work, and the cause-and-effect relationship between energy use and its impact on the environment. As a result, student learning outcomes and mastery levels for this material tend to be low

Teachers also feel the limitations of learning media. Most teachers admit that they do not yet have adequate competence in developing and utilizing digital learning media, even though they are highly motivated to innovate. On the other hand, students show great enthusiasm for the use of technology in learning. Students are more interested in learning that utilizes videos, animations, simulations, and educational games because they are considered more interesting, easy to understand, and not boring. This fact shows that there is a gap between the learning needs of students and the learning practices that take place in the classroom. In this context, the development of interactive digital learning media has become an urgent need.

Interactive digital learning media is capable of presenting IPAS material visually, dynamically, and contextually through the integration of text, images, audio, video, animation, and interactive simulations. This type of media not only functions as a tool for delivering material, but also as a means to increase student engagement, facilitate independent learning, and provide direct feedback. The use of interactive media has been proven to improve students' conceptual understanding, learning motivation, and learning outcomes, especially in science learning in elementary schools.

Methodology

This study uses a research and development (R&D) approach. The R&D approach was chosen because it is in line with the research objectives, namely to produce innovative interactive learning media products while testing their feasibility, practicality, and effectiveness in the context of IPAS learning in fifth grade elementary school. According to Sugiyono (2020:407), research and development is a research method used to create specific products and test their effectiveness in achieving the desired objectives, making this method highly relevant for the development of interactive digital learning media.

In addition, development research is considered highly relevant to the context of 21st-century education, which demands the use of digital technology in learning. According to Borg and Gall (1983), R&D enables researchers to produce innovative products while measuring their effectiveness through expert validation and real classroom trials. This is in line with the objectives of this study, namely to develop Articulate Storyline-based interactive learning media that can increase student learning motivation, active participation, and learning outcomes. Thus, the use of the R&D approach not only produces ready-to-use products but also provides an empirical basis for the effectiveness of the developed learning media, making it relevant and useful for the implementation of the Merdeka Belajar Curriculum in elementary schools (Mayer, 2023; Susanto & Priyono, 2022).

The product developed in this study is an interactive learning media based on Articulate Storyline that is specifically designed to support IPAS learning in fifth grade elementary school. This media emphasizes the presentation of material in a contextual manner, so that students can understand IPAS concepts through learning experiences that are relevant to their daily lives. In addition, this media is designed to be participatory and interesting, facilitating active student involvement in the learning process through the use of multimedia elements such as text, images, audio, video, animation, and interactive questions that challenge students' critical and creative thinking skills (Mayer, 2023). This research was conducted in the odd semester of the 2025/2026 academic year, starting from the planning stage to the final product evaluation stage. The entire series of research activities was carried out in stages, starting from needs analysis, media design, product development, expert validation, field trials, to analysis of the effectiveness of interactive learning media.

The research location was in Enrekang Regency, South Sulawesi Province, involving several fifth-grade elementary schools that had implemented the Merdeka Belajar Curriculum. Enrekang Regency was chosen as the research location purposively, considering several factors, including: the readiness of schools to implement digital-based learning, the availability of ICT facilities and infrastructure, and the support of schools for learning innovations that utilize interactive technology. This research focuses on the development and application of Articulate Storyline-based interactive learning media for fifth-grade elementary school Natural and Social Sciences (IPAS) subjects. Product testing was conducted by involving 300 students from 120 elementary schools in Enrekang Regency, so that the results of this study are expected to describe the effectiveness of the use of digital learning media in an elementary school environment in a representative manner. The subjects in this study were fifth-grade elementary school students in Enrekang Regency. The subjects were selected purposively, considering the involvement of schools that had implemented the Merdeka Belajar Curriculum and were ready to use technology-based learning media. A total of 300 students from 120 elementary schools in Enrekang Regency participated in this study. These students were used as direct users of Articulate Storyline-based interactive learning media in Natural and Social Sciences (IPAS) subjects. In addition to students, this study also involved fifth-grade IPAS teachers as users and evaluators of the practicality of the developed media. Teachers played an important role in providing feedback on the ease of use, accuracy of content, and benefits of the media in assisting the learning process in the classroom.

In addition to teachers and students, this study also involved three categories of experts, namely subject matter experts, media experts, and language experts. Subject matter experts played a role in assessing the suitability of learning content with learning outcomes and the Pancasila student profile in the Merdeka Belajar Curriculum. Media experts focused on assessing visual appearance, navigation, interactivity, and the effectiveness of media use in the context of digital learning. Meanwhile, language experts assess the clarity of language, sentence coherence, and the appropriateness of the terms used so that they are easily understood by elementary school students. Through the involvement of these experts, the media validation process is carried out comprehensively to ensure that the developed product is valid, practical, and effective before being tested on a wider scale.

The object of this study is Articulate Storyline-based interactive learning media, which is specifically designed to support IPAS learning in fifth grade elementary school in accordance with the principles of the Merdeka Belajar Curriculum. This media emphasizes contextual, participatory learning that is oriented towards developing students' competencies and character through meaningful learning experiences. In its development, this media combines various multimedia elements such as text, images, audio, video, animation, and interactive questions to create an interesting, interactive, and enjoyable learning experience for students. In addition, this media is designed to be used flexibly by both teachers and students independently, so that it can support active and collaborative learning in the classroom.

Result and Discussion

The results of research on the development of interactive digital learning media based on Articulate Storyline show that the product meets the criteria of validity, practicality, and effectiveness in improving science literacy and IPAS learning outcomes for fifth-grade elementary school students in Enrekang Regency. The initial stage of the research began with an analysis of the needs of teachers and students as the basis for media development. The findings show that although almost all teachers (98.3%) are aware of the importance of using learning media, the implementation of technology-based digital media is still very limited, with only 23.9% of teachers routinely utilizing digital learning applications in the learning process. This condition reflects a gap between pedagogical awareness and actual learning practices. The results of expert validation show that the developed learning media has a very high level of feasibility. The average expert validation score for the material was in the highly valid category, indicating the suitability of the media content with IPAS learning outcomes and the cognitive development characteristics of elementary school students. Expert validation of the media also showed that the visual display, navigation, and interactivity of the media met the principles of effective digital learning design, while expert validation of the language confirmed the use of simple, communicative language appropriate to the level of understanding of elementary school students.

The media practicality test involving teachers and students showed very consistent results. The media obtained an average practicality score of 87.5% in the very practical category, both from the perspective of teachers and students. There were no significant differences in practicality assessments based on school location (urban, rural, and mountainous), indicating that the media can be implemented flexibly in various geographical contexts. Teachers assessed that the media helped explain abstract IPAS concepts, saved learning time, and facilitated evaluation through an automatic scoring system. Meanwhile, students stated that the media was interesting, easy to use, and increased their motivation to learn. The effectiveness of the media was tested through a One Group Pretest–Posttest design. The results of the analysis showed a significant increase in student learning outcomes after using interactive learning media. The average pretest score of 57.8 increased to 79.5 on the posttest, with an increase of 21.7 points. The results of the paired sample t-test showed a statistically significant difference ($p < 0.001$), confirming that the use of media had a positive impact on student learning outcomes. The N-Gain value of 0.514 was in the moderate category, indicating that the media was quite effective in improving understanding of IPAS concepts. In addition, the level of learning completeness increased dramatically from 17.3% to 84.3% after using the media.

Discussion

The findings of this study reinforce the view that the development of learning media must be based on a comprehensive needs analysis. Branch (2009) emphasizes that the analysis stage is the main foundation in learning design, because it determines the relevance and acceptability of the products developed. The low utilization of digital media by teachers, despite an awareness of the importance of technology, is in line with the concepts of first-order and second-order barriers in the integration of educational technology as proposed by Ertmer and Ottenbreit-Leftwich (2010).

External barriers such as limited facilities and networks, as well as internal barriers in the form of low self-confidence and digital competence among teachers, are the main factors that hinder learning innovation. Expert validation results show that Articulate Storyline-based interactive learning media has met content and design quality standards. This finding is in line with Mayer's (2023) opinion that multimedia learning that integrates text, images, animations, and interactions can significantly improve students' conceptual understanding, especially in science learning. The success of the media in visualizing the concept of energy and its changes helps students relate abstract material to concrete phenomena in everyday life. The high practicality of the media indicates that the usability aspect has been well fulfilled. Nielsen (1993) emphasizes that digital learning systems must be easy to learn and use in order to be widely adopted by users. The consistency in the assessment of practicality between teachers and students shows that the media is not only visually appealing but also functional in supporting learning activities. The time efficiency perceived by teachers, especially in the evaluation process, is an important finding given the relatively high workload of teachers. This is in line with Darling-Hammond's (2000) view, which emphasizes the importance of teachers' time resources in improving the quality of learning. In terms of effectiveness, the improvement in learning outcomes and student achievement shows that interactive learning media can create meaningful learning experiences. Plomp and Nieveen (2013) state that the effectiveness of development products is demonstrated by the achievement of predetermined learning objectives. Consistent improvements in learning outcomes across various school locations indicate that the media is adaptive and inclusive, although there are differences in effectiveness based on school accreditation. These findings indicate that the learning environment and institutional support also influence the results of learning media implementation.

However, this study has several limitations. The evaluation instruments used still focus on cognitive aspects and do not fully measure affective dimensions and higher-order thinking skills. Anderson and Krathwohl (2001) emphasize that learning outcomes are multidimensional, so evaluations should cover various aspects of student abilities. In addition, the relatively short implementation period did not allow researchers to observe the long-term impact of media use on knowledge retention and changes in student learning behavior. Hattie (2009) reminds us that the initial effects of a learning intervention may decline over time, so further research with a longitudinal design is needed. Overall, the results and discussion of this study indicate that Articulate Storyline-based interactive digital learning media is a relevant and effective innovation in improving the quality of IPAS learning in elementary schools. This media not only contributes to improving learning outcomes but also supports the implementation of the Merdeka Curriculum, which emphasizes active, contextual, and learner-centered learning.

Conclusion

Based on the results of research and discussions related to the development of interactive learning media based on Articulate Storyline in IPAS lessons for fifth grade elementary school students in Enrekang Regency, several important conclusions can be drawn.

First, the media development process was carried out through systematic and structured stages, starting from the analysis of the needs of teachers and students, media design, product development, validation by experts, to field trials. Each stage was developed by taking into account the characteristics of elementary school students and the suitability with the IPAS learning outcomes in accordance with the Merdeka Curriculum, so that the resulting media was relevant and easy for students to understand.

Second, the results of expert validation show that the interactive learning media developed are very suitable for use. The average expert validation score for the material was 4.6, for the media 4.5, and for the learning 4.7 on a scale of 5.0. These results confirm that the media meet the criteria for content quality, display design, interactivity, and language readability in accordance with good learning standards at the elementary school level. Third, field trials involving 300 fifth-grade elementary school students in Enrekang Regency showed a significant improvement in student learning outcomes. The average pretest score of 57.8 increased to 79.5 on the posttest, with an N-Gain score of 0.507, which is classified as moderate. These findings prove that the use of Articulate Storyline-based media is effective in improving students' understanding of IPAS concepts and critical thinking skills.

Fourth, the interactive learning media developed was considered effective and interesting by both teachers and students. This media facilitates active and independent learning, as students can learn through visual displays, animations, interactive simulations, and quizzes that encourage cognitive and affective engagement. In addition, teachers are also assisted in delivering material and implementing technology-based learning optimally, making the teaching and learning process more efficient and enjoyable. Overall, this study confirms that Articulate Storyline-based interactive learning media is feasible and effective for use in IPAS learning in elementary schools. This media can be used as a digital learning innovation that supports the implementation of the Merdeka Curriculum, increases student motivation to learn, and enriches teachers' learning strategies.

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