
Optimizing local wisdom-based learning through digital media

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Abstract

This literature review explores the optimization of learning based on local wisdom through the integration of digital media in an effort to improve the quality of education in the midst of the challenges of cultural preservation in the era of globalization. This study aims to find out what are the digital media of local wisdom used in improving the quality of education and analyze effective strategies to integrate digital technology with local values to strengthen the cultural identity of the younger generation while improving learning outcomes. By applying the Narrative Literature Review (NLR) method equipped with a Non-Systematic Literature Review approach, this study synthesized 100 articles published between 2021-2024, where the 30 most relevant articles were then comprehensively analyzed through the process of identifying themes, categorizing findings, and evaluating the consistency of results. Of the various existing local wisdom-based digital media innovations, VR, AR, e-modules, as well as video and web platforms will be discussed in this article. The development of digital media based on local wisdom has proven itself to be an important breakthrough in the world of education, not only as a learning tool but also as a bridge between tradition and modernity

Keywords

Digital-media, education, learning, local-wisdom

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Introduction

Education is an important order for the progress of a nation. Indonesia is a country rich in cultural diversity (Jayadi, 2022). It is very important to integrate local wisdom in the process of learning and teaching activities because local cultural wisdom not only functions as a cultural identity but can also be a source of inspiration and a fun learning method. This is also in line with (Polii & Ahmadi, 2024) Local cultural wisdom is a significant foundation for education, as it enriches learning experiences, strengthens cultural identity, and supports liberating pedagogy. Research by Sakti, Endraswara, and Rohman (2024) demonstrates that education grounded in local wisdom increases the relevance of teaching materials by aligning them with students' socio-cultural contexts, thus making learning more meaningful. In today's digital era, the use of digital media in the education sector can be a bridge to optimize learning based on local wisdom. The application of digital technology in education has shown significant results in improving the quality of learning. According to a report from the World Economic Forum *Annual Report* (2022), the use of digital technology in education can improve accessibility, interactivity, and flexibility in learning. Learning based on local wisdom and innovative media is recognized as an effective approach to enhancing education quality. Local wisdom encompasses indigenous knowledge, values, traditions, and practices that evolve within communities, serving as valuable resources for contextual learning (Yaqin et al., 2024). This approach aligns education with students' cultural environments, fostering deeper engagement and relevance. Integrating local wisdom with digital learning media has been recognized as an innovative strategy to enhance educational quality (McGreal et al., 2022). This approach leverages culturally rooted knowledge and modern technology to create contextually relevant and engaging learning experiences

Digital technologies have the potential to revolutionize the way we create, share, and learn from educational content and offer new opportunities for personalized and collaborative learning (Horn, 2014). A deep understanding of the principles of psychology allows educators to create a learning environment that is responsive to each student's unique needs and potential (Biechler, 1978). Therefore, a combination of local wisdom, knowledge, and educational practices can provide a culturally and contextually relevant foundation for educational experiences (Couros, 2015). The transformation of traditional classrooms through the incorporation of digital resources and tools has the potential to challenge and improve existing teaching practices. The digital learning environment can encourage an approach between students, educators, and learning media (Gera, 2024). Therefore, students are active in the process of learning and teaching activities.

Digital tools are transforming education by creating immersive environments that deepen students' engagement with local cultural knowledge (Reinhold et al., 2024). When thoughtfully integrated, these technologies offer multiple benefits - they provide access to diverse cultural resources, enable flexible learning experiences, and increase student motivation through interactive content (Sharma & Sharma, 2021). This technological potential sets the stage for innovative approaches to cultural education, yet significant implementation barriers remain.

However, despite this potential, educators face significant challenges in effectively combining digital technologies with local wisdom-based learning. Recent studies highlight a troubling gap: while 78% of teachers recognize the value of digital tools for cultural education, only 32% feel adequately prepared to implement them (Sari et al., 2024). This disparity between recognition and readiness underscores the complexity of merging modern technology with traditional knowledge systems.

The obstacles are multifaceted. Many schools lack the necessary technological infrastructure, particularly in rural areas where local wisdom is most prevalent. Even when tools are available, teachers often struggle without proper training in both technology use and culturally responsive pedagogy (Astuti et al., 2024). This explains why well-designed digital materials based on local wisdom, though scoring highly in expert validations, frequently underperform in actual classroom implementation - a paradox that this review seeks to examine more deeply.

This article aims to synthesize existing research on the relationship between local and digital wisdom-based learning media in improving the quality of learning. Building on the identified opportunities and challenges, this literature review will discuss the main findings from the latest research on the use of digital media to support education based on local wisdom and the use of technology in every learning process. Specifically, the review will address three key questions that emerge from the current landscape: (1) What are the forms of digital media that have been used to support learning based on local wisdom, (2) How effective is the integration of digital media in supporting learning based on local wisdom to improve the quality of education, and (3) What are the challenges faced in the implementation of digital duality the intersection of digital tools and cultural knowledge.

Literature Review

Local wisdom represents a heritage of knowledge, values, and cultural practices developed and preserved by communities over generations (Sari et al., 2023). In education, it serves not only as cultural identity but also as a contextual and relevant learning resource that enriches students' experiences while strengthening their understanding of socio-cultural environments (Yaqin et al., 2024). Recent studies highlight its role in fostering inclusive and meaningful learning climates (Lestari et al., 2024). By integrating local wisdom into curricula, educators can cultivate a sense of pride and belonging among students, ensuring that learning is not only theoretical but also deeply personal and culturally resonant. This approach encourages critical thinking by comparing indigenous knowledge with modern scientific perspectives, fostering respect for diverse ways of knowing. Moreover, it promotes sustainable development by teaching students the importance of preserving ecological balance, social cohesion, and traditional arts values that are increasingly vital in a globalized yet fragmented world. Beyond the classroom, local wisdom strengthens community engagement in education, as elders and local knowledge holders become active participants in the learning process. This collaborative model nurtures mutual respect between generations and ensures the continuity of cultural heritage. Ultimately, embedding local wisdom in education helps shape well-rounded individuals who are not only academically competent but also culturally aware and socially responsible.

The digital revolution has transformed global education paradigms (McGreal et al., 2022). Technologies like e-modules, augmented reality (AR), and online platforms enable flexible, personalized learning (World Economic Forum, 2022). However, challenges persist in infrastructure readiness and educators' digital competencies (Astuti et al., 2024). Despite these advancements, significant disparities remain in digital infrastructure, particularly in rural and underdeveloped regions, where limited internet connectivity and inadequate hardware hinder equitable access (Astuti et al., 2024). Additionally, many educators face challenges in adapting to rapidly evolving digital tools due to insufficient training and support. This "digital divide" exacerbates educational inequalities, leaving marginalized students at a disadvantage. To fully harness the potential of digital education, systemic investments in broadband expansion, affordable devices, and teacher upskilling are essential. Furthermore, a balanced approach that integrates technology with human-centered pedagogy ensuring that digital tools complement rather than replace traditional learning values will be key to sustainable and inclusive educational transformation.

This integration merges traditional cultural values with modern technology, creating dynamic learning experiences (Reinhold et al., 2024). Frameworks like Technological Pedagogical Content Knowledge (TPACK) emphasize balancing technological, pedagogical, and content knowledge (Biechler, 2023). Studies show it enhances both academic outcomes and cultural appreciation (Xia et al., 2024). This study employs a Narrative Literature Review (NLR) to analyze recent research (Kraus et al., 2024). The process includes: Topic identification (digital-local wisdom integration) Systematic literature collection from peer-reviewed journals Thematic analysis to identify key trends (Eram et al., 2024). Key barriers include digital divides in rural areas and teacher training gaps (Okoye et al., 2023). Collaborative efforts among governments, institutions, and communities can address these while developing culturally responsive digital content (Wang et al., 2024).

Methodology

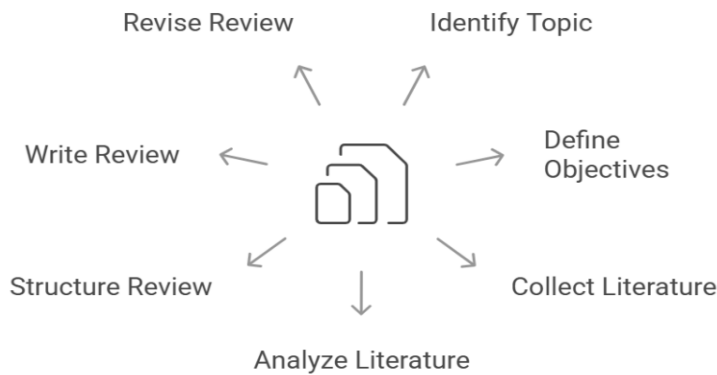
This literature review explores the optimization of local wisdom-based learning through the use of digital media to enhance education quality. The research method employed in this study is the Narrative Literature Review (NLR), which involves searching and analyzing existing literature on a specific topic by collecting data from books, journals, and other academic sources to synthesize them into a new scientific paper (Onwuegbuzie & Frels, 2016). Additionally, the NLR approach is applied to develop the theoretical framework and select relevant concepts related to the research topic (Sunaryo et al., 2024). The literature review process begins with collecting the most recent publications from 2021 to 2024. Articles related to local wisdom-based learning using digital media were identified using specific keywords, resulting in 100 relevant articles, of which approximately 30 were selected for in-depth analysis. These selected articles were then systematically reviewed and analyzed, with the findings presented in the form of a comprehensive review article.

Stages

This research stage describes the methodology and research framework used in solving research problems. Additionally, the **NLR** approach is applied to develop the theoretical

framework and select relevant concepts related to the research topic (Koman et al., 2024). The following are the stages of research methodology shown in the figure below:

Figure 1. *Process of research methodology*



Based on Figure 1 above, it can be explained the process of research methodology stages which ultimately leads to the classification of student understanding in writing scientific articles: Based on the figure above, the research methodology follows a structured Narrative Literature Review (NLR) process. This study follows the Narrative Literature Review (NLR) methodology which is structured in seven main stages. The researcher first identifies specific topics about learning based on local wisdom through digital media, then formulates a clear research objective. The next stage involves the collection of 100 related articles from trusted databases such as Scopus and Google Scholar, with the 30 most relevant articles selected for in-depth analysis. The researchers then analyzed the literature thematically to identify research patterns and gaps. The results of the analysis are arranged in a logical structure before being written into a coherent literature review. The final stage is a thorough revision to ensure academic quality and clarity of arguments. This NLR process allows researchers to present a comprehensive synthesis while identifying opportunities for further research in the field of integration of local wisdom and educational technology.

Identify topic, the first step involves determining the main research topic, which focuses on optimizing local wisdom-based learning using digital media. This step is crucial to ensure that the research aligns with current educational challenges and contributes to improving learning quality.

Define objectives, at this stage, clear research objectives are established. The study aims to explore how digital media can integrate local wisdom into education and analyze its impact on learning outcomes. Additionally, this phase helps refine the research scope by setting specific questions to be addressed through the literature review.

Collect literature, relevant literature is collected from academic databases such as Scopus, Web of Science, and Google Scholar, focusing on publications between 2022 and 2024. The selection process uses keywords related to local wisdom, digital learning, and education quality, resulting in an initial pool of 50 articles, of which 30 are selected based on relevance.

Analyze literature, the collected studies are reviewed to identify key themes, patterns, and gaps in the existing research. This stage involves categorizing the literature based on methodologies, findings, and theoretical perspectives to ensure a comprehensive synthesis of knowledge.

Structure review, the findings from the analysis are organized systematically, following a structured framework. This step ensures that the literature review presents a logical flow, addressing the research objectives effectively while integrating insights from various sources.

Write review, the structured literature is then compiled into a coherent narrative, ensuring clarity and academic rigor. The writing process focuses on synthesizing key findings, drawing meaningful conclusions, and discussing the implications of integrating digital media with local wisdom-based learning.

Revise review, finally, the review undergoes a revision process to refine the arguments, improve clarity, and ensure the study meets academic standards. This stage involves verifying citations, enhancing the structure, and ensuring that the review provides valuable contributions to the field. This structured Narrative Literature Review (NLR) methodology ensures a systematic and comprehensive approach to analyzing the role of digital media in local wisdom-based education, ultimately contributing to the improvement of education quality (Onwuegbuzie, 2016).

Findings

This stage involves analyzing and interpreting the research findings and drawing conclusions based on the results obtained. This study systematically examines three main research questions regarding the integration of digital media in learning based on local wisdom: (1) the forms of digital media used, (2) its effectiveness in improving the quality of education, and (3) implementation challenges in digital duality. The findings are presented thematically to answer each research question, based on an analysis of 30 selected studies (2021-2024) that meet the inclusion criteria. This structured approach allows for a comprehensive understanding of how digital technologies can preserve and promote local cultural knowledge while improving learning outcomes. The findings are then presented in a systematic and scientific format, often as part of a report or scientific paper.

Table 1. *Research findings*

No	Researcher(s)	Years	Key Findings	Education Policy Recommendations
1	Lambert et al.	2024	Local wisdom-based learning strengthens students' cultural identity	Integrate local cultural content into national curriculum standards
2	Yuliarti et al.	2023	Local wisdom integration improves science critical thinking	Develop culture-based science teaching guidelines

No	Researcher(s)	Years	Key Findings	Education Policy Recommendations
3	Basri	2024	Traditional learning models enhance socio-economic studies	Fund research on indigenous pedagogical approaches
4	Latifah et al.	2023	Culture-based learning improves science outcomes	Implement teacher training programs for culturally-responsive teaching
5	Okoye et al.	2023	Digital media increases accessibility of cultural materials	Invest in digital infrastructure for rural schools
6	Haerullah et al.	2023	Interactive e-modules boost critical thinking	Establish e-module development training for teachers
7	Syahfitri & Muntahanah	2024	Islamic education with local wisdom increases engagement	Develop standards for cultural integration in religious education
8	Jaelani	2020	Culture-infused learning increases student interest	Revise religious education curriculum to include local values
9	Dick and Carry	1996	ADDIE model effective for e-module development	Create national standards for digital teaching materials
10	Ade et al.	2023	Qualitative analysis evaluates e-module effectiveness	Build data-driven assessment systems for learning materials
11	Wariastuti et al.	2024	Book Creator effective for history modules	Provide digital content creation tools for educators
12	Evi	2023	Flipbook e-modules increase learning flexibility	Develop national digital repository for teaching resources
13	Manggala et al.	2024	E-modules enhance inclusive education	Implement digital inclusion policies in schools

No	Researcher(s)	Years	Key Findings	Education Policy Recommendations
14	Polii & Ahmadi	2024	VR improves folklore writing skills	Establish VR labs in model schools
15	Hajar et al.	2023	Virtual galleries enhance creativity	Allocate budgets for digital cultural content development
16	Sofia et al.	2023	AR boosts literacy and test preparation	Incorporate AR technology into national assessment systems
17	Suprpto et al.	2022	VR/AR potential for cultural tourism promotion	Create school-community partnerships for cultural tourism
18	Utaminingsih et al.	2024	Animated videos strengthen cultural understanding	Establish regional animation production centers
19	Yulianto et al.	2023	Audiovisual media improves character education	Integrate cultural media into character building programs
20	Bulkani et al.	2022	Animation improves learning outcomes (54.82 to 81.02)	Provide multimedia training for teachers
21	Pitriani	2022	Culture-based math videos effective	Create local context video libraries for STEM subjects
22	Lysia	2024	Art websites promote cultural SMEs	Launch school-based cultural entrepreneurship programs
23	Syarifuddin et al.	2022	Online photo galleries document local wisdom	Implement school-based cultural documentation initiatives
24	Smith et al.	2021	Local wisdom enhances environmental awareness	Align curriculum with sustainable development goals
25	Johnson & Lee	2020	AR increases history engagement	Include AR tools in school procurement lists

No	Researcher(s)	Years	Key Findings	Education Policy Recommendations
26	Brown et al.	2023	Interactive e-modules boost PBL participation	Develop digital collaboration infrastructure for schools
27	Garcia & Martinez	2022	VR improves abstract science concepts	Establish virtual science labs in secondary schools
28	Wilson et al.	2021	Cultural videos increase motivation	Support production of locally-relevant educational media
29	Anderson	2023	Web platforms improve remote access	Expand internet connectivity to underserved areas
30	Taylor & Clark	2022	Flipbooks enhance creativity	Provide digital creativity tools for classrooms

Based on Table 1. This table shows that the development of learning media based on local wisdom has become a global trend due to its ability to bridge traditional culture with the needs of modern education. Of the various innovations that exist, VR, AR, e-modules, and, video and web platforms will be discussed in this article.

Discussion

This study has several limitations in methods, scope, and data. The *Narrative Literature Review* approach used is more flexible than *systematic review*, so it has the potential to contain bias in study selection. The analysis is limited to the 2021-2024 publication with the predominance of the Southeast Asian context, which may not represent the global dynamics as a whole. The variation in the definition of "local wisdom" between studies also makes it difficult to compare the findings. In addition, the lack of longitudinal studies and limited access to paid literature also affect the depth of the analysis. However, the research still tries to maintain credibility through a focus on empirical studies and triangulation of sources.

Learning based on local wisdom is an educational approach that emphasizes the use of local values, knowledge, and traditions in the teaching and learning process. This approach is crucial because it not only preserves cultural heritage, but also connects students with their own cultural identity. The world of education has highlighted the importance of incorporating local wisdom into the educational environment. This approach not only helps students learn about their local environment and cultural traditions, but also connects their knowledge with real-life experiences (Lambert et al., 2024). Empirical evidence shows that students' cultural backgrounds have a greater impact on learning activities than the subject matter itself. For example, integrating local wisdom into science learning can improve critical thinking skills, scientific thinking skills, and mastery of science concepts (Yulianti et al., 2023). In today's

modern era, the integration of digital media and local wisdom in learning is increasingly an important topic of discussion. Local wisdom that includes the knowledge, practices, and traditional values of a particular region can serve as a valuable resource to enhance students' learning experience and foster a deeper connection with their cultural heritage. This is in line with (Achmadi & Basri., 2024) research that tradition-based learning models are effectively able to improve student learning outcomes in socioeconomic studies, this shows that the value of local wisdom can improve learning experiences. Learning based on local wisdom effectively improves student learning outcomes that show its value in improving the learning experience, especially in science subjects (Latifah et al., 2023) This also needs to be supported in the use of digital media.

However, in reality, in the field, there are still many teachers who focus too much on the application and introduction of technology in learning so that they forget the aspect of the local culture-based approach in it. In fact, if these two things are combined, it can create more meaningful and holistic learning. This is supported by research by Ji (2024) which states that many students today tend to forget cultural values because they are too influenced by technological currents. Other research also reveals that cultural integration in learning can increase students' sense of identity and pride in their cultural roots (He, 2023). By combining technology and culture, students not only become enthusiastic about learning, but also stay connected to their own cultural heritage. Indonesia itself has taken positive steps in efforts to integrate culture in education, one of which is through P5 (Pancasila Student Profile Strengthening Project) which emphasizes strengthening cultural values and local wisdom (Armadi & Kumala., 2023) In addition, regional languages have also been introduced and included in the curriculum as an effort to preserve the cultural richness of the archipelago (Pamungkas et al., 2023). Therefore, the challenge for teachers today is how to align the use of technology with the introduction of local culture in the learning process. Thus, education not only advances student competence in the digital era, but also maintains and respects cultural diversity as a national identity. One of the effective solutions in using a local culture-based approach is to develop and utilize digital media.

Digital media has the potential to increase the delivery and accessibility of learning materials based on local wisdom. By leveraging digital platforms, educators can create interactive and engaging learning experiences that blend traditional knowledge with modern technology (Okoye et al., 2023) Digital resources can help learners better understand the relationship between local wisdom and scientific principles, ultimately improving their science literacy and environmental awareness. For example, the development of digital textbooks and flipbooks that incorporate local wisdom has become an important field of research. These digital learning materials can provide students with a more immersive and interactive learning experience, while preserving and promoting local cultural heritage. In addition, the use of digital technology such as Augmented Reality (AR) and Virtual Reality (VR) further strengthens the learning experience based on local wisdom (Amil et al., 2023). AR and VR allow students to explore local cultures, traditions, and history in more depth through immersive simulations and visual experiences. For example, the use of VR in learning regional history can bring students into a virtual environment that replicates the cultural conditions of the past, so that they can experience firsthand how traditional community life unfolds (Polii & Ahmadi, 2024).

Gamification-based platforms are also an innovation in learning based on local wisdom. With a game-based approach, students can be more motivated in understanding material related to the culture and traditions of their area. Gamification can be applied in a variety of subjects, such as science, mathematics, and languages, by showcasing elements of local culture such as traditional games, legends, and myths in interactive challenges (Manggala et al., 2024). In addition to advanced digital technology, the use of e-modules based on local wisdom is also an effective strategy in introducing cultural values to students. This e-module can be designed with interactive multimedia features, such as videos, animations, and quizzes that are relevant to local wisdom material. The use of interactive e-modules based on local wisdom in social science learning can increase students' understanding of cultural and social values in society (Syahfitri & Muntahanah, 2024). Furthermore, the digitization of folklore in the form of audiobooks or podcasts is also an innovation in preserving local cultural heritage. With this format, students can easily access local stories through their digital devices, both in classroom learning activities and independently at home. This approach also provides flexibility for students to access materials according to their respective learning styles (Latifah et al., 2023).

The use of digital media in learning based on local wisdom also opens up opportunities for collaboration between regions. With the existence of a digital platform, various regions can share their local wisdom-based learning materials with each other, thereby enriching students' understanding of cultural diversity in Indonesia. Platforms such as interactive websites, educational applications, and online learning communities can be a forum for students and educators to explore and exchange information about cultural heritage from various regions (Sofia et al., 2023). With the continued development of digital technology, learning based on local wisdom has great potential to provide a more in-depth, interesting, and relevant learning experience for students in the modern era. Through the integration of technologies such as AR, VR, gamification, e-modules, audiobooks, and interactive digital platforms, local cultural heritage can not only be preserved, but also packaged in a format that is more attractive to the younger generation.

The development of e-modules for learning based on local wisdom is one of the strategic steps in modernizing the educational process and maintaining and introducing local cultural values. E-modules are designed to present learning materials in an interactive and engaging manner, integrating local knowledge with digital technology.

Table 2. *Research finding development of e-modules for learning based on local wisdom*

Authors	Year	Purpose of E-Module Development
Haerullah et al.	2023	Developing local wisdom-based e-modules to modernize education while preserving cultural values.
Syahfitri & Muntahanah	2024	Comparing interactive digital modules (local wisdom-based) with conventional modules,

Authors	Year	Purpose of E-Module Development
		showing significant improvement in students' critical thinking.
Jaelani	2020	Integrating Islamic Religious Education (PAI) with local wisdom to enhance student understanding and engagement.
Syahfitri & Muntahanah	2024	Designing interactive modules (with images, videos, quizzes) to boost student motivation and analytical skills.
Dick & Carry	1996	Providing the ADDIE model (Analysis, Design, Development, Implementation, Evaluation) for e-module development.
Ade et al.	2023	Analyzing the need for interactive local wisdom-based e-modules using SPSS.
Wariastuti et al.	2024	Using Book Creator to develop history e-modules, improving student outcomes in independent learning.
Evi	2023	Developing e-modules using flipbooks to enhance accessibility and flexibility in learning.
Manggala et al.	2024	Creating inclusive e-modules with interactive elements (videos, quizzes, animations, or AR/VR) for engaging learning.
Nucifera et al.	-	Highlighting teachers' potential in developing e-modules using available digital tools.
Kassem et al.	2024	Identifying challenges in e-module development, including lack of creativity and teacher confidence.
Ratnawati et al.	2024	Emphasizing the need for teacher training to design e-modules that suit diverse learning styles.

Authors	Year	Purpose of E-Module Development
Setyasi et al.	2024	Showing that low digital literacy hinders the development of digital teaching materials.
Hermansyah et al.	2023	Revealing that teachers' heavy workloads limit their time for e-module development.
Symeonidis et al.	2023	Stating that many e-modules are still text-heavy and underutilize multimedia features.
Manggala	2024	Highlighting infrastructure disparities as a barrier to e-module development.

The following are the findings from a literature review related to the development of e-modules for learning based on local wisdom (Haerullah et al., 2023) The first discovery, this study has compared interactive digital modules based on local wisdom with conventional modules and explained that interactive modules significantly improve students' critical thinking, especially in the search for truth, supporting their development for local wisdom-based learning (Syahfitri & Muntahanah, 2024) This research cuses on the development of Islamic Religious Education modules that integrate local wisdom, increasing student understanding and engagement. This is also in accordance with (Jaelani, 2020) research in integrating Islamic Religious Education (PAI) learning loaded with local wisdom to increase insight into religious knowledge and students give a positive response and there is an increase in interest in the learning process. Modules with interesting display innovations equipped with images, videos, audiovisuals, and quizzes in presenting local wisdom material can stimulate students' motivation, curiosity, and analysis and evaluation skills so that they can practice the use of students' critical thinking skills in learning (Syahfitri & Muntahanah, 2024). Research on the development of e-modules can be carried out using the ADDIE development research model developed by Dick and Carry (1996).

The development of ADDIE consists of 5 stages, namely; Analysis, Design, Development or Production, Implementation and Evaluation. The indicator aspects that are used as a benchmark in the development of e-modules for learning based on local wisdom are: 1) the learning system used, 2) students' knowledge of interactive modules, 3) students' knowledge of local wisdom and 4) biology learning resources used by students, (5) students' responses to interactive modules; (6) students' needs for interactive modules based on local wisdom. Furthermore, data was obtained from interviews. The results were analyzed qualitatively with the help of SPSS (Ade et al., 2023). There are many applications that can help to develop e-modules, one of which is using Book Creator. Using the Book Creator application to develop E-modules for history learning, proving its suitability, feasibility, and high effectiveness in improving student outcomes in independent learning (Wariastuti et al., 2024). This is different from Evi's (2023) research that e-modules can be developed by utilizing

flipbooks. E-modules increase accessibility, flexibility, and inclusivity in learning (Manggala et al., 2024).

Teachers today have great potential to create e-modules, especially with the many digital applications and tools available (Nucifera., 2022). However, the challenge often lies in a lack of creativity or confidence in implementing these tools effectively (Kassem et al., 2024). E-modules are a great solution because they are practical, portable, and can be accessed anywhere. E-modules can be equipped with interactive elements such as videos, quizzes, and animations, making learning more engaging for students. With the right training and support, teachers can hone their creativity to design e-modules that suit various learning styles and student needs (Ratnawati et al., 2024). By taking advantage of this opportunity, teachers can not only improve their teaching methods, but also make learning more flexible and enjoyable for students. Hopefully more teachers will take advantage of this potential.

The challenges in making e-modules are quite diverse. First, the limitation of technological skills is the main obstacle, as research shows that low digital literacy hinders the development of digital teaching materials (Setyasi et al., 2024). Second, lack of time and support is also a problem, as revealed in a study where teachers' dense workloads make it difficult for them to take the time to create e-modules (Hermansyah et al., 2023). Third, the lack of creativity in content design is also a challenge, according to research that states that many e-modules are still textual and underutilize multimedia features (Symeonidis et al., 2023). Finally, uneven access to infrastructure and devices also hampers the process of making e-modules, especially in areas with limited facilities (Manggala., 2024). Although the challenges in creating e-modules are quite complex, they can be overcome with the right collaboration and support. The solutions include providing training and mentoring to improve teachers' digital literacy, encouraging collaboration between teachers through learning communities, utilizing easy-to-use tools such as Canva or Google Slides, providing adequate infrastructure and tools, and allocating special time for teachers to focus on developing e-modules. With these steps, teachers can be more creative and confident in creating interactive and effective e-modules, so that digital learning is better accessible to all students.

With the creation of e-modules based on local culture, the potential to introduce and preserve local culture is huge, not only for students but also for the wider community. This is because e-modules can be accessed digitally by anyone, anytime, and anywhere, reaching a wider audience without being limited by space and time. Local cultural content presented in interactive form, such as text, images, videos, audio, or even AR/VR elements, can make learning more engaging and easier to understand. In addition, e-modules based on local culture can also be a means to increase pride and love for Indonesia's cultural heritage, as well as promote it to the younger generation and the international world. Thus, e-modules are not only an educational tool, but also an effective medium for cultural preservation and promotion.

AR and Virtual Reality development for learning based on local wisdom, the development of Augmented Reality (AR) and Virtual Reality (VR) technology opens up great opportunities to enrich learning based on local wisdom. By utilizing AR and VR, students can experience local culture, traditions and knowledge in a more interactive and immersive way. This technology can bring to life lessons that were previously only textbook-based learning but are able to create deeper engagement and real relevance to daily life. AR and VR not only make local

wisdom a subject of study, but also present a meaningful learning experience. Just like Ahmad's research that develops VR-based maritime literature learning that connects it with local Madura wisdom from Jokotole folklore, this shows that VR is able to significantly improve writing skills and involve students in reinterpreting folklore content through VR technology (Polii & Ahmadi, 2024).

This was also done by Ibnu, by developing a virtual gallery on local folklore to improve creative thinking skills in Nature Schools capable of displaying the potential of technology to integrate local wisdom that can benefit from education (Hajar et al., 2023). This is different from Eva's research which developed Augmented Reality for learning based on local wisdom to prepare AKM through literacy in grade IV students, this shows high effectiveness and acceptance rate (Sofia et al., 2023). This is also in line with Nadi, which focuses on promoting village tourism using virtual reality, showing the potential to utilize virtual reality and augmented reality for learning based on local wisdom in the development of tourism villages (Suprpto et al., 2022). The development of AR and VR is highly recommended to improve student learning outcomes.

Although AR (Augmented Reality) and VR (Virtual Reality) have become promising new media in the world of education, their application in Indonesia, especially VR, still faces major obstacles. This is mainly due to limited access and adequate infrastructure. To realize the widespread implementation of VR, government support is urgently needed, as has been done by countries such as Japan that have successfully integrated virtual reality in various sectors. Although VR tools are widely sold at affordable prices, not all teachers or educational institutions have the ability to support their optimal use. Therefore, collaboration between the government, the private sector, and the world of education is needed to create an ecosystem that supports the use of this technology for the advancement of education in Indonesia.

AR and VR are great for introducing culture because they are able to create an immersive experience, as if the user is actually in a situation or environment of the culture being shown. For example, VR can be used to introduce Indonesian history in a more interactive and interesting way, such as inviting students to visit Borobudur Temple, witness important events such as the Proclamation of Independence, or explore people's lives during the time of the archipelago's kingdoms. With VR, learning is not only limited to text or pictures, but students can feel and experience for themselves the richness of Indonesian culture and history, so that their understanding and appreciation of the nation's heritage will be deeper.

Development of Animated Videos for learning based on local wisdom, the development of animated videos for learning based on local wisdom is an innovative step in strengthening students' understanding of regional culture and traditions (Utaminingsih et al., 2024). Animation allows concepts of local wisdom that may be difficult to explain conventionally to be more vivid, interesting and easy to understand. Developing audiovisual learning media based on the local wisdom of the Baduy tribe to improve students' character, displaying the potential of animated videos in learning based on local wisdom (Yulianto et al., 2023). Developing animation learning media based on local wisdom can effectively improve student learning outcomes with the average score increasing from 54.82 to 81.02 post-test with Macromedia Flash Software for animation design (Bulkani et al., 2022). Pitriani also explained that developing mathematics learning videos based on local wisdom of Palembang with a focus on prism materials for eighth grade students integrates local culture into education through

animated videos (Pitriani, 2022). The development of animated videos for learning local wisdom is a strategic step in preserving culture while educating the younger generation. Through attractive visuals and educational storylines, animation is able to revive traditional values that have begun to be forgotten.

The creation of animation media in Indonesia that utilizes Artificial Intelligence (AI) actually has great potential to support local culture-based learning. However, even though this technology is becoming more accessible, many teachers are still unable to make optimal use of it. This is due to several factors, such as lack of understanding of technology, time constraints, and inadequate infrastructure. In fact, AI-based animation media can be a very effective tool to introduce and preserve local culture to students. For example, teachers can create animations about folklore, customary traditions, or local history that are loaded with cultural values. With AI, the animation creation process becomes faster and more efficient, and can even produce characters or backgrounds that match the cultural characteristics of a certain region. Unfortunately, many teachers do not have the skills to use AI-based animation tools, let alone integrate them into learning. In addition, not all schools, especially in remote areas, have adequate internet access or computer devices to support this.

This limitation can actually be overcome if there is support and training from the government or related institutions. For example, by holding workshops or special training for teachers to learn how to create AI-based animations that raise the theme of local culture. In addition, collaboration with local communities or cultural experts can also enrich the animated content created, making it more authentic and in-depth. If teachers are able to master this technology, AI-based animation media can be a bridge that connects the younger generation with Indonesia's cultural richness. Students not only learn through text or images, but can also "see" and "feel" their culture through interactive and engaging animations. This not only enhances students' understanding, but also fosters a sense of pride and love for the local culture. Thus, learning based on local culture can be more dynamic, relevant, and have a wide impact on the preservation of Indonesia's cultural heritage.

Development of Website for learning based on local wisdom, the development of the website can also be done to include learning based on local wisdom. This research was conducted by Lysia (2024) explaining the development of the Braga Art Website in promoting MSME products, digital citizenship, and local wisdom. This serves as a platform to market local cultural products and educate related to digital literacy, while the proposal of this research is to provide counseling on the importance of digital media to market products and apply work licensing rights in a work so that MSME actors can implement digital and always maintain local wisdom related to their artworks. The collection of data on painting MSME actors is input into a website, so that it can support the amount of information obtained by consumers when accessing the website. His research uses qualitative methods and descriptive analysis that provide an overview of the environment of MSME actors. In the field of education, this was carried out by (Syarifuddin et al., 2022) developing a website-based photography gallery by collecting data on local wisdom spread across Palembang and Surakarta. This study uses the ADDIE Model which includes the following stages: data is collected through individual interviews (cultural practitioners, historians, local residents of Palembang and Surakarta, etc.) then reviews existing websites with the same category and the final process of this study has

gone through expert validation in terms of material, media, and language, and is considered valid.

The development of websites as a medium for learning local culture has great potential to introduce and preserve Indonesia's cultural richness, but challenges such as limited internet access, lack of quality content, limited teacher skills, and lack of participation of local communities are the main obstacles. On the other hand, the website's advantages such as wide accessibility, practicality to use anytime and anywhere, and ease of content updates make it an effective tool for cultural learning. The website also offers interactivity through features such as videos, audio, quizzes, and discussion forums, which can increase user engagement. In addition, websites are scalable, meaning they can be developed as needed, and cost-effective because they don't require physical media such as books or prints. Solutions that can be done include improving internet infrastructure, providing digital training for teachers, involving local communities in content creation, and optimizing interactive features to attract users. With collaboration between the government, schools, and the community, local cultural learning websites can be an effective means to preserve and promote Indonesia's cultural heritage to the younger generation and the international community.

Conclusion and Recommendations

The development of digital media based on local wisdom has proven itself to be an important breakthrough in the world of education, not only as a learning tool but also as a bridge between tradition and modernity. Digital media not only injects motivation to learn through an interactive student-centered approach, but also expands access to quality education, especially for students in remote areas who have limited resources. However, implementation challenges such as infrastructure gaps, limited teacher training, and the need for quality local content remain barriers that need to be addressed. For this reason, further research is recommended not only to adopt a mixed-methods approach to strengthen the validity of the findings, but also to expand the scope of the study by involving more geographical variation and time periods. The development of a standard evaluation framework that is able to measure the effectiveness of various digital media ranging from VR, AR, interactive video, to e-modules is also an urgent need so that its impact can be measured more objectively and comprehensively. Thus, efforts to preserve local wisdom through technology do not only stop at innovation, but are truly able to transform education to be more inclusive, relevant, and meaningful for future generations.

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