

Research Article

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Bridging Literacy in Remote Area Toraja: Developing Multilingual Digital Learning Materials using Flipbook Apps

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Abstract

Background/purpose. Educational inequality in Indonesia's remote regions is intensified by a shortage of culturally relevant multilingual resources and insufficient teacher training. Students whose first language differs from Bahasa Indonesia face barriers in literacy acquisition, leading to persistent learning gaps. This study was conducted to design and evaluate multilingual children's literature supported by a flipbook application, with the primary purpose of improving literacy outcomes and ensuring practical usability in isolated school settings.

Materials/methods. The research employed a design-based research (DBR) framework, involving iterative cycles of design, implementation, and evaluation. The flipbook-supported literature was implemented with Grade VII students across three junior high schools in Toraja. The number of participants in the study are 68 students and 3 teachers who teach Indonesian subjects. Effectiveness was measured through student post-tests, while practicality was assessed using structured questionnaires capturing students' perceptions of usability and accessibility.

Results. Instrument validity was confirmed using the Pearson Product-Moment correlation, and paired sample t-tests indicated a significant improvement in student literacy skills (mean pre-test = 68.41, post-test = 86.89; $t(67) = -25.744$, $p = 0.000$). Observations and interviews revealed that teacher facilitation, prior exposure to digital tools, classroom management, and access to technological resources influenced the practical usability and effectiveness of the Flipbook. Differences in socioeconomic background and school facilities affected students' access to digital learning, prompting teachers to employ adaptive strategies such as printed materials, group work, and locally adapted media to maintain engagement.

Conclusion. The findings demonstrate that Flipbook-supported multilingual digital materials are practical, effective, and adaptable in remote contexts, though minor usability improvements could enhance outcomes. This study is limited to three schools and selected Toraja folktales, suggesting future research should broaden the sample and cultural content to improve generalizability and long-term literacy development.



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1. Introduction

Educational inequality in Indonesia, particularly in geographically isolated and socioeconomically disadvantaged regions, is exacerbated by several structural limitations that hinder equitable access to quality learning opportunities. These barriers manifest in inadequate infrastructure, a dearth of qualified teaching personnel, and limited access to culturally relevant learning materials, which collectively undermine the educational capacity of schools in these areas. For instance, in regions like Toraja, many students predominantly speak local languages as their mother tongues, while educational instruction is primarily delivered in Bahasa Indonesia. This misalignment poses additional challenges, complicating literacy acquisition and cognitive development among learners (Garcia & Schleppegrell, 2021; Hartmann, 2022; Polat & Lange, 2025).

Literacy is widely recognized as the foundation of educational achievement and lifelong learning; thus, its early acquisition is critical not only for academic success but also for broader socio-economic participation and identity development (Hur et al., 2020; Zoeller, 2024). Research indicates that classrooms with linguistic diversity require pedagogical strategies that are sensitive to students' linguistic backgrounds. When instruction does not align with their home languages, students may struggle with comprehension, significantly slowing down their literacy development and limiting their academic potential (Aleksić & Duruş, 2025; Duek & Nilsberth, 2022; Han, 2021). In contexts where culturally responsive pedagogies and multilingual materials are scarce, the long-term impacts on literacy acquisition can be profoundly negative, influencing educational trajectories across generations (Henry, 2020; Ratminingsih et al., 2024).

Translanguaging, an approach that encourages the use of multiple linguistic resources in educational settings, has been identified as a vital strategy for addressing these disparities. By embracing students' varied linguistic repertoires, this pedagogical stance affirms multilingualism as an asset rather than a hindrance (Presiado & Frieson, 2021; Quinn, 2021; Subiyantoro et al., 2024). Educators who adopt a translanguaging framework can create more inclusive environments where students' cultural and linguistic identities are valued, thereby enhancing literacy outcomes and fostering a deeper engagement with learning materials (Charamba & Nkomo, 2022; Xu & Shan, 2021). This practice serves as a proactive measure to bridge pedagogical gaps that arise when educational content fails to reflect local languages and cultures, thereby promoting a more equitable learning landscape (Vogelzang et al., 2024; Yafele, 2024).

Addressing educational inequity in Indonesia requires multifaceted, innovative strategies centered on inclusivity, accessibility, and pedagogical effectiveness. These initiatives should focus on creating and disseminating culturally relevant learning resources, enhancing teacher training programs to better equip educators in multilingual settings, and reinforcing the integration of home languages in instructional practices (Kusters et al., 2021; Stewart & Muszyńska, 2025). The outcomes of such strategic interventions can ultimately empower students, enabling them to thrive academically and socially within diverse learning environments.

The systemic lack of multilingual, culturally relevant literature for children in isolated regions significantly impedes the educational development of students, particularly those from indigenous and minority backgrounds. This shortage affects their ability to connect their prior linguistic knowledge with the formal curriculum, consequently hindering instructional effectiveness and reducing overall student engagement. As noted by Zaidi & Sah (2024), the scarcity of multilingual children's literature is a critical issue that exacerbates literacy deficits among these populations.

Teachers in remote areas face compounded challenges; they often lack the requisite training and digital resources needed to address these literacy gaps. This leads to a reinforcing cycle where structural deficiencies contribute to persistent inequities in educational outcomes (Mashinja & Mwanza, 2020). Effective pedagogical strategies that incorporate culturally relevant and linguistically

appropriate resources can bridge this divide, as translanguaging practices in multilingual classrooms have been shown to enhance epistemic access to students' learning processes.

Technological advancements present viable solutions to these entrenched challenges. The incorporation of technology-enhanced learning tools, such as digital storytelling, e-books, and multimedia applications, can foster student motivation while increasing accessibility to culturally adaptable learning materials. These digital innovations not only promote differentiated instruction but also cater to diverse learning preferences and linguistic backgrounds, supporting student engagement and comprehension. The integration of technology in educational contexts, particularly in remote areas, has shown promise in mitigating barriers related to literacy acquisition, thus addressing the inequities faced by these students. In summation, to combat the dual challenges of a lack of resources and insufficient teacher training in isolated regions, leveraging digital innovations and culturally relevant pedagogy presents a crucial strategy. These approaches not only enhance literacy but also promote more equitable educational outcomes for students in marginalized communities.

Flipbook applications have emerged as innovative digital solutions that blend traditional reading experiences with interactive features, significantly enhancing pedagogical practices. Flipbooks combine visual and textual elements, akin to those in printed books, while integrating multimedia components, such as audio, video, and hyperlinks, which facilitate deeper comprehension and engagement among students (Nuha et al., 2021; Roemintoyo & Budiarto, 2021). Studies indicate that materials embedded in flipbooks not only heighten student motivation but also promote self-paced learning amidst diverse classroom scenarios (Sabitri et al., 2024; Yani et al., 2023). This adaptability makes flipbooks a promising resource in environments where conventional publishing methods are accessible, thereby democratizing educational resources (Awaliyah et al., 2023).

In multilingual contexts, the flipbook's design can seamlessly incorporate multiple languages, foster inclusivity, and address literacy disparities within diverse student populations. The integration of local languages alongside standard languages, like Bahasa Indonesia, supports literacy development while affirming cultural identities within the classroom. Such pedagogical strategies are crucial for enhancing metalinguistic awareness and leveraging students' linguistic backgrounds to improve literacy skills (Anas & Hasibuan, 2023; Sabitri et al., 2024; Wulandari & Nurharini, 2023). Research underscores the effectiveness of multilingual digital children's literature in cultivating better literacy outcomes, suggesting that exposure to such resources promotes not only comprehension but also educational equity (Yani et al., 2023).

Despite these advantages, the literature reveals significant limitations regarding the application of flipbook technology across various contexts. Current research is predominantly centered on urban environments with ample resources, leaving a gap in understanding the efficacy of these tools in rural or underserved areas (Khaerunnisa et al., 2023; Zou et al., 2021). Furthermore, while the benefits of multilingual education are well-established, empirical evidence linking the practical use of digital tools in enhancing literacy outcomes in low-resource settings remains elusive. Questions about the usability, accessibility, and effective integration of flipbooks into daily classroom routines persist, necessitating further investigation (Wulandari & Nurharini, 2023). The present study seeks to address these gaps by designing, implementing, and evaluating a multilingual children's literature product supported by a flipbook application for Grade VII students in remote areas of Toraja. Based on the background mentioned above, the research questions of study are (1) How is the effectiveness of multilingual children's literature teaching materials based on flipbook applications in improving the literacy skills of students in remote areas?, (2) How is the effectiveness of multilingual children's literature teaching materials based on flipbook applications in improving the literacy skills of students in remote areas?, (3) How are the experiences of teachers and students from socioeconomic backgrounds different in facing challenges Gaps in access and use of digital technology in the learning

process?. The objective is to examine both the effectiveness of the product in enhancing literacy skills and its practicality in real classroom contexts. By systematically analyzing student performance and feedback across multiple schools, this research provides empirical validation of an instructional innovation tailored to the needs of marginalized learners. The novelty of this study lies in its integration of multilingual pedagogical principles with digital flipbook technology, offering a model that is both culturally responsive and technologically feasible. Ultimately, the study contributes to the broader discourse on equity in education by demonstrating how digital innovations can be harnessed to support literacy development in geographically and socioeconomically disadvantaged settings.

2. Literature Review

2.1. Educational Inequality and Literacy Challenges in Remote Contexts

Educational inequality remains a persistent challenge, especially in remote areas of developing countries like Indonesia. Structural barriers such as inadequate infrastructure, a shortage of qualified educators, and the unavailability of culturally relevant learning materials significantly impede access to quality education. This issue is acutely evident in regions like Toraja, where linguistic differences between students' home languages and the national language, Bahasa Indonesia, complicate the instruction of literacy and comprehension skills. The UNESCO (2020) report emphasizes that literacy is not merely an academic requirement but a cornerstone for lifelong learning and social inclusion, making its disparities in these marginalized settings particularly concerning.

The linguistic diversity present in Indonesia necessitates pedagogical frameworks that integrate students' home languages into the learning process. Hornberger (2009) argues that effective instruction should be inclusive of students' linguistic repertoires, as such approaches foster better comprehension and engagement in learning activities. Unfortunately, the scarcity of multilingual educational resources in these remote schools exacerbates literacy challenges and hinders cognitive development. Cummins (2000) notes that excluding students' native languages from instruction can stagnate their cognitive and linguistic growth. Similarly, Rasmin & Samsudin (2024) highlight the vulnerability of indigenous and minority groups when educational materials do not resonate with their cultural and linguistic backgrounds. This collective evidence underscores the pressing need for multilingual and inclusive educational resources to bridge existing literacy gaps in Indonesia's remote educational settings.

Recent studies have identified translanguaging as an effective pedagogical strategy in multilingual classrooms, promoting the use of all linguistic resources available to students. Putrawan & Sinaga (2022) advocate for recognizing translanguaging as essential for teaching English in Indonesia, suggesting it can facilitate various academic practices while enhancing comprehension for multilingual learners. Moreover, research by Rasmin & Samsudin (2024) reinforces the importance of incorporating local languages in instruction to support cognitive and linguistic development among students. Such instructional approaches not only affirm students' identities but also enhance their academic performance by allowing them to navigate complex linguistic landscapes more effectively. In light of these challenges and supports, the educational inequality and literacy deficits in remote Indonesian regions call for a concerted effort towards integrating multilingualism and culturally relevant pedagogies into the educational framework. Ensuring access to resource-rich, inclusive, and linguistically responsive educational materials could significantly mitigate these disparities, facilitating a more equitable learning environment for all students.

In conclusion, as Indonesia grapples with educational disparities, especially in remote areas, a focus on fostering multiliteracy through the integration of local languages and translanguaging teaching strategies represents a crucial step forward. Addressing these critical factors can play an

essential role in promoting literacy and educational success among marginalized communities in Indonesia.

2.2. The Central Research Problem: Scarcity of Multilingual Materials

The challenge of integrating multilingual literature into educational settings in isolated regions, such as many areas in Indonesia, significantly hampers students' learning experiences, particularly for those whose first language is not Bahasa Indonesia. Research has shown that students achieve better comprehension and engagement when they encounter instructional resources that reflect their home languages, as these resources validate their identities and support cognitive development (Kirss et al., 2021; Zahro, 2023). Such a context affirms the importance of students' linguistic backgrounds in educational settings and addresses broader issues of equity in educational access and success for multilingual learners.

Despite the acknowledged benefits of multilingual educational materials, the systemic insufficiency of these resources in Indonesian classrooms, specifically in remote regions, remains a pressing issue. This scarcity of multilingual literature correlates with students' struggles in understanding the educational content presented in Bahasa Indonesia, which may not be their first language. Access to relevant linguistic resources has been shown to enhance learners' academic performance and foster a more inclusive educational atmosphere (Putrawan et al., 2022; Zhunussova et al., 2024). However, even as the necessity for multilingual literature is recognized, its implementation remains largely absent, perpetuating a cycle of academic disadvantage for multilingual students (Duarte et al., 2020; Wang et al., 2021).

Compounding the issue is the lack of teacher preparedness and training in utilizing multilingual pedagogical approaches. Research indicates that many educators teaching in multilingual contexts lack the skills and knowledge to effectively incorporate diverse linguistic backgrounds into their teaching practices (Messenger & Gallagher, 2024; Wunseh, 2023). Furthermore, the professional development opportunities available to these educators are often limited, exacerbating the challenges of balancing linguistic diversity in the classroom (Eslit, 2023; Noutchie, 2024). The integration of technology in the educational process, which can significantly aid in delivering multilingual content, is also hindered by inadequate infrastructure and support (Roberts & Olarte, 2023). As a result, teachers find themselves at a disadvantage, unable to create engaging and responsive learning environments that cater to their students' varied linguistic needs.

The research problem encompasses several interrelated facets: the insufficient provision of multilingual and culturally responsive children's literature, the inadequate training and professional development opportunities for teachers, and the limited access to technological resources that can facilitate diverse learning modalities. Addressing these gaps is essential to fostering an inclusive educational framework that recognizes and validates students' multilingual identities, encouraging not only academic achievement but also personal and cultural growth (Duarte et al., 2020). Efforts to implement multilingual literature and support teacher development are crucial in breaking down the barriers faced by students in isolated educational settings.

2.3. Digital Technology as a General Solution in Education

Digital technology has increasingly become a pivotal tool in addressing educational disparities, particularly in resource-constrained environments. Advances in educational technology allow the creation of engaging, interactive, and adaptable learning materials that cater to diverse learning needs, ultimately enhancing the educational experience for students from various backgrounds. Kučírková & Jarkovská (2016) highlight the effectiveness of digital storytelling and multimedia applications, which boost student motivation and improve comprehension through various modalities of content presentation. This assertion aligns with Mayer's cognitive theory of multimedia

learning, which advocates that multimodal presentations—integrating visual, auditory, and textual components—enhance learners' ability to form connections and retain knowledge effectively. The versatility of digital formats enables differentiated instructional methods; for example, digital platforms can easily integrate text, images, and audio to support varied learning styles, which is particularly beneficial for literacy development.

Moreover, empirical studies depict the benefits of interactive digital tools in educational settings and reinforce the notion that students, particularly those in disadvantaged contexts, can significantly improve their learning outcomes when provided with self-paced, engaging digital platforms. For instance, Gopinathan et al., (2022) suggest that the use of digital collaborative tools supports student engagement, which is vital in literacy acquisition—an essential aspect in combating educational inequities. In areas where traditional print resources are limited, the rapid dissemination and updating capabilities of digital content present a practical alternative, making digital solutions vital for learners in isolated or underserved regions.

The successful integration of digital technologies into learning environments is evident in studies on students' experiences during transitions to remote learning. For example, how digital tools facilitate learning and change methods of instruction, reflecting how digital tools modulate interaction and engagement in classrooms. Reports indicate that students tend to express a strong preference for interactive and dynamic learning mediums that not only supplement traditional instructional methods but also encourage active participation, fostering a more profound educational experience. These findings reflect a larger trend advocating for technology-enhanced pedagogies that cater to the needs of diverse learners while helping to bridge educational gaps rooted in socio-economic disparities.

2.4. Flipbook Applications as a Specific Digital Solution

Flipbook applications have emerged as transformative instructional media, effectively bridging traditional reading experiences with contemporary digital interactivity. These applications simulate the act of reading a printed book while integrating multimedia features, thereby enhancing student engagement and learning outcomes. Awaliyah et al., (2023) state that resources based on flipbook technology can increase student motivation and learning outcomes, supporting independent learning and catering to diverse learning styles. Similarly, Susanto et al., (2022) report a significant increase in student motivation and engagement facilitated by such applications.

The advantages of flipbook technology are particularly pronounced in educational environments where logistical constraints make the distribution of traditional print materials challenging. Alviano Firhan, Oktawati Hersysa (2020) emphasize the relative cost-effectiveness of producing and disseminating flipbooks, allowing educators to create resources accessible to diverse learners, including multilingual classrooms (Karimah et al., 2023). This capability is pivotal in regions that require instructional materials in multiple languages, aligning educational resources with students' linguistic needs.

Moreover, flipbooks serve as effective teaching tools in enhancing literacy, particularly for learners with limited proficiency. By embedding audio narrations and visual aids, flipbooks create an inclusive learning environment that addresses diverse literacy levels and supports readers in developing their skills incrementally (Kharisna & Amini, 2023). Widiawati et al. (2023) corroborate this perspective, noting that digital formats prioritizing interactivity can foster greater engagement and understanding among students. This is particularly vital in educational contexts that increasingly rely on technology, where student engagement with diverse material formats correlates strongly with improved educational outcomes.

The integration of flipbook technology within pedagogical frameworks illustrates a significant shift from conventional instructional methods towards more dynamic learning experiences. Such digital innovations necessitate continued adaptation to meet evolving educational demands, ensuring that digital tools remain effective in fostering learning. Various studies underscore the importance of equipping educators with the skills to use flipbook applications effectively, thereby further promoting their adoption in mainstream education (Jayanti & Setyasto, 2024). This comprehensive adoption enhances teaching practices and prepares students for a digitally-driven future by fostering skills such as critical thinking and creativity through interactive learning experiences (Purba, 2025).

2.5. Multilingual Digital Literature as a Targeted Intervention

The integration of multilingual content into digital formats is increasingly recognized as a strategic approach to addressing literacy disparities in linguistically diverse classrooms. Researchers advocate that exposure to multilingual resources can significantly enhance metalinguistic awareness, which plays a crucial role in literacy development. Zaidi et al. (2022) point out that multilingual instruction not only affirms students' cultural identities but also enhances inclusivity, which is vital for maintaining student motivation. This perspective is mirrored in the findings of Machado & Gonzales (2020), who present empirical evidence indicating that multilingual e-books and digital stories lead to improved literacy outcomes in minority populations, highlighting the effectiveness of culturally relevant resources in fostering engagement and learning.

The practicality of digital formats offers additional benefits, particularly in low-resource environments where instructional materials can be readily updated to reflect current curricula. This adaptability is especially significant for remote educational contexts, such as in Indonesia, where multilingual digital literature serves to bridge language barriers while providing engaging and accessible content. The merging of multilingualism with digital literacy is not only about improving academic outcomes but also about reshaping the educational environment, creating spaces where cultural diversity is recognized as an asset rather than a barrier. In this manner, integrating digital and multilingual instruction can cultivate a more inclusive atmosphere that encourages diverse linguistic capabilities to flourish.

Furthermore, the importance of designing educational materials that reflect linguistic diversity and are tailored for broader dissemination cannot be overstated. Zaidi et al., (2022) emphasize the role of dual language books in enhancing language awareness and engagement in educational settings, thereby reinforcing the need for resources that acknowledge linguistic realities. Similarly, Machado & Gonzales (2020) highlight how translanguaging practices within the classroom enable students to navigate and negotiate their linguistic environments effectively, thus furthering their literacy and language skills. Research underscores the necessity of embracing a pedagogy that allows for the fluid use of multiple languages, creating opportunities for students to engage with content meaningfully in their own linguistic contexts.

3. Methodology

This research employed the Design-Based Research (DBR) methodology, Design-Based Research (DBR) methodology is increasingly recognized in educational studies for its ability to bridge theoretical frameworks and practical application through dynamic cycles of design, implementation, analysis, and refinement (Lehrmann et al., 2022; Shieh et al., 2023). This essential characteristic of DBR makes it particularly effective for developing educational interventions that align with the contextual realities of remote schools, representing a customized response to the unique challenges faced in these settings. Researchers have highlighted the collaborative nature of DBR, which facilitates co-design between researchers and educational practitioners, ensuring that proposed

solutions are not only theoretically informed but also grounded in the actual needs of the learners and educators involved (Cochrane et al., 2024; Tinoca et al., 2022).

3.1. Research Design and Framework

The study was structured into three major DBR phases: (1) problem identification and needs analysis, (2) design and development of digital media, and (3) implementation and evaluation. This cyclical structure fosters continuous feedback and collaborative reflections, which are pivotal in enhancing the effectiveness and relevance of the developed interventions (Howell et al., 2023; Wilson et al., 2025). During the problem identification phase, researchers conducted preliminary observations and interviews with educators and students in rural school settings to understand the educational context and specific challenges faced in using digital instructional media. This needs analysis helped shape the initial design criteria for the educational content, ensuring its relevance and usability.

3.2. Participants and Sampling Strategy

Purposive sampling was employed to select participants who could provide rich and relevant data aligned with the research objectives. This non-probabilistic strategy was used to ensure that participants had direct experience with the use of digital instructional media in educational contexts, particularly within under-resourced rural schools.

The participants in this study consisted of 3 Indonesian teachers and 9 junior high school (SMP) students who were directly involved in learning activities using multilingual digital materials via the Flipbook application in remote areas of Toraja. The teacher chosen is an Indonesian-language teacher with at least 10 years of experience teaching in junior high school. This criterion was chosen because Indonesian teachers play a strategic role in improving students' literacy skills, understanding the dynamics of multilingual text-based learning, and assessing the effectiveness of digital media use in literacy learning in areas with limited access, such as Toraja. In addition, these teachers are expected to provide pedagogical reflections on the challenges and successes of integrating Flipbook into teaching and learning.

Meanwhile, student participants were selected from a population of 68 junior high school students who had used Flipbook to learn. From this population, nine students were selected purposively based on the literacy ability cluster, which consisted of three groups: high, medium, and low, each totaling three people. This grouping is based on teacher observations, literacy scores, and the level of student participation during the learning process. Students with high literacy skills are chosen because they can provide an in-depth view of the advantages of Flipbook in supporting the understanding of text content and structure. Moderate-ability students represented a group that was adaptive to learning media innovations, while low-ability students were selected to assess the extent to which Flipbooks could help improve their reading interest and understanding of multilingual-based children's literature materials.

3.3. Development of Digital Instructional Media

Based on findings from the needs analysis, the research team collaborated with teachers to co-design digital instructional media that aligned with the existing curriculum and addressed specific learning objectives. The co-design process was a critical feature of the DBR methodology, as it ensured that the media reflected both pedagogical theory and classroom realities.

The media development phase involved creating digital content using accessible and low-bandwidth formats to accommodate the infrastructural limitations of rural areas. Initial prototypes were reviewed by a panel of educational technology experts and revised based on their feedback.

The iterative design and feedback cycle enhanced the usability and instructional quality of the materials.

3.4. Implementation Procedures

Following the development phase, the digital media were implemented in selected classrooms over a period of six weeks. Teachers were provided with brief training sessions to ensure their familiarity with the content and intended pedagogical strategies. This professional development component was essential for effective implementation and is consistent with DBR's focus on practitioner collaboration and capacity-building.

During implementation, researchers conducted classroom observations and collected feedback from both teachers and students. Observations focused on how the digital media were integrated into instructional activities, student engagement levels, and any logistical challenges that arose. The data collected informed the subsequent refinement of the instructional materials.

3.5. Evaluation and Data Collection Methods

Multiple data collection methods were employed to evaluate the practicality and effectiveness of the digital instructional media. Quantitative data were gathered through structured questionnaires distributed to students and teachers at the end of the implementation period. These instruments measured dimensions such as usability, engagement, satisfaction, and perceived learning outcomes. Jumlah angket yang diberikan kepada siswa berjumlah 20 soal melalui pre test dan 20 soal melalui post test yang dilakukan. The 20 multiple-choice questions cover various aspects of understanding the story, such as characters and their roles, the flow of events, the setting of place and time, the meaning or moral message, and the sequence of important events. Through this questionnaire, the researcher can assess the extent to which students understand the content, structure, and values of Toraja folklore.

Qualitative data were obtained through semi-structured interviews with participating teachers and students. Qualitative data in this study were obtained through semi-structured interviews with 9 participants, comprising 3 Indonesian teachers and 6 junior high school students in a remote area of Toraja. All participants have completed learning activities involving questions about multilingual digital children's literature materials using the Flipbook application developed by the researcher. The interview was conducted face-to-face after respondents completed a learning satisfaction questionnaire, lasting between 20 and 30 minutes per interview. The semi-structured interview was chosen to explore users' experiences, perceptions, and satisfaction with the Flipbook application in literacy learning within the local Toraja culture. Each interview consists of 10 main questions, accompanied by follow-up questions (probes) to deepen understanding of the respondents' answers. These sessions provided deeper insights into user experiences and allowed for a more nuanced evaluation of the media's impact. In addition, observational checklists were used during classroom visits to systematically record students' interactions with digital materials and the instructional flow.

The integration of qualitative and quantitative data collection allowed for methodological triangulation, which enhanced the validity and reliability of the findings. The evaluation also included expert reviews of the media content, which assessed alignment with curricular standards and instructional soundness.

3.6. Validation of Instruments and Content

Instrument validation was a key component of the methodology to ensure the accuracy and relevance of the tools used for data collection. All questionnaires and observation checklists underwent a multi-phase validation process, beginning with expert review by educational

practitioners and instructional designers. Feedback from this process was incorporated to improve item clarity and content validity.

Pilot testing of the instruments was conducted with a small group of non-participating teachers and students who shared similar characteristics with the study population. Data from the pilot tests were analyzed to determine internal consistency and item reliability, with necessary revisions made before full-scale deployment.

The digital instructional media themselves were validated using a content evaluation rubric adapted from Shieh et al., (2023), focusing on usability, pedagogical soundness, and learning effectiveness. A panel of experts independently reviewed the materials, and their scores were averaged to determine overall quality. This systematic review process ensured that the media met established educational standards.

3.7. Ethical Considerations

Ethical standards were upheld throughout the research process. Participants were informed of the study's purpose, procedures, and their rights, including voluntary participation and withdrawal. Consent was obtained from all participants or guardians in the case of minors. Anonymity and confidentiality were maintained in data reporting, and all data were securely stored and used exclusively for research purposes.

By applying a rigorous DBR methodology supported by validated instruments and collaborative practices, this study developed and refined digital instructional media that are contextually appropriate, pedagogically sound, and capable of enhancing learning outcomes in rural educational settings.

4. Results

The implementation of multilingual digital children's literature, supported by a flipbook application, was designed to address persistent challenges in literacy education in remote Indonesian schools. This study evaluated the product in terms of both its effectiveness, measured by student learning outcomes, and its practicality, assessed through student feedback and supported by teacher and student interviews. These two dimensions were chosen as they are widely recognized in educational research as critical indicators of instructional innovation, determining not only whether a product can enhance comprehension but also whether it can be sustainably integrated into real classroom settings. The results presented below provide empirical evidence from three junior high schools, SMP 3, SMP 4, and SMP 5, demonstrating how the product performed across diverse learning contexts, highlighting both its instructional value and areas for refinement.

4.1. Practical of Multilingual Digital Children's Literature Teaching Material Supported by a Flipbook Application for Children in Remote Areas

The implementation of the multilingual digital children's literature teaching material, supported by a flipbook application, demonstrated notable levels of effectiveness across three different schools: SMP 3, SMP 4, and SMP 5. The measurement of effectiveness was assessed through post-test scores administered after the completion of the learning intervention. The outcomes highlight both the instructional validity of the product and its adaptability across different student populations.

To ensure that the assessment of the learning material's effectiveness is accurate and reliable, an instrument validity test was conducted prior to data analysis. The validity of each questionnaire item was evaluated using the Pearson Product-Moment correlation in SPSS, which determines whether the items appropriately measure the intended constructs. The results of this validity analysis are presented in Table 1.

Table 1. Instrument Validity Test Results

Item No.	Pearson Correlation (r)	Sig. (2-tailed)	r _{table} (N = 68, α = 0.05)	Validity Category
1	0.732	0.000	0.239	Valid
2	0.685	0.000	0.239	Valid
3	0.701	0.000	0.239	Valid
4	0.764	0.000	0.239	Valid
5	0.749	0.000	0.239	Valid
6	0.812	0.000	0.239	Valid
7	0.693	0.000	0.239	Valid
8	0.778	0.000	0.239	Valid
9	0.735	0.000	0.239	Valid
10	0.801	0.000	0.239	Valid

The instrument validity test was conducted using the Pearson Product-Moment correlation in SPSS version 26. With an r_{table} value of 0.239 for N = 68 at a 0.05 significance level, all calculated r-values exceeded the r_{table} and all Sig. (2-tailed) values were less than 0.05. This indicates that all items are valid and appropriately measure the constructs related to the effectiveness of the multilingual digital learning product.

Table 2. Descriptive Statistics for Pre-Test and Post-Test Scores

Paired Samples Statistics					
		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre-test	68.41	68	6.752	.819
	Post-test	86.89	68	5.431	.658

The results show an increase in the mean score from the pre-test (M = 68.41) to the post-test (M = 86.89) for 68 students. The relatively small standard deviations indicate consistent data, suggesting that most students experienced improvement after using the digital multilingual learning product. These descriptive results support the assumption that the learning intervention positively impacted students' comprehension, which will be further confirmed through the Paired Samples Test (t-test).

Table 3. Paired Samples t-Test Results for Pre-Test and Post-Test Differences

Paired Sample Test								
Paired Differences								
		Mean Difference	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	Sig. (2-tailed)
					Lower	Upper		
Pair 1	Pre-test – Post-test	-18.48	5.923	0.718	-19.91	-17.05	-25.744	.000

Before discussing the interpretation of the numbers in the "Paired Samples Test" output table above, it is first necessary to understand the formulation of the research hypotheses and the guidelines for decision-making in the paired sample t-test. Formulation of the Research Hypotheses:

H_0 (Null Hypothesis): There is no significant difference in the level of practicality when using the multilingual digital children's literature flipbook teaching material in remote areas.

H_1 (Alternative Hypothesis): There is a significant difference or improvement in the level of practicality when using the multilingual digital children's literature flipbook teaching material in remote areas.

The guidelines for decision-making in the paired sample t-test based on the significance value (Sig.) from the SPSS output are as follows:

1. If the Sig. (2-tailed) value < 0.05 , then H_0 is rejected and H_1 is accepted.
2. Conversely, if the Sig. (2-tailed) value > 0.05 , then H_0 is accepted and H_1 is rejected.

The mean difference of -18.48 indicates a decrease in scores from the pre-test to the post-test. This suggests an improvement in the level of practicality, as the post-test scores are higher than the pre-test scores. The standard deviation is 5.923, and the standard error of the mean is 0.718. The 95% confidence interval of the difference ranges from -19.91 to -17.05. The t-value is -25.744, with a degree of freedom (df) of 67, and the p-value (Sig. 2-tailed) is 0.000. At a significance level of $\alpha = 0.05$, the decision rule is as follows:

1. If the p-value $< \alpha$, then H_0 is rejected.
2. If the p-value $\geq \alpha$, then H_0 is accepted.

From the table, the p-value is 0.000, which is less than 0.05, indicating statistical significance. The 95% confidence interval (-19.91, -17.05) does not include zero, supporting the conclusion that the difference between the pre-test and post-test scores is real. Furthermore, the t-value of -25.744 indicates a highly significant difference between the pre-test and post-test scores. Based on the results of the paired sample test:

1. H_0 is rejected
2. H_1 is accepted

This indicates a significant improvement in practicality when using the multilingual digital children's literature flipbook teaching material in remote areas of Toraja. The findings suggest that the digital flipbook effectively enhances teachers' practical application of the material and the overall effectiveness of instruction in the field.

4.2. The Effectiveness of Multilingual Digital Children's Literature Teaching Material Supported by a Flipbook Application in Improving Literacy Skills of Students in Remote Areas

The practicality of the multilingual digital children's literature teaching material, supported by a flipbook application, was systematically assessed using structured student feedback collected through questionnaires. In this study, practicality refers to the product's usability, accessibility, and integration into classroom instruction, as well as its ability to support students' learning experiences. Practicality is a crucial factor in determining the success of instructional innovations, as it directly impacts sustainability and long-term adoption.

Inferential Statistics

To determine whether the observed differences in practicality before and after using the flipbook-supported teaching material were statistically significant, a Paired Sample t-test was conducted in SPSS.

Table 4. Inferential Statistics and Paired Samples t-Test for Teaching Material Practicality

Paired Sample t-test								
Pair	Mean Difference	Std. Deviation	Std. Error Mean	95% CI Lower	95% CI Upper	t	df	Sig. (2-tailed)
Pre-test – Post-test	-18.48	5.923	0.718	-19.91	-17.05	-25.744	67	0.000

The mean difference of -18.48 indicates a substantial improvement from pre-test to post-test scores. The negative value reflects higher post-test scores, signifying enhanced student literacy performance and increased practicality of the material. The standard deviation of 5.923 and standard error of the mean of 0.718 demonstrate relatively low variability in student responses. The 95% confidence interval (-19.91, -17.05) does not include zero, further confirming a statistically significant improvement.

At a significance level of $\alpha = 0.05$, the p-value = 0.000, which is well below 0.05. Therefore, the null hypothesis (H_0) is rejected, and the alternative hypothesis (H_1) is accepted, indicating that the flipbook-supported multilingual digital literature material significantly improved students' literacy skills and demonstrated high practical usability.

Comparative analysis across SMP 3, SMP 4, and SMP 5 highlights that the product consistently achieved "High" practicality ratings, although with incremental differences. SMP 3's slightly lower scores suggest areas for refinement, particularly in navigation and visual support. SMP 4 and SMP 5 achieved higher scores due to favorable classroom conditions, prior digital exposure, and effective teacher facilitation.

These findings indicate that the flipbook-supported multilingual teaching material is not only practical and user-friendly but also adaptable across diverse school contexts. The results provide strong evidence of the product's scalability, suggesting that with minor improvements, it can achieve optimal usability and effectiveness in remote areas, supporting literacy development sustainably and engagingly.

4.3. The experiences of teachers and students from different socioeconomic backgrounds in facing the challenges of access gaps and the use of digital technology in the learning process.

a. The Use of Digital Technology in Learning

The participants in this study comprised three Indonesian-language teachers and nine junior high school (SMP) students who were directly engaged in learning activities using multilingual digital children's literature teaching materials supported by the Flipbook application in remote areas of Toraja. The selected teachers had at least 10 years of teaching experience at the junior high school level. This criterion was applied because Indonesian language teachers play a pivotal role in enhancing students' literacy skills, understanding the dynamics of multilingual text-based learning,

and evaluating the effectiveness of digital instructional media, particularly in contexts with limited access, such as Toraja. Moreover, these teachers were expected to provide pedagogical reflections on both the challenges and successes associated with integrating the Flipbook into classroom instruction.

Student participants were drawn from a population of 68 junior high school students who had experienced learning with the Flipbook. From this population, nine students were purposively selected according to literacy skill clusters, comprising three groups—high, medium, and low literacy levels—with three students in each cluster. The classification was based on teacher observations, literacy assessment scores, and levels of participation during the learning process. Students with high literacy skills were selected to provide detailed insights into the Flipbook’s capacity to enhance comprehension of content and text structure. Students with medium literacy skills represented those who are responsive to innovative learning media. In contrast, students with low literacy skills were included to evaluate the extent to which the Flipbook could foster reading interest and improve their understanding of children’s literature.

During the interviews, the three teachers demonstrated different approaches to utilizing digital technology in their teaching, largely influenced by their technical skills and the available school facilities.

Teacher A from SMPN 3 reported, *“I regularly use Google Classroom, Canva, and Flipbook to create interactive lessons for my students. These tools help me make learning more engaging and dynamic.”*

Teacher B from SMPN 4 preferred simpler platforms, stating, *“I mostly use PowerPoint and WhatsApp Groups because they are easy for students to access and follow. Not all students have advanced devices, so I try to keep it simple.”*

Teacher C from SMPN 5 relied primarily on personal mobile devices, explaining, *“I make simple learning videos using my phone. It is the only tool I have, but I try to make it as clear as possible for my students.”*

These interviews revealed that differences in socioeconomic background and school facilities significantly influence the type and quality of technology integration. Teachers with better resources were able to innovate more extensively. At the same time, those with limited economic means had to rely on basic tools, which affected the scope and interactivity of their digital instruction.

The observations and interviews collectively revealed that students’ engagement with the Flipbook-supported learning material was closely linked to both teacher facilitation and the availability of technological resources. In SMP 3, students demonstrated moderate ease in navigating the Flipbook, which corresponded to Teacher A’s use of multiple digital platforms, such as Google Classroom, Canva, and Flipbook, to create interactive lessons. While students generally responded positively, some reported minor navigation difficulties, aligning with the observation that classroom guidance was necessary for optimal use. In SMP 4, students displayed smoother interaction with the Flipbook, reflecting Teacher B’s choice of simpler, more accessible tools, such as PowerPoint and WhatsApp Groups, which were easier for students to follow. Observations confirmed that prior exposure to digital learning platforms contributed to greater adaptability and engagement. Meanwhile, in SMP 5, students exhibited the highest levels of engagement and comprehension, which corresponded to Teacher C’s reliance on personal mobile devices to produce tailored learning videos. The combination of smaller class sizes, more personalized instruction, and students’ familiarity with technology facilitated an environment in which the Flipbook could be maximally effective. Overall, these findings indicate that both teacher competence and the availability of

technological resources significantly shape students' ability to benefit from digital instructional materials in remote learning contexts.

b. Primary Obstacles in Technology Use

The integration of digital technology into classroom instruction in remote areas of Toraja faces significant challenges, primarily due to limited internet access and unstable network connectivity. All three teachers in this study reported encountering these issues, although their ability to overcome them varied by socioeconomic background and access to technological resources. Teacher A from SMP 3, who had access to moderate technological resources, described frequent lesson disruptions caused by slow network speeds: *"Sometimes the network is too slow for the Flipbook or Google Classroom, so I have to prepare offline materials as a backup."* Observations confirmed that these interruptions occasionally halted instruction, requiring the teacher to provide additional guidance or alternative learning materials. These pauses affected students' engagement, as they often had to wait for content to load or redo interrupted tasks.

Teacher B from SMP 4 reported similar constraints but relied on simpler, more accessible tools, such as PowerPoint and WhatsApp Groups: *"I rely mostly on WhatsApp because the school signal is weak, and not all students can access the online content at the same time."* Observations showed that this strategy allowed students to access lessons asynchronously, minimizing some negative effects of connectivity issues, though real-time interaction with the Flipbook content was limited. Teacher C from SMP 5 relied on personal mobile devices and hotspots to deliver digital lessons. This teacher highlighted both the benefits and limitations of this approach: *"Using my personal hotspot helps, but it's not always stable, especially when many students are online simultaneously."* In SMP 5, where class sizes were smaller, students experienced fewer disruptions and could interact more effectively with the Flipbook, illustrating how classroom conditions can mitigate technological challenges.

Students' experiences mirrored these teacher-reported obstacles, providing insight into how access disparities affected learning outcomes. In SMP 3, students frequently encountered slow loading times and interrupted activities. One student noted, *"I liked using the Flipbook, but sometimes the pages didn't load, and I had to wait a long time."* Similarly, in SMP 4, students appreciated the accessibility of WhatsApp-based lessons, yet some experienced delays in receiving content or missed parts of lessons due to connectivity interruptions: *"It was easy to follow the lessons, but sometimes I missed parts because the internet kept disconnecting."* In SMP 5, students generally reported smoother access, although occasional delays occurred when multiple students used the hotspot simultaneously: *"The lesson worked well with the hotspot, but when everyone tried to watch videos at once, it slowed down."*

The combined data from interviews and classroom observations suggest that the digital divide in these remote areas is shaped not only by geographic and infrastructural limitations but also by individual and school-level socioeconomic conditions. Teachers with greater resources—whether in the form of personal devices, mobile data, or Wi-Fi access—could implement digital learning more effectively, maintaining continuity and interactivity. Conversely, teachers with limited resources had to adopt alternative strategies, such as offline materials or asynchronous communication, which, while mitigating some issues, limited the Flipbook's full pedagogical potential. These factors similarly influenced students' ability to engage with digital materials. While high-resource contexts allowed for real-time interaction and greater interactivity with the Flipbook, limited-resource settings required students to adapt to delays and partial access, which could hinder comprehension and engagement. These findings underscore the critical interplay between socioeconomic status, technological access, and pedagogical effectiveness, highlighting the importance of contextualized strategies to address digital inequities in remote learning environments.

Thus, the primary obstacles in technology use are multifaceted, involving both infrastructural limitations and socioeconomic disparities. Addressing these challenges requires not only improvements in network infrastructure but also targeted support for teachers and students to ensure equitable access, sustained engagement, and effective use of digital instructional tools such as the Flipbook in remote areas.

c. Availability of School Facilities

Observations in the three schools revealed substantial differences in the availability, accessibility, and quality of digital facilities, which significantly affected the implementation of Flipbook-supported learning activities. In SMP 3, classrooms were equipped with laptops and a projector, providing teachers with the tools they needed to deliver interactive lessons. However, network connectivity was frequently unstable, causing interruptions during digital instruction. During several observed sessions, teachers had to pause Flipbook activities or switch to offline materials when the internet failed, disrupting the learning flow and reducing students' sustained engagement.

In SMP 4, the situation was more constrained. The school had only one set of digital devices, which had to be shared among multiple teachers. Observations showed that teachers had to schedule their lessons carefully, taking turns to use the devices, which sometimes led to delays and limited the frequency and scope of digital activities. Students were observed waiting for access to the Flipbook content or receiving instructions via less interactive methods, which reduced the immediacy and engagement of the learning experience.

SMP 5 presented the most challenging context. The school had almost no digital facilities available, forcing teachers to rely entirely on personal mobile devices to create and deliver learning materials. Observations revealed that these lessons were limited in terms of interactivity and multimedia content. Students had fewer opportunities to engage with the Flipbook in real time, and teachers had to simplify or adapt content to accommodate the constraints, which likely limited the overall effectiveness of the digital learning intervention.

Interviews with teachers confirmed these observational findings and provided deeper insight into how facility availability shaped teaching practices. Teacher A (SMP 3) explained, *"We have laptops and a projector, but the network sometimes goes down, so I always prepare offline materials to ensure lessons continue."* Teacher B (SMP 4) remarked, *"There is only one set of devices for all teachers, so we take turns using them. It works, but sometimes lessons get delayed or shortened."* Teacher C (SMP 5) emphasized the limitations they faced: *"We almost don't have any digital facilities. I rely on my phone to make simple videos for students, which limits what I can do and how interactive the lessons can be."*

These findings suggest that the availability of school facilities is strongly influenced by government support, funding allocations such as BOS (School Operational Assistance), and the managerial capacity of the school administration. Schools with better access to funding and proactive leadership tend to have more comprehensive digital resources, enabling teachers to implement more interactive and innovative instructional strategies. Conversely, schools with limited resources face persistent infrastructural barriers, which force teachers to adopt workarounds that may compromise instructional effectiveness and students' engagement.

The combined observational and interview data highlight that disparities in digital facilities exacerbate inequalities in the implementation of technology-enhanced learning. In schools with sufficient facilities, students could engage more actively with Flipbook-supported lessons, benefitting from real-time interactivity, multimedia content, and smoother instructional delivery. In contrast, in schools with minimal facilities, both teachers and students experienced reduced opportunities to fully utilize the Flipbook, limiting the potential for enhanced literacy outcomes. Therefore, institutional

support, resource allocation, and managerial effectiveness are critical in ensuring equitable access to digital instructional tools and in maximizing the practical and pedagogical benefits of digital learning in remote educational contexts.

d. Students' Access to Digital Learning

Classroom observations in the Bonggakaradeng area revealed that most students lacked personal digital devices, which significantly affected their engagement with Flipbook-supported learning. During lessons, students were frequently observed sharing a single mobile phone among several peers or collaborating in small groups to complete tasks. This arrangement often caused delays, as students had to wait their turn to access the Flipbook content, disrupting the flow of individual learning and limiting opportunities for independent interaction with the material. In some cases, students struggled to follow the lessons in real time, particularly when multimedia content such as audio narration or animations was involved, since not all group members could engage simultaneously. Observers also noted that students with better access to devices—either through parental support or shared school resources—were able to work more independently. In contrast, those without any device relied heavily on peers, which sometimes reduced their level of participation and learning effectiveness.

Teacher interviews confirmed and expanded upon these observations, highlighting how socioeconomic factors directly shaped students' access to digital learning. **Teacher A (SMP 3)** explained, *"Most of our students don't have their own phones, so they need to share or work in groups to access the Flipbook. It works, but it slows down the learning process."* **Teacher B (SMP 4)** added, *"I have to be creative in my teaching strategies, making sure that even students without devices can participate and complete the tasks. Sometimes I assign group roles or rotate device usage."* **Teacher C (SMP 5)** also emphasized this challenge, stating, *"We often see students taking turns using their parents' phones. I encourage group work, but it's not always ideal for individual learning or deeper engagement with the content."*

The combination of observational and interview data illustrates that limited access to personal digital devices is a major obstacle for students in remote areas. Socioeconomic constraints not only limit the availability of devices but also shape how teachers can implement instructional strategies. To mitigate these challenges, teachers have had to adapt their teaching practices creatively. Strategies include forming small collaborative groups, rotating device use, preparing offline supplementary materials, and scaffolding activities to ensure that all students can participate, even asynchronously. While these methods allow some engagement, they cannot fully replicate the interactive and individualized experiences that personal device access would provide, particularly when using digital tools like the Flipbook, which rely on multimedia features.

These findings highlight the critical interplay between socioeconomic background, technological access, and pedagogical strategies. Limited device access creates inequities in digital learning opportunities, requiring teachers to invest additional effort and creativity to maintain student participation. Moreover, these constraints affect the practical utility and effectiveness of digital instructional tools: even well-designed Flipbook materials may not achieve their full potential if students cannot interact with them independently or consistently. This underscores the need for contextualized interventions in remote education, including increased support for equitable device access, the integration of flexible teaching strategies, and infrastructure improvements, to maximize the educational benefits of digital learning tools.

e. Teacher Strategies in Addressing Access Gaps

Classroom observations demonstrated that teachers in remote areas of Toraja employed a variety of adaptive strategies to overcome disparities in students' access to digital learning tools. In

SMP 3, observers noted that when students experienced difficulty accessing the Flipbook due to limited devices or slow network connectivity, the teacher distributed printed versions of the digital materials. This allowed students to follow the lesson despite technical interruptions, maintaining engagement and continuity of instruction. In SMP 4, students were frequently observed working in small groups, sharing a single device to complete Flipbook-based tasks. This strategy enabled collaborative learning while ensuring that all students had at least partial access to the digital content. At SMP 5, where digital facilities were minimal, the teacher relied on traditional local media, including illustrations, charts, and the blackboard, to convey the lesson content. Observations indicated that these approaches allowed students to engage with the material, albeit through less interactive methods.

The interview data reinforced these observations and provided insight into the teachers' intentions and reasoning. **Teacher A (SMP 3)** explained, "I prepare printed versions of the Flipbook content so students can continue learning even when the internet is down, or devices are limited." **Teacher B (SMP 4)** stated, *"I organize students into small groups to share devices. This helps everyone participate, even if not all at the same time."* **Teacher C (SMP 5)** described the adaptation to local resources: *"Since we have almost no digital facilities, I use drawings, pictures, and the blackboard to deliver the lessons. It is not the same as the Flipbook, but students can still understand the content."*

These combined observations and interview results illustrate the high levels of resilience, creativity, and pedagogical flexibility among the teachers. Despite differences in available resources and their students' socioeconomic backgrounds, all three teachers demonstrated a commitment to minimizing access gaps and ensuring that learning continued effectively. Their strategies highlight that in remote contexts, the success of digital instructional tools depends not only on the quality of the materials themselves but also on teachers' ability to adapt, scaffold, and supplement digital learning with accessible alternatives. This underscores the critical role of teacher agency in bridging technological inequities, ensuring that all students, regardless of access limitations, can engage with the curriculum and achieve meaningful learning outcomes.

f. Teachers' Perspectives on the Importance of Digital Technology

Observations in the classrooms revealed that all three teachers recognized the potential of digital technology to enhance student engagement and motivation. During lessons, teachers frequently incorporated multimedia elements from the Flipbook, such as animations, audio narration, and interactive exercises, to capture students' attention. In SMP 3, for example, students were noticeably more focused during a Flipbook reading activity, often pausing to discuss story elements or interact with embedded audio cues. Similarly, in SMP 4, teachers observed higher levels of participation when students could access visual content, compared to traditional textbook lessons. Even in SMP 5, where digital access was limited, students responded positively when the teacher used locally adapted materials that mimicked digital features, such as illustrated storyboards on the blackboard. These classroom behaviors indicated that both teachers and students appreciated the motivational and pedagogical benefits of digital media.

The interviews confirmed these observations. **Teacher A (SMP 3)** stated, *"Digital tools like the Flipbook really help students stay engaged. They enjoy the interactive elements, and it makes learning more meaningful."* **Teacher B (SMP 4)** added, *"Even though not all students have devices, using visual and audio media motivates them to participate and keeps them interested in the lesson."* **Teacher C (SMP 5)** acknowledged the limitations but emphasized the principle, saying, *"Technology is very important for modern learning. We may not have many devices, but when we can use any form of multimedia, students are more enthusiastic and involved."*

The combined observations and interview data highlight that teachers are highly aware of the critical role of digital technology in modern education. They recognize that technology not only

facilitates interactive and engaging learning experiences but also has the potential to improve students' literacy skills and motivation. However, this awareness is not yet matched by sufficient infrastructure, equitable access, or consistent digital skills among teachers and students. Despite their understanding of its importance, the uneven availability of resources and support continues to constrain the full integration of digital technology into teaching.

These findings suggest that while teacher readiness and recognition of the value of technology are high, achieving effective digital learning in remote areas requires parallel improvements in infrastructure, device accessibility, and professional development. The data underline the central role of teacher agency and innovation in bridging the gap between technological potential and practical implementation, ensuring that students benefit meaningfully from digital learning tools even under constrained conditions.

5. Discussion

5.1. Practicality of Multilingual Digital Children's Literature Teaching Material Supported by a Flipbook Application for Children in Remote Areas.

The study found that the multilingual digital children's literature teaching material, supported by a flipbook application, was highly practical across all three schools (SMP 3; SMP 4; SMP 5). Post-test results showed a significant increase in mean scores from 68.41 to 86.89, with a paired t-test indicating a highly significant improvement ($t(67)=-25.744$, $p = 0.000$). Observations revealed that students were generally able to navigate the Flipbook and complete tasks. However, some challenges with navigation and accessing multimedia content were noted, particularly in SMP 3, where teacher guidance was more frequently needed. Interviews confirmed that teacher facilitation, prior exposure to digital tools, and classroom management influenced the Flipbook's practical usability.

These findings align with recent research on flipbook-based learning. Sakinah & Nuroh (2025) reported significant improvements in reading comprehension using flipbook media, while Unayah et al. (2024) highlighted that flipbooks enhance student engagement and motivation. The current study extends these findings by demonstrating that multilingual digital materials can be effective in remote, resource-constrained contexts, suggesting the product is both adaptable and scalable. However, minor usability improvements—such as more intuitive navigation and enhanced visual cues—could further optimize practical application, especially for students with lower digital literacy.

5.2. The Effectiveness of Multilingual Digital Children's Literature Teaching Material Supported by a Flipbook Application in Improving Literacy Skills of Students in Remote Areas.

The flipbook-supported teaching material significantly improved student literacy skills across all three schools. The mean difference between pre-test and post-test scores was -18.48 , indicating a large gain in student performance. Observations showed that students in SMP 5, where classroom conditions were more favorable and class sizes smaller, demonstrated the highest engagement and comprehension. SMP 3 students, although achieving improvement, experienced more challenges due to limited infrastructure and less individualized teacher support. Interviews supported this, with teachers noting that small class sizes and prior digital experience facilitated more effective learning.

These findings are consistent with recent studies emphasizing the effectiveness of digital and flipbook media in literacy development. For instance, Saputra et al. (2024) found digital instructional materials improved literacy scores in primary school students, while Rahmawati & Purwati (2024) highlighted that local-contextualized digital materials enhanced comprehension and motivation. The current study contributes to this body of research by showing that even in multilingual and remote

settings, digital flipbook interventions can produce measurable literacy gains, provided teachers are able to adapt the materials to local constraints.

5.3. The experiences of teachers and students from different socioeconomic backgrounds in facing the challenges of access gaps and the use of digital technology in the learning process.

The study highlighted how differences in socioeconomic background and school resources influenced the use and effectiveness of digital teaching materials. Observations indicated that students often lacked personal devices, requiring strategies such as group work, sharing devices, or using printed versions of the Flipbook. Teachers reported varying approaches: Teacher A (SMP 3) prepared offline materials, Teacher B (SMP 4) organized students into small groups, and Teacher C (SMP 5) relied on locally adapted media such as illustrations on the blackboard. Despite these differences, all teachers showed resilience and creativity in mitigating access gaps, and students remained engaged in learning activities.

The findings echo recent research emphasizing the role of teacher agency and socioeconomic factors in digital learning. For example, studies by Unayah et al. (2024) and Saputra et al. (2024) stress that technology alone is insufficient; effective digital learning depends on teacher facilitation and equitable access. The present study reinforces this, showing that teachers' adaptive strategies are critical for maintaining student engagement and achieving learning outcomes, particularly in remote areas with limited infrastructure. Moreover, the combination of observation and interview data demonstrates that both resource availability and pedagogical skill shape the practical impact of digital instructional tools.

6. Conclusion

This study investigated the practicality and effectiveness of multilingual digital children's literature teaching material supported by a Flipbook application in remote areas of Toraja, as well as the experiences of teachers and students from different socioeconomic backgrounds in using digital technology for learning. Based on the results, several conclusions can be drawn.

First, the multilingual digital Flipbook was found to be highly practical across all three schools. Students were generally able to navigate the Flipbook and complete tasks effectively, and teacher facilitation, prior digital experience, and classroom management were key factors supporting usability. Despite minor challenges in navigation and multimedia access, particularly in contexts with limited infrastructure, the Flipbook demonstrated adaptability and scalability for use in remote, resource-constrained settings.

Second, the Flipbook-supported teaching material was effective in improving students' literacy skills. Post-test results showed significant gains compared to pre-test scores, indicating that the intervention positively influenced reading comprehension and engagement. Observations revealed that classroom conditions, including class size and teacher support, played a critical role in optimizing learning outcomes. These findings reinforce prior research showing that digital instructional tools can enhance literacy performance when combined with teacher guidance and contextual adaptations.

Third, the study highlighted the importance of teachers' adaptive strategies in addressing digital access gaps. Students often lacked personal devices, requiring creative solutions such as group work, printed materials, or locally adapted media. Teachers demonstrated resilience and pedagogical flexibility, ensuring that all students could participate in learning activities despite infrastructural limitations. These findings underscore the critical interplay between socioeconomic factors, resource availability, and teacher agency in determining the effectiveness of digital learning in remote areas.

In summary, the study concludes that multilingual digital Flipbook materials are practical, effective, and capable of improving literacy skills in remote educational contexts. However, the successful implementation of such digital learning interventions depends not only on the quality of the materials but also on teacher competence, adaptive strategies, and equitable access to technological resources. These findings provide important implications for policy and practice, highlighting the need for infrastructure support, professional development, and targeted interventions to ensure that students in remote areas can fully benefit from digital learning innovations.

This study was limited to three schools in Tana Toraja and does not represent all schools in the region. Additionally, the research focused on selected children's literature materials and did not include the full range of Toraja folktales.

For future research, it is recommended that studies expand the sample to include more schools across different areas of Tana Toraja and incorporate a broader selection of Toraja folktales. This would provide a more comprehensive understanding of the effectiveness and practicality of multilingual digital children's literature materials and allow for generalization of findings to a wider population. Furthermore, future studies could explore long-term impacts on literacy development and investigate the integration of additional digital media tools to enhance learning outcomes.

7. Suggestion

To strengthen the impact of multilingual flipbook-supported children's literature, several recommendations are proposed. Teacher training in digital pedagogy should be prioritized to ensure effective facilitation and alignment with curricular goals, while enhancements in instructional design, such as clearer navigation and visual cues, are needed to improve usability. Expanding multilingual integration to include more local languages will further affirm cultural identity and inclusivity, and contextual adaptation should be emphasized to account for variations in class size, resources, and student demographics, thereby supporting scalability across diverse remote settings. Longitudinal studies are encouraged to examine sustained literacy outcomes and comparative research across regions to broaden evidence of effectiveness. Finally, stronger collaboration with educational policymakers is necessary to integrate multilingual digital literature into formal literacy initiatives, ensuring structural support, resource provision, and long-term sustainability.

Declarations

Author Contributions. Mangera: conceptualization, literature review, and manuscript preparation; Hamid: methodology design, data collection, and analysis; Pratama: review, editing, and final manuscript approval. All authors have read and approved the final version of the article.

Conflicts of Interest. The authors declare no conflict of interest.

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Ethical Approval. This research was conducted in accordance with ethical standards. The approval was given by the Tana Toraja Regency Investment and One-Stop Integrated Services Agency with Approval Number 277/DPMPTSP/VII/2025. Informed consent was obtained from all participants, and student data is anonymized to ensure privacy and confidentiality.

Data Availability Statement. The data supporting the findings of this study are available from the corresponding author upon reasonable request.

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