

Digital Media Innovation for Enhancing Numeracy Literacy in Elementary Schools

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Keywords:	Abstract
digital; media; numeracy; literacy	<i>The increasing use of digital media in education has emphasized the need for effective tools to enhance numeracy skills among primary school students. These tools provide interactive and engaging learning experiences that can significantly boost mathematical understanding. This study aimed to develop and assess the practicality of digital media for improving numeracy skills in fourth-grade students at Elementary School Dukuh in Kulon Progo. Following the Four-D (4D) model—define, design, develop, and disseminate—the research involved both small- and large-scale trials. Classroom teachers and peer reviewers evaluated the media, rating it as highly practical. The effectiveness of the Microsoft Sway-based tool was confirmed by a high N-Gain Score, indicating substantial improvements in learning outcomes. This study contributes to research on digital media in education by showcasing its potential to support numeracy development. The findings suggest that well-designed digital tools can be widely adopted to improve students' mathematical proficiency and engagement.</i>

INTRODUCTION

Background of the Study

The advent of digital technology has significantly expanded access to information, enabling seamless data retrieval and offering insights into dynamic shifts in global education. The Fourth Industrial Revolution (commonly termed "Revolution 4.0") marks a transformative shift in education, particularly during foundational learning stages characterized by critical developmental phases. As

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Zabidi (2018) observes, the integration of technology into pedagogical practices represents an inevitable progression, driven by the parallel evolution of instructional media and advancements in information and communication technologies. Delello et al. (2025), similarly contends that education serves as a cornerstone for unlocking human potential, fostering individual development and societal prosperity. Echoing this perspective, Prakoso et al. (2024), asserts that educational processes must be rooted in Pancasila principles to meaningfully contribute to national development.

Ayuningtyas and Sukriyah (2020) emphasize that improving educational quality requires systematic enhancement of students' literacy skills through targeted learning activities and media. In alignment, Juliani and Bastian (2021) advocate for a dual focus: strengthening literacy-based pedagogy while simultaneously cultivating character traits consistent with Pancasila values. Achieving these goals necessitates developing learning materials that incorporate digital components, strengthen literacy and numeracy competencies, and integrate Pancasila principles. This approach resonates with Devi and Rusdinal (2023), assertion that strategically implemented digital media can substantially elevate students' literacy capacities. Budiman (2017), further highlights the critical role of information technology in education, arguing that it enhances the effectiveness and efficiency of learning processes—elements directly tied to national productivity. Such advancements are propelled by technology's capacity to accelerate information dissemination, exceeding the pace achievable through conventional approaches.

The widespread integration of electronic media into modern society encompasses diverse domains such as social media and gaming, which students disproportionately utilize. When employed strategically, electronic media can act as a catalyst for advancing digital literacy. An APJII (2023), survey by the Association of Internet Service Providers in Indonesia (APJII) reported that internet usage in Indonesia totaled 215.63 million users as of 2023, highlighting the broad adoption of digital technologies. Complementing this trend, Desi's (2020) study identified universities as the primary users of digital literacy resources (56.4%), followed by government institutions (14.34%), non-governmental organizations (5.32%), schools and corporations (3.68% each), professional associations and mass organizations (2.86%), and media outlets (0.4%). This research distinguishes itself by examining how digital media can enhance numeracy skills among elementary school students via digitized learning tools. The study provides a unique contribution to educational technology research by addressing a significant gap in the application of digital tools within foundational education.

Problem of The Study

The urgency for timely research aligns with the transformative shifts brought by the Fourth Industrial Revolution (Industry 4.0), the rise of Society 5.0, and the integration of Student Learning Outcomes (SLOs) within the innovative paradigm curriculum for elementary education. Developing digital learning environments that emphasize literacy and numeracy is critical, as these competencies underlie most digital information. Nevertheless, Indonesian students exhibit lower proficiency in these foundational skills.

According to the 2022 Programme for International Student Assessment (PISA) results (OECD, 2023), Indonesia ranked 71st out of 81 countries in reading literacy, scoring 371—well below the OECD average of 487. In mathematical literacy, Indonesia ranked 72nd, achieving a score of 379 compared to the OECD benchmark of 489. These results underscore persistent deficiencies in students' ability to interpret, analyze, and apply textual and numerical data. Reinforcing this concern, Aiken et al. (2021) observes that while many students demonstrate basic reading skills, they frequently struggle to derive meaning from texts, indicating a critical gap in higher-order comprehension skills.

Indonesia's educational quality varies significantly across regions. Hakim (2016) reveal insufficient educational infrastructure in many areas, particularly for fostering literacy and numeracy

skills. Griswold et al. (2017), further observes that a considerable number of students struggle to grasp fundamental literacy concepts in instructional settings. These challenges are compounded by the inadequate integration of digital literacy into online learning environments, stemming largely from students' limited understanding and proficiency with digital tools.

Given these persistent systemic gaps, developing targeted digital learning media to strengthen elementary students' numeracy and literacy competencies has become imperative. Such interventions could serve as a strategic mechanism to mitigate these critical educational inequities.

Research's State of the Art

The digitization of learning media can be framed as a systematic communicative process aimed at achieving targeted educational goals. Cobos et al. (2024), emphasize that effective learning demands sustained student commitment, facilitated through innovative pedagogical strategies that encourage active participation in questioning, discussions, and problem-solving. Incorporating gaming elements into such frameworks can foster dynamic and meaningful educational experiences. Bose and Seetso (2016), for example, illustrate that strategically designed games promote a low-pressure learning atmosphere by integrating enjoyable, interactive tasks, facilitating the scaffolding of knowledge. Hamari et al. (2016), similarly characterizes gamified learning as a pedagogical approach that delivers content through game-based formats or enhances instruction with game-inspired elements to heighten student engagement.

Rizkasari et al. (2024), contend that game-based learning outperforms conventional methods in developing 21st-century skills, including creativity, collaboration, communication, and critical thinking. Fathi-Najafi et al. (2025), expand this framework by categorizing gamification effectiveness into two types: "original" games, which are intentionally designed from the outset to meet educational objectives, and "modified" games, which adapt existing structures to align with specific learning outcomes. Zolfaghari et al. (2025), reinforce this distinction, noting that "original" games are purpose-built for pedagogical aims, while "modified" games repurpose pre-existing formats. Grounded in these principles, this study seeks to adapt and transform educational games into digital formats to advance literacy and numeracy competencies among students.

Ekowati et al. (2019) define numeracy literacy as the capacity to apply reasoning by analyzing and interpreting statements through mathematical symbols or everyday language, and then communicating these interpretations verbally or in writing. This aligns with the goals of Indonesia's National Literacy Movement (GLN), instituted via the Minister of Education and Culture Regulation No. 23 of 2015 to advance character education. Implemented through the School Literacy Movement (GLS), the GLN fosters literate school communities and character development by integrating activities such as daily 15-minute non-academic reading sessions Candiasa et al. (2021).

Lugli et al. (2018), categorize numeracy literacy into three core elements: counting, numerical relationships, and arithmetic operations. Shah and Soosai, (2024) expands this framework, describing literacy as the ability to analyze information through reading, computation, logical reasoning, and critical thinking. Within this context, "numeracy" specifically denotes the skill of counting objects orally and discerning quantitative differences (e.g., identifying whether one quantity exceeds, is less than, or differs from another). Arithmetic operations refer to executing basic mathematical procedures, such as addition and subtraction. Together, these dimensions form foundational pillars of mathematics education, underscoring the necessity of introducing and reinforcing them early in primary schooling.

The increasing emphasis on numeracy and literacy skills stems from the ubiquity of information requiring proficiency in both domains. Din Eak and Annamalai, (2024) outline strategies to enhance literacy in educational contexts, such as implementing daily reading sessions, creating classroom reading corners, incorporating storytelling games, and developing comics. Angriani et al. (2020) similarly highlight the efficacy of diverse media for literacy development, particularly electronic books,

which enable flexible, context-independent learning opportunities—aligning with modern educational needs.

For elementary students, cultivating strong numeracy and literacy skills remains imperative. While many students exhibit foundational numeracy literacy, there is a persistent demand for more dynamic and effective instructional tools. Digital platforms like Microsoft Sway hold significant potential to advance these competencies, positioning their development as a critical educational priority. Research underscores the role of information technology in boosting the efficacy and efficiency of learning outcomes, with cascading benefits for national productivity. Adopting Microsoft Sway as a pedagogical tool thus offers a viable pathway to address existing gaps in numeracy and literacy education.

Gap Study & Objective

In today's digital age, proficiency in numeracy and literacy is vital for students to navigate and critically assess diverse information sources. Literacy extends beyond traditional reading and writing to include interpreting visual, numerical, and digital data (OECD, 2023). However, Indonesian students continue to face significant challenges in these areas. The 2022 Programme for International Student Assessment (PISA) results highlight this issue, with Indonesia ranking 71st in reading literacy and 72nd in mathematical literacy among 81 countries, far below the OECD averages, underscoring the urgent need for innovative pedagogical approaches (OECD, 2023).

Existing research explores strategies to enhance literacy competencies. Kolers (2022), identifies four key dimensions—reading, identification, analysis, and self-reflection—with reading as the foundational skill for processing information. Similarly, Ahsani et al. (2021) highlight the growing importance of digital literacy amid the widespread integration of electronic media in education. Despite technological advancements, studies by Oral et al (2020), reveal persistent difficulties among Indonesian students in comprehending and analyzing digital texts and numerical data. These challenges are compounded by regional disparities in educational infrastructure (Hakim, 2016; Elias, 2024), which impede equitable digital literacy development and worsen educational inequities.

Although existing research highlights the importance of literacy and digital media in education, few studies have specifically examined the efficacy of interactive digital platforms in fostering numeracy literacy among elementary students. While Ardyansyah and Rahayu (2023), suggest that digital learning media can improve engagement and comprehension, the direct impact of platforms like Microsoft Sway on numeracy literacy remains understudied. Addressing this gap, this study aims to develop and evaluate the practicality of Microsoft Sway as an interactive digital tool to enhance numeracy literacy skills among elementary students.

More precisely, the research seeks to design and assess the feasibility of Microsoft Sway as a medium for advancing numeracy literacy. It further investigates whether this platform can effectively enhance students' abilities to comprehend, interpret, and analyze numerical and visual data, thereby contributing to the broader enhancement of mathematical literacy.

METHOD

Type and Design

This research is conducted within the research and development (R&D) framework, focusing on creating digital learning media to strengthen elementary students' numeracy and literacy competencies. The development process adheres to the 4-D model (Thiagarajan, 1974), structured into four sequential stages: *define*, *design*, *develop*, and *disseminate*. The *define* stage involves a systematic analysis of scholarly literature and a needs assessment through field surveys to identify educational challenges. The *design* stage focuses on conceptualizing the product framework, while

the *develop* stage incorporates expert validation, iterative refinement, and testing through individual and small-group trials. Finally, the *disseminate* stage includes dissemination activities and final product refinements.

Figure 1 describes the section that outlines the procedural framework and trial methodology, which is regularly aligned with the 4-D model's principles.

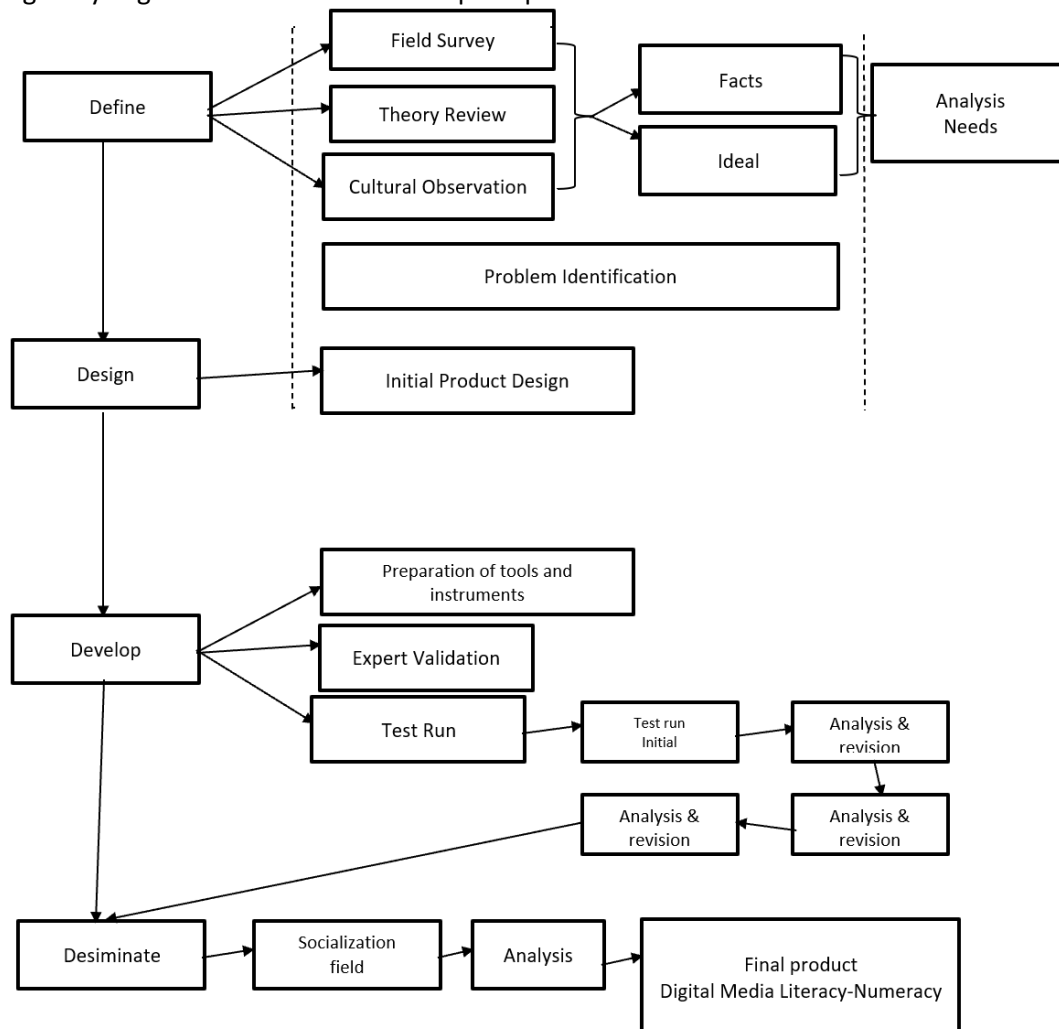


Figure 1. Research procedure

Data and Data Sources

This study involved fourth-grade students from State Elementary School Dukuh in Kulon Progo, who were selected through purposive sampling from the school's fourth-grade cohort. The sample consisted of 24 participants, organized into three phases: (1) three randomly selected students underwent individual assessments; (2) six additional students, distinct from the first group, participated in small-group evaluations; and (3) eleven further students, excluding those from the previous phases, were included in a large-scale field trial.

Data Collection Technique

This study employs a methodology to assess the quality and feasibility of the digital learning media under development, aligned with the four research phases of the 4-D model. During the define phase, preliminary data are triangulated through observation, documentation, and interviews to establish foundational insights. The design phase involves systematically organizing data

from the preliminary stage, supported by a comprehensive literature review. In the development phase, a prototype is created and validated through expert evaluations, with empirical feedback collected via one-to-one and small-group trials using observational protocols and structured questionnaires. Finally, the disseminate phase gathers data through questionnaires, observational analysis, and assessments of the product's scalability and contextual adaptability.

Data Analysis

This study employs a mixed-methods approach, integrating qualitative and quantitative descriptive analyses. Qualitative analysis focuses on developmental stages and provides detailed insights into the implementation and effectiveness of digital media in field settings. Quantitative analysis evaluates empirical outcomes during the develop and disseminate phases. The analytical process is structured into three phases: (1) compiling and analyzing data on digital media development outcomes and validity using both qualitative and quantitative methods; (2) conducting one-to-one and small-group trials, with results from the numeracy-focused digital media application assessed quantitatively; and (3) refining the developmental framework through large-scale field trials, employing a quantitative approach. This structure aligns with Borg and Gall (1983), ten-step research development model, adapted to incorporate validation and limited-scale trials (small- and large-scale assessments).

To ensure media quality, rigorous validation steps were implemented. Expert ratings from validation sheets were collected, converted into qualitative categories using a four-point scale (Table 1), and analyzed to assess product feasibility.

Table 1. Conversion of Quantitative Data to Qualitative Scale 4

Interval	Category
$3,5 < M \leq 4,5$	Very good
$2,5 < M \leq 3,5$	Good
$1,5 < M \leq 2,5$	Less Good
$0,5 < M \leq 1,5$	Not good
M = Average score for each aspect assessed	

To evaluate the validity of the developed digital media, validation instruments were reviewed by experts in instructional design, content accuracy, and linguistic precision, aligned with Nieveen's (1999) criteria. Media were deemed valid if average expert ratings fell within the "valid" category; otherwise, revisions were made based on feedback, followed by iterative revalidation until meeting validity thresholds. Practicality was assessed by experts and practitioners, with media classified as practical if minor revisions were needed and implementation feasibility was demonstrated. Effectiveness was assessed via descriptive analysis and N-Gain Score criteria, revealing effectiveness within a limited scope. Inter-rater reliability was analyzed using Cohen's kappa coefficient and percentage agreement (Shahsavari & Naderi, 2019; Tan et al., 2023) with $R \geq 0.7$ indicating satisfactory consistency. Data analysis was performed using Microsoft Excel (for mean calculations) and SPSS (for inter-rater reliability).

RESULTS

The need to integrate digital learning resources at State Elementary School Dukuh in Kulon Progo is unequivocal. Ausrianti et al. (2020) emphasizes that modernizing educational approaches is critical in the post-COVID-19 era, where digital media has become pervasive across sectors for operational and informational purposes. The education sector is poised to align with this shift by embedding digital media into pedagogical practices and informational frameworks. However, despite the availability of

digital infrastructure in many schools—such as internet access and LCD projectors—its application in learning processes remains limited. In rural contexts like elementary schools, the absence of engaging and innovative teaching methods has exacerbated student disengagement with literacy, compounded by the underdeveloped state of literacy education. This aligns with Hakim's (2016) observation that educational equity in Indonesia remains unrealized, hindered by systemic barriers to implementation and resource distribution. Furthermore, existing media resources are inadequate to support digital literacy development.

Observations at State Elementary School Dukuh reveal that most students are proficient in using digital media, a byproduct of online learning necessitated by the pandemic since 2020. Mobile phones have emerged as their primary learning tool, with most students owning personal devices. This widespread access presents a critical opportunity to cultivate digital literacy skills that can be leveraged flexibly across contexts. Integrating Microsoft Sway to cultivate digital literacy addresses students' evolving needs by highlighting literacy's importance in academic and personal contexts. This approach uses diverse content from books, videos, and audio, allowing students to interact with materials visually and auditorily. By adopting this multisensory method, educators reduce monotony in traditional literacy practices. Digital media's dynamic nature also lets teachers spark students' literacy interest through interactive platforms.

Studies show many students at the observed school are proficient with digital media, a result of online learning frameworks adopted during the COVID-19 pandemic. Mobile phones are now the main way students access educational content, as most own personal devices. This widespread ownership offers opportunities to strengthen digital literacy, enabling engagement with resources anywhere. Using Microsoft Sway aligns with students' modern needs and enhances their learning through versatile, innovative methods. This is attributable to its incorporation of written content from a diverse array of sources, including books, videos, and audio materials, which students can engage with both visually and aurally. Such a multisensory approach effectively mitigates the monotony often associated with conventional literacy practices, thereby enhancing student engagement and interest.

The preliminary testing phase involves rigorous evaluation by two specialists: a material expert and a media expert. The material expert evaluates the content's quality and usefulness within the media, focusing on alignment with learning objectives, comprehensiveness, logical organization, factual accuracy, depth of coverage, and relevance of animations to the subject. Results from using Microsoft Sway to enhance students' numeracy literacy are shown in Figure 2.

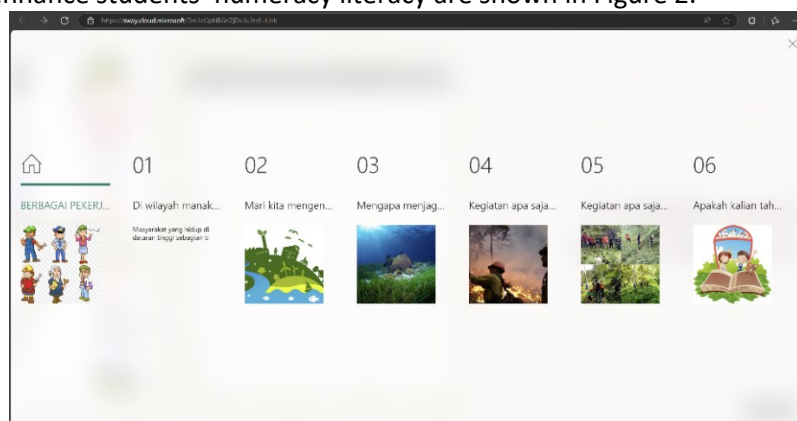


Figure 2. Microsoft Sway Interface

Data analysis indicates that the Microsoft Sway-based learning media demonstrates high quality, validated through expert assessments. The material quality aspect achieved an average score of 3.2 ("good"), while material benefits scored 3.0 ("very good"). These results yield a composite average of 3.1, classifying the media within the "good" category. A detailed score breakdown is provided in Table 2.

Table 2. Expert Validation Results on Learning Media

Assessment Aspect	Average Score	Category
Material Quality	3.2	Good
Material Benefits	3.0	Very Good
Overall Score	3.1	Good

Following reviewer feedback, targeted refinements were implemented to strengthen the learning media. Reviewers emphasized enhancing interactivity and visual appeal to better support student comprehension. Revisions included integrating interactive features, refining instructional clarity, and aligning content with curriculum standards. Post-revision expert validation confirmed the media's feasibility and usability in advancing numeracy literacy education.

The media was evaluated across two dimensions: ease of use (intuitiveness of access and navigation) and visual communication (readability, color/shape composition, layout appropriateness, image / animation quality, and text-visual integration). Expert validation outcomes are detailed in Table 3.

Table 3. Media Assessment by Experts

Assessment Aspect	Average Score	Category
Ease of Use	3.4	Good
Visual Communication	2.8	Good
Overall Score	3.1	Good

Informed by reviewer feedback, targeted enhancements were prioritized to improve the media's clarity and visual design. Reviewers emphasized refining text readability, optimizing color contrast, and reorganizing visual layouts. Revisions included standardizing font sizes and typefaces to improve legibility, enhancing color contrast for accessibility and visual coherence, streamlining content layouts for logical flow and intuitiveness, and optimizing the resolution and positioning of images and animations to align with instructional goals. Following these refinements, expert validation confirmed the media's usability and efficacy in advancing numeracy and literacy skills. These improvements collectively affirm Microsoft Sway's suitability as a robust digital tool for elementary education, supported by an overall expert evaluation score of 3.1, classifying the media as "good."

Empirical trials conducted at the research site confirmed the practicality of Microsoft Sway as an instructional medium. In small-scale evaluations, classroom teachers assessed its applicability, with results comprehensively detailed in Table 4.

Table 4. Average Results of Microsoft Sway Media Practicality Assessment in Improving Literacy and Numeracy Skills of Elementary Students

Appraiser	Average	Classification
Teacher	158	Very Easy to Implement

The evaluation questionnaire completed by the class teacher (Table 2) revealed that Microsoft Sway Media is classified as "Very Easy to Implement." This determination was derived from a total score of 158, calculated by aggregating the responses to each item on the questionnaire. The effectiveness of Microsoft Sway Media in facilitating numeracy literacy instruction was assessed with a cohort of 28 students at the observed school. The data presented below reflect the practitioner's evaluation of the learning model's efficacy within a single elementary school, categorized into three distinct assessment types: peer assessment, teacher assessment, and student assessment.

Table 5. Results of the Assessment of the Effectiveness of Microsoft Sway Media in Enhancing Numeracy Literacy Skills Based on User Satisfaction Levels

Appraiser	Average	Classification
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Peers	53	Highly Effective
Class Teacher	116	Effective
Learners	36.8	Highly Effective

Assessment data indicate the learning model's effectiveness during trial implementation, as validated by evaluations from three practitioners, all rating it minimally "effective." Peer reviewers scored the model an average of 53 ("highly effective"), while classroom teachers assigned a mean score of 116 ("effective"). Student evaluations yielded an average of 36.8 ("highly effective"), based on established metrics. These results collectively affirm Microsoft Sway's efficacy as a tool for advancing numeracy literacy in elementary education.

The effectiveness of the instructional media was evaluated through pretest and posttest assessments of students' literacy and numeracy skills. Analysis revealed a pretest mean score of 25.71, rising significantly to a posttest mean of 71.78, demonstrating substantial improvement attributable to Microsoft Sway. To validate these findings, the study applied Hake's (1999) N-Gain Score criteria, as outlined in Table 6.

Table 6. N-Gain Score Criteria

Percentage (%)	Interpretation
N-Gain < 40	Ineffective
$40 \leq \text{N-Gain} < 55$	Less Effective
$55 \leq \text{N-Gain} < 75$	Effective Enough
N-Gain ≥ 75	Effective

The empirical analysis of N-Gain Scores yielded an average of 62.83 for Microsoft Sway, classifying the media within the "Effective Enough" category according to Hake's (1999) criteria. This outcome exceeds the predefined improvement threshold established in the study, demonstrating the platform's pedagogical utility as a digital learning resource. The comprehensive results of the N-Gain Score analysis are delineated in Table 7.

Table 7. N-Gain Score Results for Microsoft Sway Media

Indicator	Pre-Test Score (Mean)	Post-Test Score (Mean)	N-Gain Score (%)	Effectiveness Category
Microsoft Sway Media	25.71	71.78	62.83	Moderate

These findings confirm that Microsoft Sway moderately enhances literacy and numeracy skills among elementary students, validating its utility as a pedagogical tool in the studied context.

DISCUSSIONS

This study evaluated the validity, practicality, and effectiveness of Microsoft Sway-based digital media in advancing numeracy and literacy skills among elementary students. Findings confirm that the developed media satisfy standards across all three parameters. Validity was established through expert evaluations of material content and media design, a critical step in educational research (Nieveen, 1999), which mandates that digital media align with instructional design, content accuracy, and linguistic appropriateness. Experts rated material quality at 3.2 ("good") and material benefits at 3.0 ("very good"), yielding an overall validity score of 3.1 ("good"). These findings align with Leacock and Nesbit, (2007) emphasis on rigorous validation to ensure alignment with instructional goals and learner needs, as well as Bilotserkovets et al. (2021) advocacy for iterative refinements to optimize technology-enhanced learning tools.

Practicality, assessed through usability and visual communication criteria, achieved an average score of 3.4 ("good") for ease of use and 2.8 ("good") for visual design, resulting in an overall

practicality score of 3.1. This indicates the media's readiness for classroom implementation, requiring minimal revisions for optimization. Effectiveness, measured via pretest-posttest gains and N-Gain analysis, demonstrated significant improvements in student outcomes (pretest: 25.71; posttest: 71.78), with an N-Gain Score of 62.83 ("effective enough").

Collectively, these results validate Microsoft Sway as a practical and pedagogically robust tool for fostering numeracy and literacy competencies in elementary education. These findings align with Supendra et al. (2022), who posit that digital media's practicality hinges on user-friendliness and adaptability to classroom contexts. Similarly, Milner-Bolotin, (2015) emphasize that technology-enhanced tools require intuitive interfaces and pedagogically structured components to maximize engagement for educators and learners. This study corroborates these principles, demonstrating Microsoft Sway's suitability for elementary education.

The media's effectiveness was assessed through trials involving teachers and students. Teachers rated its practicality with a mean score of 158 ("very easy to implement"), while peer, teacher, and student evaluations yielded scores of 53 ("very effective"), 116 ("effective"), and 36.8 ("very effective"), respectively. These outcomes collectively confirm the media's efficacy in supporting instructional processes. An N-Gain Score analysis further quantified skill improvement, revealing an average of 62.83 ("moderately effective"). This aligns with Multahada, (2024) and Saefurohman et al (2021), who underscore digital media's role in advancing numeracy and literacy competencies. Ronimus et al (2019), observation that interactive platforms enhance motivation and comprehension further substantiates Microsoft Sway's value in fostering digital literacy and educational outcomes.

This study's findings align with established scholarship on digital learning media. Han (2015) and Gordillo et al. (2023), emphasize technology-enhanced media's critical role in fostering student engagement and comprehension, noting that game-based learning and interactive multimedia significantly enhance learning outcomes—a conclusion consistent with this research. Rulviana et al. (2023), further argues that e-books and digital platforms enrich learning through visually dynamic and interactive content, reinforcing the practicality and effectiveness of Microsoft Sway demonstrated here. The Ministry of Education and Culture (2020) similarly advocates integrating digital literacy with character education, a principle indirectly advanced through this study's use of engaging, interactive materials (Candiasa, et al. 2021).

The results confirm Microsoft Sway as a valid, practical, and effective tool for advancing numeracy and literacy skills in elementary education. However, future studies should investigate its long-term impact on learning and efficacy across diverse educational contexts. Incorporating gamification and adaptive learning features, as proposed by Bilotserkovets et al. (2021) and Milner-Bolotin, (2015) could further optimize its pedagogical utility. Overall, this study contributes to the growing body of research on digital learning tools, advocating their adoption in elementary education. By leveraging interactive platforms, educators can create dynamic learning environments aligned with 21st-century paradigms, equipping students with competencies essential for success in a digitized world.

CONCLUSION

This study successfully developed and evaluated Microsoft Sway Media as a digital learning tool designed to enhance students' numeracy and literacy skills. The findings confirm its alignment with the essential criteria of validity, practicality, and effectiveness. The validation process, conducted by material and media experts, affirms its high quality and suitability for classroom use. Practicality assessments, based on feedback from teachers and students, demonstrate that the tool is user-friendly and well-received. Furthermore, effectiveness analysis, particularly through the N-Gain Score, demonstrates its significant enhancement of students' numeracy and literacy skills, thereby meeting

established effectiveness benchmarks. In terms of originality, this research contributes to the growing body of literature on digital learning media by applying Microsoft Sway within elementary mathematics education. Unlike conventional tools, Microsoft Sway Media offers an interactive and engaging learning experience through multimedia features aligned with the preferences of Generation Z learners. It also highlights the value of integrating accessible digital resources into mathematics instruction to foster independent learning and deepen comprehension, offering a model for addressing contemporary educational challenges through technology.

Despite these contributions, the study has limitations. Conducted within a localized educational context, its findings may lack generalizability to diverse settings. Additionally, the focus on numeracy and literacy implies opportunities for future research to explore the tool's efficacy across other disciplines. Subsequent studies could expand sample sizes, investigate long-term impacts, and incorporate adaptive learning functionalities to further optimize Microsoft Sway Media's effectiveness. The findings hold practical implications for educators and policymakers. The successful deployment of Microsoft Sway Media demonstrates the potential for educational institutions to adopt similar technology-enhanced resources to improve engagement and academic performance. Professional development programs should incorporate digital literacy training to equip educators with the expertise needed to integrate such tools effectively. Future research should explore scalability and potential integration into national education frameworks to advance innovative teaching strategies and foster 21st-century learning environments.

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