Sosioedukasi
JURNAL ILMIAH ILMU PENDIDIKAN DAN SOSIAL
ISSN: 2086-6135 E-ISSN: 2541-612x
Volume 14 No. 4. Desember 2025 https://ejournal.unibabwi.ac.id/index.php/sosioedukasi/index

DEVELOPMENT AND EFFECTIVENESS OF TRI N-INTEGRATED DIGITAL LEARNING MEDIA TO ENHANCE EARLY LITERACY SKILLS IN ELEMENTARY SCHOOL STUDENTS

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ARTICLE HISTORY
Received : 30-10-2025
Revised : 15-11-2025
Accepted : 15-12-2025

KEYWORDS
Tri N Values
Digital Learning
Early Literacy
Elementary Education
Interactive Media

ABSTRACT
This study examines the development and effectiveness of digital learning media integrating the Tri N values *Niteni* (observing), *Niroke* (imitating), and *Nambahi* (developing) to enhance early literacy skills among elementary school students. Using the Research and Development (R&D) approach with the ADDIE model, the media were designed to incorporate interactive text, animations, narration, and multisensory learning components. Data were collected through expert validation, student response questionnaires, and pretest–posttest assessments in experimental and control groups. The results show that the Tri N–integrated digital media significantly improved early reading and writing skills, as reflected by an increase in the experimental group's mean score from 70,1 to 85,7 and a moderate N-Gain of 57,76%. Statistical tests further confirmed significant effects on reading (p = 0,000) and writing (p = 0,015). Despite its effectiveness, expert and student evaluations highlighted the need for improved navigation flow and instructional clarity. Overall, the findings demonstrate that embedding Tri N values into digital learning offers a culturally grounded, pedagogically robust, and highly promising model for supporting early literacy development in the digital era.

INTRODUCTIONS

Rapid advancements in digital technology have reshaped educational practices worldwide, particularly in early literacy instruction, where digital learning environments offer interactive, engaging, and student-centered experiences for young learners. Global concerns regarding early literacy achievement highlight the need for more effective and culturally grounded pedagogical innovations. In this context, digital transformation presents both urgency and opportunity for improving foundational reading and writing skills among elementary students. For early literacy development, particularly in reading and writing, digital learning offers new opportunities to create interactive, engaging, and student-centered learning environments. At the same time, integrating local educational philosophies

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such as Ki Hadjar Dewantara's Tri N values can strengthen the cultural relevance and pedagogical depth of digital literacy instruction. This combination positions digital learning not merely as a technological shift but as a pedagogical innovation rooted in local wisdom.

Education is a conscious and planned effort to create a learning environment that enables students to develop their potential optimally spiritually, intellectually, and skillfully for personal and social life (Ichsan, 2021). In the learning context, instructional activities serve as a fundamental process in which students acquire knowledge, skills, and values through a variety of learning resources (Rohani, 2019). To ensure learning effectiveness, teachers must employ diverse and innovative learning media, including digital technologies, as intermediaries to facilitate students' understanding (Magdalena et al., 2021). Learning media play a crucial role in delivering instructional content and strengthening non-verbal communication within the learning process. Properly designed media stimulate interest, attention, and motivation, creating learning environments that are more active, enjoyable, and meaningful (Andari, 2019; Magdalena et al., 2021). Media also serve as a stimulus that clarifies lesson content, as verbal explanations alone often lead to rapid forgetting (Furoidah, 2020). Therefore, the integration of media particularly digital media has become essential for improving learning quality.

Despite these global and theoretical opportunities, empirical realities in Indonesia show persistent challenges in developing early literacy skills. Many schools still face limited technological readiness, low student interest, and insufficient use of engaging digital media (Nugroho & Aditya, 2018; Prawanti & Sumarni, 2020). These gaps are evident in SD Negeri 3 Tegaldowo, where several students demonstrate limited fluency in reading and writing and struggle to differentiate letter shapes. Teachers must therefore select learning resources that are relevant, contextual, and capable of fostering active participation (Firdaus & Nurjannah, 2021). Learning media themselves function as communication tools in both hardware and software forms that support the instructional process (Anomeisa & Ernaningsih, 2020).

These empirical findings indicate a clear *research gap*: although digital learning has been widely promoted, few studies integrate culturally grounded pedagogical frameworks specifically Tri N (niteni, niroke, nambahi) into digital media for strengthening early literacy skills. Most previous studies focus either on digital media effectiveness or Tri N–based learning, but not on the combination of both, leaving a significant gap in the development of digital literacy models rooted in national educational philosophy.

The Tri N pedagogical framework *niteni* (observing), *niroke* (imitating), and *nambahi* (developing) offers a culturally grounded approach aligned with constructivist principles and supports active literacy development introduced by Ki Hadjar Dewantara. Niteni involves careful observation of an object through sensory and cognitive processes. Niroke refers to imitating examples or models provided by the teacher, while nambahi represents the creative stage in which students develop or modify what they have learned (Arigiyati et al., 2021). This approach aligns with constructivist learning principles by providing opportunities for direct experience, creativity, and self-expression.

In the context of elementary education, integrating Tri N values into digital learning represents a promising strategy for developing early literacy skills. Reading enables students to understand messages and identify letters, words, and sentences systematically (Chasanah et al., 2021). Writing encompasses expressing ideas using graphic symbols requiring coordination between motor, visual, and cognitive abilities (Harianto et al., 2020). Strengthening these foundational skills at an early stage is essential for supporting learners' academic progression across grade levels.

However, various studies have shown that early literacy performance among elementary students remains low due to limited learning interest, weak motivation, and inadequate learning media (Oktaviyanti et al., 2022). Many young learners still struggle with recognizing letters, distinguishing shapes, and combining syllables into words (Lukács et al., 2021). Digital learning technology offers an effective solution by creating more interactive and engaging literacy experiences (Andriyani & Hermanto, 2022). Previous research supports the importance of integrating cultural and pedagogical values such as Tri N into technology-enhanced learning. Yusindra et al. (2023) found that Tri N-based media significantly improved learning outcomes, with average scores increasing from 64.2 to 96.7. Interactive digital media also facilitate multimodal learning through text, sound, and images, strengthening literacy development (Park, 2022). Other studies also indicate that technology-based learning enhances engagement and overall learning effectiveness (Aryawan et al., 2018; Setiawan & Oka, 2020).

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Thus, integrating Tri N values into digital learning offers a contextual and culturally responsive solution to address the early literacy challenges faced by Indonesian elementary schools. The alignment of Tri N stages with digital features niteni through interactive observation, niroke through guided imitation, and nambahi through creative digital tasks provides opportunities for deeper literacy engagement.

The role of learning media as instructional intermediaries is closely linked to their ability to clarify content, enhance motivation, and create concrete experiences (Kuncahyono, 2017; Haryono, 2015; Arsyhar, 2020). According to Edgar Dale's Cone of Experience, more concrete learning experiences lead to deeper understanding. Digital multimedia integrating text, graphics, audio, video, and animation creates stimulating experiences that increase motivation and critical thinking (Gayestik, 2012; Dadan, 2019; Lestari, 2020; Limbong & Simarmata, 2020).

Based on these considerations, the present study aims to develop Tri N–integrated digital learning media and examine its effectiveness in improving early literacy skills among elementary school students. The novelty of this study lies in integrating Ki Hadjar Dewantara's Tri N philosophy with modern digital learning media within an R&D framework resulting in a culturally grounded innovation that has not been widely explored in previous empirical studies on early literacy.

METHOD

This study employed a quantitative Research and Development (R&D) design to produce and test the effectiveness of Tri N–integrated digital learning media aimed at improving early literacy skills. The quantitative approach was used to analyze numerical data obtained from expert validation, learning outcomes, and student responses objectively (Sujarweni, 2017). Following Sugiyono (2017), the R&D method was applied to develop an educational product digital media incorporating the values of Niteni, Niroke, and Nambahi and to test its feasibility, practicality, and effectiveness. The ADDIE development model consisting of Analysis, Design, Development, Implementation, and Evaluation (Fransisca & Putri, 2019; Sugiyono, 2020) guided the research procedures. The study took place at SD Negeri 3 Tegaldowo using purposive sampling aligned with the school's early literacy needs. Data collection occurred from August to October 2025.

The ADDIE steps were implemented systematically. The Analysis stage identified early literacy challenges through observations and teacher interviews. The Design stage produced media blueprints incorporating Tri N stages in reading and writing tasks. During the Development stage, digital media were constructed by integrating Niteni (observation), Niroke (imitation), and Nambahi (development), then validated by content experts, media experts, and practitioners. In the Implementation stage, trials were conducted in two phases: a limited trial (6 students, ages 9–12) selected randomly (Sugiyono, 2017) and a field trial involving 30 different students. The Evaluation stage included formative and summative procedures to determine validity, practicality, and effectiveness (Sa'adah & Wahyu, 2020). Data were collected using observation sheets, interview guides, documentation, and questionnaires (Mar'atusholihah, 2019; Sugiyono, 2020; Sendekie, 2022). Instrument validity was tested using Pearson Product Moment, while reliability was measured using Cronbach's Alpha assisted by SPSS version 25 (Hidayat, 2021).

Data analysis used descriptive quantitative techniques. Product validity and practicality were interpreted using percentage classifications, with ≥75% considered valid and positive (Sendekie, 2022). Effectiveness was assessed using normality (Kolmogorov–Smirnov), homogeneity tests, N-Gain scores, and Independent Sample T-Test to compare pretest–posttest results (Sugiyono, 2020). Ethical considerations were maintained throughout the study, including obtaining informed consent from school authorities, teachers, and parents; ensuring student anonymity; securing data confidentiality; and guaranteeing that participation posed no risk to children's psychological or academic well-being. All procedures complied with ethical guidelines for research involving minors**.**

RESULT AND DISCUSSION

Result

This research and development study produced a digital learning media that integrates Tri N values—Niteni (observing), Niroke (imitating), and Nambahi (developing) to enhance elementary students' early literacy skills. The digital media were designed to support active and meaningful literacy learning by combining text, images, animations,

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audio narration, and interactive activities. The development process followed the ADDIE model, consisting of the Analysis, Design, Development, Implementation, and Evaluation stages. The results of each stage are presented below.

The development process using the ADDIE model

The analysis phase identified key challenges in early literacy development, including students' difficulty in recognizing letters, segmenting syllables, and constructing simple words. Observations and teacher interviews revealed that existing learning practices relied heavily on traditional drill-based approaches, resulting in student boredom and limited engagement. Curriculum analysis confirmed that letter recognition, phoneme awareness, syllable formation, and sentence construction form the core of early literacy instruction within the Indonesian Language subject. The student characteristics analysis indicated that young learners respond more effectively to visual, auditory, and kinesthetic stimuli. Based on these findings, Tri N values were considered highly relevant to digital learning design. The principles of Niteni, Niroke, and Nambahi support gradual, interactive, and experience-based learning attributes essential for early reading and writing development in the digital era.

During the design stage, the structure, flow, and interaction model of the digital media were formulated. The media were designed to include: (1) Visual elements such as animated letters and illustrated word cues. (2) Audio narration to support phoneme recognition. (3) Interactive literacy tasks, including clicking, matching, and word-building activities. (4) Tri N–based learning stages: (a) *Niteni:* observing letters, words, and sentences through animated demonstrations. (b) *Niroke:* imitating through guided reading and writing practice. (c) *Nambahi:* developing new words or sentences based on digital prompts and images. A story-based interface and colorful layout were designed to maintain engagement and support the literacy needs of early elementary students.

The digital learning media were constructed using a combination of animated content, interactive narration, and structured literacy activities. Each feature was designed to align with Tri N values and support step-by-step literacy progression. Table 1 presents the main components of the developed media.

Table 1. Components and Features of the Digital Tri N–Integrated Learning Media

No	Media Component	Description
1	Letter Introduction Page	Animated letters with narrated pronunciation.
2	Syllable Matching Activity	Students match syllables with related images.
3	Word Formation Task	Students drag letters to form basic words.
4	Reading Practice Page	Sentence reading activities accompanied by illustrations.
5	Evaluation Page	Tasks to assess understanding of letter recognition and word formation.

Figure 1 shows the main interface, which serves as the navigation hub for students. The layout is colorful, intuitive, and developmentally appropriate for early elementary students, enabling independent use.

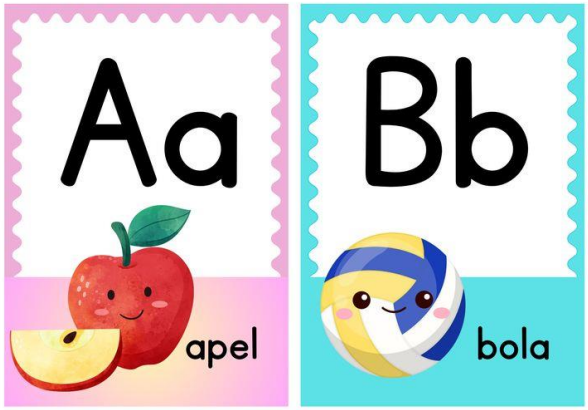

Figure 1. Main Interface of the Developed Learning Media

The implementation stage was conducted in two classes: (1) Class II A (Experimental group): Used the digital learning media integrating Tri N values. (2) Class II B (Control group): Learned through conventional methods, such

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as lectures, blackboard drills, and workbook exercises. A total of 28 students in the experimental class used laptops and tablets to interact with the digital media. The learning process followed Tri N steps: (1) *Niteni*, observing animated demonstrations, letter cues, and narrated syllables. (2) *Niroke*, imitating through guided reading and writing tasks. (3) *Nambahi*, creating simple words or sentences from the prompts provided in the media. Due to limited device availability, implementation was conducted on a restricted scale, with full-scale use planned for the subsequent semester.

Evaluation involved expert validation, student response assessment, and pre-test/post-test analysis to determine the validity, practicality, and effectiveness of the digital media integrating Tri N values.

Expert Validation Results

Two experts one media expert and one content expert validated the product's content accuracy, visual design, usability, and alignment with literacy learning objectives.

Table 2. Validation Results of the Digital Tri N–Integrated Media

No	Assessed Aspect	Score	Max	%	Category
1	Media Expert Validation	52	100	52%	Fairly Valid
2	Content Expert Validation	52	100	52%	Fairly Valid

The results indicate that the media meet minimum validity criteria but require refinement, particularly in narration clarity and user interaction. Validators noted strong visual appeal and age-appropriate design but suggested improvements to navigation and instructional flow.

Effectiveness Trial Results

Student response trials measured appearance, usability, and clarity using a 1–5 Likert scale.

Table 3. Student Response Results

No	Aspect	Score	Max	%	Category
1	Appearance & Attractiveness	18	30	60%	Fairly Positive
2	Ease of Use	12	30	40%	Less Positive
3	Material Clarity & Navigation	14	40	35%	Less Positive
	Total	**44**	100	**44%**	Less Positive

The findings reveal that although students were attracted to the visual design, improvements are needed to increase ease of navigation and clarity of instructions.

Learning Outcomes: Pre-Test and Post-Test

To evaluate the effectiveness of integrating Tri N values into digital learning, pre-test and post-test assessments were administered.

Table 4. Pre-Test and Post-Test Results

Class	Lowest	Highest	Dominant Range	Mean
Experimental (Pre)	48	84	65.5–74.5 (33%)	70.1
Experimental (Post)	75	91.5	88.5–91.5 (40%)	85.7
Control (Pre)	55	89	69–82 (71%)	73.2
Control (Post)	66	83	66–83 (75%)	74.1

The experimental class showed a substantial improvement in mean literacy scores, indicating that Tri N–integrated digital media fostered more effective early reading and writing outcomes than traditional instruction from 70.1 to 85.7, compared to the control class, which increased only from 73.2 to 74.1. The N-Gain analysis showed: (1) Experimental class: 57.76% (Moderate), (2) Control class: 9.71% (Low)

Normality and homogeneity tests showed Sig. = 0.967 > 0.05, indicating normally distributed and homogeneous data. Independent t-test results: (1) Reading skills: Sig. = 0.000 < 0.05, (2) Writing skills: Sig. = 0.015 < 0.05. These results confirm a significant effect of integrating Tri N values into digital learning on early literacy development.

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The integration of Tri N values effectively enhanced early literacy performance by providing a structured, multisensory, and developmentally appropriate learning sequence students' early literacy skills. The digital media facilitated structured literacy activities aligned with Niteni, Niroke, and Nambahi stages and provided engaging multisensory learning experiences. Although improvements are needed in navigation and instruction clarity, the media demonstrated strong potential to increase motivation, engagement, and literacy achievement in elementary students.

Discussion

The findings indicate that integrating Tri N values into digital learning environments significantly enhances early literacy, as evidenced by the experimental class's substantial score improvement (N-Gain 57.76%) compared to the control group (N-Gain 9.71%). This effectiveness aligns with prior studies demonstrating that digital multimedia when combining visual, auditory, and kinesthetic modalities facilitates comprehension, retention, and literacy gains (Park, 2022; Lukács et al., 2021; Aryawan et al., 2018). The strong t-test significance for early reading ($p = 0.000$) and writing ($p = 0.015$) further supports the argument that Tri N values enhance literacy not merely through exposure but through structured cognitive scaffolding. The effectiveness is theoretically grounded in constructivist and experiential learning principles, which emphasize active meaning-making, guided discovery, and learner-centered progression mechanisms inherently embedded in the Niteni, Niroke, and Nambahi stages. Thus, the integration works because it organizes digital tasks into sequential cognitive pathways, enabling students to observe patterns, imitate models, and generate independent responses, thereby strengthening early literacy foundations.

However, the contrast between learning gains and evaluation scores indicates a design–pedagogy gap. Although literacy outcomes improved, expert validation (media = 52%; content = 52%) and student practicality responses (44%) fell below the desired thresholds. This discrepancy suggests that pedagogical value alone cannot compensate for suboptimal usability, interface clarity, and navigational flow factors widely documented as determinants of user engagement in digital learning (Magdalena et al., 2021; Furoidah, 2020; Anomeisa & Ernaningsih, 2020). Prior research similarly notes that multimedia can yield cognitive benefits despite UX limitations, but sustained engagement deteriorates when learners struggle with navigation or interpretive cues. Therefore, the implication is that improving interface intuitiveness and multimodal alignment is essential to convert short-term cognitive gains into long-term adoption. This is further supported by expert recommendations emphasizing clearer instructions, stronger feedback loops, and richer contextual examples across Tri N stages (Sendekie, 2022; Hidayat, 2021).

The moderate N-Gain obtained by the experimental class reflects the cognitive logic of the Tri N framework. Niteni allows structured attention and pattern recognition, Niroke supports procedural fluency through imitation, and Nambahi fosters generative thinking three mechanisms consistently associated with early literacy fluency in multisensory and practice-based instruction (Nisa et al., 2019; Lukács et al., 2021). Yet, the lower practicality scores highlight contextual constraints such as limited digital infrastructure, varied device performance, and teachers' limited readiness in digital pedagogy factors known to influence technology acceptance (Kuncahyono, 2017; Muali, 2018). These constraints explain why students' academic performance increased (the ***what***), but their user experience remained low (the ***how***), demonstrating that contextual readiness mediates the perceived usefulness of educational technology. Reliability analysis (Cronbach's Alpha = 0.904) and parametric assumptions further strengthen the conclusion that the product is statistically sound, even if not yet optimally user-friendly.

Theoretically, this study expands the discourse on the integration of indigenous pedagogical values in this case, Tri N within modern digital ecosystems. By demonstrating that observation–imitation–creation sequencing enhances literacy in digital formats, the study reinforces arguments from constructivist and experiential learning theorists who view learning as an active, iterative process rather than passive reception. Empirically, this supports the notion that local cultural frameworks can be effectively harmonized with contemporary digital media designs to meet foundational literacy needs. Practically, the digital product offers a promising learning tool adaptable to classroom, blended, and independent settings. However, to achieve large-scale implementation, the media must reach "valid" and "positive practicality" categories (≥75%) through interface simplification, navigational refinement, and strengthened teacher support. Without such improvements, the innovation may remain effective in controlled trials but struggle to achieve systemic integration in elementary school environments**.**

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CONCLUSION

This study demonstrates that Tri N–integrated digital learning media significantly improve early literacy skills among elementary students. The combination of guided observation (Niteni), structured imitation (Niroke), and creative application (Nambahi) aligns with children's cognitive development and supports multisensory engagement. While the media proved statistically effective, improvements in interface design and navigation are required to enhance usability and ensure broader adoption. Future research should explore larger samples, diverse school settings, and cross-platform digital integration to further validate the model's scalability and impact.

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