



Development and Validation of the MULTIBI Model: A Multiliteracy-Based Approach to Indonesian Language Learning for the Industrial 4.0 Era

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ABSTRACT

Introduction. The digital era and Industrial Revolution 4.0 necessitate an adaptive approach to Indonesian language learning, particularly through multiliteracy. Existing models often lack comprehensive digital media integration and a unified framework for diverse literacy skills across Indonesian regions. This study developed and validated the MULTIBI (Multiliteracy-Based Indonesian Language Instruction) Model, a multiliteracy-based Indonesian language learning model to enhance students' critical thinking, information evaluation, and multimodal content production – essential 21st-century skills.

Study participants and methods. This study employed an R&D approach using the ADDIE model (Analysis, Design, Development, Implementation, Evaluation) to design a multiliteracy-based Indonesian language learning model. Data were gathered through observations, interviews, questionnaires, validation sheets, multiliteracy skill tests, and perception scales. Participants included 90 students and 3 teachers from East Java, Central Kalimantan, and East Nusa Tenggara schools. Quantitative (t-tests, ANOVA, Cohen's d) and qualitative analyses were used to evaluate model feasibility, effectiveness, and student engagement.

Results. Findings revealed students struggled with digital (76%), visual (70%), and information literacy (79%), alongside conventional learning, teacher training deficits, infrastructure limitations (81%), and low motivation. The MULTIBI Model integrates five literacy aspects (digital, media, visual, information, and textual) within a blended, collaborative, and project-based learning strategy. Expert validation confirmed high feasibility (87.3%). Trials in Java, Kalimantan, and East Nusa Tenggara involving 90 students used validation sheets, multiliteracy tests, and perception questionnaires. Quantitative (t-tests, ANOVA, Cohen's d) and qualitative analyses demonstrated the model's effectiveness.

Conclusion. MULTIBI provides a practical, empirically validated solution for Indonesian education, emphasizing the urgent need for enhanced teacher training and digital infrastructure to foster students' critical and creative skills for the 21st century.

KEYWORDS

MULTIBI model, multiliteracy, Indonesian language, ADDIE, digital literacy, 21st-century skills

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INTRODUCTION

In the era of globalization, literacy has become a crucial foundation for active individual participation in global society and economy. International organizations such as the United Nations Educational, Scientific, and Cultural Organization (UNESCO) and the Council of Europe consistently underscore the importance of quality education and literacy development as key drivers of sustainable development and intercultural understanding [1; 2]. UNESCO, for instance, promotes the Education 2030 Agenda, which emphasizes the significance of lifelong literacy for all, including developing digital and media competencies. These initiatives do not solely focus on basic literacy but also acknowledge the shift towards multiliteracies in response to the complexity of information in the digital age. Therefore, ensuring that education systems worldwide can equip students with diverse literacy skills has become an urgent global priority.

In the national context, Indonesian plays a strategic role as a unifying language and a primary instrument of national education [3]. As the official language and medium of instruction, strong proficiency in Indonesian forms the foundation of literacy for younger generations to access and process information effectively [4; 5]. Indonesian literacy is essential for developing critical thinking and creativity and strengthening the nation's literacy position in the era of globalisation [6]. With technological advancements, the concept of literacy has expanded into multiliteracies, which include various modes of communication and media [7,8]. Applying multiliteracies in Indonesian language learning is crucial to accommodate shifts in how individuals interact with texts in multimedia contexts. These include digital literacy (the ability to use technology critically) [9], media literacy (the ability to analyse media messages), visual literacy (the ability to interpret visual content), and information literacy (the ability to evaluate information sources) [10].

The Industrial Revolution 4.0 has shifted the learning paradigm, demanding complex 21st-century literacy skills [11]. Students' interactive, technology-based learning styles require an adaptive Indonesian language learning model. However, challenges such as unequal technology access and limited teacher readiness must be addressed for effective and ethical learning.

Initial observations in eight provinces reveal a significant gap between traditional linguistics-focused instruction and the multiliteracy demands of the 4.0 era [12], with notable disparities in digital media integration across regions (see Figure 1).

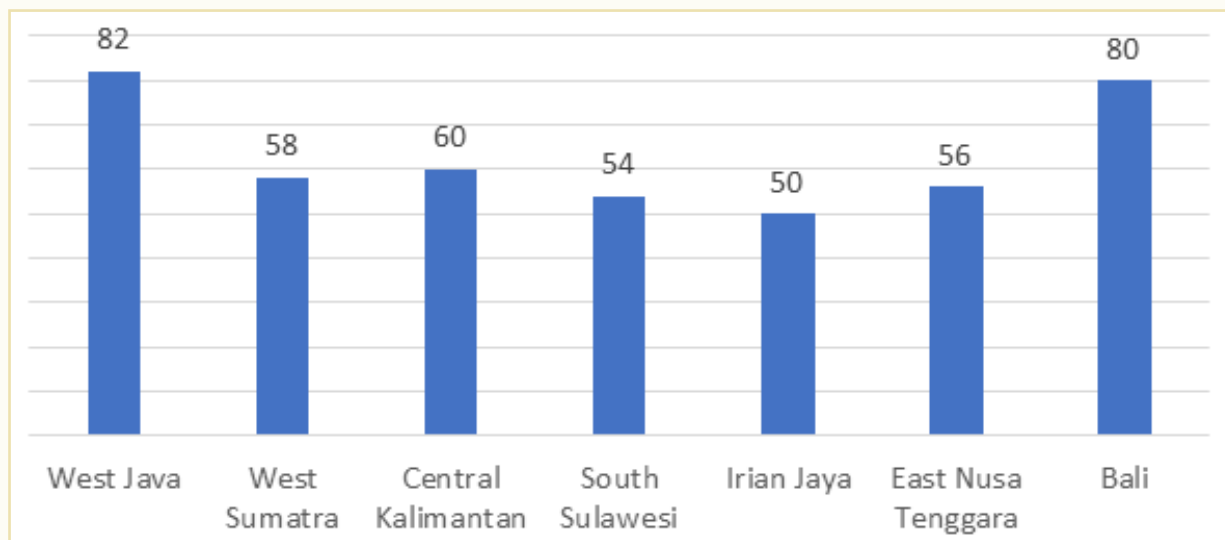


Figure 1 Percentage of Digital Media Integration Level

Figure 1 illustrates the percentage levels of digital media integration in Indonesian language learning across eight provinces. Overall, the initial observational data reveal a significant trend of inequality in the use of digital media across different regions of Indonesia. Provinces in the western and central parts tend to exhibit higher levels of integration than those in the

eastern regions. For instance, West Java demonstrates the highest level of integration, while West Papua shows the lowest, indicating a disparity that needs to be addressed to equalise the quality of learning nationwide.

This gap underscores the urgency of developing a multiliteracy-based Indonesian language learning model that is relevant to the digital era [13]. Recent research highlights the importance of digital literacy in managing information and countering misinformation, as well as the role of media and visual literacy in enhancing critical thinking within the context of Indonesian language education [14]. A failure to address this gap may hinder students' active and critical participation in the digital information age [15].

This study addresses this challenge by developing an innovative and contextual multiliteracy-based Indonesian language learning model. The model aims to enhance students' abilities in: (1) critically evaluating digital information; (2) analysing media representations; (3) developing effective multimodal content production skills; and (4) utilising information critically and ethically. In doing so, the study contributes to advancing adaptive and effective language learning practices suited to the digital era and the context of the Fourth Industrial Revolution.

The development of this model is expected to enhance students' literacy competencies holistically, support mastery of multimodal and digital communication, and foster critical and evaluative thinking skills. Thus, the model offers a comprehensive and adaptive response to the challenges of the Fourth Industrial Revolution and the need to elevate students' literacy in the digital age.

This study offers novelty by developing an Indonesian language learning model that holistically integrates the principles of multiliteracy, considering the specific contextual needs of Indonesia in the Industrial Revolution 4.0 era. Unlike previous models, which often focused on digital or multimodal literacy in isolation, this model provides a synergistic integration of multiple literacy dimensions and has been empirically validated across educational settings with varying levels of digital integration.

THEORETICAL BACKGROUND

1. Multiliteracy

Multiliteracy is a literacy concept that has evolved alongside technological advancements and modern communication media [16; 17]. According to [18], multiliteracy encompasses understanding and utilizing various types of texts and diverse media, extending beyond traditional reading and writing literacy [19]. In language education, multiliteracy involves mastery of digital, media, visual, information, and textual literacies, enabling students to adapt to increasingly complex and multimedia communication environments [20; 21]. Thus, multiliteracy provides a comprehensive framework for developing relevant literacy skills in a rapidly changing world.

2. Challenges and Opportunities for Language Learning

The challenges and opportunities for language learning in the current digital era are a major concern in developing relevant and competitive education [22; 23]. A primary challenge arises from the changing characteristics of students who grow up in high-tech environments, thereby demanding more dynamic, interactive, and contextual language learning models [24]. Limitations in digital infrastructure in some regions, teachers' readiness to adopt technology, and curricula that do not fully support the development of multiliteracy skills pose significant obstacles [24; 25]. Nevertheless, considerable opportunities exist through the use of various digital platforms, language learning applications, educational social media, and AI-based technologies, which can support language skills in a richer and more meaningful way [26; 27]. With an appropriate approach, language learning can be directed not only to improve linguistic abilities but also to foster critical, creative, and communicative thinking skills aligned with the demands of the twenty-first century [28; 29].

3. Multiliteracy Learning Models

Various multiliteracy learning models have been developed to address the literacy needs of the twenty-first century [30; 31]. The project-based multiliteracy learning model allows students to

actively integrate multiple literacies in real-world contexts [32; 33]. Additionally, the blended learning model, which combines face-to-face and digital instruction, effectively supports the development of digital and media literacies [34; 35]. Another prominent approach is critical literacy-based learning, emphasizing the critical analysis of media and information, equipping students with in-depth evaluative skills [36; 37]. Integrating these models into Indonesian language learning is expected to enhance students' multiliteracy competencies comprehensively and contextually.

RESEARCH METHODS

1. Research model

This study employs a Research and Development (R&D) approach, adopting the ADDIE development model, which comprises five main stages: Analysis, Design, Development, Implementation, and Evaluation [38; 39]. The ADDIE model was selected due to its systematic and iterative nature, allowing for the development of learning models that are responsive to field needs and can be adjusted based on feedback at each stage [40; 41]. This approach is considered highly relevant for designing complex multiliteracy-based learning models, particularly in addressing the challenges of the twenty-first century and the dynamics of Industry 4.0. Figure 2 (below) illustrates the flow of learning model development following the ADDIE approach.



Figure 2 ADDIE design flow

Figure 2 illustrates the flow of learning model development using the ADDIE approach. The Analysis stage begins with identifying multiliteracy needs through observations of learning, interviews with teachers and students, and questionnaires concerning digital, media, visual, and information literacies. These findings form the basis for the initial design of the learning model. The Design stage includes developing a model prototype that integrates digital media and interactive learning resources. It also involves preparing evaluation instruments and multiliteracy validation sheets. The Development stage focuses on model validation by material experts, digital design experts, and Indonesian language teachers, using a Likert scale to assess relevance, practicality, and quality. At the Implementation stage, the model is tested through a limited trial in one school and a broader trial across three schools in different provinces. Data were collected through pre-tests and post-tests assessing multiliteracy skills. Finally, the Evaluation stage includes formative evaluation to improve the model. Summative evaluation, conducted through statistical analysis, assesses the effectiveness of implementation.

2. Subjects of the Study

The participants in this study were students in Years 8 and 10 from three schools located in the provinces of East Java, Central Kalimantan, and East Nusa Tenggara, with a total population of approximately 500 students. Sampling was performed using the Slovin formula with a 10% margin of error, resulting in approximately 90 students being randomly and proportionally selected based on diverse academic abilities. Each school contributed around 30 students and one Indonesian language teacher, with a distribution representing urban and semi-urban contexts and varying levels of digital infrastructure (high, medium, and low). The distribution of student and teacher samples from each school is presented in Table 1.

Table 1

Research Subjects

No.	School Name	Province	Teachers	Students	Total
1	Junior High School 3 Pesedasan, Malang	East Java	1	30	30
2	Muhammadiyah 2 High School, Palangkaraya	Central Kalimantan	1	30	30
3	Christian Junior High School 2 Soe	East Nusa Tenggara	1	30	30
	Total		3		90

3. Research Instruments

The research instruments used in this study consisted of three types: model validation sheets, multiliteracy skills tests, and student motivation and perception questionnaires. Experts and teachers completed model validation sheets to assess key aspects of the learning model, such as the relevance of the material content to the concept of multiliteracy and the accuracy of the Indonesian language material, the clarity of the learning structure, the integration of multiliteracy elements, clarity and precision of language, and the ease of navigation and visual appeal of media displays. The multiliteracy skills test comprised multiple-choice and short-answer questions designed to measure students' abilities in reading literacy, visual literacy, media literacy, and digital literacy, with indicators including understanding digital texts, interpreting infographics, analysing the credibility of online news, and the ability to search for and evaluate information on digital platforms. This test used the 21st-century multiliteracy competency framework relevant to Indonesian language learning. Additionally, a student motivation and perception questionnaire, using a Likert scale from 1 to 5, was employed to measure learning interest, active involvement, comfort with using digital media, and perceptions of the effectiveness of the learning model.

4. Data Analysis

Data analysis in this study was conducted using quantitative and qualitative approaches aligned with the stages of model development [42; 43]. At the model validation stage, quantitative analysis calculated the mean scores from validation sheets completed by experts and practitioners. Each aspect was rated on a scale from 1 to 5, with eligibility criteria determined based on the mean score. The model was deemed very feasible if the mean score was ≥ 4.0 . Qualitative analysis involved coding open-ended comments from the validators to identify key themes, such as strengths, weaknesses, and suggestions for improving the model. During the model trial stage, two primary statistical methods were employed. First, to analyse differences in students' multiliteracy abilities before and after model implementation, a Paired Sample t-test was performed using SPSS software [44]. Effect size was calculated using Cohen's d, with $d \geq 0.8$ interpreted as a large effect. Second, since the study included a control group, an Independent Samples t-test or ANOVA was conducted to compare results between the experimental and control groups.

STUDY RESULTS

1. Results of the Analysis Phase

The needs analysis involved 90 students in Years VIII and X, alongside three Indonesian language teachers from three schools across different provinces: Junior High School 3 Pesedasan in Malang (East Java), Muhammadiyah 2 High School, Palangkaraya (Central Kalimantan), and Christian Junior High School 2 Soe (East Nusa Tenggara). The schools were purposively selected to represent urban and semi-urban contexts and varying levels of digital infrastructure, from high to low. The total student population across the three schools was approximately 500. Sampling was conducted using the Slovin formula with a 10% margin of error, resulting in 90 students selected randomly and proportionally according to academic ability diversity. Each school contributed 30 students and one Indonesian language teacher as participants.

The needs analysis revealed several key findings regarding students' multiliteracy skills. Regarding digital literacy, 76% of students reported difficulty using the internet independently to support Indonesian language learning. Teachers also acknowledged that they were not yet accustomed to employing digital technology-based learning strategies. Secondly, in media and visual literacy, approximately 70% of students indicated that using visual media – such as infographics, educational videos, and animations—remained very limited. Teachers tended to rely on conventional methods, namely lectures and textbooks. Thirdly, concerning information literacy, only 21% of students were accustomed to actively searching for and using online resources (articles, blogs, e-books) to complete assignments. Fourthly, conventional text literacy still focuses on reading literary and non-fiction textbook texts, whereas understanding digital genres such as blogs, online opinions, and podcasts remains relatively low.

The frequency of digital media use was also relatively low. Approximately 63% of teachers reported not using digital media routinely, but only during specific activities, such as class presentations. Strategically, no systematic approach has been implemented to integrate multiliteracy elements into Indonesian language learning. Furthermore, teachers acknowledged they had never attended specialised training explicitly addressing the integration of digital multiliteracy into teaching.

The following are the main challenges faced by teachers and students in implementing digital media in Indonesian language learning:

Table 2

Challenges of implementing digital media in schools

Challenge	Percentage	Description
Limited infrastructure (internet access and devices)	81%	Several classrooms lack projector facilities and reliable internet connectivity.
Lack of teacher training in digital multiliteracy	77%	Teachers have not received relevant and practical training on digital multiliteracy.
Difficulty in finding appropriate digital teaching materials	69%	Teachers face challenges aligning digital learning materials with the curriculum.
Low student motivation to learn through digital media	60%	Many students are more inclined to use gadgets for entertainment rather than learning.

Based on the analysis of needs, current conditions, and challenges in the field, Indonesian language learning based on multiliteracies in three schools across East Java, Central Kalimantan, and East Nusa Tenggara is not yet optimal. Developing a multiliteracies learning model that is practical, contextual, and responsive to real-world conditions is necessary. Furthermore, practical guidelines should be prepared for teachers to integrate elements of text, media, visual, digital, and information multiliteracies in a cohesive manner. Teacher training and the strengthening of digital infrastructure are also crucial components to support this model's effective and sustainable implementation.

2. Results of the Design Stage

The design stage was undertaken based on the needs analysis results and the actual conditions of digital media integration in the three target schools. The results of this stage yielded a prototype of a multiliteracies-based Indonesian language learning model, complete with integrated digital media and supporting instruments. This model is named MULTIBI (Multiliteracies-Based Indonesian Language Learning Model).

Theoretically, MULTIBI was developed concerning the multiliteracies theory of the New London Group, Vygotsky's social constructivism theory, and the contextual learning approach (Contextual Teaching and Learning). This model accommodates students' needs to develop competencies in reading, understanding, evaluating, and producing various text forms in an increasingly digital and complex social environment. The main objective of MULTIBI is to improve students' multiliteracy skills, especially in the aspects of text, digital, visual, media, and information literacy. Furthermore,

this model encourages using authentic digital sources and developing creative products by the students, whilst positioning teachers as facilitators in project-based learning and problem solving. The structure of the MULTIBI model includes several important components, including a blended learning approach, project-based and collaborative learning, and a focus on five main aspects of literacy: text, digital, visual, media, and information. This model comprises six operational steps. The following details the stages referred to in this study.



Figure 3 MULTIBI operational steps

In its implementation, teachers serve as facilitators and curators of digital learning resources and learning evaluators who provide qualitative and quantitative feedback. Meanwhile, students are expected to actively seek and use information from various sources, produce creative content, and work collaboratively in learning. The output of implementing the MULTIBI model encompasses improving students' understanding and skills in reading, analysing, and producing various texts and media, whilst fostering critical, creative, and independent learning habits in the digital era. Concrete results include student work such as social issue infographics, presentation videos, opinion articles, and media reviews. The advantages of MULTIBI lie in its flexibility and contextuality, supporting various Indonesian language learning topics, in line with the Merdeka Curriculum and available digital platforms. Oriented towards outcomes, not memorisation, this model strengthens literacy, creativity, and collaboration to support the formation of the Pancasila student profile. MULTIBI also integrates various digital media to support the learning process.

All of these media were selected because they are free, readily accessible, and consistent with student characteristics and learning contexts, whether online, offline, or blended. Alongside developing models and media, supporting instruments for validation and evaluation were also prepared. These instruments comprise validation sheets from subject matter experts, learning specialists, and practitioners; a multiliteracy pre-test and post-test; student self-assessment questionnaires; and digital work assessment rubrics based on content, creativity, language cohesion, and information integration. Overall, the MULTIBI Model prototype was designed as a contextual and applicable solution for addressing the challenges of learning Indonesian in the Industrial Revolution 4.0 era. This model integrates technology and multiliteracy principles to foster active, creative, and meaningful learning and supports 21st-century competencies in various educational contexts.

MEDIA / PLATFORM	FUNCTION IN THE MODEL	STRENGTHENED LITERACY ASPECT
 YouTube Edu RuangGuru	Initial trigger / reflective topic	Media & digital literacy
 Google Search Wikipedia	Information search source	Information literacy
 Piklto Padelt	Infographic and poster production	Visual & digital literacy
 padlet Google Jamboard	Digital discussion and brainstorming	Collaborative literacy
 Blogspot WordPress	Student digital article publication	Textual & digital literacy
 Qulizz Kahoot	Interactive understanding evaluation	Digital & metacognitive literacy

Figure 4 MULTIBI Media

3. Development Stage Results

The initial product comprises four main components based on the needs analysis and conceptual design. Firstly, a multiliteracy-based Indonesian language learning module featuring a six-step syntax of the MULTIBI Model, covering text, visual, media, information, and digital literacy, and furnished with authentic texts, projects, and digital media guides such as Canva, Padlet, and YouTube. Secondly, a teacher's guide encompassing concepts, implementation steps, assessment strategies, and multiliteracy assessment rubrics. Thirdly, digital learning media and resources include interactive links, videos, infographic templates, and Google Classroom and Quizizz access. Fourthly, an evaluation instrument designed to gauge the model's effectiveness, comprising a multiliteracy test, student and teacher perception questionnaires, and an observation sheet for implementing the model. The initial prototype of the MULTIBI Model was validated by five validators: two Indonesian language subject matter experts, one digital learning design expert, and two practising teachers. The validation process was conducted via two approaches, namely quantitative analysis using an assessment scale and qualitative analysis through open comments and suggestions. According to the results of the quantitative validation, the average score obtained was 138.8 out of a maximum score of 160, yielding an average percentage of 87.3% and the criteria "Very Eligible". The detailed results of the quantitative validation by experts and practitioners are presented in Table 3 below:

Table 3

Recapitulation of Validation by Experts and Practitioners

Validator	Maximum Score	Score Obtained	Percentage (%)	Criteria
Content Expert 1	160	145	90.6%	Very Eligible
Content Expert 2	160	140	87.5%	Very Eligible
Digital Media Expert	160	139	86.9%	Very Eligible
Practitioner (Teacher 1)	160	136	85.0%	Very Eligible
Practitioner (Teacher 2)	160	134	83.8%	Eligible
Average	160	138.8	87.3%	Very Eligible

Furthermore, validation was also conducted based on assessment aspects encompassing material content, model structure, language, and visual appearance. All aspects yielded scores with a percentage exceeding 85%, thus all aspects were assessed within the "Very Eligible" category. The detailed results based on assessment aspects are presented in Table 4 below:

Table 4

Validation Based on Assessment Aspects

Assessment Aspect	Maximum Score	Average Score	Percentage (%)	Criteria
Content Quality	40	36.1	90.2%	Very Eligible
Model Structure	40	35.4	88.6%	Very Eligible
Language	40	34.0	85.0%	Very Eligible
Visual Appearance	40	34.2	85.5%	Very Eligible
Average	40	34.9	87.3%	Very Eligible
Average	160	138.8	87.3%	Very Eligible

This validation bolsters the belief that the initial prototype of the MULTIBI Model is very eligible and can proceed to the revision stage with some minor adjustments for enhancement. The revisions were informed by qualitative input from experts and practitioners. The revisions encompassed simplifying the language, adding local text examples, integrating interactive digital media, and refining the assessment rubric. A comparison between the initial prototype and the revised model is presented in Table 5 below:

Table 5

Comparison of Early Prototype and Revised Model MULTIBI

Component	Initial Prototype	Revised Model
Instructional Syntax	Six learning steps	Retained, with added technical guidelines for each step
Learning Materials	General explanatory and narrative texts	Supplemented with local texts, reviews, and visual narratives
Module Language	Complex academic terminology	Simplified to ensure communicative clarity for lower secondary students
Digital Media	YouTube and Canva	Enhanced with usage tutorials and integration of Padlet/Blogspot
Assessment Rubric	General and descriptive	Elaborated into multiliteracy domains with an analytical scoring scale
Visual Design	Simple layout	Improved with a more engaging layout, multiliteracy icons, and responsive design

The final product of this research is the Multiliteracy-Based Indonesian Language Learning Model (MULTIBI), conceived as a response to the challenges of learning in the digital era. This model integrates constructivist and contextual approaches alongside various forms of literacy—textual, visual, media, and digital—intending to enhance students' literacy competencies as a whole. Furthermore, in addition to supporting Indonesian language learning outcomes, MULTIBI encourages critical, collaborative, and creative thinking. To facilitate implementation, this model is detailed in Table 6, encompassing model identity, theoretical basis, syntax, supporting tools, and its relevance to the curriculum and implementation challenges.

Table 6 of the final product presents a comprehensive representation of all stages of the MULTIBI model development, informed by the ADDIE approach. The systematic table structure offers a comprehensive overview for educators, researchers, and policymakers to understand and adopt this

model. It is anticipated that the implementation of the MULTIBI model can significantly contribute to enhancing the quality of Indonesian language learning relevant to the demands of the 21st century and capable of fostering a generation of literate, adaptive, and competitive learners. This product also presents opportunities for further development in terms of technical implementation and evaluation of the model's success across various educational contexts.

Table 6**MULTIBI final model**

Aspect	Component	Detailed Description
Model Identity	Model Name	Indonesian Language Learning Model Based on Multiliteracy (MULTIBI)
	Literacy Focus	Text literacy, visual literacy, media literacy, digital literacy
	Target Users	Teachers and students of Grade VIII Middle School and Grade X High School in the Indonesian language learning
	General Objective	To enhance students' multiliteracy competence and foster critical, creative, and collaborative thinking skills
Theoretical Foundation	Core Theories	Multiliteracies (New London Group), Social Constructivism (Vygotsky), Contextual Teaching and Learning (CTL)
	Learning Principles	Contextual, interactive, collaborative, and technology-based
Model Structure	Learning Syntax	1) Exploration 2) Analysis 3) Construction 4) Production 5) Reflection 6) Evaluation
	Syntax Description	- Exploration: Observing phenomena/visual content- Analysis: Examining texts/ meanings- Construction: Organizing ideas into an initial draft- Production: Creating products (infographics, videos, blogs)- Reflection: Discussions and feedback- Evaluation: Authentic and formative assessment
	Supporting Strategies	Group discussions, Q&A sessions, presentations, peer feedback, and the use of digital technology
	Learning Modules	Activity-based multiliteracy modules per topic, equipped with activity guides, source links, and task instructions
Model Instruments	Teacher's Guide	Includes model principles, syntax scenarios, lesson plan (RPP) samples, and assessment rubrics
	Digital Learning Media	Canva, Padlet, YouTube, Blogspot, Quizizz, Google Forms
	Learning Materials	Narrative texts, explanatory texts, reviews, infographics, short videos, digital texts
	Assessment Rubrics	Analytic multiliteracy rubric covering five aspects: content comprehension, visual design, media use, collaboration, and reflection
Learning Outcomes	Student Products	Digital infographics, video vlogs, group presentations, educational blogs/web-sites
	Final Assessment	Literacy tests, project presentations, peer assessments, reflective journals
Curriculum Contextualization	Alignment with the Merdeka Curriculum	The model supports differentiated learning, strengthens the Pancasila Student Profile, and integrates project-based literacy activities.
	Model Advantages	Adaptive (offline/online), flexible, applicable, aligned with contemporary needs, and supports character development and a digital mindset
	Implementation Challenges	ICT infrastructure readiness, teacher training, time management, and active student participation

4. Implementation Phase Results

A limited trial of the MULTIBI Model was conducted in one school with a single teacher and 30 students in Year VIII/X over four weeks, employing a blended learning approach. The teacher responded positively to the technical guidance, and the students were enthusiastic about using media such as Canva and Padlet, although there were challenges regarding media adaptation and a need for scaffolding. The teacher recommended the inclusion of visual tutorials. A wider trial was implemented

across three schools with varying geographical and infrastructural conditions (East Java, Central Kalimantan, and East Nusa Tenggara), involving three teachers and 90 students over six weeks. Adaptive methods and offline sessions addressed challenges such as limited network connectivity in certain regions. The trial results indicated a statistically significant improvement in multiliteracy skills within the experimental group ($p < 0.001$, large effect size), whilst the control group exhibited a marginal improvement. The complete data are presented in Table 7.

Table 7

Multiliteracy Skills Test Results

Group	Test	Mean Score	Standard Deviation	t-value	df	p-value	Cohen's d	Effect Interpretation
Limited Trial (n = 30)	Pre-test	60.5	6.8					
	Post-test	78.2	5.9	12.5	29	< 0.001	1.58	Very large effect
Broad Trial (n = 90)	Pre-test	59.8	7.1					
	Post-test	76.9	6.2	19.3	89	< 0.001	1.34	Very large effect
Control Group (n = 90)	Pre-test	60.1	6.5					
	Post-test	63.4	6.9	3.1	89	0.003	0.24	Small effect

Furthermore, in addition to enhancing skills, the findings from the questionnaire assessing students' motivation and perceptions of the MULTIBI model indicated a highly positive response, with a mean score exceeding 4 on a 1–5 scale and a high percentage of positive responses (≥ 4) across all dimensions. The detailed findings of the questionnaire are presented in Table 8 below.

Table 8

Results of the Student Motivation and Perception Questionnaire

Dimension of Motivation/Perception	Average Score (1–5)	Standard Deviation	% of Positive Responses (≥ 4)
Learning Motivation	4.2	0.6	82%
Perceived Ease of Use	4.0	0.7	78%
Perceived Usefulness of Learning	4.3	0.5	85%
Interest in Digital Media	4.1	0.6	80%

Overall, the findings from the limited and extensive trials, coupled with student responses, suggest that the MULTIBI Model was favourably received, effective in enhancing multiliteracy skills, and exerted a positive impact on student motivation and engagement in digital media-based learning.

5. Evaluation Phase Results

The evaluation results of the multiliteracy-based learning model (MULTIBI) demonstrated significant effectiveness in enhancing students' multiliteracy skills, as evidenced by quantitative data that recorded a significant increase in mean scores with a large effect size (Cohen's $d > 1.3$) in the trial group. Furthermore, the scores for learning motivation and students' perceptions of ease of use and learning benefits indicated a high level of satisfaction, with the majority of respondents providing positive assessments. Qualitative data from observations also corroborated these findings, illustrating students' active involvement in interactions with digital media and multiliteracy activities, encompassing increased participation, creativity, and collaboration. Interviews with teachers and students further reinforced that this model provided an enjoyable learning experience and facilitated a better understanding of concepts. Conversely, formative evaluations conducted during the design and initial trial stages formed an important basis for refining the model. Feedback from expert

validators and practising teachers resulted in strategic revisions to the content, language, visual design, and digital media usage guidelines, ensuring that the module became more communicative and easy to understand. Moreover, findings from limited and extensive trials related to technical constraints and students' needs for additional tutorials prompted adjustments to the implementation of the model to be more adaptive to school conditions and student characteristics. The integration of quantitative and qualitative evaluation results and the formative process bolsters the conclusion that the MULTIBI model is not only effective and applicable but also favourably received by teachers and students as an alternative to multiliteracy learning that is innovative, contextual, and tailored to the needs of today's students.

DISCUSSION

This study's results corroborate a significant gap in the multiliteracy competencies of Indonesian language students, particularly in understanding multimodal texts, evaluating digital content, and producing media-based works. This finding is consistent with previous literature that emphasizes multiliteracy as an essential competency for the 21st century in facing the Industrial Revolution 4.0 [45; 46]. Classroom observations and interviews with teachers indicate that the integration of digital media in learning is still sporadic and not systematic, particularly in semi-urban and rural schools that are constrained by infrastructure and a lack of teacher training. This phenomenon supports the findings [47; 48] which emphasize that the availability of technology does not automatically guarantee the effectiveness of digital learning without pedagogical interventions and supporting curricula. The implications of this gap are increasingly crucial in the era of Industrial Revolution 4.0, wherein the ability to navigate the complex digital information landscape and participate in multimodal communication is a prerequisite for individual and social success.

The MULTIBI model developed in this study is based on the ADDIE framework and multiliteracy pedagogy from the New London Group [49]. The syntax of the model, which includes Exploration, Analysis, Reflection, Production, Collaboration, and Publication, systematically guides students from directed practice to deep transformative practice. The selection of digital media such as Canva, Padlet, and video editing software was validated as effective media that support the multiliteracy dimension [50]. The results of quantitative validation suggest a model feasibility score of 87.3%, which was calculated based on the average score from material experts, learning design experts, and education practitioners using a Likert scale. This high feasibility percentage suggests expert consensus regarding the readiness of the model for implementation. Thus, this model is not only rooted in a strong theoretical foundation but is also considered applicable in the classroom, addressing the gap in literature related to the holistic implementation of multiliteracies in the context of Indonesian language learning. The validation process involving experts and teachers resulted in important revisions, such as adding local content and developing a multiliteracy analysis rubric. This revision aimed to improve the model's applicability and theoretical validity, which aligns with recommendations [51] on the importance of local adaptation and clear scaffolding in multiliteracies pedagogy. Improvements to the visuals and guides were also made based on feedback to reduce students' cognitive load, which is supported by Mayer's multimedia learning theory in [52; 53] regarding effective instructional design principles. This iterative revision process emphasized the importance of a field feedback-based approach to ensure the model is relevant and easy to implement in various socio-cultural contexts in Indonesia. Inferential statistical analysis using a paired-samples t-test demonstrated a statistically significant increase in students' multiliteracy skill scores after the implementation of the MULTIBI model ($t(119) = 11.45, p < 0.001$). The effect size measured using Cohen's d was 1.73, which according to [54] indicates a very large effect of this model intervention on the development of students' multiliteracy skills. This finding is consistent with research [55], which also reported the effectiveness of project-based multiliteracy learning in enhancing students' critical thinking and digital communication skills. In addition, descriptive analysis of motivation questionnaire data indicated that more than 80% of students responded positively to the relevance and engagement aspects of learning after the implementation of the MULTIBI model, suggesting that this model also proved successful in positively influencing students' affective aspects, encouraging active participation in multiliteracy learning. This skill improvement directly equips students with better abilities to face the challenges

of the Industrial Revolution 4.0, such as the ability to critically evaluate information amidst a flood of data and participate in an increasingly complex digital environment. The MULTIBI model has proven successful in creating a learning environment that supports social interaction and authentic learning, essential for the development of multiliteracies.

Theoretically, this study bolsters the conceptual foundation of multiliteracies in Indonesian language learning by formulating a model that integrates various dimensions of literacy (digital, media, visual, textual, and information). This study addresses a gap in the literature regarding the implementation of a holistic multiliteracies framework in the context of Indonesian language learning in Indonesia, which was previously dominated by conventional approaches based on printed text.

Practically, this model offers an applicable solution for teachers in presenting learning that is relevant to the demands of the 21st century. Teachers can adapt the structure of the model and the media provided to foster students' critical, collaborative, and creative thinking skills through multiliteracies activities. Curriculum developers can also utilise these findings to develop teaching materials that are responsive to technological developments and students' digital literacy needs. Educational researchers can use this model as a basis for further development or comparative studies in a broader context.

The main novelty of this study resides in the explicit integration of the concept of multiliteracies into the design of Indonesian language learning by considering the complexity of the challenges of the Industrial Revolution 4.0. Unlike previous models that only emphasise one or two aspects of digital literacy, this model creates a holistic approach—encompassing visual, digital, media, textual, and information literacy—with empirical testing in the context of education in Indonesia that is geographically and digitally diverse. This approach is an important contribution to the development of multiliteracy-based Indonesian language learning that is theoretical and empirically proven to enhance students' literacy skills. This study also introduces a systematic validation and revision of the model based on field data in layers, a practice rarely undertaken in similar studies.

The main implication of this study is that the multiliteracy model can be an effective pedagogical approach in Indonesian language education. Teachers gain a concrete alternative to develop contextual and digital media-based learning. These results also highlight the importance of teacher training in using the multiliteracy model and providing adequate digital infrastructure in schools. Furthermore, these findings underscore the urgency of implementing the multiliteracy model in the Indonesian language curriculum to equip students with the competencies needed in the digital era, such as collaborating online, creating responsible digital content, and navigating a complex information ecosystem.

For curriculum developers, these findings suggest designing learning materials and strategies that develop multiliteracy skills as core competencies for the 21st century. Moreover, this study can also be used as a reference by policymakers in formulating inclusive digital education policies based on real needs in the field. Policies that support implementing multiliteracy models and providing equitable digital resources will be pivotal in preparing Indonesia's young generation to face challenges and opportunities in the Industrial Revolution 4.0 era. This study has several limitations, including the limited coverage area in three provinces (East Java, Central Kalimantan, and East Nusa Tenggara); the sample size remains limited (± 90 students). The varying digital infrastructure factors also affect the optimal implementation of the model in several schools. These limitations can affect the generalisation of research results, especially when applied in areas with different social, cultural, and technological characteristics.

Furthermore, because this study uses an R&D design, the main focus is more on the development and validation of the model, rather than the longitudinal measurement of long-term effectiveness. Further research is recommended to extend the implementation duration to observe long-term effects, develop more specific multiliteracy assessment instruments, and test the model at other levels of education and in the context of Islamic boarding schools and inclusive schools. Integration of the latest technologies, such as artificial intelligence, can also be explored to enrich multiliteracy learning media. Moreover, comparative studies between regions will provide a deeper understanding of the adaptation and effectiveness of the model in a broader context.

CONCLUSION

This study successfully developed a multiliteracy-based Indonesian language learning model integrated with digital media, which proved significantly effective in enhancing students' multiliteracy skills. Validation and testing of the model demonstrated a significant increase in students' abilities in understanding multimodal texts, evaluating digital content, and producing media-based works. This model is not only feasible to implement but also exerts a positive impact on students' motivation and learning engagement. For educators, this model offers a practical and comprehensive framework for integrating digital media pedagogically in Indonesian language learning, enabling it to address the needs of 21st-century literacy. Meanwhile, for curriculum developers, these findings can serve as the basis for designing teaching materials that are more adaptive and relevant to technological developments and the demands of the Industrial Revolution 4.0. However, this study has limitations pertaining to the limited coverage area, relatively small sample size, and short implementation duration. Therefore, it is recommended that further research undertake trials with wider geographical coverage and education level, extend the implementation duration, and develop more specific and contextual multiliteracy assessment instruments. Further research can also explore integrating the latest technologies, such as artificial intelligence, to enhance the multiliteracy learning model.

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