

Strategic Formulation of Digital Literacy Learning in Indonesian Elementary Education: A SWOT-AHP Approach

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ABSTRACT

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The implementation of digital literacy in Indonesian elementary schools is essential for 21st-century education, yet it faces persistent challenges in teacher competence, infrastructure availability, and curriculum integration. This study aims to develop prioritized digital literacy strategies for elementary schools in Indonesia based on a comprehensive analysis of internal and external factors. A sequential mixed methods approach was used. The qualitative phase involved focus group discussions and interviews with 71 educators and experts, selected through purposive sampling, to identify Strengths, Weaknesses, Opportunities, and Threats (SWOT). The quantitative phase applied the Analytical Hierarchy Process (AHP) with eight key experts to weigh the SWOT factors and the resulting alternative strategies. The SWOT analysis identified high student motivation and potential for developing 21st-century skills as key strengths; limited teacher pedagogical and technological competence and limited access to infrastructure as major weaknesses; government support and digital learning resources as main opportunities; and cybersecurity and disinformation as serious threats. The AHP results showed that Opportunities had the highest priority (weight 0.385), followed by Weaknesses (0.310). The priority strategies were: (1) improving teacher competence through continuous training (WO1, 0.350); (2) developing students' critical thinking skills (ST2, 0.330); (3) leveraging students' enthusiasm for learning innovation (SO1, 0.320); and (4) simultaneously improving teacher competence and students' digital ethics awareness (WT2, 0.300). These findings offer actionable priorities to guide national efforts in advancing digital literacy at the elementary level.

Keywords: Digital Literacy, Elementary School, SWOT Analysis, AHP, Learning Strategy, Education Policy.

1. INTRODUCTION

Implementing digital literacy education in primary schools faces significant challenges, particularly at the teacher level. Recent studies have identified that teachers often struggle to integrate digital literacy due to limited competencies, insufficient training, and low confidence in using digital technologies [1]. Many educators feel inadequately prepared to incorporate technology into their teaching, underscoring the need for comprehensive professional development programs that enhance their confidence and pedagogical skills in using digital tools effectively [2]. The lack of preparation and resistance to change further exacerbate these challenges, hindering educators' adoption of new technologies.

At the curriculum and system levels, implementing digital literacy education faces several structural barriers. There is a lack of clear frameworks and inconsistent pedagogical approaches, which complicate the effective integration of digital literacy programs in schools [3]. Moreover, the definition of digital literacy remains ambiguous, further complicating curriculum integration [4]. These issues underscore the need for well-defined standards and a structured, cohesive approach to digital literacy education in primary schools.

1.1 Digital Literacy

Implementing digital literacy education in Indonesian primary schools faces several significant challenges. Limited access to technology and infrastructure hinders the effectiveness of online learning, especially in underdeveloped areas, where many schools struggle with inadequate digital resources and unstable internet connections [5], [6]. This disparity exacerbates the digital divide, which remains a critical barrier to equitable education. In addition, teachers often lack the digital competencies and confidence needed to integrate technology effectively into their teaching. As a result, there is a strong reliance on traditional methods, limiting the potential for classroom innovation [7], [8].

Moreover, the availability of high-quality digital learning materials remains insufficient, further complicating the integration of digital literacy into the curriculum [9]. Parental engagement with digital education also remains limited, further hindering the implementation of

digital literacy programs [10]. The COVID-19 pandemic has further highlighted these challenges, necessitating a rapid shift to online learning and amplifying existing disparities [11]. Successful implementation of digital literacy education requires technological readiness, stakeholder collaboration, and support from government and educational institutions [10].

One of the major challenges in formulating effective digital literacy strategies in Indonesia is the disparity in access to technology and digital resources, which is exacerbated by socio-economic inequalities. This lack of access hampers the effective implementation of digital literacy programs, particularly in schools located in rural or economically disadvantaged areas [12], [13]. Additionally, there is a significant gap in digital skills among both teachers and students, further complicating the integration of digital literacy into the curriculum. Many teachers lack the necessary training and support to effectively use digital tools, leading to the continued reliance on conventional teaching methods and minimal use of innovative digital media [14], [15]. Furthermore, the absence of comprehensive guidelines and operational indicators from the Ministry of Education and Culture has resulted in inconsistent implementation of digital literacy initiatives across schools [16]. Another critical issue is the low level of digital ethics and awareness among students, leaving them vulnerable to online risks, including exposure to inappropriate content and the spread of misinformation [16], [17]. Despite the importance of parental involvement in digital literacy development, the roles of parents and communities remain underutilized, underscoring the need for greater collaboration among stakeholders [13], [18]. To address these challenges, a coordinated approach that includes curriculum development, teacher training, and infrastructure improvements is essential, along with efforts to raise awareness of the importance of digital literacy and foster supportive learning environments [13], [19].

While various studies have highlighted the challenges of digital literacy in both global and Indonesian contexts, a gap exists in research that applies an integrated SWOT-AHP framework to systematically formulate digital literacy strategies at the elementary school level. This study addresses this gap by combining SWOT analysis with the Analytical

Hierarchy Process (AHP) to prioritize and formulate actionable strategies for improving digital literacy in Indonesian elementary schools. Previous research has explored the need for teacher training, curriculum integration, and stakeholder collaboration [20]–[22], as well as the ranking of challenges in primary-school digital literacy programmes [23] and the role of technology in early digital literacy development in Indonesia [24]. However, no studies have integrated these approaches with a comprehensive strategic framework, such as SWOT-AHP, to provide concrete, evidence-based recommendations for digital literacy policy and practice.

1.2 Research Objectives

This study has two main objectives: (1) to identify and analyze internal factors (strengths and weaknesses) and external factors (opportunities and threats) that influence digital literacy learning in elementary schools in Indonesia; and (2) to formulate strategically prioritized digital literacy strategies for elementary schools in Indonesia by integrating SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis with the Analytical Hierarchy Process (AHP).

The integration of SWOT and AHP was chosen as the research approach due to their complementary strengths in addressing the complexity of strategy formulation in digital literacy education. SWOT analysis helps identify internal and external factors influencing the implementation of digital literacy, providing a comprehensive understanding of the issue [25], [26]. AHP, on the other hand, supports prioritizing these factors by providing a structured, quantitative mechanism for assessing the relative importance of different strategies [27], [28]. The synergy of these methods enables a balanced approach that combines rich contextual insights with rigorous prioritization, as demonstrated in the A'WOT hybrid method [29], making it particularly suitable for formulating actionable digital literacy strategies in the Indonesian context.

1.3 Research Significance

This study is expected to make significant contributions both theoretically and practically. Theoretically, it advances the field

of Educational Technology by applying the SWOT-AHP framework to the development of digital literacy strategies. Practically, it provides evidence-based, structured recommendations for schools, educators, and policymakers to enhance the effectiveness of digital literacy education in Indonesian elementary schools..

2. METHODS

This study is designed to formulate an effective digital literacy learning strategy in Indonesian elementary schools through a comprehensive analysis of internal and external factors and prioritization using the SWOT-AHP approach.

2.1 Research Approach and Type

This study employs an exploratory sequential mixed-methods design, combining qualitative and quantitative phases. In the qualitative phase, contextual factors are explored through a SWOT analysis to identify internal (Strengths and Weaknesses) and external (Opportunities and Threats) factors affecting digital literacy learning. The quantitative phase then applies the Analytical Hierarchy Process (AHP) to prioritize these factors and strategic alternatives identified in the qualitative stage. The study is descriptive in nature and employs a multi-site case study approach across selected elementary schools in various regions of Indonesia.

2.2 Location and Time of Research

Data collection was conducted between January 1 and May 30, 2025, in alignment with the 2024/2025 academic calendar under the Muhammadiyah Research Grant (Batch VII). Primary data were collected from schools located in Pamekasan and Ponorogo Regencies (East Java) through face-to-face interaction, and from Makassar City and other regions through remote data collection methods, including online interviews and surveys.

2.3 Research Subjects/Informants

Purposive sampling was employed to select informants with relevant expertise and

experience in digital literacy in elementary education. Participants included:

1. 69 elementary teachers and 2 principals from 71 schools participated in Focus Group Discussions (FGDs).
2. 8 key informants for in-depth interviews, consisting of 4 senior teachers, 2 principals, and 2 digital literacy experts.
3. 8 education experts for the AHP analysis, selected based on their subject-matter expertise and professional experience.
4. The Analytic Hierarchy Process (AHP) is widely acknowledged as a decision-support method that relies on structured expert judgment to prioritize criteria and strategies rather than on large-sample statistical inference. AHP does not prescribe a rigid minimum number of respondents; instead, methodological sources note that the selection of relevant domain experts and the consistency of their pairwise judgments are central to the validity of the prioritization process [30].

2.4 Data Collection Techniques

The following instruments were used for

data collection:

1. First, FGD and Interview Guides were developed based on a review of literature and expert input [30]. These guides contained open-ended questions designed to elicit detailed responses and insights.
2. In addition, the SWOT Worksheet was used to structure and classify the factors identified through the qualitative data collection process. The worksheet ensured consistent categorization of internal and external factors.
3. Furthermore, the AHP Questionnaire was designed to use pairwise comparison matrices with Saaty's 1–9 scale to evaluate the relative importance of different factors and strategies.

To ensure robustness, qualitative instrument validity was ensured through source and method triangulation. The AHP questionnaire, meanwhile, was based on a hierarchical design reviewed by experts and tested for logical consistency

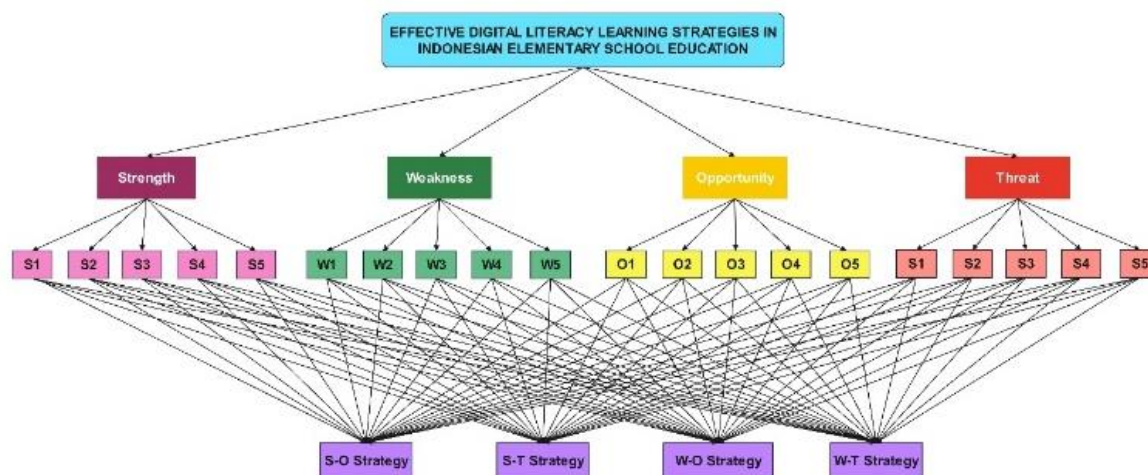


Figure 1. SWOT-AHP Integration Model for Digital Literacy Learning in Indonesia

2.5 Data Analysis Techniques

Qualitative Analysis:

To begin, transcripts from the FGDs and interviews were coded using thematic analysis. The data were then classified into SWOT categories, followed by data reduction and presentation. Source triangulation was used to

verify and conclude the findings, resulting in a list of SWOT factors and potential strategic alternatives.

Quantitative Analysis (AHP):

AHP data were analyzed using Super Decisions software. The process involved

several steps: constructing a pairwise comparison matrix, normalizing the data, calculating eigenvectors, and conducting consistency testing. Consistency was ensured with a Consistency Index (CI) & Consistency Ratio (CR ≤ 0.10).

SWOT-AHP Integration:

The strategic alternatives identified from the SWOT analysis were ranked based on their priority weights from the AHP. Ultimately, the strategy with the highest global weight was considered the most actionable and was recommended for implementation. The integration model is visualized in Figure 1 in the report.

2.6 Research Step

This study (see figure 2) follows a structured approach, beginning with the Preparation phase, which involves identifying the primary issues related to digital literacy, conducting a literature review on digital literacy and elementary education, conducting a SWOT analysis and an AHP, and formulating the research objectives and questions. The objective of this phase is to understand the research context and establish the study's direction, with the expected output being the problem formulation, research objectives, research questions, and theoretical framework.

The Data Collection phase consists of identifying SWOT factors through interviews, surveys, Focus Group Discussions (FGDs), and literature studies. The SWOT factors and their weights are determined using the AHP method, enabling the collection of qualitative and quantitative data on both internal and external factors influencing digital literacy learning. The expected output of this phase includes data from interviews, surveys, FGDs, literature studies, and AHP pairwise comparison matrices.

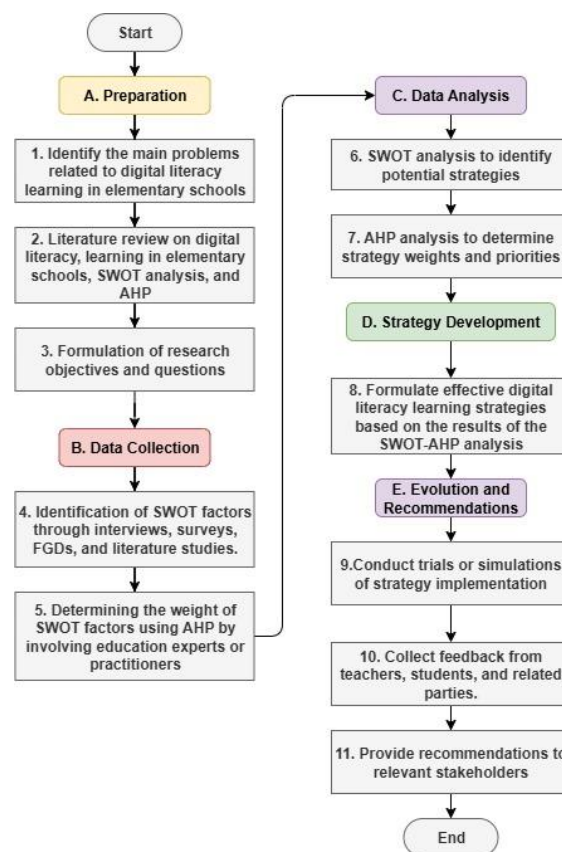


Figure 2. Research Step

In the Data Analysis phase, a SWOT analysis is conducted to identify potential strategies, and an AHP analysis is used to determine their weights and priorities. The goal of this phase is to analyze the qualitative and quantitative data to generate effective strategies for digital literacy learning. The output from this phase includes the SWOT matrix, AHP calculation results, and a list of potential strategies along with their corresponding weights and priorities.

The Strategy Development phase focuses on formulating effective digital literacy learning strategies based on the results from the SWOT-AHP analysis. The strategies developed are expected to be relevant and feasible, and to positively improve students' digital literacy competencies. The output of this phase is practical, implementable digital literacy learning strategies.

Finally, the Evaluation and Recommendations phase involves conducting strategy implementation trials or simulations, collecting feedback from teachers, students, and other relevant stakeholders, and providing recommendations to key stakeholders. The

purpose of this phase is to evaluate the effectiveness of the strategies and offer suggestions for improvements and further implementation. The expected output includes the strategy evaluation report and recommendations for the government, schools, and educators.

3. RESULTS AND DISCUSSION

3.1 Data Description

Primary data for this study were collected through two main stages: a qualitative stage for identifying SWOT factors and a quantitative stage for weighting priorities using AHP. Data collection was carried out at Lawangan Daya 2 School, Pamekasan and Ponorogo Regencies, East Java, face-to-face and in Makassar City, South Sulawesi, and several other cities online, from January 1 to May 30, 2025.

3.2 Qualitative Data (Identification of Problems and SWOT Factors)

Qualitative data to identify the main problems of digital literacy learning and Strengths, Weaknesses, Opportunities, and Threats (SWOT) factors were obtained through:

- Focus Group Discussion (FGD): A total of three FGD sessions were held on Thursday, February 20, and Thursday, February 27, 2025, in Pamekasan and Makassar, respectively, and on March 3, 2025, in Ponorogo, involving a total of 71 participants, consisting of 69 class/subject teachers and two principals from 71 different elementary schools. The discussion focused on identifying key issues and SWOT factor analysis of Digital Literacy learning for elementary schools.
- In-depth Interviews: In-depth interviews were conducted with eight key informants, consisting of 4 senior teachers, two principals with >10 years of experience, and 2 Educational Technology/Curriculum experts. The interviews were conducted between May 1 and 14, 2025. The main topics of the interviews included perceptions of SWOT factors, strategies that had been tried, and expert views on priorities.

3.3 Quantitative Data (AHP Weighting)

Quantitative data on SWOT factor weighting and alternative strategies were obtained through Paired Comparison Questionnaires (AHP), which were distributed to eight key experts/respondents selected for their comprehensive understanding of the research context. These experts included experienced teachers, principals, and education experts. The questionnaire was distributed and collected between May 1 and 14, 2025. The AHP process involved constructing a decision hierarchy to prioritize the SWOT factors and strategic alternatives using expert judgment. The consistency of the assessments was validated by calculating the Consistency Ratio (CR) using the pairwise comparison matrix. A CR value of less than 0.10 ($CR < 0.10$) was considered acceptable, ensuring consistency in the expert responses. The data analysis was conducted using AHP software tools Super Decisions.

3.4 SWOT Analysis Results

Based on the results of Focus Group Discussions (FGD), in-depth interviews with key informants (teachers, principals, experts), and analysis of related documents, internal factors (Strengths and Weaknesses) and external factors (Opportunities and Threats) that influence digital literacy learning in Indonesian elementary schools have been identified. The identified internal and external factors are as follows:

3.4.1 Internal Factors: Strengths

The positive internal factors that are owned or can be utilized in digital literacy learning in elementary schools that are identified are:

- S1: High student motivation and support for using digital technology in learning.
- S2: The potential of digital technology to encourage creativity and innovation in the teaching and learning process.
- S3: Flexibility and accessibility offered by digital learning (learning anytime, anywhere).
- S4: The ability of digital technology to facilitate collaboration and interaction between students and teachers.

- S5: The potential of digital literacy learning for developing 21st-century skills (critical thinking, problem-solving, communication, collaboration).

3.4.2 Internal Factors: Weaknesses

The negative internal factors or obstacles faced in digital literacy learning in elementary schools that are identified are:

- W1: Limited access and infrastructure (unstable/non-existent internet, lack of digital devices, maintenance problems).
- W2: Lack of teacher competence in integrating digital technology into learning (lack of training and understanding of digital pedagogy).
- W3: Curriculum that has not explicitly and optimally integrated digital literacy.
- W4: Available digital learning materials are often less relevant or of poor quality.
- W5: Resistance to change from some teachers to adopt technology in learning.
- W6: Lack of student awareness of digital ethics and cybersecurity.
- W7: Lack of support and understanding of parents towards children's digital literacy learning

3.4.3 External Factors: Opportunities

Positive external factors in the environment that can be utilized to support digital literacy learning in elementary schools have been identified:

- O1: Potential government support (policies, budgets, training programs).
- O2: Opportunities for collaboration with other parties (communities, organizations, industries) for additional resources and expertise.
- O3: Availability of professional development opportunities for teachers to improve digital competency.
- O4: Availability of various digital learning resources that can be utilized (online platforms, videos, educational applications).
- O5: Efforts to improve better and more affordable internet access nationally.
- O6: Rapid technological developments offer innovations for learning (eg, VR, AR).

3.4.4 External Factors: Threats

Negative external factors in the environment that can hinder or pose a risk to digital literacy learning in elementary schools have been identified:

- T1: Increased risk of cyberbullying and other online crimes, along with the use of technology.
- T2: The spread of disinformation and fake news in cyberspace.
- T3: Risk of dependence on technology and potential reduction in real social interaction.
- T4: There are difficulties in access and digital divides that can widen socio-economic inequalities.
- T5: Rapid technological change requires continuous adaptation from schools and teachers.

3.5 SWOT Matrix

Based on the identification of internal and external factors above, the following SWOT Matrix is compiled to map conditions and become the basis for formulating alternative strategies. Identifying factors in this matrix becomes the basis for AHP analysis to determine priorities and formulate the most effective strategy in the next section.

Table 1. SWOT Matrix of Digital Literacy Learning in Indonesian Elementary Schools

Internal /External Factors	Strengths	Weakness
Opportunities	S1: High student motivation & support S2: Potential for creativity & innovation S3: Flexibility & Accessibility S4: Facilitation of collaboration & interaction S5: Development of 21st century skills	W1: Limited access & infrastructure W2: Lack of teacher competence W3: Curriculum not yet integrated W4: The Material is less relevant W5: Resistance to change W6: Lack of awareness of digital ethics W7: Lack of parental support

Internal /External Factors	Strengths	Weakness
Threats	O1: Government support	SO Strategy (Using Strengths to Seize Opportunities)
	O2: Cooperation with other parties	
	O3: Teacher professional development	
	O4: Utilization of digital learning resources	
	O5: Increasing Internet access	
	O6: Technological developments	
	T1: Cyberbullying and online crime	ST Strategy (Using Strengths to Face Threats)
	T2: Disinformation and fake news	
	T3: Technology dependency	
	T4: Digital divide	
	T5: Rapid technological change	

3.6 AHP Analysis Results

Analysis of the AHP questionnaire data filled out by eight key experts/respondents produced priority weights for the SWOT factor groups and alternative strategies as follows:

3.6.1 Priority Weight of SWOT Factor Groups

The table below shows the relative importance levels between SWOT factor groups in influencing the effectiveness of digital literacy learning in elementary schools.

Table 2. Priority Weight of SWOT Factor Groups

SWOT Factor Group	Priority Weight	Ranking
Opportunities - O	0.385	1
Weaknesses – W	0.31	2
Strengths	0.185	3
Threats – T	0.12	4
Total	1	
Note: CR = 0.05 (< 0.10)		

Based on expert assessments, exploiting Opportunities (O) is considered the most critical factor (highest priority), followed by efforts to overcome Weaknesses (W). Leveraging Strengths (S) and dealing with Threats (T) have lower priorities in this context.

3.6.2 Alternative Strategy Priority Weights

The following are the local priority weights for each alternative strategy in each group (SO, WO, ST, WT) Strategies were categorized using the SWOT matrix: WO (Weakness–Opportunity), ST (Strength–Threat). These weights indicate the relative priority of the strategy within its respective group.

Table 3. Strength and Opportunity (SO) Group Strategies Priority Weight

Code	SO Strategy Alternative	Weight Local Priority	Rank (in SO)
SO1	Harnessing students' enthusiasm for learning innovation	0.32	1
SO5	Integrating 21st-century skills in digital learning	0.25	2
SO4	Enhancing collaboration through digital platforms	0.18	3
SO2	Developing creative digital content by students	0.15	4
SO3	Expanding access & flexibility (blended/online)	0.1	5
Total		1	

Note: CR = 0.04 (< 0.10)

Table 4. Weakness Opportunity (WO) Group Strategies Priority Weight

Code	WO Strategy Alternative	Weight Local Priority	Rank (in WO)
WO1	Improving teacher competency through ongoing training	0.35	1
WO2	Developing an integrated digital literacy curriculum	0.24	2
WO5	Increasing students' awareness of digital ethics & cybersecurity	0.15	3
WO6	Increasing parental support through socialization & Education	0.12	4
WO3	Increasing the relevance of teaching materials with digital sources	0.08	5
WO4	Overcoming teacher resistance through a phased approach	0.06	6
Total		1	

Note: CR = 0.06 (< 0.10)

Table 5. Strength-Threats (st) Group Strategies Priority Weight

Code	ST Strategy Alternative	Weight Local Priority	Rank (in ST)
ST2	Developing critical thinking skills (countering disinformation)	0.33	1
ST5	Investing in teacher professional development (technology adaptation)	0.26	2

Code	ST Strategy Alternative	Weight Local Priority	Rank (in ST)
ST1	Harnessing student creativity (anti-cyberbullying campaigns)	0.17	3
ST3	Encouraging balanced and healthy use of technology	0.14	4
ST4	Leveraging collaboration to address the digital divide	0.1	5
Total		1	
Note: CR = 0.03 (< 0.10)			

Table 6. Weakness-Threats (wt) Group Strategies Priority Weight

Code	WT Strategy Alternative	Weight Local Priority	Rank (in WT)
WT2	Improving teacher competency & digital ethics awareness simultaneously	0.3	1
WT5	Creating a safe & inclusive digital learning environment	0.25	2
WT1	Addressing infrastructure limitations incrementally	0.2	3
WT4	Building strong partnerships with parents & communities	0.15	4
WT3	Developing a relevant & adaptive curriculum	0.1	5
Total		1	
Note: CR = 0.05 (< 0.10)			

From the results of this AHP, it can be concluded that the primary focus is to utilize Opportunities and overcome Weaknesses. Among the specific strategies, Teacher Competency Improvement (WO1) is the highest priority in the WO group, while Student Critical Thinking Development (ST2) is the priority in the ST group. The results of this priority will be the primary basis for formulating final strategy recommendations in the next section (3.7 Strategy Formulation). Global Priority Weight can be calculated to rank the overall strategy across groups.

3.7 Effective Strategy Formulations

After identifying internal and external factors through SWOT analysis and weighting priorities using AHP, the next step is formulating effective digital literacy learning strategies. This formulation is based on alternative methods with the highest priority weight in the AHP analysis in each strategy group (SO, WO, ST, WT). Based on the results of the AHP analysis (Sub-chapter 3.6), the following strategies are prioritized for implementation to improve the effectiveness of digital literacy learning in Indonesian

elementary schools:

3.7.1 SO (Strengths-Opportunities) Group Priority Strategy

This strategy focuses on leveraging internal strengths to seize external opportunities. The SO strategies with the highest priority are:

- SO1 (Priority 1 - Local Weight: 0.320): Leveraging students' enthusiasm for learning innovation. Description: Implementing innovative and engaging learning methods by leveraging students' enthusiasm for technology, for example, through interactive digital platforms, educational applications, and other digital learning resources to create a more enjoyable and practical learning experience.
- SO5 (Priority 2 - Local Weight: 0.250): Integrating 21st-century skills into digital learning. Description: Designing learning activities that systematically integrate and develop 21st-century skills (critical thinking, problem-solving, communicating, collaborating) through digital technology.

3.7.2 WO (Weaknesses-Opportunities) Group Priority Strategy

This strategy focuses on minimizing internal weaknesses by leveraging external opportunities. The WO strategies with the highest priority are:

- WO1 (Priority 1 - Local Weight: 0.350): Improving teacher competency through ongoing training. Description: Leveraging professional development opportunities (e.g., through collaboration with the government or other parties) to provide relevant and ongoing training to improve digital pedagogical competency and teacher confidence in integrating technology.
- WO2 (Priority 2 - Local Weight: 0.240): Developing an integrated digital literacy curriculum. Description: Leveraging government support and curriculum development opportunities to design or adopt a comprehensive, explicit, and systematically integrated digital literacy curriculum into the existing primary school curriculum.

3.7.3 ST Group Priority Strategies (Strengths-Threats)

This strategy focuses on using internal strengths to avoid or mitigate the impact of external threats. The highest priority ST strategies are:

- ST2 (Priority 1 - Local Weight: 0.330): Developing students' critical thinking skills to counter disinformation. Description: Optimizing the development of students' critical thinking skills (one of the strengths of digital learning) to equip them with the ability to identify, evaluate, and respond critically to online information, to avoid disinformation and fake news.
- ST5 (Priority 2 - Local Weight: 0.260): Investing in continuous teacher professional development for technology adaptation. Description: Using the strength of teacher competencies (continuously improved) to face the threat of rapid technological change through constant investment in professional development, ensuring that teachers can continue to adapt and utilize the latest technology effectively.

3.7.4 WT Group Priority Strategy (Weaknesses-Threats)

This defensive strategy aims to minimize internal weaknesses and avoid external threats. The WT strategies with the highest priority are:

- WT2 (Priority 1 - Local Weight: 0.300): Simultaneously improve teacher competency and students' digital ethics awareness. Description: Address weaknesses in teacher competency and students' digital ethics awareness (who are vulnerable to online threats) through a comprehensive and integrated intervention program, including teacher training and digital ethics/cybersecurity education for students.
- WT5 (Priority 2 - Local Weight: 0.250): Create a safe, inclusive, and supportive digital learning environment. Description: Minimize weaknesses related to the digital divide and cyberbullying threats by proactively creating school policies and practices that create a safe, comfortable, inclusive, and supportive digital learning environment

for all students.

- The strategies outlined above result from synthesizing the SWOT analysis and AHP prioritization. The discussion section will further discuss the implications, interrelationships between strategies, and their potential implementation.
- The following table summarizes prioritized digital literacy learning strategies based on the SWOT analysis results and weighting using the Analytical Hierarchy Process (AHP). The strategies shown are the top 1-2 priorities from each strategy group (SO, WO, ST, WT).

Table 7. Summary of Priority Digital Literacy Learning Strategies Based on SWOT-AHP Analysis Result

Strategy Group	Code	Priority (Local)	Description of Priority Strategy	Local Weight AHP
SO (Strengths - Opportunities)	SO1	1	Harnessing students' enthusiasm for learning innovation (using interactive platforms, educational apps, etc.)	0.320
	SO5	2	Integrating 21st-century skills (critical thinking, problem solving, communication, collaboration) systematically in digital learning	0.250
WO (Weaknesses - Opportunities)	WO1	1	Enhancing teacher competency through ongoing training (leveraging government support & collaboration opportunities for digital pedagogy training)	0.350
	WO2	2	Developing an integrated digital literacy curriculum (leveraging government support to create/adopt a comprehensive & explicit LD curriculum)	0.240
ST (Strengths - Threats)	ST2	1	Developing students' critical thinking skills to counter disinformation (leveraging this strength to equip students with the ability to evaluate online information)	0.330

Strat egy Gro up	Code	Prio rity (Loc al)	Description of Priority Strategy	Local Weig ht AHP
WT (Wea knes ses- Thre ats)	ST5	2	Investing in ongoing teacher professional development for technology adaptation (addressing the threat of rapid technological change through enhancing teacher competency)	0.260
	WT2	1	Enhancing teacher competency & students' digital ethics awareness simultaneously (addressing dual weaknesses through integrated intervention programs)	0.300
	WT5	2	Creating a safe, inclusive, and supportive digital learning environment (minimizing the risk of inequality & cyberbullying through proactive school policies & practices)	0.250

This table presents a summary of priority strategies that can be the primary focus in implementing efforts to improve digital literacy learning in elementary schools based on the findings of this study.

The priority strategies for improving digital literacy in Indonesian elementary schools were determined through a comprehensive SWOT-AHP analysis, which integrates expert judgment from a range of educational stakeholders. The results highlight key strategic priorities, with the most important strategies receiving the highest weights. These weights reflect the experts' assessments of each strategy's potential impact on addressing the identified barriers and opportunities for digital literacy education.

The top-ranked strategy (see figure 3), with a priority weight of 0.350, is focused on improving teacher competency through continuous training (WO1). This indicates the consensus among experts that enhancing teacher skills through sustained professional development is essential for overcoming the current limitations in digital literacy teaching. Following closely, developing students' critical thinking skills (ST2) and harnessing students' enthusiasm for learning innovation (SO1) both received a weight of 0.320, underscoring the importance of fostering students' cognitive abilities and leveraging their interest in digital tools as effective learning drivers.

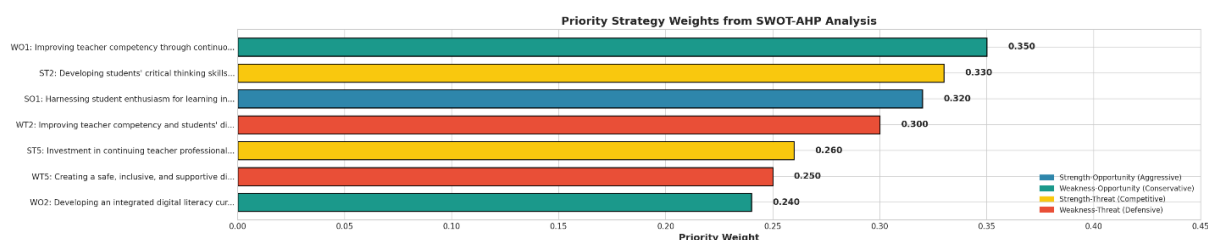


Figure 3. Priority strategy weights from SWOT-AHP Analysis

4. Discussion

This section presents an in-depth discussion of the results of the SWOT and AHP analyses that have been given previously. The discussion includes an interpretation of the significance of SWOT factors and AHP priorities, a discussion of the selected priority strategies by linking them to relevant theoretical and research studies, a justification for the selection of strategy, and an analysis of the potential and challenges of their implementation in the context of digital literacy learning in Indonesian elementary schools.

4.1 Interpretation of SWOT Analysis Results and AHP Priorities

The results of the SWOT factor identification emphasize the complexity of digital literacy learning in Indonesian elementary schools. Strengths such as high student motivation (S1) and the potential for developing 21st-century skills (S5) are essential assets. However, fundamental weaknesses related to infrastructure (W1), teacher competence (W2), and curriculum integration (W3) are still significant obstacles, in line with the findings of various previous studies. On the external side, opportunities in the form of government support (O1), cooperation (O2),

and technological developments (O6) are wide open. Still, they are overshadowed by serious threats such as the digital divide (T4), cybersecurity issues (T1), and disinformation (T2).

The AHP analysis provides a quantitative perspective on these factors. The highest priority is given to the Opportunities (O) (Weight: 0.385) and Weaknesses (W) (Weight: 0.310) factor groups. This indicates that, according to key experts/respondents, the primary focus of efforts to improve the effectiveness of digital literacy learning should be directed at strategies that can take advantage of existing external opportunities while addressing the most pressing internal weaknesses. The lower weights for Strengths (S) (0.185) and Threats (T) (0.120) do not mean that they are unimportant. Still, they may be considered as aspects whose priority is to be addressed after efforts to optimize opportunities and minimize weaknesses have been carried out.

4.2 Discussion of Priority Strategies

Based on the AHP prioritization of alternative strategies formulated from SWOT, the following strategy (presented in Subchapter 3.6) is the focus of discussion:

- Teacher Competency Improvement (WO1 - Priority #1 WO, Weight 0.350) and Continuous Teacher Professional Development Investment (ST5 - Priority #2 ST, Weight 0.260): The very high priority of WO1 confirms consistent findings in the literature that teachers are the primary key, but their competencies are often a significant weakness. This strategy aligns with recommendations for continuous training to improve teachers' self-efficacy and digital pedagogical skills. Its relationship with ST5 suggests that this competency improvement is not only to address current weaknesses but also a long-term investment to face the threat of rapid technological change (T5). Justification: Digitally competent teachers can integrate technology effectively, choose the right learning resources, guide students in digital ethics, and adapt to innovation. The successful

implementation of other strategies is contingent upon foundational teacher competence.

- Development of Integrated Digital Literacy Curriculum (WO2 - Priority #2 WO, Weight 0.240): This strategy directly addresses the weakness of W3 (curriculum is not yet integrated) by utilizing government support opportunities (O1) or other curriculum development initiatives. Siregar [21] and Tsvetkova [22] emphasize the importance of a structured and explicit curriculum. A good curriculum serves as a guide for teachers and ensures that digital literacy learning runs systematically. Justification: Curriculum integration ensures that digital literacy is not just an incidental activity but a core part of the learning process, providing clear direction for teachers and students.
- Utilizing High student motivation for Learning Innovation (SO1 - Priority #1 SO, Weight 0.320): This strategy strategically leverages internal strengths in the form of high student motivation (S1) with opportunities to use various digital learning resources (O4) and technological developments (O6). This aligns with the principle of student-centered learning and harnessing their intrinsic motivation. Justification: Student enthusiasm constitutes a critical motivational asset in digital literacy initiatives. Directing this positive energy into innovative and interactive learning activities can significantly increase engagement and learning effectiveness.
- Developing Students' Critical Thinking Skills (ST2 - Priority #1 ST, Weight 0.330): Facing the threat of disinformation (T2), this strategy harnesses the potential for developing 21st-century skills (S5), especially critical thinking. This is crucial because digital literacy is about 'being able to use' and 'being able to evaluate'. Justification: In an era of abundant and often inaccurate information, critical thinking skills are the main defense for students so that they are not easily manipulated and become smart consumers of information.

- Simultaneous Improvement of Teacher Competence & Students' Digital Ethics Awareness (WT2 - Priority #1 WT, Weight 0.300) and Creation of a Safe & Inclusive Digital Learning Environment (WT5 - Priority #2 WT, Weight 0.250): This defensive WT strategy is very important. WT2 addresses the dual weaknesses (teacher competence W2 and students' ethical awareness W6) in dealing with threats T1 (cyberbullying) and T2 (disinformation). WT5 aims to minimize threats T1 and T4 (digital divide) by creating a safe and equal ecosystem. Wijayanti et al. [20] emphasize the need for online safety and responsible digital citizenship. Justification: Safety and inclusivity are prerequisites. Learning will not be effective if students feel unsafe or marginalized. Competent teachers must also be able to guide students in cyber ethics and security.

4.3 Potential and Challenges of Implementation

Implementation of these priority strategies in the field has great potential, but also faces challenges:

a. Potential:

- High student motivation can be a driver of innovation adoption.
- Potential government support and external cooperation can provide resources (training, infrastructure, curriculum).
- Massive teacher professional development (if WO1 & ST5 are successful) will significantly improve the quality of learning.
- Increasing awareness of ethics and cybersecurity (WO5, WT2, WT5) can create a more positive digital environment.

b. Challenges:

- Resource Limitations: Addressing infrastructure weaknesses (W1) evenly requires significant investments and long-term commitments, especially to reach areas with digital divides (T4). Strategy WT1 (addressing infrastructure

in stages), although the 3rd priority of WT, remains crucial.

- Scalability of Teacher Training: Implementing teacher training (WO1, ST5, WT2) effectively and sustainably nationally is a major logistical and financial challenge.
- Resistance to Change: Overcoming teacher resistance (W5), although the WO4 strategy is low in weight, still needs to be considered so that other priority strategies can run.
- Curriculum & Material Development: Developing an integrated curriculum (WO2) and relevant materials (W4) requires time, expertise, and stakeholder coordination.
- Parental Involvement: Increasing parental support (W7) through the WO6 strategy (4th priority WO) requires consistent socialization and education efforts that reach various socio-economic backgrounds.
- Technological Dynamics: The threat of rapid technological change (T5) demands agility and continuous adaptation in ST5 and WT3 strategies.

Overall, this SWOT-AHP analysis provides a structured and prioritized roadmap. Focusing on utilizing opportunities and addressing weaknesses, especially those related to teacher competence, and curriculum, utilizing high student motivation, developing critical thinking, and creating a safe and ethical learning environment, is expected to accelerate the effectiveness of digital literacy learning in Indonesian elementary schools. Implementation success will depend mainly on all stakeholders' commitment, collaboration, and resources.

Table 8. Summary of Priority Digital Literacy Learning Strategy Discussion

Priority Strategy	Relationship to SWOT/AHP Results	Relationship to Theory/Literature	Justification of Effectiveness	Potential & Challenges of Implementation
WO1: Improving teacher competency through continuous training	Priority #1 WO (0.350); Overcoming Weaknesses (W2) with Opportunities (O3, O1).	In line with the studies of Stringer et al. [2], Redmond et al. [4], and Wijayanti et al. [20] on the importance of teacher readiness & competence.	Competent teachers are the key to effective implementation, able to integrate technology, guide students, and adapt.	Potential: Improve teaching quality and technology adoption. Challenges: Training scalability, cost, consistency, teacher resistance (W5).
WO2: Developing an integrated digital literacy curriculum	Priority #2 WO (0.240); Overcoming Weaknesses (W3) with Opportunities (O1).	Supported by Siregar [21], Tsvetkova [22] emphasized the need for a structured & explicit LD curriculum.	Provide classroom guidance for teachers and students, ensuring LCDs are a core part of learning, not incidental.	Potential: Standardization of LD learning. Challenges: Requires time, expertise, coordination between parties, and relevance of material (W4).
SO1: Harnessing high student motivation for learning innovation	Priority #1 SO (0.320); Leveraging Strengths (S1) with Opportunities (O4, O6).	In line with the principles of student-centered learning and the use of intrinsic motivation.	Capitalizing on huge capital (high student motivation) to increase learning engagement and effectiveness through innovative methods.	Potential: Learning is more interesting & participatory. Challenges: Requires teacher creativity and availability of varied learning resources (O4).
ST2: Developing students' critical thinking skills (countering disinformation)	Priority #1 ST (0.330); Using Strength (S5) to deal with Threats (T2).	The importance of critical aspects in LD is emphasized	Equipping students with the ability to evaluate information in the digital era is crucial to becoming thoughtful digital citizens.	Potential: Forming students who are resistant to hoaxes. Challenges: Requires special pedagogy, a change in mindset from just 'being able to use' technology.
ST5: Investment in continuing teacher professional development (technology adaptation)	Priority #2 ST (0.260); Using Strength (improved teacher competency) to face Threats (T5).	Related to WO1 and the need for continuous adaptation to technological change.	Ensuring the relevance of teacher competencies in the long term, and ensuring that rapid technological developments do not leave teachers behind.	Potential: Increase the adaptability of the education system. Challenges: Same as WO1 (scalability, cost, consistency), requires long-term commitment.
WT2: Improving teacher competency and students' digital ethics awareness simultaneously	Priority #1 WT (0.300); Overcoming Weaknesses (W 2, W 6) and Avoiding Threats (T1, T2).	The need for cybersecurity & ethics education is emphasized by Wijayanti et al. [20].	Addressing digital security & responsibility holistically (teachers & students) as the foundation of a healthy digital environment.	Potential: Reduce online risks and shape positive digital behavior. Challenges: Requires integrated programs, and an active role of teachers & schools.
WT5: Creating a safe, inclusive, and supportive digital learning environment	Priority #2 WT (0.250); Addressing Weaknesses (W1, W7 related to access) and avoiding Threats (T1, T4).	In line with the principles of justice and security in education.	An important prerequisite for effective learning is ensuring that no student feels unsafe or marginalized (digital divide).	Potential: Increase participation and equal access. Challenges: Requires clear school policies, supervision, parental cooperation (W7), and overcoming infrastructure constraints (W1/WT1).

CONCLUSION

This study identified and prioritized key internal and external factors affecting digital literacy in Indonesian elementary schools using an integrated SWOT-AHP methodology. The AHP analysis revealed that external Opportunities (O) (weight = 0.385) and internal Weaknesses (W) (weight = 0.310) were the most critical factor groups influencing strategic decisions. This underscores the strategic imperative of leveraging external opportunities to address the most pressing internal weaknesses within the educational system. The

four highest-priority strategies derived from the SWOT-AHP integration are:

- WO1 – Enhance teacher competence through continuous professional development (local weight: 0.350).
- ST2 – Strengthen students' critical thinking skills to mitigate disinformation (local weight: 0.330).
- SO1 – Leverage students' enthusiasm for digital learning innovation (local weight: 0.320).
- WT2 – Simultaneously improve teacher competence and students' awareness of digital ethics (local weight: 0.300).

Other relevant strategies include:

- a. Development of an integrated curriculum (WO2).
- b. Continuous investment in teacher professional development (ST5).
- c. Integration of 21st-century competencies (SO5).
- d. Ensuring a safe and inclusive digital learning environment (WT5).

In summary, the findings highlight that strategic emphasis should be placed on improving teacher capacity, developing relevant curricula, leveraging innovative student engagement, strengthening critical thinking skills, and ensuring a safe and ethical digital learning environment are fundamental steps to accelerate the effectiveness of digital literacy learning in Indonesian primary schools. These findings offer practical, evidence-based recommendations for education stakeholders seeking to enhance digital literacy competencies in the primary education sector. Emphasis on teacher capacity-building, ethical digital engagement, and curriculum reform is essential in supporting Indonesia's broader educational transformation in the digital era.

FUTURE RESEARCH

Future research should focus on validating these strategies through pilot implementations and evaluating their impact on student learning outcomes and digital citizenship behaviors.

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