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Improving Elementary School Students' Critical Thinking Skills Through Wordwall-Based Learning Integrated with Banyumas Local Wisdom

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Abstract
This article aims to analyze the improvement of elementary school students' critical thinking skills through science learning using word walls and integrated with Banyumas local wisdom. This research is descriptive qualitative research with an ethnopedagogical approach and case study method. The research uses data obtained from observation, interviews, and documentation studies. The data came from 100 fourth-grade students from four schools in the Kencana Cluster. The data was then analyzed using Miles and Huberman's triangulation model. Data validity was determined through credibility, transferability, dependability, and confirmability. The results showed that the initial critical thinking skills were in the adequate category. The weaknesses were mainly in the basic support and conclusion drawing indicators. After learning science using word walls integrated with Banyumas local wisdom, there was an increase in the informants' involvement in learning. Teachers also stated that students were better able to give reasons, connect the context of the material with Banyumas local wisdom, and conclude information more accurately. The findings of this study indicate that Wordwall integrated with Banyumas local wisdom improves the critical thinking skills of elementary school students. This study emphasizes the importance of integrating local wisdom into science learning, which is an implementation of Merdeka Belajar (Freedom of Learning). However, this study has limitations in terms of the number of informants and was only conducted in one subject. It is recommended to expand the sample and test Wordwall in other subjects.

INTRODUCTION

The contemporary global education landscape, as articulated by UNESCO's Delors Commission, emphasizes four fundamental pillars of learning—learning to know, learning to do, learning to live together, and learning to be—that provide a comprehensive framework for holistic educational development (Delors et al., 1996). This framework resonates with Indonesia's national education objectives, which aspire to cultivate students' potential into individuals who are faithful, possess noble character, and are knowledgeable enough to compete internationally. These educational functions serve as directional instruments for curriculum development and as motivational tools for evaluating educational processes (Suyitno, 2021). However, translating these aspirational goals into practical pedagogical approaches remains a persistent challenge, particularly in integrating local cultural contexts with contemporary learning technologies.

The 21st-century educational paradigm demands the cultivation of essential competencies, commonly termed the 6Cs: character, citizenship, communication, collaboration, creativity, and critical thinking (Fullan, 2015). Among these competencies, critical thinking stands as a foundational cognitive process involving interpretation, analysis, and self-evaluation essential for decision-making and problem-solving (Care et al., 2018; Rahayu et al., 2025; Nabilah & Suyanto, 2025). This cognitive capability, which must be developed from the elementary school level, forms the cornerstone of educational development as children begin to evaluate information credibility and develop analytical reasoning (Heyman & Legare, 2005; Mastuti et al., 2022). The Indonesian Ministry of Education and

Culture has recognized this significance by incorporating critical thinking as a primary character trait within the Merdeka Curriculum, positioning it as indispensable for future success (Novianti, 2020). Critical thinking not only directs students to confront complex challenges regarding economic, social, environmental, and technological changes (Ayala et al., 2024) but also enables them to understand and solve problems more effectively while adhering to logical reasoning frameworks (Ariadila et al., 2023; Andriani et al., 2023).

Despite this recognized importance, substantial gaps persist between educational aspirations and classroom realities. Preliminary observations in the Kencana Cluster, Banyumas, reveal that students' critical thinking abilities remain inadequate, with most students merely memorizing information without engaging in deeper analysis or evaluation. Conventional teaching approaches dominated by lectures and repetitive assignments prove insufficient in developing critical thinking skills. Furthermore, the integration of local wisdom into learning processes remains suboptimal, despite Banyumas possessing rich cultural potential (Dadan & Sulistyoningsih, 2023). This disconnect between cultural resources and pedagogical practice represents a missed opportunity, particularly as local wisdom integration can enhance educational relevance and develop critical thinking within culturally contextualized frameworks (Patras et al., 2025; Nurlaili & Sukirno, 2024).

Recent scholarship has demonstrated the potential of digital interactive learning platforms in fostering critical thinking and engagement. Gamification—the integration of game design elements into educational contexts—has proven effective in enhancing student motivation, engagement, and learning outcomes in elementary settings (Buckley & Doyle, 2016). Syafiullah et al. (2025) established that interactive media like Wordwall effectively improve students' critical thinking abilities in science subjects. However, this research has not specifically examined Wordwall's integration with local wisdom contexts, particularly Banyumas cultural elements, as a pedagogical strategy for enhancing critical thinking. This knowledge gap is particularly significant given that culturally responsive teaching integrated with local wisdom holds substantial potential not only for developing cognitive skills but also for preserving cultural heritage (Khusyairin et al., 2024). The intersection of digital interactive platforms and ethnopedagogical approaches remains theoretically underdeveloped, despite both strands showing independent promise in educational research.

The theoretical foundation of this research draws from Islamic epistemology, specifically QS. Ali 'Imran (3:190-191), which emphasizes critical reflection activities (Rifai et al., 2025), and Ki Hadjar Dewantara's educational philosophy concerning *sistem among*, *kodrat alam* (nature's law), and *kodrat zaman* (the law of the times). Dewantara's framework posits that education must guide children's natural powers toward achieving optimal safety and happiness, both individually and societally (Hussen et al., 2024). This indigenous educational philosophy provides a culturally grounded rationale for integrating local wisdom with contemporary pedagogical technologies.

This research aims to analyze elementary school students' critical thinking skills before implementing Wordwall integrated with Banyumas local wisdom, examine the implementation process, and evaluate the effectiveness of this integrated approach in improving critical thinking abilities. The study employs Robert H. Ennis's critical thinking framework, encompassing simple explanation, basic support, drawing conclusions, further explanation, and strategies and tactics (Fatiah et al., 2022). By bridging ethnopedagogical approaches with interactive digital platforms, this research addresses a significant gap in understanding how culturally contextualized technology-enhanced learning can simultaneously preserve cultural heritage and develop 21st-century competencies, contributing to both theoretical advancement in digital learning models and practical implications for educational stakeholders.

METHODS

This research uses descriptive qualitative research with an ethnopedagogical approach and case study method. This research aims to depict how Wordwall integrated with Banyumas local wisdom can improve students' critical thinking skills, which have been weak. The ethnopedagogical approach

allows researchers to directly understand from the experiences of students, teachers, and school principals regarding the dynamics of using Wordwall integrated with Banyumas local wisdom.

This research was conducted in semester 1 of the 2025/2026 academic year. The research went through the stages of pre-fieldwork, fieldwork, and data analysis. The pre-fieldwork stage was carried out from July to September 2025. The fieldwork and data analysis stage was conducted in October 2025. The research was conducted at four elementary schools located in Kencana Cluster, Banyumas, at the address of Banyumas District, Banyumas Regency, Postal Code 53192. The four schools are Dawuhan State Elementary School, Binangun 1 State Elementary School, Binangun 3 State Elementary School, and Majingklak State Elementary School. The data sources used in this research are primary data sources. Primary data sources consist of Grade IV students, classroom teachers, and school principals. Secondary data sources consist of school documentation, relevant literature and research, and educational policies from the government. The research subjects used are Grade IV students, classroom teachers, and school principals from the four elementary schools.

Informants were selected using purposive criterion-based sampling technique. The informants met the criteria of being students who actively participated in learning and had accessed and had experience in using technology. From this technique, 3 students, 1 teacher, and 1 school principal were selected from each school, resulting in a total of 12 students, 4 teachers, and 4 principals. This number allows for in-depth exploration of experiences according to the purpose of qualitative research.

The learning intervention was conducted in 4 sessions, each lasting 70 minutes. The use of Wordwall included activities such as match-up game, grouping challenge, quiz, and random wheel, used to train students' critical thinking indicators. The Banyumas local wisdom material integrated into Wordwall during Science learning included arts, clothing, traditional weapons, customs, traditional food, 'unggah-ungguh" (etiquette) values, and social values. The research instruments included observation sheets, interview guides, Wordwall answer analysis rubrics, and documentation studies.

Data collection techniques used consisted of observation, interviews, and documentation studies. Data analysis was performed using the Miles and Huberman model, consisting of data reduction, data display, conclusion drawing, and verification. In the data reduction stage, the researcher selected, simplified, and organized data to filter important data related to the use of Wordwall integrated with local wisdom and its impact on improving critical thinking. In the data display stage, the researcher arranged the data in the form of descriptive narrative. The goal was to visualize the relationship between the components of using Wordwall integrated with local wisdom in Science learning and critical thinking ability. The conclusion drawing and verification stage was to conclude whether the themes raised were appropriate.

The validity of the research data included four criteria: credibility, transferability, dependability, and confirmability. The credibility stage was carried out through triangulation of sources, techniques, and time. Source triangulation involved comparing and checking the consistency of information obtained in the research from various sources. Technique triangulation used different data collection techniques for the same data source. And time triangulation was done by collecting data at different times to see consistency over time. The transferability stage involved explaining the background of the four schools, student conditions, and how to use Wordwall containing local wisdom. The dependability stage assessed whether the obtained data was consistent. The final stage, confirmability, assessed whether the research results were of quality or not. The researcher did not include personal opinions. All conclusions made were based on field data.

RESULTS AND DISCUSSION

Results

This section will describe the results of the analysis regarding the initial condition of students' critical thinking skills before using Wordwall integrated with Banyumas local wisdom in Science learning, and the implementation and effectiveness of Wordwall integrated with Banyumas local

wisdom in improving students' critical thinking skills. The research involved students divided into three categories: students with good critical thinking character level, students with moderate critical thinking character level, and students with sufficient critical thinking character level. Therefore, the number of informants from each school was 3 students, 1 teacher, and 1 principal.

Initial Condition of Students' Critical Thinking Skills Before Using Wordwall Integrated with Banyumas Local Wisdom in Science Learning

Observation results showed that the majority of students did not yet possess critical thinking skills. Only 4 students were able to ask questions for clarification when the teacher delivered the material. There were 7 students who were still passive, waiting for teacher instructions without providing arguments for their answers. 9 students also did not provide clear reasons during classroom discussions. In the researcher's notes, students often answered "Because that's what the book says." When drawing conclusions, only 3 students could summarize the essence of the material using their own sentences. During discussion activities, only one or two students dominated. Others did not contribute ideas. Students' ability to connect material with local context was still low. Overall, student observation data indicated that students' critical thinking skills were still at a low to adequate stage. The weakest indicators were in the aspects of drawing conclusions and providing reasons.

The interview results with student, teacher, and principal informants are as follows:

Table 1. Student Interview Results

No	Aspect Observed	Data Obtained	Student Ability Category
1.	Access to digital technology	8 students already have digital devices. 5 students use them to search for information and learn IPAS	Adequate
2.	Skills in using technology	Students mentioned popular media they know; 10 students cannot yet use Wordwall and when having difficulty using technology, students ask the teacher or parents.	Adequate

From the student interviews, it can be concluded that students already possess digital devices for technology access, but these are not yet utilized optimally for learning and critical thinking. One student stated, "I have a cellphone, but I use it for playing" (S4). Only 5 students use them to search for information and learn IPAS. 10 students are not yet able to use Wordwall. They ask the teacher or parents when having difficulty using technology. The general category of student ability is in the adequate category. The minimal experience of students in using interactive platforms can be an initial obstacle in Wordwall-based learning.

Table 2. Teacher Interview Results

Informant	Aspect Observed	Data Obtained	Student Ability Category
Teacher 1	Initial student condition	2 students do not yet possess critical thinking character and the weakest aspect of critical thinking is drawing conclusions	Adequate
Teacher 2	Initial student condition	2 students are at the basic concept stage of critical thinking. The weakest aspect is basic support.	Adequate
Teacher 3	Initial student condition	2 students are not yet able to connect concepts with real life. The weakest aspect is drawing conclusions.	Adequate
Teacher 4	Initial student condition	1 student is not yet confident in giving opinions. And the weakest aspect is drawing conclusions.	Moderate

Two teachers rated the weakest aspect as drawing conclusions, while one teacher rated basic support as the weak aspect. Teacher 4 conveyed, "1 student is not yet brave to give a reason" (G4). From the teacher interviews, it can be concluded that the majority of students are at a basic stage.

The weakest aspect is drawing conclusions. Therefore, it can be concluded that the student ability category is in the adequate category. Students are not yet able to develop logical reasoning.

Table 3. School Principal Interview Results

Informant	Aspect Observed	Data Obtained	Student Ability Category
Principal 1	Initial school and student condition	3 students still tend to think one-dimensionally and the school does not yet have a specific program	Adequate
Principal 2	Initial school and student condition	Student abilities are varied and the school supports the P7 program	Moderate
Principal 3	Initial school and student condition	3 students are not accustomed to giving opinions and the school has a discussion program through "kombel" (teacher working group	Adequate
Principal 4	Initial school and student condition	Students are passive and the school does not yet have a program	Adequate

Two out of four principals stated that they did not yet have special programs to encourage students' critical thinking. One school had integrated a discussion program through the school's "kombel". From the interviews with school principals, it can be concluded that students are partly passive, think one-dimensionally, and some schools do not yet have programs. The general student ability category is in the adequate category. Thus, it appears that the school culture does not yet fully support the improvement of critical thinking skills.

Table 4. Documentation Study Results

Source Document	Aspect	Main Findings
LKPD	All 4 schools still emphasize that learning activities focus on understanding and repetition of material.	Adequate
Teaching Module	All 4 teachers have arranged learning activity sequences, but critical thinking indicators have not been specifically formulated.	Adequate
Teaching Journal	In 2 reflective notes, teachers indicate a lack of depth in thinking when explaining answers.	Moderate
Teacher Assessment Sheet	The main focus of all 4 assessments is still on knowledge aspects. Affective and skill assessment components exist but do not yet assess critical thinking aspects systematically.	Adequate
School Vision and Mission	1 school emphasizes the formation of students with character, faith, and environmental awareness	Adequate
Graduate Profile Program	All 4 schools target the character of critical thinking	Good
Learning Innovation Program	Thematic literacy innovation programs, project-based learning, and 2 schools use digital media.	Moderate
Academic Supervision Document	Teachers are beginning to foster aspects of active learning, but aspects of high-order thinking skills (HOTS) are still a main note	Adequate

Based on the documentation study, it can be obtained that learning documents already show good administrative readiness, but critical thinking ability indicators have not been strongly integrated into learning planning, implementation, and assessment. Student ability is in the adequate category. Adequate pedagogical strategies are needed.

According to the results of observation, interviews, and documentation studies, students' critical thinking skills are in the basic to adequate category. The aspects experiencing main weaknesses are drawing conclusions and basic support. These research results reinforce the urgency of implementing Wordwall in learning integrated with Banyumas local wisdom to improve critical thinking indicators.

Implementation of Wordwall Integrated with Banyumas Local Wisdom

The implementation of Science Wordwall integrated with Banyumas local wisdom in learning in Kencana Cluster, Banyumas, went through several stages including planning, implementation, and evaluation. In the planning stage, teachers prepared Science teaching modules with learning objectives oriented towards improving critical thinking ability. Teachers included critical thinking indicators in the modules. Teachers then prepared Wordwall integrated with Banyumas local wisdom such as *ngapak* language and the folk tale *lutung kasarung*, which were considered closer to students' daily experiences. However, not all elements of local wisdom are easily integrated with Science. As stated, "Elements that are close to daily life are easier" (G1). This shows the pedagogical limits of cultural integration.

In the implementation stage, teachers used Wordwall media as an interactive medium. Students were allowed to use the media. Active participation and positive responses from students occurred. "With Wordwall, I become interested in learning" (S2). Students appeared braver in expressing opinions. However, some students had difficulty navigating Wordwall due to limited digital literacy.

Student evaluation of the implementation was done through Wordwall quiz scores, observation of critical thinking indicators, and student reflection. The results showed that the context of Banyumas local wisdom was very helpful for students in understanding Science concepts. It also improved abilities, especially when explaining, drawing conclusions, and giving reasons. However, there were still students who had difficulty when providing data-based basic support. Teacher evaluation, conducted through teaching journals and post-learning discussions, assessed that the Wordwall implementation brought improvements in the critical thinking process, assessed the adequacy of question difficulty levels and student focus when answering. This led to improvements in teacher actions to adjust questions, provide reinforcement after Wordwall, and mentor students with weak literacy. Evaluation of learning tools was done by reviewing the suitability of teaching modules, LKPDs, and assessment rubrics. There were several assessment instruments that did not yet assess aspects of further clarification and deeper critical thinking strategies.

The implementation of Wordwall contributed to indicators of critical thinking character, including:

Simple Explanation

Students have shown their ability to focus attention on the teacher's explanations, especially when they are faced with case studies from surrounding phenomena. Students are also able to analyze the core of a problem. If disagreements occur among peers, students show the ability to give polite and logical reasons. On the other hand, some students showed a tendency to give normative reasons not based on evidence, "Because that's the custom in Banyumas" (S5). This certainly creates an interesting tension between traditional local wisdom values and scientific reasoning. Student ability in this indicator is in the good category.

Basic Support

Students show the ability to choose valid information sources. Most students verify the truth of information displayed in Wordwall through digital sources or teacher explanations. Students are able to relate events around them to the material being studied. However, assessment instruments that distinguish cultural reasons and empirical data are needed, indicating a need for increased evidence literacy. Student ability in this indicator is in the good category.

Drawing Conclusions

Interview results with students showed that students could logically conclude the learning after using Wordwall media without teacher assistance. Some students sought answers by linking local wisdom with the topic. Some students were able to provide alternative answers when their opinions differed. Student ability in this indicator is in the moderate category.

Further Explanation

Some students are able to explain terms in Science in their own words, also related to daily life in Banyumas. However, for abstract concepts, integration with conceptual learning is still needed. All students can also recognize the reciprocal value of a phenomenon. Student ability in this indicator is in the moderate category.

Strategies and Techniques

Students use systematic thinking strategies in answering questions in Wordwall. They evaluate several answer choices before determining the most correct answer. Students are already able to collaborate in groups. Students show critical thinking ability by interacting actively and giving opinions. But there are some students who tend to focus more on the speed of completing the game. Student ability in this indicator is in the good category.

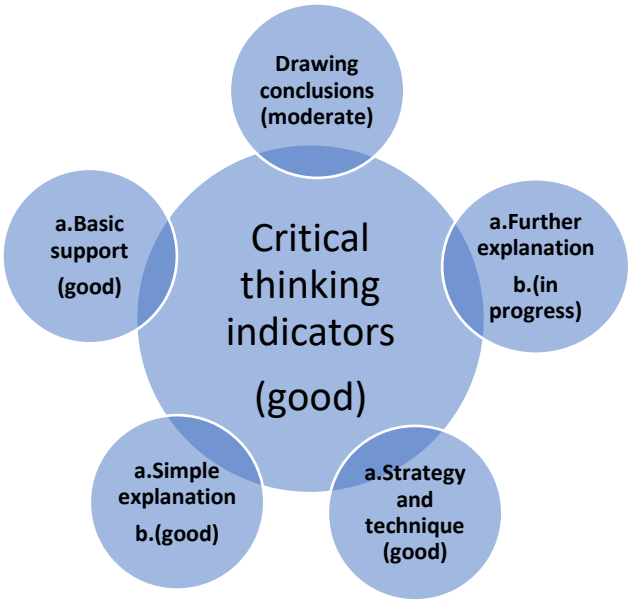

Figure 1 Strengthening Critical Thinking Indicators

The documentation study results strongly support this. Among other things, by including critical thinking indicators and local wisdom content in the teaching modules created by teachers. This is visible from the learning objectives, learning activities, and the integration of local wisdom values. In the LKPDs, learning activities are already focused on Science material that can strengthen critical thinking character and are linked to the Science content. From the teaching journals, teachers' reflective notes show that students have begun to have depth of thinking. In the teacher assessment sheets, all aspects are assessed, although not yet fully assessing higher-order critical thinking skills. School visions and missions are being reviewed to include critical thinking character. Graduate profile programs are being reviewed to target critical thinking. In learning innovation programs, schools have implemented digital media. And in academic supervision documents, teachers are fostering critical thinking character using HOTS questions. From the overall documents, student ability can be categorized as good.

It is concluded that the implementation of the interactive Wordwall media containing local wisdom has been carried out well. It supports the improvement of critical thinking ability. However, this implementation depends on the cultural relevance to the Science topic, the digital literacy possessed by students, and the pedagogical strategies owned by teachers.

The Effectiveness of Wordwall Integrated with Banyumas Local Wisdom in Science Learning in Improving Students' Critical Thinking Skills

The research results show that the use of Wordwall integrated with Banyumas local wisdom in Science learning is effective in improving students' critical thinking skills. However, this effectiveness is influenced by several conditions presented in the triangulation of interviews, observation, and documentation studies. Interviews with students showed that 10 students felt Wordwall was easier to understand because its instructions were simple and its display was attractive. As one student opined, "I feel Wordwall is easier to understand" (S7). These findings are reinforced by observation which showed that match-up games and grouping challenges helped students identify the presented problems more quickly, especially if the questions used a local context. One student said, "Now I understand the cause and effect of local phenomena faster" (S8). Looking at the variation in ability, it is evident in the basic support indicator which has shown variation: 7 students were able to verify information, but 5 students still guessed answers due to the fast pace of the game. In the drawing conclusions indicator, there were still 4 students who provided empirical data.

From the teacher's perspective, it was stated that the use of Wordwall encouraged significant development in students' critical thinking ability. Students more frequently asked "why" and "how," and were brave in conveying reasons for each answer. Teachers viewed that Wordwall not only strengthened the understanding of Science concepts but also instilled relevant local wisdom values, such as responsibility towards the environment and a spirit of cooperation. The school principal explained that Wordwall had shown a positive impact on strengthening students' critical thinking character. They observed changes in student learning behavior towards being more independent, argumentative, and brave in expressing opinions. The principal also assessed that this media aligns with the policy direction of elementary school digitalization and supports the implementation of culture-based learning.

The results of document analysis, such as teaching modules, teacher journals, assessment sheets, and Wordwall evidence, show consistency between learning planning and implementation. Teaching modules list learning objectives aimed at strengthening critical thinking ability and instilling local wisdom values. Teaching journals show that teachers routinely use Wordwall for reflection and learning evaluation activities. Teacher assessment sheets show an improvement in learning outcomes and students' reasoning ability. Wordwall evidence displays content relevant to Banyumas culture and environment, and integrates local values into Science questions. Overall, Wordwall is effective in improving students' critical thinking skills. However, its effectiveness is influenced by several factors including the design of learning activities, the readiness of participating students, and the teacher mentoring process during learning.

Discussion

The findings confirm that elementary students' initial critical thinking skills in conventional learning environments remain inadequate, consistent with broader literature documenting elementary students' difficulties generalizing science concepts to real-world contexts (Ennis, 1989). The specific weaknesses in conclusion-drawing and basic support align with Ennis's (2011) framework positing that these competencies require substantial cognitive scaffolding, particularly the ability to synthesize diverse information sources and distinguish credible from questionable evidence. The baseline findings corroborate Heyman and Legare's (2005) observations that young children often accept information uncritically without evaluating source reliability or logical coherence, though they possess latent capacities for such evaluation when provided appropriate instructional support.

The effectiveness of Wordwall in enhancing student engagement and critical thinking resonates with extensive gamification literature. Bai et al. (2020) conducted meta-analysis demonstrating that gamification significantly improves learning outcomes, with elementary students showing particularly strong effects (Huang et al., 2020). The present study's findings that students reported increased interest ("With Wordwall, I become interested in learning") and demonstrated elevated participation patterns align with Buckley and Doyle's (2016) evidence that game-based elements enhance motivation through immediate feedback, visual appeal, and interactive challenges. The match-up

games and grouping challenges proved especially effective for simple explanation and basic support indicators, supporting Alshammari's (2020) contention that gamified platforms optimize elementary students' cognitive engagement through developmentally appropriate interactive mechanisms. However, this research extends existing gamification literature by documenting effectiveness variations across critical thinking indicators—a granularity rarely examined in prior studies that typically measure learning outcomes holistically without disaggregating specific cognitive processes.

The integration of Banyumas local wisdom introduces ethnopedagogical dimensions that complicate straightforward technological determinism narratives. Sakti et al. (2024) demonstrated that ethnopedagogy enhances cultural awareness and character development by embedding local wisdom values in learning processes, findings the present research confirms regarding environmental responsibility and cooperative spirit cultivation. The culturally proximate elements (*ngapak* language, local folktales) functioned as cognitive bridges connecting abstract science concepts with lived experiences, operationalizing Battiste's (2002) principle that Indigenous Knowledge Systems provide culturally responsive pedagogical frameworks. This aligns with recent scholarship emphasizing that local wisdom integration strengthens educational relevance (Andriani et al., 2023; Septina, 2025) and supports contextualized meaning-making (Demssie et al., 2020).

However, the present research reveals a critical theoretical tension inadequately addressed in ethnopedagogical literature: the potential conflict between cultural reasoning and scientific empiricism. When Student 5 justified an answer by stating "Because that's the custom in Banyumas," cultural explanation substituted for empirical evidence, creating pedagogical challenges for science learning requiring hypothesis testing, systematic observation, and evidence-based inference. This finding problematizes ethnopedagogical approaches that uncritically celebrate local wisdom integration without acknowledging epistemological differences between traditional knowledge systems and scientific methodologies. Aikenhead and Michell (2011) recognized this tension in Indigenous science education contexts, arguing that effective integration requires explicit attention to epistemological boundaries and careful negotiation between knowledge systems rather than naive conflation.

The research extends Ennis's (1985, 2011) critical thinking framework by demonstrating that basic support—typically conceptualized as evidence evaluation—requires not only logical assessment skills but also epistemological discrimination between cultural authority and empirical verification. In culturally embedded learning contexts, students must develop meta-cognitive awareness about when cultural knowledge appropriately informs reasoning versus when scientific evidence standards apply. This finding suggests that ethnopedagogical approaches in science education necessitate explicit pedagogical attention to these epistemological distinctions, perhaps through comparative discussions highlighting complementary roles of traditional wisdom (e.g., environmental ethics, sustainable practices) and scientific inquiry (e.g., hypothesis testing, quantitative measurement) rather than treating them as interchangeable explanatory frameworks.

The variable effectiveness across critical thinking indicators challenges uniform cognitive development assumptions. Simple explanation and basic support demonstrated substantial improvement, while conclusion-drawing and advanced clarification showed more modest gains. This pattern suggests that Wordwall's interactive immediate-feedback mechanisms particularly support lower-order analytical processes (identifying, categorizing, verifying) but require supplementary scaffolding for higher-order synthesis and evaluation competencies. This aligns with McLean's (2004) observation that interactive technologies effectively develop foundational critical thinking skills but may insufficiently address complex reasoning requiring extended contemplation and iterative refinement—cognitive processes potentially disrupted by game pacing that prioritizes rapid responses.

The finding that 5 students guessed answers due to fast game pacing illuminates an important limitation of gamification approaches emphasizing speed and competition. While these elements enhance engagement, they may inadvertently privilege quick thinking over careful reasoning, potentially undermining critical thinking objectives prioritizing thoughtful deliberation. This suggests need for differentiated Wordwall design: rapid-fire formats for consolidating acquired knowledge

versus untimed reflective formats for developing analytical depth. Recent scholarship on gamification design principles (Li et al., 2024) similarly emphasizes matching game mechanics to specific learning objectives rather than applying gamification universally.

Digital literacy emerged as a significant moderating variable, with students' varying Wordwall navigation facility creating differential learning experiences. This finding reinforces Patton's (2015) observation that educational technology interventions presuppose baseline digital competencies unevenly distributed across student populations. The implementation revealed that technological integration requires concurrent digital literacy development, not merely technology introduction. This has important equity implications: without explicit attention to digital skill building, technology-enhanced learning risks exacerbating rather than ameliorating achievement gaps, privileging students with prior technology exposure.

The research findings advance practical realization of UNESCO's four pillars of learning (Delors et al., 1996) and 21st century competency frameworks (Fullan, 2015). Learning to know was enhanced through Wordwall's inquiry-based interactive activities requiring information verification and concept connection. Learning to do manifested in students' improved capacity to apply critical thinking in problem-solving situations. Learning to be emerged through enhanced confidence in opinion articulation and reasoning defense. Learning to live together developed through collaborative Wordwall activities and local wisdom values emphasizing communal responsibility. This demonstrates that well-designed technology-culture integration can operationalize comprehensive educational objectives rather than narrowly targeting cognitive skill acquisition.

The research addresses Care et al.'s (2018) call for evidence-based approaches developing 21st century competencies in culturally diverse contexts. By demonstrating that critical thinking development can proceed through culturally grounded rather than culturally neutral pedagogies, the findings challenge implicit Western-centrism in critical thinking frameworks assuming universal cognitive processes divorced from cultural contexts. The successful integration of Banyumas wisdom suggests that critical thinking competencies develop most effectively when pedagogically connected to students' cultural identities and community contexts, supporting culturally responsive teaching principles (Gay, 2002; Sleeter, 2001).

For practitioners, the research offers several actionable insights. First, Wordwall implementation should incorporate post-game pedagogical reinforcement explicitly addressing analytical processes rather than assuming game participation alone develops critical thinking. Teachers should facilitate reflective discussions exploring reasoning strategies, evidence evaluation criteria, and conclusion justification, helping students metacognitively process their interactive experiences. Second, local wisdom element selection requires careful evaluation of pedagogical suitability—not all cultural content equally supports specific learning objectives. Elements proximate to students' daily experiences and conceptually alignable with curricular content prove most effective, while abstract or peripherally related cultural elements may create cognitive distraction rather than scaffolding. Third, teachers need explicit training navigating the cultural-scientific reasoning tension, developing strategies that honor traditional knowledge while clarifying epistemological distinctions appropriate for science learning. This might include comparative frameworks highlighting when cultural wisdom provides valuable ethical or contextual insights versus when empirical scientific methods must guide conclusions.

For policymakers, findings support Indonesia's Merdeka Belajar policies encouraging local wisdom integration while highlighting implementation complexities requiring support systems. Professional development programs should address ethnopedagogical approaches in science education specifically, as generic cultural integration training may inadequately prepare teachers for epistemological navigation challenges. Additionally, digital infrastructure and literacy support emerge as prerequisites for technology-enhanced learning rather than optional enhancements, necessitating equitable resource allocation ensuring all students develop baseline competencies.

For researchers, the study demonstrates value in disaggregating learning outcomes by specific cognitive processes rather than measuring critical thinking holistically. The differential effectiveness across Ennis's indicators provides actionable insights unavailable through aggregate measurement, enabling targeted pedagogical refinement. Future research should examine longitudinal sustainability of critical thinking gains, transfer effects to non-gamified contexts, and comparative effectiveness across cultural contexts with different indigenous knowledge traditions.

This research acknowledges several limitations constraining generalizability and interpretation depth. First, the limited informant sample (20 participants across four schools) restricts statistical generalization, though qualitative research prioritizes transferability through thick description rather than probabilistic generalization (Lincoln & Guba, 1985). Second, single-subject (science) focus limits understanding of how Wordwall-local wisdom integration functions across disciplines with different epistemological structures; humanities or social studies may exhibit different cultural-curricular alignment patterns. Third, the research's temporal concentration in one semester prevents assessment of long-term retention and developmental trajectories. Fourth, assessment instruments initially lacked comprehensive critical thinking indicators, requiring iterative refinement that introduced measurement inconsistency across evaluation points. Fifth, the study did not systematically vary local wisdom elements or Wordwall formats, preventing identification of optimal combinations. Finally, the research examined one specific cultural context (Banyumas); findings may not transfer to communities with different indigenous knowledge characteristics, power dynamics around traditional versus modern knowledge, or varying technological access levels.

CONCLUSION

This research demonstrates that Wordwall integrated with Banyumas local wisdom effectively improves elementary students' critical thinking skills, though this effectiveness is moderated by cultural relevance, digital literacy, and pedagogical mediation. Baseline assessment revealed students' critical thinking abilities in the adequate category, with pronounced weaknesses in conclusion-drawing and basic support indicators. The intervention successfully enhanced student engagement and critical thinking across most dimensions, particularly simple explanation and basic support, while conclusion-drawing and advanced clarification showed modest improvement. A significant unexpected finding emerged regarding epistemological tension between cultural reasoning and scientific empiricism, where students occasionally substituted normative cultural explanations for evidence-based reasoning, highlighting complexities in ethnopedagogical science education approaches.

The research contributes theoretically by demonstrating that digital-ethnopedagogical integration can simultaneously develop 21st century competencies and preserve cultural heritage, extending Ennis's critical thinking framework to culturally embedded contexts and revealing that effective local wisdom integration requires explicit epistemological negotiation rather than uncritical conflation of knowledge systems. Practically, findings support Indonesia's Merdeka Belajar policies while identifying implementation prerequisites: teachers need training navigating cultural-scientific reasoning tensions, local wisdom selection must consider pedagogical suitability, and post-game pedagogical reinforcement proves essential for consolidating critical thinking development.

Research limitations include small sample size, single-subject focus, short intervention duration, and context-specific cultural elements restricting broader generalizability. Future research should expand samples across multiple subjects and grade levels, conduct longitudinal studies examining long-term retention and transfer effects, systematically vary local wisdom elements and Wordwall formats to identify optimal combinations, develop refined assessment instruments comprehensively measuring advanced critical thinking dimensions, and investigate cross-cultural applicability in diverse indigenous knowledge contexts. Such investigations will advance understanding of how technology-enhanced culturally responsive pedagogies can optimize elementary students' critical thinking development while honoring cultural heritage.

REFERENCES

Aikenhead, G. S., & Michell, H. (2011). *Bridging cultures: Indigenous and scientific ways of knowing nature*. Pearson Canada.

Alshammari, M. T. (2020). Evaluation of gamification in e-learning systems for elementary school students. *TEM Journal*, *9*(2), 806–813. https://doi.org/10.18421/TEM92-51

Andriani, A., Wijarnako, B., Wakhudin, W., & Nugroho, A. (2023). Local wisdom of Kampunglaut community facing flood disaster rob. *Proceedings Series on Social Sciences & Humanities*, *8*, 41–54. https://doi.org/10.30595/pssh.v8i.606

Ariadila, S. N., Silalahi, Y. F. N., Fadiyah, F. H., Jamaludin, U., & Setiawan, S. (2023). Analisis pentingnya keterampilan berpikir kritis terhadap pembelajaran bagi siswa. *Jurnal Ilmiah Wahana Pendidikan*, *9*(20), 664-669. https://www.jurnal.peneliti.net/index.php/JIWP/article/view/5151

Ayala, E., Fuertes, W., & Jarrin, F. (2024). Critical thinking skills in research process, a literature review: An input to propose a new measurement instrument to gauge critical thinking. *International Journal of Religion*, *5*(11), 1–14. https://doi.org/10.61707/pwy5df19

Bai, S., Hew, K. F., & Huang, B. (2020). Does gamification improve student learning outcome? Evidence from a meta-analysis and synthesis of qualitative data in educational contexts. *Educational Research Review*, *30*, Article 100322. https://doi.org/10.1016/j.edurev.2020.100322

Battiste, M. (2002). *Indigenous knowledge and pedagogy in First Nations education: A literature review with recommendations*. National Working Group on Education and the Minister of Indian Affairs.

Buckley, P., & Doyle, E. (2016). Gamification and student motivation. *Interactive Learning Environments*, *24*(6), 1162–1175. https://doi.org/10.1080/10494820.2014.964263

Care, E., Vista, A., Kim, H., & Anderson, K. (2018). *Education system alignment for 21st century skills: Focus on assessment*. Brookings Institution.

Dadan, S., & Sulistyoningsih, E. D. (2023). Penguatan ketahanan budaya masyarakat adat melalui pewarisan kearifan lokal integratif: Studi pada komunitas Bonokeling Banyumas. *Prosiding Konferensi Nasional Sosiologi (PKNS)*, *1*(1), 380-384. https://www.pkns.portalapssi.id/index.php/pkns/article/view/62

Delors, J., Al Mufti, I., Amagi, I., Carneiro, R., Chung, F., Geremek, B., Gorham, W., Kornhauser, A., Manley, M., Padrón Quero, M., Savané, M. A., Singh, K., Stavenhagen, R., Won Suhr, M., & Nanzhao, Z. (1996). *Learning: The treasure within*. UNESCO Publishing.

Demssie, Y. N., Biemans, H. J., Wesselink, R., & Mulder, M. (2020). Combining indigenous knowledge and modern education to foster sustainability competencies: Towards a set of learning design principles. *Sustainability*, *12*(17), 6823. https://doi.org/10.3390/su12176823

Ennis, R. H. (1985). A logical basis for measuring critical thinking skills. *Educational Leadership*, *43*(2), 44–48. https://jgregorymcverry.com/readings/ennis1985assessingcriticalthinking.pdf

Ennis, R. H. (1989). Critical thinking and subject specificity: Clarification and needed research. *Educational Researcher*, *18*(3), 4–10. https://doi.org/10.3102/0013189X018003004

Ennis, R. H. (2011). *The nature of critical thinking: An outline of critical thinking dispositions and abilities*. University of Illinois. https://informallogic.ca/index.php/informal_logic/article/view/2378/1820

Fatiah, A., Riyadi, R., & Daryanto, J. (2022). Analisis karakter berpikir kritis dalam pemecahan masalah matematika berdasarkan teori robert h ennis pada kelas v sekolah. *Didaktika Dwija Indria*, *9*(6). https://doi.org/10.20961/ddi.v9i6.56158

Fullan, M. (2015). *The new meaning of educational change* (5th ed.). Teachers College Press.

Gay, G. (2002). Preparing for culturally responsive teaching. *Journal of Teacher Education*, *53*(2), 106–116. https://doi.org/10.1177/0022487102053002003

Heyman, G. D., & Legare, C. H. (2005). Children's evaluation of sources of information about traits. *Developmental Psychology*, *41*(4), 636–647. https://doi.org/10.1037/0012-1649.41.4.636

Huang, R., Ritzhaupt, A. D., Sommer, M., Zhu, J., Stephen, A., Valle, N., Hampton, J., & Li, J. (2020). The impact of gamification in educational settings on student learning outcomes: A meta-analysis. *Educational Technology Research and Development*, *68*(4), 1875–1901. https://doi.org/10.1007/s11423-020-09807-z

Hussen, T. N., Fatimah, S. N., Puspa, N. D., Willenda, Z., Megayani, W., Saliya, I. I., Amirudin, M., Wijaya, D. F. S., Wicaksono, H. A., & Sofwan, M. (2024). Relevansi dasar pendidikan Ki Hajar Dewantara (kodrat alam dan kodrat zaman) terhadap konsepsi Kurikulum Merdeka. *JIIP: Jurnal Ilmiah Ilmu Pendidikan*, *7*(5), 4999–5006. https://doi.org/10.54371/jiip.v7i5.4463

Khusyairin, K., Sa'ud, U. S., Sururi, S., & Hartini, N. (2022). Integrating local wisdom into learning in school's curriculum: A bibliometric analysis. *Inovasi Kurikulum*, *21*(4), 2155-2172. https://doi.org/10.17509/jik.v21i4.75667

Li, L., Hew, K. F., & Du, J. (2024). Gamification enhances student intrinsic motivation, perceptions of autonomy and relatedness, but minimal impact on competency: a meta-analysis and systematic review. *Educational technology research and development*, *72*(2), 765-796. https://doi.org/10.1007/s11423-023-10337-7

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Sage Publications.

Mastuti, A. G., Abdillah, A., Sehuwaky, N., & Risahondua, R. (2022). Revealing students' critical thinking ability according to Facione's theory. *Al-Jabar: Jurnal Pendidikan Matematika*, *13*(2), 261–272. https://doi.org/10.24042/ajpm.v13i2.13005

McLean, J. E. (2004). *Improving education through action research: A guide for administrators and teachers*. Corwin Press.

Nabilah, N., & Suyanto, S. (2025). A CIPP-based evaluation of critical thinking in science: Implementation of the Merdeka curriculum in Mataram public junior high schools. *STEM Education*, *5*(4), 587–616. https://doi.org/10.3934/steme.2025028

Novianti, W. (2020). Urgensi berpikir kritis pada remaja di era 4.. *Journal of Education and Counseling (JECO)*, *1*(1), 38–52. https://doi.org/10.32627/jeco.v1i1.519

Nurlaili, F. I., & Sukirno. (2024). Nilai pendidikan karakter dan kearifan lokal dalam cerita rakyat Banyumas serta implementasinya terhadap pembelajaran Bahasa Indonesia. *Proceedings Series on Social Sciences & Humanities*, *19*, 123–127. https://doi.org/10.30595/pssh.v19i.1340

Patras, Y. E., Japar, M., Rahmawati, Y., & Hidayat, R. (2025). Integration of Culturally Responsive Teaching Approach, Local Wisdom, and Gamification in Pancasila Education to Develop Students' Multicultural Competence. *Educational Process: International Journal*, *14*, e2025045. https://doi.org/10.22521/edupij.2025.14.45

Patton, M. Q. (2015). *Qualitative research & evaluation methods: Integrating theory and practice* (4th ed.). Sage Publications.

Rahayu, S., Markhamah, M., & Fathoni, A. (2025). Analisis karakter berpikir kritis siswa dalam pembelajaran berbasis proyek di sekolah dasar. *METODIK DIDAKTIK: Jurnal Pendidikan Ke-SD-an*, *20*(2), 122–135. https://doi.org/10.17509/md.v20i2.72360

Rifai, A., Halimatussa'diyah, H. D., & Kusnadi, K. (2025). Memahami Makna Ulil Albab dalam Surah Ali Imron 190-191 Sebagai Keseimbangan Zikir dan Fikir Menuju Akhlaq yang Mulia. *PESHUM: Jurnal Pendidikan, Sosial dan Humaniora*, *4*(2), 1712-1721. https://ulilalbabinstitute.co.id/index.php/PESHUM/article/view/7119

Sakti, S. A., Endraswara, S., & Rohman, A. (2024). Revitalizing local wisdom within character education through ethnopedagogy apporach: A case study on a preschool in Yogyakarta. *Heliyon*, *10*(10). https://doi.org/10.1016/j.heliyon.2024.e31370

Septina, E. A. (2025). Korelasi budaya, potensi lokal dan kearifan lokal pada pembelajaran ipa berbasis etnosains. *JOSERI*, *1*(1), 25-32. https://journal.innoscientia.org/index.php/joseri/article/view/149

Sleeter, C. E. (2001). Preparing teachers for culturally diverse schools: Research and the overwhelming presence of whiteness. *Journal of Teacher Education*, *52*(2), 94–106. https://doi.org/10.1177/0022487101052002002

Suyitno, Y. (2021). *Landasan pedagogik* [Pedagogical foundation]. UPI Press.

Syafiullah, M., Lastuti, S., & Akbar, M. R. (2025). Pengembangan media kartu interaktif menggunakan Wordwall untuk meningkatkan kemampuan berpikir kritis siswa pada mata pelajaran IPAS kelas IV SDN Naganuri Sape. *Jurnal Pendidikan dan Pembelajaran Indonesia (JPPI)*, *5*(2), 805–815. https://doi.org/10.53299/jppi.v5i2.1453