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Deep Learning–Based QuizWhizzer for Innovative IPAS Assessment in Elementary School

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Abstract

This classroom action research aims to improve students' learning outcomes and engagement through an innovative learning evaluation based on Deep Learning using the QuizWhizzer digital platform in the Natural and Social Sciences (IPAS) subject. The initial problem identified was the low level of student participation in evaluation activities and the limited use of varied and engaging digital assessment media aligned with 21st-century learning demands. Integrating Deep Learning principles into the evaluation process was expected to help students develop deeper conceptual understanding, contextual reasoning, and reflective learning abilities. The study was conducted in two cycles following the Kemmis and McTaggart model, consisting of planning, action, observation, and reflection stages. The research subjects were 30 fifth-grade students. Data were collected through observations, interviews, documentation, and learning outcome tests, and analyzed using descriptive qualitative and quantitative approaches. The findings indicate a significant improvement in both student activity and learning outcomes. Mastery learning increased from 58% in the pre-cycle to 76% in Cycle I and reached 91% in Cycle II. Students also demonstrated higher motivation, stronger collaboration, and improved critical-thinking skills during the gamified evaluation process. The use of QuizWhizzer created an interactive, enjoyable, and competitive learning atmosphere that supported mindful, meaningful, and joyful learning. This study concludes that the Deep Learning–based evaluation using QuizWhizzer is an effective and innovative assessment strategy that enhances IPAS learning quality in elementary schools and can be recommended as an alternative digital evaluation method within the Merdeka Curriculum.

Keywords: deep learning; QuizWhizzer; learning evaluation; integrated natural and social sciences

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Introduction

The rapid development of information and communication technology in the 21st century has transformed the demands of education, shifting learning from traditional knowledge transmission toward the cultivation of higher-order thinking, creativity, collaboration, and student character (Fadel, C., & Trilling, 2009). Schools are required to design meaningful learning environments that promote deep understanding, contextual reasoning, digital competence, and reflective learning. In Indonesia, the Merdeka Curriculum reinforces this shift by emphasizing deep learning as a core pedagogical orientation to enhance students' conceptual mastery and engagement in authentic learning tasks (Madeamin, R., & Sahriani, 2025). This transformation places new demands on teachers to function not only as knowledge transmitters but also as facilitators and learning designers capable of integrating digital tools into classroom instruction (John Hattie, 2013).

Despite this policy direction, preliminary observations at SD Negeri 10/II Muara Bungo indicate that the learning process in the Natural and Social Sciences (IPAS) subject remains teacher-centered, with evaluation practices still dominated by conventional written tests. These assessments primarily measure recall-based competencies (lower-order thinking skills), leading to low student participation, limited motivation, and insufficient conceptual understanding (Peneliti, 2025a). Interviews with teachers revealed that only 58% of fifth-grade students met the minimum mastery criteria, and many struggled to relate scientific concepts, such as weather change and its impacts, to everyday experiences (Peneliti, 2025b). This condition highlights the urgent need for innovative digital-based evaluation strategies to enhance student engagement, conceptual understanding, and reflective learning.

Recent literature underscores the potential of gamification and digital quiz platforms in strengthening classroom participation and formative assessment quality. Digital gamified tools have been shown to increase student motivation, foster healthy competition, and improve learning outcomes through real-time feedback (Deterding, S., Dixon, D., Khaled, R., & Nacke, 2021). In Indonesia, studies report that interactive quiz media can enhance elementary students' learning performance by up to 25–30% due to increased engagement and contextual visualization (Kurniasari & Widiarti, 2025). Whizzer, a board-game-style digital quiz platform, has emerged as an effective tool for promoting collaboration, communication, and joyful learning in classroom settings (Hermawanti, E., Prasetya, G. A. A., Purnamasari, N. D., Utami, R. D., & Maulidah, 2025). However, most existing studies focus primarily on motivation and learning outcomes, with limited exploration of how digital gamified quizzes can be systematically aligned with deep learning principles.

A critical gap identified in previous research concerns the integration of deep learning with gamification-based evaluation to promote conceptual understanding, contextual reasoning, and reflective thinking. While deep learning emphasizes mindful, meaningful, and joyful learning experiences (Putri, D. A., & Mulyadi, 2024), existing gamification studies rarely examine how these dimensions can be embedded into classroom assessments, particularly in IPAS learning at the elementary level. Moreover, research that simultaneously examines student motivation, digital literacy, and higher-order thinking through classroom action research remains limited in the Indonesian context (Khirubanraj Muruga, 2025).

Addressing this gap, the present study implements a Deep Learning–based evaluation strategy using QuizWhizzer to enhance students' learning outcomes, engagement, and conceptual understanding in the IPAS subject. This research offers three main contributions: (1) providing an empirical model of integrating deep learning principles into digital gamified assessment; (2) demonstrating the effectiveness of QuizWhizzer in improving mastery learning and reflective thinking in elementary settings; and (3) offering practical insights for teachers and schools in implementing digital formative assessments aligned with the Merdeka Curriculum. The novelty of this study lies in its systematic combination of deep learning and gamification to create an interactive, contextual, and student-centered evaluation ecosystem.

Method

This study employed a Classroom Action Research (CAR) design aimed at improving students' learning outcomes and engagement through a Deep Learning–based evaluation using the QuizWhizzer digital platform in the IPAS subject. The research followed the model of Kemmis and McTaggart (1988), whose cyclical framework of planning, acting, observing, and reflecting has been widely adopted in educational action research (Cohen, L., Manion, L., &

Morrison, 2018; Fraenkel, J. R., Wallen, N. E., & Hyun, 2019). The four main stages above can be illustrated as shown in the figure below:

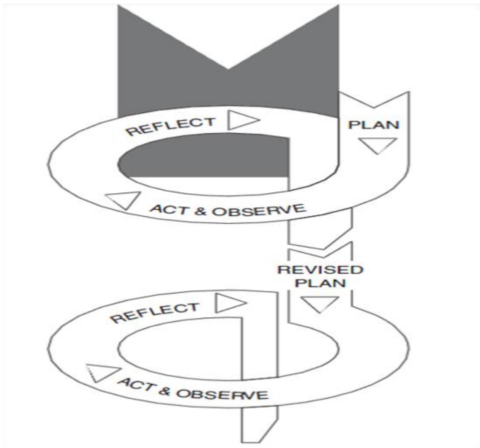

Figure 1.
Stages of Classroom Action Research (CAR) by Kemmis and Taggart

(Source: Valsa Koshy in (Benidiktus Tanujaya, 2016))

Two complete cycles were implemented, with each cycle comprising two learning meetings. The research was conducted at SD Negeri 10/II Muarabungo during the first semester of the 2025/2026 academic year. The study involved 30 fifth-grade students (16 boys and 14 girls). The learning topic "Weather Changes and Their Impacts on Life" was selected based on preliminary observations indicating low student mastery, limited conceptual understanding, and low engagement conditions that align with typical challenges identified in primary science learning in Indonesian schools (Sugiyono, 2022; Cresswell, 2015).

Multiple data collection techniques were used to ensure triangulation and enhance the credibility of findings, as recommended in qualitative and action research (Miles, M.B., Huberman, A. M., & Saldana, 2014; Patton, 2015). Learning achievement tests (pre-test and post-test) were administered to measure changes in students' cognitive outcomes. Classroom observations were conducted to record student participation, collaboration, and engagement during the QuizWhizzer-assisted evaluation, consistent with observation procedures recommended by Cohen et al. (2018). Semi-structured interviews with teachers and students were carried out to gain insights into their experiences and perceptions of the intervention. Documentation, including field notes, photographs, and student worksheets, served as supplementary evidence to strengthen qualitative interpretation (Miles, M. B., Huberman, A. M., & Saldana, 2014).

Data were analyzed using a combination of quantitative and qualitative approaches. Quantitative data from tests were analyzed descriptively to determine changes in average scores and mastery learning percentages across cycles, a standard approach in CAR evaluation (Kemmis, S., & McTaggart, 2005). Qualitative data from observations, interviews, and documentation were analyzed thematically following the analytical procedures outlined by, involving data reduction, data display, and conclusion drawing. Two criteria were used to determine the success of the intervention: (1) at least 85% of students achieving a minimum mastery level of 75, and (2) at least 80% of students demonstrating active participation in digital-based learning activities. These thresholds align with evaluative standards commonly used in classroom action research and school-based formative assessments (Sugiyono, 2022).

The implementation procedures followed two action cycles. In Cycle I, the teacher introduced the core concept of weather changes, facilitated QuizWhizzer-based evaluation using basic and intermediate-level questions, and conducted reflection sessions to identify learning challenges. In Cycle II, the teacher strengthened Deep Learning components by incorporating context-based higher-order thinking (HOTS) tasks within QuizWhizzer. As recommended by Creswell and Creswell (2018), cycle-to-cycle comparison was used to determine the effectiveness of the intervention in enhancing student learning outcomes, engagement, and conceptual understanding.

Results and Discussion

Initial Condition of Learning Outcomes and Engagement

Before the implementation of the Deep Learning based evaluation using QuizWhizzer, IPAS learning in SD Negeri 10/II Muarabungo was dominated by conventional teacher-centered instruction. Observations and teacher interviews indicated low student enthusiasm, limited participation, and minimal interaction during evaluation sessions. The pre-test results on the topic Weather Changes and Their Impacts showed that only 13 out of 30 students (43%) achieved the minimum mastery criterion of 75, while 17 students (57%) scored below the required standard. The class average score was 68.4, and student participation in questioning and discussion activities reached only 55%. These conditions confirm the need for more engaging and interactive learning evaluation strategies.

The first cycle focused on introducing QuizWhizzer and integrating it with Deep Learning elements. Students were organized into five groups, each participating in a game-based quiz consisting of 20 questions combining multiple-choice and contextual items. Group members collaborated to answer questions while observing their real-time movement on the digital game board. Post-test results in Cycle I showed notable progress, with 21 students (70%) achieving mastery and an average score of 77.3. Classroom observations indicated increased enthusiasm and cooperation, although some students still struggled with analytical items requiring cause-and-effect reasoning.

Based on the reflection from Cycle I, Cycle II introduced more complex tasks, including HOTS-based questions, contextual images, and short videos to reinforce conceptual understanding. Instructional activities were structured according to the *mindful, meaningful, joyful* learning stages to strengthen deep learning experiences. The results demonstrated significant improvement. A total of 28 students (93%) achieved mastery with an increased class average of 88.6. Students displayed higher engagement, asked more reflective questions, and demonstrated greater confidence in explaining their reasoning. These findings indicate that deep learning combined with digital gamification substantially improved students' conceptual understanding and active participation.

Student Activity and Motivation Analysis

Student learning activity was assessed using four indicators: questioning, collaboration, answer accuracy, and enthusiasm. Results across the two cycles are shown in Table 1.

Table 1.
Student Activity Across Cycles

Component	Cycle I	Cycle II	Increase
1. Questioning	65%	85%	+20%
2. Group Collaboration	70%	90%	+20%
3. Answer Accuracy	68%	88%	+20%
4. Enthusiasm	75%	95%	+20%
Average Activity	**69.5%**	**89.5%**	**+20%**

The consistent 20% increase across all activity indicators can be theoretically justified through the integration of Deep Learning routines and gamification principles within the QuizWhizzer platform. According to (Marton, F., & Säljö, 1976), deep learning occurs when students are prompted to engage in reflective reasoning, justify answers, and relate concepts to real contexts and activities that were explicitly strengthened in Cycle II. Empirically, gamified digital quizzes have been shown to increase student participation and attention through challenge, competition, and real-time feedback (Deterding, S., Dixon, D., Khaled, R., & Nacke, 2011). These design elements create a low-anxiety, high-engagement environment that encourages students to ask more questions, collaborate actively, and respond with higher accuracy. Classroom observations recorded in both cycles support this theoretical basis: students demonstrated increased enthusiasm, more frequent peer interaction, and greater persistence when solving contextual questions. Therefore, the +20% improvement is not incidental but reflects a cumulative effect of strengthened deep learning processes, enhanced cognitive engagement, and the motivational impact of digital gamification.

The consistent improvements across indicators show that QuizWhizzer successfully fostered intrinsic motivation and encouraged students to participate more actively. The gamified format created a positive, non-threatening learning atmosphere that aligned with the characteristics of digital-native learners. These findings support earlier studies demonstrating that gamified learning environments significantly increase student motivation and engagement (Huang, K., Hew, K. F., & Lo, 2023) (Khofifah Indra Sukma, 2022). The real-time feedback and competitive elements in QuizWhizzer are consistent with the motivational principles outlined in digital gamification literature (Deterding, S., Dixon, D., Khaled, R., & Nacke, 2021).

Teacher Reflection and Perception

Teacher reflections indicated that the intervention improved classroom dynamics. QuizWhizzer allowed the teacher to monitor students' understanding in real time, provide immediate feedback, and facilitate discussion effectively. Teachers reported that students developed stronger curiosity, critical thinking, and peer collaboration features commonly associated with deep learning environments (Marton, F., & Säljö, 1976).

Improvement in Learning Outcomes

The results show a clear improvement in students' learning outcomes after the integration of Deep Learning principles with the QuizWhizzer platform. The class average increased from 68.4 (baseline) to 77.3 in Cycle I and further to 88.6 in Cycle II. Mastery learning also rose significantly from 43% to 93%. These improvements align with previous studies showing that deep learning strategies significantly enhance conceptual understanding and long-term retention by encouraging students to construct meaning through explanation, justification, and contextual reasoning (Putri, D. A., & Mulyadi, 2024). Several factors contributed to this improvement.

First, the gamified format of QuizWhizzer created a low-anxiety, interactive learning environment that has been widely reported to improve student attention, enjoyment, and persistence (Muhammad Yusuf Salam, 2022). Gamification studies indicate that digital quiz platforms through challenge, real-time feedback, and competitive visual elements increase students' cognitive engagement and stimulate more active processing of information (Aisyiah Al Adawiyah, 2023) (Nacional, 2024). Similar findings were reported by (Rahmaa Ayu Erwindah Kusuma, 2024), who found that digital quizzes improved learning outcomes in elementary science by supporting immediate correction of misconceptions (Patrícia Christine Silva, 2025). These mechanisms were clearly visible in Cycle II, where students improved accuracy after receiving instant feedback.

Second, the integration of contextual and HOTS-based questions aligns with research demonstrating that deep learning is strengthened when students are encouraged to analyze, evaluate, and apply concepts rather than simply recall factual information (Indunil Karunarathna, 2024). This approach promotes higher-quality cognitive engagement, which has been linked to significant gains in science learning (Muhibbuddin, 2023). In the present study, students showed increasing ability to explain the impact of weather changes using real-life examples, consistent with previous literature on contextual science learning in primary education.

Third, collaborative learning activities facilitated by QuizWhizzer resonate with Vygotsky's sociocultural theory (Saul McLeod, 2025), which posits that peer interaction enhances cognitive development through shared meaning-making (Ivo Retna Wardani, 2023). This is supported by studies showing that cooperative problem-solving and group-based gamified assessments lead to higher student performance and improved reasoning skills (Chaiyarat, 2024). During Cycle II, students worked more efficiently in determining answers, distributing roles, and verifying correctness, which contributed to higher achievement scores.

Finally, the findings are consistent with recent global literature indicating that digital gamification is particularly effective for Generation Alpha learners who respond better to interactive, visual, and competitive learning environments (Francis Thaise A. Cimene, 2024). These conditions help sustain attention and motivation, two variables strongly correlated with improved mastery learning in elementary science education. In this sense, the increase observed in this study is theoretically and empirically supported by a broad body of research. Taken together, the findings demonstrate that the combination of Deep Learning routines, gamification elements, contextual reasoning, and collaborative engagement effectively enhanced students' IPAS learning outcomes. Theoretical frameworks and empirical studies consistently support the mechanisms through which this improvement occurred.

Increased Engagement and Motivation

Student engagement and motivation improved significantly after the implementation of the Deep Learning based QuizWhizzer evaluation. Observational data show that activity indicators, questioning, collaboration, accuracy, and enthusiasm increased from an average of 69.5% in Cycle I to 89.5% in Cycle II. Students demonstrated greater curiosity, active participation in discussions, and higher confidence in expressing ideas. This improvement is closely related to the interactive nature of gamification, which encourages sustained attention and emotional involvement. Research indicates that gamified learning environments enhance intrinsic motivation by providing challenge, instant feedback, and a sense of progress (Deterding, S., Dixon, D., Khaled, R., & Nacke, 2021). The real-time movement of game tokens and the competitive yet enjoyable atmosphere helped students stay focused and energized throughout the learning process.

Deep Learning routines such as guided reflection, contextual reasoning, and collaborative meaning-making also played a role in increasing engagement. By prompting students to explain their reasoning and relate concepts to real-life situations, the learning experience became more meaningful, aligning with the mindful, meaningful, joyful learning framework. Group interaction strengthened motivation further, as peer collaboration fostered shared responsibility and supportive teamwork. Overall, the combination of gamified evaluation and deep learning strategies successfully transformed the classroom environment into one that was more dynamic, student-centered, and motivating. This finding reinforces earlier studies showing that digital gamification and reflective learning can significantly boost student engagement in elementary science learning.

Strengthening 21st-Century Skills

The integration of Deep Learning principles with the QuizWhizzer platform also contributed to the development of key 21st-century skills, particularly critical thinking, collaboration, communication, and creativity. Throughout the learning cycles, students demonstrated improved ability to analyze questions, justify their reasoning, and connect scientific concepts to real-world contexts. This shift reflects a movement from procedural understanding toward more conceptual and reflective thinking, which aligns with modern competency demands in science education. The collaborative nature of the QuizWhizzer activities encouraged students to work together, negotiate ideas, and make joint decisions during gameplay. Such interactions nurtured communication and teamwork abilities, consistent with (Saavedra, A. R., & Opfer, 2012) framework that emphasizes the importance of social learning experiences in building 4C competencies. Students also displayed creative approaches when interpreting contextual images and videos included in Cycle II tasks.

Furthermore, the immediate feedback provided by the digital platform supported the development of metacognitive awareness. Students were able to monitor their understanding, identify errors quickly, and adjust their strategies an essential component of self-regulated learning. Through these processes, learners gradually became more independent and reflective, characteristics central to 21st-century readiness. Overall, the findings indicate that combining Deep Learning routines with gamified digital evaluation fosters not only cognitive achievement but also the holistic skill set needed for future learning and daily life problem-solving.

Teacher as Facilitator in Deep Learning Implementation (Concise & Elegant Version)

The implementation of Deep Learning with QuizWhizzer required a clear shift in the teacher's role from being the primary source of information to functioning as a facilitator who guides students through reflective inquiry and collaborative meaning-making. Throughout the cycles, the teacher supported students in analyzing questions, justifying answers, and connecting concepts with real-life weather phenomena. This facilitative approach is consistent with Hattie's *Visible Learning* framework, which emphasizes that the most effective teachers actively scaffold student thinking and provide timely, actionable feedback (John Hattie, 2013). During the learning process, the teacher acted as a mediator who encouraged students to articulate their reasoning, negotiate understanding in groups, and evaluate the accuracy of their responses. This aligns with (Vygotsky, 1978) sociocultural theory, which highlights the central role of guided interaction and the Zone of Proximal Development (ZPD) in enhancing higher-order thinking. By asking reflective questions such as "Why do you think this answer is correct?" or "What evidence supports your explanation?", the teacher promoted deeper processing aligned with the principles of deep learning described by (Marton, F., & Säljö, 1976).

The shift in teacher role also contributed to improved classroom dynamics. Rather than focusing on delivering content, the teacher monitored group interactions, facilitated discussions, and ensured that each student had the opportunity to contribute. This approach supported students' development of metacognition, as they continuously evaluated their understanding during the game-based evaluation. According to Anderson & Krathwohl's (2001) revision of Bloom's taxonomy, such reflective engagement is essential for moving learners from lower-order to higher-order thinking. Overall, the findings indicate that the teacher's facilitative role was crucial in ensuring that gamified evaluation did not merely motivate students but also fostered meaningful learning. By guiding reflection, encouraging collaboration, and providing strategic feedback, the teacher successfully transformed the learning environment into a space where students could construct knowledge more independently and deeply.

Overall Effectiveness and Contribution of the Innovation (Concise & Elegant Version)

The overall findings indicate that the integration of Deep Learning principles with the QuizWhizzer gamified platform proved highly effective in improving student learning outcomes, engagement, and competency development in the IPAS classroom. The simultaneous increase in mastery learning, activity indicators, and reflective responses shows that the innovation worked consistently across cognitive, behavioral, and social dimensions of learning. This innovation's strength lies in its ability to combine meaningful cognitive challenge with an enjoyable learning atmosphere. By embedding HOTS questions, contextual visuals, and reflective prompts into the gamified evaluation, students were encouraged to think more deeply while still experiencing enjoyment and autonomy. This aligns with findings from recent gamification meta-analyses showing that well-designed digital game-based assessments can enhance both performance and motivation (Huang, K., Hew, K. F., & Lo, 2023).

From a pedagogical standpoint, the innovation contributes to strengthening the implementation of Deep Learning in elementary science education. The mindful, meaningful, joyful learning cycle was clearly reflected in students' increased ability to justify reasoning, relate concepts to real contexts, and maintain persistent engagement throughout the lessons. The systematic scaffolding provided by the teacher further ensured that students transitioned from surface to deeper forms of understanding, supporting the theory of learning progression described by and the higher-order thinking framework by Anderson & Krathwohl (2001). Additionally, the innovation contributes to strengthening 21st-century skill integration within Indonesian classrooms. Students demonstrated improved collaboration, communication, and critical reasoning skills identified by (Saavedra, A. R., & Opfer, 2012) as essential for modern scientific literacy. The design also supports the Merdeka Curriculum's emphasis on inquiry, autonomy, and digital fluency, illustrating a practical model that teachers can replicate across various subjects.

In sum, the Deep Learning QuizWhizzer model offers a promising assessment strategy that addresses common challenges in elementary IPAS learning: low engagement, limited conceptual understanding, and conventional evaluation practices. Its adaptability, ease of implementation, and positive impact on student behavior make it a viable innovation for broader classroom adoption and future development within digital-based learning frameworks.

Table 2.
Summary of Research Findings

Variable	Baseline	Cycle I	Cycle II	Improvement
Average Score	68.4	77.3	88.6	+20.2
Mastery Learning	43%	70%	93%	+50%
Student Activity	55%	69.5%	89.5%	+34.5%
Motivation Level	Low	Medium	High	

The findings confirm that integrating Deep Learning with QuizWhizzer improved cognitive outcomes, emotional engagement, and social learning dynamics.

Conclusion

The findings of this classroom action research indicate that the integration of Deep Learning principles with the QuizWhizzer gamified evaluation platform effectively improved students' learning outcomes, engagement, and conceptual understanding in the IPAS subject. Across two action cycles, the intervention consistently increased mastery learning, strengthened collaborative interaction, and stimulated more reflective and higher-order thinking. The learning environment became more interactive, meaningful, and enjoyable, supporting the characteristics of 21st-century learning and the goals of the Merdeka Curriculum. This study contributes to the growing body of research on Deep Learning and gamified digital assessment by providing empirical evidence that the systematic integration of HOTS-based tasks, reflective reasoning routines, and collaborative digital interaction can significantly enhance conceptual understanding in elementary science learning. While previous studies have examined either deep learning or digital gamification separately, this research demonstrates how both frameworks can be combined to create an assessment ecosystem that promotes mindful, meaningful, and joyful learning. The study also extends the literature on QuizWhizzer by showing its effectiveness not only for motivation and participation—as commonly reported—but also for strengthening conceptual mastery and reasoning accuracy.

Practically, this research offers a replicable model for teachers seeking to implement digital formative assessments aligned with the Merdeka Curriculum. The Deep Learning–QuizWhizzer model provides actionable strategies for designing reflective, contextual, and student-centered assessment tasks that encourage active engagement and immediate feedback. Teachers can use this approach to diagnose misconceptions more accurately, facilitate peer collaboration, and diversify evaluation methods beyond traditional written tests. Schools may also adopt this model to strengthen digital literacy, improve classroom dynamics, and support the implementation of technology-enhanced learning environments. Overall, the study highlights the potential of integrating Deep Learning routines with gamified digital platforms as an effective, scalable, and practical innovation for improving both cognitive and behavioral aspects of elementary IPAS learning. Future research could extend this model to other grade levels, subjects, and longer intervention periods to explore broader applicability and long-term learning impact.

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