



Problem Based Learning Model Assisted by Kahoot Media and its Role in Enhancing Student Learning Outcomes in Pancasila Education at Grade V Elementary School

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ABSTRACT

Purpose of the study: This study aims to examine the effect of the Problem Based Learning (PBL) model assisted by Kahoot media on the learning outcomes of Grade V elementary school students in Pancasila Education at Kecamatan Guguk, Kabupaten Lima Puluh Kota, West Sumatra.

Methodology: A quasi-experimental method was employed using a nonequivalent control group pretest-posttest design. The experimental group (n = 12) received PBL instruction integrated with Kahoot media across two learning sessions, while the control group (n = 15) underwent conventional instruction. Data were collected using a validated 15-item multiple-choice cognitive test and analyzed using the Liliefors normality test, Fisher homogeneity test, and independent samples t-test ($\alpha = 0.05$).

Main Findings: The experimental class achieved a posttest mean of 86.67 (gain = +28.89), significantly higher than the control class mean of 71.56 (gain = +17.34). The independent samples t-test yielded $t_{\text{hitung}} = 3.524 > t_{\text{tabel}} = 2.060$ (df = 25, $p = 0.002 < 0.05$), confirming that the PBL model assisted by Kahoot exerts a significant positive effect on student learning outcomes compared to conventional instruction.

Novelty/Originality of this study: This study offers a novel empirical contribution by integrating the PBL instructional model with the Kahoot gamification platform specifically within Pancasila Education at the elementary level in the Indonesian regional context of Lima Puluh Kota Regency. Unlike prior studies examining PBL or Kahoot independently, this research provides rigorous quasi-experimental evidence of their combined synergistic effect on student achievement.

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1. INTRODUCTION

The rapid advancement of science and technology has fundamentally transformed the landscape of education globally, necessitating a transition from conventional, teacher-centered pedagogical approaches toward more dynamic, student-centered learning models. In the contemporary context increasingly described as the era of Society 5.0, classrooms are expected to be spaces where critical thinking, collaborative competence, and deep conceptual understanding are cultivated through meaningful engagement rather than passive reception [1]. This imperative is especially salient in developing-nation contexts where the persistence of transmissive instructional models constrains the quality of learning outcomes.

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Digital technology integration into instructional practice has opened promising avenues for improving student engagement, motivation, and achievement. The shift from traditional to technology-enhanced learning presents both opportunities and challenges: while access to diverse information resources has expanded substantially, effective pedagogical application of digital tools demands teacher competence, infrastructural readiness, and a willingness to innovate [2]. The confluence of these technological developments with progressive curriculum reform such as Indonesia's Merdeka Curriculum places mounting pressure on elementary school teachers to adopt evidence-based, student-centered instructional models.

Pancasila Education (Pendidikan Pancasila) constitutes a mandatory subject across all levels of Indonesian education, from elementary school through higher education. This subject holds a strategic position in the national curriculum as it aims to cultivate students' knowledge, skills, and character in alignment with the foundational values of the Indonesian state [3]. Pancasila education aims to ensure that students develop positive morals and ethics. This learning process indirectly produces students with polite behavior and good character [4]. At the elementary school level, Pancasila Education serves not merely as a vehicle for transmitting civic knowledge but as a formative instrument for shaping students' attitudes toward tolerance, cultural diversity, and national unity, as reflected in the unifying principle of *Bhinneka Tunggal Ika* [5]. In elementary school civics (PKn) subjects, learning activities need to be conducted using creative methods to enhance students' understanding of civics concepts. This is crucial for positively impacting the learning process and the outcomes achieved by students, as well as their application [6]. The subject is therefore both cognitively and affectively significant, requiring instructional approaches that engage the whole learner.

Despite its significance, field observations conducted at four elementary schools in Kecamatan Guguk, Kabupaten Lima Puluh Kota namely UPTD SD Negeri 06, 03, 05, and 09 Tujuh Koto Talago — revealed persistent challenges in instructional quality. The teaching process in Pancasila Education remained predominantly teacher-centered, largely driven by lecture-based delivery with minimal variation in digital media. Students were rarely exposed to problem-based scenarios, group discussions were infrequent, and interactive digital platforms such as Kahoot had not been systematically implemented in any of the observed schools. Consequently, students demonstrated limited critical thinking skills, low learning engagement, and below-average learning outcomes in this subject.

These empirical observations align with broader concerns in the Indonesian educational literature regarding the persistence of passive, transmissive instructional models at the primary level. The challenge is particularly acute in regional contexts where teacher professional development in innovative pedagogies and digital literacy may be limited. Addressing this gap requires not only awareness of effective approaches but also empirical evidence of their feasibility and impact in locally relevant settings.

Problem Based Learning is a student-centered instructional model that uses authentic, real-world problems as the organizing stimulus for learning [7]. Emerging from medical education in the work of Barrows and Tamblyn and later systematized by Arends and others, PBL is grounded in constructivist learning theory, specifically Vygotsky's social constructivism, which posits that knowledge is actively constructed through social interaction and engagement with meaningful contexts rather than transmitted from teacher to student [8].

Problem-based learning is a teaching model where students are presented with real-life problems they encounter in their daily lives to start learning and find solutions. It is one of the innovative teaching approaches [9]. According to [10], PBL is a teaching method that challenges students to 'learn to learn' by actively seeking solutions to complex problems in real-world situations. Each student is required to develop their own knowledge gained from their surroundings through the construction process [11]. At its core, the PBL learning technique is an educational process that requires students to reflect on and solve problems that exist in the real world [12]. In PBL, students are confronted with an ill-structured problem at the outset of instruction; they must clarify the problem, identify knowledge gaps, gather and analyze information from multiple sources, and collaboratively construct solutions. This process develops not only subject-matter understanding but also higher-order thinking skills specifically analysis, evaluation, and creation in Bloom's Revised Taxonomy along with self-regulation, communication, and collaborative competencies that are central to 21st-century educational goals [13].

[14] notes that PBL challenges students to develop their understanding in order to solve problems effectively through various resolution methods. [15] emphasizes that PBL uses real-life problems as learning material to train and improve critical thinking and problem-solving ability. [16] identifies the primary characteristics of PBL as: problems serve as the starting point of learning; problems are typically ill-structured and drawn from real-world situations; the learning process requires multiple perspectives; students are actively engaged in finding solutions through critical and analytical thinking; and the approach promotes self-directed and collaborative learning while cultivating intrinsic interest. Together, these characteristics establish PBL as a model particularly well-suited to Pancasila Education, where values and civic competencies cannot be effectively developed through passive content reception alone.

Kahoot is a cloud-based game-based learning platform that enables educators to create interactive quizzes, surveys, and challenges in a competitive and engaging format. Developed in Norway and launched in 2013, Kahoot has achieved global adoption across educational contexts, with millions of active users across more

than 200 countries. The platform operates on a real-time competitive quiz model in which students use personal devices to respond to teacher-projected questions under time pressure, earning points for both accuracy and response speed. Kahoot focuses on a learning style that involves students being active during their studies. The advantage of this Kahoot is that it is an online quiz application that includes a competitive element among students because the results can be seen directly on the screen in the classroom [17].

From a theoretical standpoint, Kahoot's educational value is grounded in multiple converging frameworks. Self-Determination Theory developed by Deci and Ryan, identifies autonomy, competence, and relatedness as the three fundamental psychological needs that underlie intrinsic motivation. Kahoot's gamified structure addresses all three dimensions: students exercise agency in responding independently (autonomy), receive immediate performance feedback that builds perceived competence, and engage in shared competitive experiences that foster social connection and peer relatedness. These motivational mechanisms collectively sustain student engagement and promote deeper information processing [18].

Kahoot is a highly educational online platform offering a variety of features that can be used as a tool for teaching and learning [19]. Game-based learning theory further posits that the integration of game elements points, leaderboards, immediate feedback, and challenge progression into educational activities creates a state of cognitive flow characterized by high concentration and intrinsic enjoyment. Research has consistently shown that Kahoot integration increases student motivation, promotes active participation, and enhances learning outcomes. [18] established that Kahoot effectively increases student motivation and learning outcomes through its engaging interactive quiz format. [20] confirmed that Kahoot stimulates students' competitive spirit and develops critical thinking skills, ultimately yielding positive effects on academic achievement.

Beyond motivational effects, Kahoot functions as a powerful formative assessment tool by providing real-time, itemized feedback on student performance [21]. This enables teachers to diagnose conceptual gaps immediately, adjust subsequent instruction accordingly, and deliver targeted reinforcement capabilities that far exceed those of traditional paper-based evaluation methods. The platform's visual dashboard allows teachers to identify specific questions that proved most challenging and to address misconceptions within the same learning session [22].

A critical review of the existing literature reveals that most prior studies have examined either PBL or Kahoot independently, without integrating both approaches within a single empirical investigation particularly at the Grade V elementary level in the context of Pancasila Education. While [23] previously explored the Kahoot-PBL combination in Pancasila Education, the methodological rigor of their design and the regional specificity of the current study present distinct opportunities for novel contribution. The present study addresses this gap by conducting a rigorous quasi-experimental investigation to examine whether the integrated PBL-Kahoot model produces a significantly greater effect on student learning outcomes compared to conventional instruction, in the specific educational context of Kecamatan Guguak, Kabupaten Lima Puluh Kota, West Sumatra. Previous studies have independently demonstrated the efficacy of PBL in improving student learning outcomes across various elementary subjects and the motivational and cognitive benefits of Kahoot as a gamified assessment tool. However, no prior quasi-experimental study has rigorously examined the synergistic effect of combining both PBL and Kahoot specifically within Pancasila Education at the Grade V elementary level in the regional context of Kabupaten Lima Puluh Kota.

This constitutes the primary novelty of the present investigation. The urgency of this research is underscored by the persistent underperformance of students in Pancasila Education in this region, the documented absence of problem-based and technology-enhanced pedagogies in observed schools, and the imperative under the Merdeka Curriculum to adopt evidence-based, student-centered instructional models that promote deep, meaningful, and joyful learning. Specifically, this study aims to: (1) describe the baseline equivalence of the experimental and control groups prior to intervention; (2) analyze the differential learning gains of both groups following the treatment; (3) statistically confirm the significance of the treatment effect through inferential testing; and (4) discuss the theoretical and practical implications of the findings for elementary Pancasila Education in Indonesia.

2. RESEARCH METHOD

2.1 Research Design

This study employed a quasi-experimental research design with a nonequivalent control group pretest-posttest model [24]. This design was selected because the assignment of participants to groups could not be carried out through random assignment; rather, intact class groups were used, which is characteristic of school-based research settings. The nonequivalent design acknowledges this limitation while still enabling causal inference through the systematic comparison of pretest-matched groups under differential treatment conditions. The research was conducted at UPTD SD Negeri 06 Tujuh Koto Talago (experimental site) and UPTD SD Negeri 05 Tujuh

Koto Talago (control site), located in Kecamatan Guguak, Kabupaten Lima Puluh Kota, during the 2025/2026 academic year.

2.2 Population and Sample

The study population comprised all Grade V students across four elementary schools in the Kenagarian Tujuh Koto Talago area: UPTD SDN 06, SDN 03, SDN 05, and SDN 09 Tujuh Koto Talago. Prior to sample selection, population-level normality (Liliefors) and homogeneity (Fisher) tests were conducted to verify that the population data met the prerequisites for parametric analysis. Purposive sampling was subsequently applied based on considerations of baseline equivalence, accessibility, and research feasibility, resulting in 12 students assigned to the experimental group and 15 students to the control group. The purposive selection of these two schools was informed by the similarity of their socioeconomic contexts, student demographic profiles, and comparable academic backgrounds as evidenced by administrative records and pretest scores.

2.3 Instructional Procedures

The experimental group received instruction through the PBL model integrated with Kahoot media across two learning meetings ($2 \times 2 \times 40$ minutes). The PBL instructional framework followed five systematic phases informed by Arend's model.

- Phase 1, Problem Orientation: Students were guided to observe their classroom environment and peer interactions to identify instances of cultural diversity. Stimulus questions were presented, such as 'Why does Indonesian society possess such diverse cultural traditions?' and 'How should we respond to cultural differences within our community?' These provocative prompts activated prior knowledge and created cognitive disequilibrium that motivated further inquiry.
- Phase 2, Organizing Students for Learning: Heterogeneous groups of 3–4 students were formed to promote collaborative learning across ability levels. A video documentary about Indonesian cultural diversity was presented to provide shared contextual knowledge as a basis for subsequent investigation.
- Phase 3, Guided Investigation: Each group collaboratively identified and analyzed phenomena of cultural diversity using structured worksheets, video content, textbooks, and personal experience as information sources. The teacher circulated to facilitate discussion, pose Socratic questions, and redirect misconceptions without directly supplying answers.
- Phase 4, Product Development and Presentation: Groups collaboratively designed and performed brief role-play scenarios demonstrating respectful cross-cultural interaction, tolerance, and cooperative engagement. Performances were conducted in front of the full class and subjected to structured peer feedback.
- Phase 5 Reflective Evaluation: The teacher facilitated whole-class reflection on the learning process, guided students in synthesizing key conceptual understandings, and reinforced the significance of cultural unity as an expression of *Bhinneka Tunggal Ika*. A Kahoot quiz session was then administered using students' personal devices, covering the key concepts of the *Keberagaman dalam Kekuatan* (Diversity as Strength) topic. Quiz results were reviewed collectively, with targeted explanations provided for items that revealed widespread conceptual gaps.

The control group received conventional instruction across the same number of sessions, comprising teacher-led explanation, textbook reading, question-and-answer exchanges, and individual written assignments, without PBL phases or Kahoot integration.

2.4 Research Instrument

The research instrument comprised a 15-item multiple-choice cognitive test covering the topic of *Keberagaman dalam Kekuatan* (Diversity as Strength), aligned with Phase C learning achievement targets in the Merdeka Curriculum for Pancasila Education at Grade V. Items were constructed to assess cognitive levels ranging from remembering (C1) and understanding (C2) through applying (C3) and analyzing (C4), in accordance with Bloom's Revised Taxonomy.

The instrument underwent a four-stage validation procedure: (1) content validity using the product-moment correlation coefficient, with items declared valid when $r_{\text{hitung}} > r_{\text{tabel}}$; (2) reliability analysis using the Kuder-Richardson formula (KR-20) to assess overall instrument consistency; (3) discriminating power analysis to evaluate each item's ability to differentiate between high- and low-achieving students; and (4) item difficulty level analysis to ensure an appropriate distribution of easy, moderate, and difficult items. Only items satisfying all four criteria were retained in the final instrument.

2.5 Data Analysis

Quantitative data were analyzed through three sequential statistical procedures. First, the Liliefors normality test was applied to both pretest and posttest data for each group ($\alpha = 0.05$), with normality confirmed when $L\text{-hitung} < L\text{-tabel}$. Second, the Fisher homogeneity test was applied to verify equal variances between groups. Third, an independent samples t-test was conducted on the posttest scores to determine whether the difference in group means was statistically significant. The hypothesis tested was: H_0 (no significant difference between groups) versus H_1 (a significant difference exists), with H_1 accepted when $t\text{-hitung} > t\text{-tabel}$ or $p < 0.05$. Effect size was additionally estimated using Cohen's d to quantify the practical magnitude of the treatment effect.

3. RESULTS AND DISCUSSION

3.1 Pretest Results and Baseline Equivalence

Prior to the intervention, pretest scores were administered to both groups to establish baseline equivalence. Table 1 presents the descriptive statistics of the pretest scores for both groups.

Table 1. Descriptive Statistics of Pretest Scores

Group	N	Sum	Mean	Std. Deviation
Experimental (PBL + Kahoot)	12	693.3	57.78	14.59
Control (Conventional)	15	813.3	54.22	16.29

As shown in Table 1, the experimental group ($n = 12$) obtained a pretest mean of 57.78 ($SD = 14.59$), while the control group ($n = 15$) recorded a mean of 54.22 ($SD = 16.29$). The close proximity of the two means (difference = 3.56 points) indicates that both groups entered the study at comparable prior knowledge levels, which is a critical prerequisite for attributing any subsequent posttest differences to the treatment rather than to pre-existing achievement disparities.

3.2 Normality and Homogeneity Tests

Prior to hypothesis testing, normality and homogeneity assumptions were verified for both pretest and posttest datasets. Table 2 presents the Liliefors normality test results for the pretest data.

Table 2. Liliefors Normality Test Results (Pretest)

Group	N	L-hitung	L-tabel ($\alpha=0.05$)	Conclusion
Experimental	12	0.120	0.242	Normal
Control	15	0.144	0.220	Normal

Both pretest datasets satisfied the normality assumption. The Fisher homogeneity test on pretest data yielded $F\text{-hitung} = 0.802 < F\text{-tabel} = 2.739$, confirming homogeneous variances between the groups. Table 3 presents the normality test results for the posttest data.

Table 3. Liliefors Normality Test Results (Posttest)

Group	N	L-hitung	L-tabel ($\alpha=0.05$)	Conclusion
Experimental	12	0.165	0.242	Normal
Control	15	0.174	0.220	Normal

Both posttest datasets also satisfied normality ($L\text{-hitung} < L\text{-tabel}$). The Fisher homogeneity test on posttest data yielded $F\text{-hitung} = 1.401 < F\text{-tabel} = 2.739$, confirming equal variances. All statistical assumptions required for independent samples t-testing were therefore confirmed.

3.3 Posttest Results and Learning Gain

Following two treatment sessions, posttest scores were collected from both groups. Table 4 presents the comparative descriptive statistics of pretest and posttest means alongside the learning gain for each group.

Table 4. Comparison of Pretest, Posttest, and Learning Gain

Group	N	Pretest Mean	Posttest Mean	Learning Gain
Experimental (PBL + Kahoot)	12	57.78	86.67	+28.89
Control (Conventional)	15	54.22	71.56	+17.34
Difference	—	3.56	15.11	+11.55

The experimental group achieved a posttest mean of 86.67, reflecting a learning gain of 28.89 points — substantially higher than the control group's gain of 17.34 points (posttest mean = 71.56). The posttest mean difference between groups was 15.11 points, demonstrating a clearly superior outcome for students who received PBL instruction integrated with Kahoot. It is notable that all 12 students in the experimental group achieved posttest scores above 70 (the established mastery threshold), with the majority scoring in the 80–100 range. In contrast, several control group students remained below the mastery threshold, indicating incomplete conceptual attainment under conventional instruction.

3.4 Hypothesis Testing

With all statistical assumptions confirmed, an independent samples t-test was conducted. Results are presented in Table 5.

Table 5. Results of Independent Samples t-Test

Parameter	Value
t-hitung	3.524
t-tabel (df = 25, $\alpha = 0.05$)	2.060
Significance (p-value)	0.002
Cohen's d (effect size)	1.37 (Large)
Decision	H ₀ rejected; H ₁ accepted
Conclusion	Significant difference (p < 0.05)

The t-test yielded t-hitung = 3.524, which exceeds t-tabel = 2.060 at the 5% level of significance, with $p = 0.002 < 0.05$. H₀ was therefore rejected and H₁ accepted. The estimated Cohen's d of 1.37 indicates a large effect size, signifying that the treatment produced not merely a statistically significant but also practically meaningful improvement in student learning outcomes. This confirms that the PBL model assisted by Kahoot media exerts a statistically significant and practically substantial positive effect on the learning outcomes of Grade V elementary school students in Pancasila Education. The significantly superior learning outcomes achieved by the experimental group are consistent with the constructivist theoretical premises of PBL and with a broad body of empirical literature. The phase-by-phase analysis of the instructional process illuminates the specific mechanisms through which PBL produced these effects in the context of Pancasila Education.

In Phase 1, the use of stimulus questions 'Why does Indonesian society have such diverse cultural traditions?' and 'How should we respond to cultural differences?' created productive cognitive disequilibrium in students, activating prior schema while exposing knowledge gaps that motivated further inquiry. This aligns with Vygotsky's zone of proximal development concept: by presenting a problem slightly beyond students' current independent competence, instruction created a scaffold for growth achievable through guided engagement [8]. [13] specifically confirmed that PBL using real-world stimuli promotes critical thinking development in elementary students.

In Phase 3, the collaborative investigation process required students to consult multiple information sources video documentaries, textbooks, peer discussion, and personal experience mirroring the scientific reasoning processes valued in higher-order thinking frameworks. Students who had entered the study with the lowest pretest scores demonstrated the largest learning gains, suggesting that the PBL model was particularly effective in scaffolding students who had not mastered content through conventional prior instruction. This finding resonates with [9] observation that PBL is effective in developing higher-order thinking skills across ability levels. The Problem-Based Learning (PBL) model has the potential to impact student learning achievement in the classroom [25]. Problem-based learning has great potential to enhance students' abilities, improve their

communication skills, encourage teamwork, increase enthusiasm, and facilitate easier collaboration in overcoming challenges [26].

Phase 4, the role-play activity, provided what [27] describe as the defining advantage of PBL: helping students transfer knowledge to understand real-world problems. For Grade V students at the concrete operational developmental stage, enacting cultural diversity through simulated social interaction made abstract concepts tolerance, mutual respect, *Bhinneka Tunggal Ika* tangible, memorable, and personally meaningful. This experiential dimension of PBL is largely absent from conventional instruction and likely accounts for a significant portion of the experimental group's superior learning gains. [28] demonstrated comparable PBL effects in Pancasila and Citizenship Education, documenting improvement from 63% to 81% across two instructional cycles. [29] affirmed PBL's effectiveness in promoting active problem-solving and independent knowledge construction. The present study extends this evidence to a quasi-experimental design with explicit between-group comparison, providing stronger causal inference than action research or pre-experimental designs.

The integration of Kahoot as a gamified reinforcement and assessment tool in Phase 5 produced several complementary effects that amplified overall learning outcomes. First, the transition from collaborative role-play to competitive quiz activity created a natural shift in cognitive mode from construction to retrieval and application that consolidated prior learning through a mechanism consistent with the testing effect in cognitive psychology: the act of retrieving information from memory strengthens retention more effectively than passive review.

Second, Kahoot's real-time leaderboard and scoring system activated the motivational mechanisms predicted by Self-Determination Theory: students who correctly answered questions quickly experienced competence satisfaction; the shared competitive format fostered relatedness; and the independence of personal-device response preserved autonomy. The result was a classroom atmosphere described by observation records as 'highly dynamic and enthusiastic,' contrasting sharply with the subdued engagement observed in control class posttest sessions. [18] specifically documented Kahoot's effectiveness in increasing motivation and learning outcomes through engaging interactive quiz formats; [20] confirmed its effect on developing competitive learning spirit and critical thinking.

Third, Kahoot's itemized performance data provided immediate formative feedback to both students and the teacher. Students received instant knowledge of results, enabling self-regulation and targeted review of missed items. The teacher could identify which questions revealed the broadest conceptual gaps and provide on-the-spot remediation before closing the session a formative assessment cycle that paper-based testing structurally cannot replicate. This aligns with Hattie and Timperley's influential meta-analytic finding that feedback is among the most powerful influences on student achievement, with effect sizes substantially exceeding those of most other educational interventions [30].

The combined PBL-Kahoot model achieves what neither approach can fully provide independently. PBL supplies the structural scaffold for deep, collaborative, critical engagement with content across phases 1–4 of the lesson sequence, developing conceptual understanding, investigative competency, and civic values through authentic problem engagement. Kahoot supplies the motivationally rich, digitally mediated, and formatively informative culmination in phase 5, consolidating the day's learning through active retrieval, immediate feedback, and intrinsically motivating game dynamics.

[23] previously documented this combined effect in a Pancasila Education context, and the present study replicates and extends their finding through a more rigorous quasi-experimental design with explicit pretest-posttest control group comparison and individual-level data. The differential learning gain trajectory experimental: +28.89; control: +17.34; difference: +11.55 suggests that the PBL-Kahoot synergy produces approximately 11.55 additional points of learning gain per student compared to conventional instruction, a practically meaningful educational improvement given that the mastery threshold is 70 and the pretest mean was approximately 56. These results are further corroborated by [25], who found that PBL significantly improved learning outcomes in elementary school settings, and by [26], who demonstrated PBL's capacity to enhance critical thinking in science learning. The convergence of these prior findings with the present study's results strengthens the evidential base for PBL-Kahoot as an effective combined instructional approach in the Indonesian elementary context. The novelty of this study lies in its quasi-experimental rigor and its specific focus on integrating PBL with Kahoot within Pancasila Education at Grade V in Kabupaten Lima Puluh Kota a combination and context not previously investigated with this level of methodological control. In terms of practical implications, these findings suggest that school-level adoption of the PBL-Kahoot model can be achieved with minimal additional cost, given that Kahoot is freely available and PBL materials are curriculum-aligned. The primary investment required is structured teacher professional development in PBL facilitation and basic digital literacy. However, several limitations of this study must be acknowledged. First, the small sample sizes ($n = 12$ experimental; $n = 15$ control) limit the statistical power and generalizability of the findings. Second, the use of purposive sampling and intact class groups — necessitated by the school-based research context restricts causal attribution despite the quasi-experimental design. Third, only cognitive learning outcomes were measured; affective and psychomotor dimensions, which are also central to Pancasila Education, were not assessed. Fourth, the short intervention duration (two sessions) does not permit conclusions about long-term retention effects. Future research should

address these limitations through larger and more geographically diverse samples, random assignment designs where feasible, mixed-methods data collection, and longitudinal follow-up assessments.

The 100% mastery rate achieved in the experimental group versus 53.3% in the control group is perhaps the most practically significant finding of this study. In educational policy terms, a model that lifts all students to mastery including those entering with the lowest prior knowledge represents a qualitatively different type of instructional effectiveness than one that raises average performance while leaving a subgroup below threshold. This equity dimension of the PBL-Kahoot model warrants further investigation in larger, more diverse samples. These findings have direct practical implications for elementary education in Indonesia under the Merdeka Curriculum framework. The Merdeka Curriculum explicitly advocates for deep learning approaches characterized by mindful, meaningful, and joyful pedagogy precisely the principles operationalized in the PBL-Kahoot model implemented in this study. The experimental class lesson design was developed under this framework, incorporating a deep learning pedagogical approach that aligns PBL's investigative structure with digital media engagement. This alignment suggests that the PBL-Kahoot model is not merely an add-on innovation but is organically consistent with the trajectory of Indonesian curriculum reform.

For school principals and educational policymakers in Lima Puluh Kota Regency and beyond, these findings indicate that investment in teacher professional development for PBL implementation and basic digital infrastructure for Kahoot access (personal devices or school-provided devices such as Chromebooks, as already available at SDN 03) represents a high-return investment in student achievement quality. The model's scalability is noteworthy: Kahoot is free for basic use and accessible on any internet-connected device; PBL implementation requires no specialized materials beyond those already available in the curriculum. The primary investment required is teacher training in PBL facilitation and digital platform literacy.

4. CONCLUSION

This study concludes that the Problem Based Learning (PBL) model assisted by Kahoot media has a significant positive effect on the learning outcomes of Grade V elementary school students in Pancasila Education at Kecamatan Guguak, Kabupaten Lima Puluh Kota. The independent samples t-test yielded $t_{\text{hitung}} = 3.524 > t_{\text{tabel}} = 2.060$ ($df = 25$, $p = 0.002 < 0.05$), with a large effect size (Cohen's $d = 1.37$), confirming that the experimental group achieved substantially higher posttest scores (mean = 86.67; gain = +28.89) than the control group under conventional instruction (mean = 71.56; gain = +17.34). The PBL model contributed to this outcome by engaging students in authentic, collaborative problem-solving processes that developed critical thinking, conceptual depth, and civic values central to Pancasila Education. Kahoot augmented these effects through gamified, real-time reinforcement and formative assessment that sustained motivation, provided immediate diagnostic feedback, and elevated the emotional engagement of the learning experience. Their combination proved more effective than either component could reasonably achieve in isolation. For future research, it is recommended that the study be replicated with larger, more geographically diverse samples to enhance generalizability. Subsequent investigations should additionally measure affective and psychomotor learning outcome dimensions, explore the long-term retention effects of PBL-Kahoot instruction, and examine the model's applicability across other elementary subjects and grade levels. Longitudinal designs and mixed-methods approaches incorporating student and teacher perspectives would further enrich the evidence base for innovative instructional models in Indonesian elementary education.

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AUTHOR CONTRIBUTIONS

Conceptualization: N.P and D.; Methodology: N.P; Formal Analysis: N.P; Investigation: N.P; Writing – Original Draft Preparation: N.P; Writing – Review & Editing: D., R., and Z.; Supervision: D., R., and Z. All authors have read and agreed to the published version of the manuscript.

INFORMED CONSENT STATEMENT

Informed consent was obtained from all participants involved in this study. Participation was voluntary, and all participants were informed about the objectives and procedures of the research before providing their consent.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY

The authors used generative artificial intelligence (AI) solely to assist with language editing and improving the clarity of the manuscript. All content was reviewed, verified, and approved by the authors, who take full responsibility for the final version of the manuscript.

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