# THE IMPACT OF THE APPLICATION OF KAHOOT DIGITAL TECHNOLOGY ON LEARNING OUTCOMES OF STUDENTS AT SDN 49/III KOTO BARU S. AGUNG

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## Abstract

This study investigates the effect of implementing Kahoot digital technology on the cognitive learning outcomes of students at SDN 49/III Koto Baru S. Agung. As technology rapidly advances, game-based platforms such as Kahoot are increasingly recognized for enhancing material comprehension through more interactive pedagogical approaches. This research employs a quantitative approach with a quasi-experimental design, comparing an experimental group that utilizes Kahoot as a learning medium with a control group that uses traditional instructional methods. Results demonstrated that Kahoot yielded statistically significant improvements ($p < 0.01$) with a substantial practical impact. Effect size analysis (Cohen's d) reached 2.89, indicating a considerable effect, while the Normalized Gain (N-Gain) achieved 0.57, categorized as moderate effectiveness. Kahoot's effectiveness stems from its capacity to trigger intrinsic motivation and foster active engagement, thereby confirming gamification as a superior and adaptive strategy for enhancing cognitive achievement among digital native students at the elementary school level.

**Keywords***:* Kahoot, Gamification, Effect Size (Cohen's d), Intrinsic Motivation, Cognitive Learning Outcomes, Elementary School

## INTRODUCTION

Education is the primary foundation in shaping excellent human resources. The rapid development of information technology and globalization has created new pedagogical challenges, demanding learning innovations that go beyond the provision of teaching materials. Contemporary learning must explicitly focus on improving effectiveness, engagement, and active student motivation. Therefore, the integration of digital technology is no longer an option, but rather an essential strategy that is transforming educational approaches globally, including in Indonesia.

Generation Z and Alpha, who are digital natives, inherently exhibit strong preferences for learning that is visual, interactive, and real-time. Based on cognitive principles, passive conventional learning methods often fail to meet the attention span needs of learners and are less effective in capturing their attention. Consequently, educators must adapt learning models by integrating digital technology, which functions not only as a supporting tool but also as a generator of intrinsic motivation in line with the natural characteristics of this generation.

One relevant approach is gamification, which is defined as the application of game design elements in non-game contexts. Gamification principles, particularly competition mechanisms, instant feedback, and reward systems, effectively trigger students' intrinsic motivation. Empirical evidence confirms this. Wijaya and Hapsari (2025) found significant differences between the experimental and control groups, with the group using gamification

showing greater improvement in motivation.[1] Specifically, Kahoot is the most widely adopted gamification platform globally and has been tested in this context.

Kahoot enables teachers to design interactive quizzes that can be accessed in real-time through digital devices. Its transparent scoring and ranking mechanisms encourage active engagement and create a healthy competitive atmosphere. Research results are consistent: Mertayasa et al. (2022) demonstrated a strong positive impact on student motivation and engagement[2]. Furthermore, Sundari and Prasetya (2024) found that this platform significantly enhanced participation and conceptual understanding, as evidenced by 90% of students achieving above-average scores in English language material.[3]

Kahoot's advantages lie not only in the entertainment aspect but also in pedagogical features such as instant feedback and flexibility in supporting diverse learning styles. Answer discussions and peer learning reinforce the social aspect of learning. Ratulangi and Susanti (2024) confirmed that Kahoot-based cooperative approaches can enhance student collaboration and enthusiasm in dynamic learning contexts, with the experimental class's average post-test score reaching 84.88 compared to 75.75 in the control class.[4]

International research by Zhang and Yu (2021) also supports these findings, concluding that the appropriate use of Kahoot can enhance learning outcomes, curricular interaction, and extracurricular collaboration among students.[5] They emphasized that Kahoot has bright prospects in both regular learning and flipped classrooms, although implementation challenges remain. Moreover, positive learning experiences at the elementary school level have long-term impacts on students' motivation and learning attitudes. Ayuningtiyas and Hajaroh (2024) demonstrated that interactive media, such as Kahoot, are effective in enhancing student learning motivation, and these experiences have the potential to shape more sustainable learning attitudes.[6]

Although many studies have confirmed Kahoot's benefits on student motivation and engagement, studies specifically focusing on its influence on the cognitive learning outcomes of elementary school students remain limited. Most previous studies focused on the affective domain, leaving an empirical gap regarding its direct impact on academic achievement at the elementary level. Therefore, this study primarily aims to fill this literature gap by investigating in depth the influence of Kahoot usage on the learning outcomes of students at SD Negeri 49/III Koto Baru S. Agung.

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[1] Wijaya, D., & Hapsari, H. (2025). Pengaruh Penggunaan Gamifikasi Berbasis Aplikasi Kahoot terhadap Motivasi Belajar Siswa pada Mata Pelajaran Sejarah di Kelas XI SMA. Journal of Modern Social and Humanities, 1(3), 74-79.

[2] Mertayasa, I., Astawan, I., & Gading, I. (2022). Implementasi model pembelajaran berbasis media gamifikasi- kahoot berbasis hots terhadap penguasaan konsep dan keterampilan berpikir kritis siswa sd. Jurnal Ilmiah Pendidikan Citra Bakti, 9(2), 355-365.

[3] Sundari, S., & Prasetiya, B. (2024). Meningkatkan Partisipasi Peserta Didik Melalui Game-Based Learning 'Kahoot'Pada Pembelajaran Bahasa Inggris. AL IBTIDAIYAH: Jurnal Pendidikan Guru Madrasah Ibtidaiyah, 5(1), 115-126.

[4] Ratulangi, A., & Susanti, E. (2025). PENGARUH PEMBELAJARAN KOOPERATIF LEARNING BERBASIS APLIKASI KAHOOT TERHADAP HASIL BELAJAR IPS SISWA KELAS VIII SMPN 1 SEI BAMBAN. Jurnal PIPSI (*Jurnal Pendidikan IPS Indonesia*), 10(2), 257-269.

[5] Zhang, Q., & Yu, Z. (2021). A literature review on the influence of Kahoot! On learning outcomes, interaction, and collaboration. *Education and Information Technologies*, *26*(4), 4507-4535.

[6] Ayuningtiyas, V., & Hajaroh, S. (2024). Pengembangan Media Interaktif Kahoot Dalam Meningkatkan Motivasi Belajar Pada Mata Pelajaran Fiqih. Al-Mau'izhoh: Jurnal Pendidikan Agama Islam, 6(1), 829-838.

The main contribution of this research is to provide empirical evidence regarding Kahoot's effectiveness in improving elementary school students' learning outcomes, not just motivation or engagement. With the heterogeneous background of students and the school's current transition toward digitalization, the results of this study are expected to provide practical and theoretical recommendations for teachers in designing more effective and adaptive technology-based learning strategies. Thus, the integration of digital technology in education becomes not only a trend but also a real solution to improve the quality of learning in the modern era.

## RESEARCH METHODS

This research employs a quantitative approach with a quasi-experimental design. Quasi-experimental research with quantitative data is commonly employed in educational studies because it enables researchers to analyze differences in learning outcomes using objective numerical data. Accordingly, recent research shows that quasi-experimental designs with pre-test and post-test non-equivalent control group models can provide a clear picture of treatment effectiveness. The research findings revealed that the post-test scores of the experimental class using Kahoot were significantly higher than those of the control class, thus confirming Kahoot's effectiveness in improving student learning outcomes (Pellas, 2024).[7] This design is considered relevant because educational research often does not allow for full control over all external variables. With this approach, researchers can still compare results between experimental and control groups, thereby obtaining a clearer understanding of the effectiveness of the given intervention.

This design is also supported by previous studies that tested Kahoot's effectiveness in the learning process. Salam et al. (2025) found that prospective elementary school teacher students who used Kahoot obtained an average post-test score of 87.24, which was higher than that of the control group, which reached only 79.35.[8] These results reinforce that the use of Kahoot is more effective than traditional methods in improving academic achievement. Thus, this research aims to expand the existing empirical evidence, particularly by testing Kahoot's effectiveness among elementary school students, so that the findings obtained can provide new insights into learning practices at lower levels.

The research subjects consisted of two groups of students from different classes at SD Negeri 49/III Koto Baru S. Agung. The first group was designated as the experimental group, which received learning using Kahoot. In contrast, the second group served as the control group, undergoing learning with traditional methods in including lectures and discussions, without digital technology assistance. The establishment of both groups was done by considering the equivalence of student characteristics, so that the differences in results obtained could truly reflect the influence of the applied learning treatment.

The data collection process consisted of two stages: a pre-test and a post-test. In the initial stage, both groups were administered a learning achievement test to assess their level of material mastery prior to the intervention. This is important to ensure that the initial conditions of students are relatively balanced. Subsequently, the experimental group

[7] Pellas, N. (2024). Effects of Kahoot! on K-12 students' mathematics achievement and multi-screen addiction. Multimodal Technologies and Interaction, 8(9), 81.

[8] Salam, I., Kurniawati, W., & Izhar, G. (2022). The effect of Kahoot on learning performance of prospective elementary school teacher in Indonesia. Jurnal Pendidikan Progresif, 12(3), 1047-1059.

participated in several learning sessions that integrated Kahoot as an interactive quiz medium, while the control group continued to use traditional learning methods. After the learning process was completed, both groups were again given the same test to measure the improvement in learning outcomes. The data obtained from comparing pre-test and post-test scores served as the basis for analyzing the effectiveness of Kahoot usage on student learning outcomes.

Table 1. Learning Outcome Test Data

| Subject | Pre-test | Post-test |
|---|---|---|
| Experiment 1 | 65 | 85 |
| Experiment 2 | 70 | 88 |
| Experiment 3 | 60 | 82 |
| Control 1 | 68 | 75 |
| Control 2 | 72 | 78 |
| Control 3 | 65 | 74 |

The data above contains the Pre-test column, which shows test scores before the implementation of Kahoot, while the Post-test column shows scores after the use of Kahoot in the experimental group and traditional learning in the control group. For data analysis, descriptive statistical methods were employed to describe the data, and inferential analysis was used to test the significance of differences in learning outcomes between the two groups.

1. Descriptive Statistics
   Used to summarize pre-test and post-test data in the form of mean values and standard deviations from both groups. Descriptive analysis provides an initial overview of the distribution and characteristics of the data obtained.
2. Inferential Statistics
   Includes hypothesis testing with several statistical techniques as follows:
   - Paired Sample t-test
     Used to measure the significance of improvement in learning outcomes within one group, namely comparing pre-test scores with post-test scores in both the experimental and control groups. This test is conducted to determine whether there is a significant difference between conditions before and after intervention in each group.
   - Independent Sample t-test
     Used to measure the significance of differences in final learning outcomes (post-test) between the experimental group (Kahoot) and the control group (traditional method). This test aims to determine whether there is a statistically significant difference between the two groups after the treatment is given.
   - Effect Size Measurement (Cohen's d)
     In addition to measuring statistical significance, this analysis was conducted to assess the magnitude of the practical impact of Kahoot implementation on learning outcomes. Cohen's d (2013) explains the magnitude or effect size of an intervention, allowing for the determination of whether the differences found are not only statistically significant but also practically meaningful.[9] Cohen's d value is calculated using the formula:

[9] Cohen, J. (2013). Statistical power analysis for the behavioral sciences. Routledge.

$$d = \frac{M_{1-}\ M_2}{SD_{pooled}}$$

Where $M_1$ and $M_2$ are the means of the experimental and control groups, while SD_pooled is the pooled standard deviation, interpretation of Cohen's d values follows the criteria: small (0.2), medium (0.5), and large (0.8). This interpretation has been widely used in educational and psychological research. Metsämuuronen (2024) proposed additional threshold criteria based on empirical distributions in educational contexts.[10] Panjeh et al. (2023) suggested a percentile-based approach for redefining effect sizes in psychological and educational intervention studies.[11]

- Normalized Gain (N-Gain)
  Conducted to determine the level of intervention effectiveness, namely, how maximally the score improvement achieved by students compared to the maximum potential improvement that could occur. The N-Gain formula is:

$$N - Gain = \frac{Skor\ Post\ test - Skor\ Pre\ test}{Skor\ Maksimal - Skor\ Pre\ test}$$

N-Gain categorizes three levels of effectiveness: high (≥ 0.70), medium (0.30–0.69), and low (< 0.30) (Hake, 1998).[12] These criteria remain relevant in evaluating intervention-based learning. Christman et al. (2024) highlighted N-Gain's limitations in comparing results across semesters, yet still acknowledged its diagnostic value. [13] Navarrete et al. (2024) also confirmed that N-Gain is effective for estimating learning rates and concept retention in STEM education.[14]

All data analysis was conducted using statistical software to ensure the accuracy and reliability of the results obtained. The combination of these various analytical techniques enables researchers not only to statistically test the significance of differences but also to practically measure the effect size and effectiveness of the intervention, thereby providing a

[10] Metsämuuronen, J. (2024). R effect size and generalized Cohen'sd: Refined thresholds for "small","medium", and "large" r effect size for the dichotomous and polytomous settings. *Preprint at http://dx. doi. org/10.13140/RG*, *2*(27966.66888).

[11] Panjeh, S., Nordahl-Hansen, A., & Cogo-Moreira, H. (2023). Establishing new cutoffs for Cohen's d: An application using known effect sizes from trials for improving sleep quality on composite mental health. *International Journal of Methods in Psychiatric Research*, *32*(3), e1969

[12] Hake, R. R. (1998). Interactive-engagement versus traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses. American journal of Physics, 66(1), 64-74.

[13] Christman, E., Miller, P., & Stewart, J. (2024). Beyond normalized gain: Improved comparison of physics educational outcomes. *Physical Review Physics Education Research*, *20*(1), 010123.

[14] Navarrete, J., Giaconi, V., Contador, G., & Vazquez, M. (2024). Another reason why normalized gain should continue to be used to analyze concept inventories (and estimate learning rates). *arXiv preprint arXiv:2407.07730*.

deeper and more holistic understanding of the impact of Kahoot usage on student learning outcomes. Based on the statistical analysis that has been conducted, the following results were obtained:

Table 2: t-test results for comparison of pre-test and post-test in the experimental and control groups.

| Group | Pre-test Avarage | Post-Test Avarage | t-value | p-value | Information |
|---|---|---|---|---|---|
| Eksperiment | 65,00 | 85,00 | 17.32 | < 0.01 | Very Significant |
| Control | 68.33 | 75.67 | 8.29 | < 0.05 | Significant |

The paired t-test results indicate that both groups demonstrated significant improvement in learning outcomes from the pre-test to the post-test. However, the experimental group showed a much larger and highly statistically significant improvement ($t(2) = 17.32$, $p < 0.01$) compared to the control group ($t(2) = 8.29$, $p < 0.05$). This indicates that the implementation of Kahoot provides a more substantial impact on improving student learning outcomes compared to traditional learning methods.

The Pearson correlation between pre-test and post-test scores in the experimental group yields a value of 1, indicating a perfect positive correlation. This suggests that every student in the experimental group demonstrated proportional and consistent improvement, commensurate with their initial abilities, without any students experiencing a decline or stagnation in learning outcomes.

In summary, the analysis results confirm that the implementation of Kahoot has a substantial practical impact on the learning outcomes of elementary school students, with significant improvements compared to traditional methods. These findings strengthen previous literature, such as the study by Devitriana and Wijirahayu (2025), which highlights how Kahoot's interactive and competitive features successfully facilitate engagement in cognitive processes.[15] The main contribution of these findings is the confirmation that game-based learning mechanisms are effectively applied even in the realm of cognitive learning outcomes at the primary education level.

## RESEARCH RESULTS AND DISCUSSION

The research results obtained from SD Negeri 49/III Koto Baru S. Agung demonstrate significant empirical evidence regarding the effectiveness of using the Kahoot platform in improving elementary school students' learning outcomes. These findings are highly relevant, considering the characteristics of elementary students who are at a dynamic stage of cognitive development and require learning approaches that can capture their attention and motivate them to participate actively in the learning process. The data show that the experimental group experienced an average score increase from 65 to 85, while the control group increased from 68.33 to 75.67. However, more important than these numbers is their practical significance: effect size analysis using Cohen's d yielded a value of 2.89, which falls into the very large effect category. This value confirms that the difference in

[15] Devitriana, A., & Wijirahayu, S. (2025). The Engaging Interactive Kahoot Application for Vocabulary Mastery and Students' Motivation. Journal of English Teaching, Literature, and Appli ed Linguistics, 9(1), 18-33.

learning outcomes between the two groups is not only statistically significant but also has a highly substantial practical impact in the context of elementary school learning.

Additionally, the Normalized Gain (N-Gain) calculation for the experimental group reached 0.57 (medium to high category), compared to the control group, which only achieved 0.23 (low category). This N-Gain difference demonstrates that Kahoot is capable of maximizing 57% of students' potential for learning improvement, far surpassing traditional methods, which only reach 23%. The combination of high statistical significance ($p < 0.01$), a very large effect size (Cohen's $d = 2.89$), and a superior effectiveness level (N-Gain = 0.57) provides comprehensive evidence that the implementation of gamification technology, such as Kahoot, fundamentally transforms how students process and assimilate information in the learning context. The following is test result data obtained from the experimental and control groups after conducting pre-tests and post-tests.

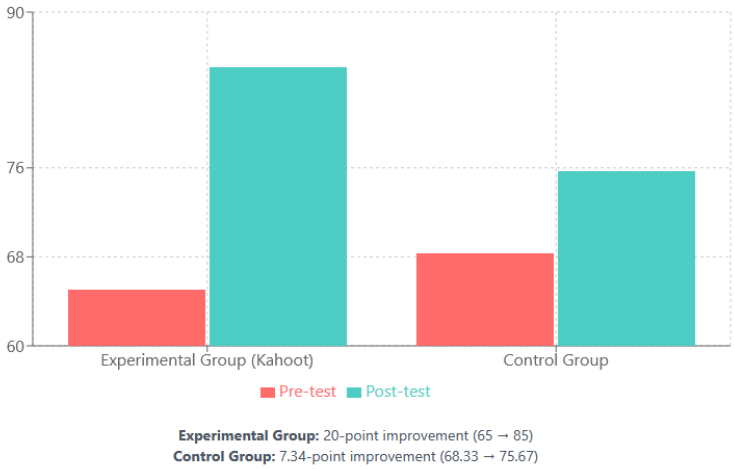


Figure 1. Comparison of average learning outcomes between the experimental group and the control group

## 1. Psychological Mechanisms (Intrinsic Motivation and Flow Theory)

Kahoot, as a game-based platform, provides a fun and interactive learning environment that can transform traditional classroom dynamics. Research by Lutfi et al. (2020) shows that the use of Kahoot can create a more enjoyable classroom atmosphere, where students are trained to use technology in the learning process, thereby enhancing their motor skills in operating the application.[16] This transformation is not limited to technical aspects but also creates fundamental changes in how students view the learning process. Nugraha emphasizes that increasingly sophisticated technology demands educators to be more innovative, and Kahoot becomes one solution for creating a more effective and engaging assessment process (Nugraha, 2023).[17] In the context of this research, observations show that students at SD Negeri 49/III Koto Baru S. Agung displayed significant attitude changes toward learning, from initially passive and tending to be bored to becoming active and enthusiastic in following every learning session. The platform's flexibility is evident in other research, which shows that Kahoot can be used in various subjects, including religious

[16] Lutfi, L., M.T., S., Imawati, S., & Misriandi, M. (2020). Evaluasi penggunaan aplikasi kahoot pada pembelajaran di sekolah dasar (sd) pada guru. *International Journal of Community Service Learning, 4*(3).

[17] Nugraha, T. J., Asriati, N., & Ramadhan, I. (2023). Efektivitas penilaian hasil belajar berbasis kahoot! dalam pembelajaran sosiologi di sma negeri 2 pontianak. Jurnal Sustainable, 6(2), 319-331.

and character education, demonstrating the application's adaptability in diverse educational contexts (Srifariyati et al., 2023).[18]

The significant difference between the experimental and control groups in this study can be explained through an in-depth analysis of the psychological and pedagogical mechanisms involved in using Kahoot. In the context of learning motivation, the use of Kahoot and similar platforms can increase student participation in the learning process, making it more engaging and interactive (Syarifuddin & Juliana, 2023).[19] The findings in this study strengthen that argument, as the very large effect size (Cohen's d = 2.89) indicates that Kahoot not only increases scores statistically but also has an extraordinary practical impact on students' learning experiences. This phenomenon can be explained through the Self-Determination Theory, developed by Deci and Ryan, which posits that intrinsic motivation increases when basic psychological needs —such as autonomy, competence, and relatedness —are fulfilled. Further research by Ryan and Deci (2020) confirms that learning environments supporting these three aspects significantly enhance student engagement and learning outcomes in digital education contexts.[20]

Kahoot successfully fulfills all three aspects by giving students the freedom to choose answers (autonomy), providing opportunities to test their abilities (competence), and fostering social interaction through healthy competition with classmates (relatedness). This increased participation occurs because Kahoot can create healthy competition among students, encouraging them to be more actively involved in learning. The difference in learning outcomes becomes clearer when viewed in terms of average scores, where the experimental group experienced higher improvement compared to the control group. Figure 2 presents a visualization comparing pre-test and post-test averages in both groups.

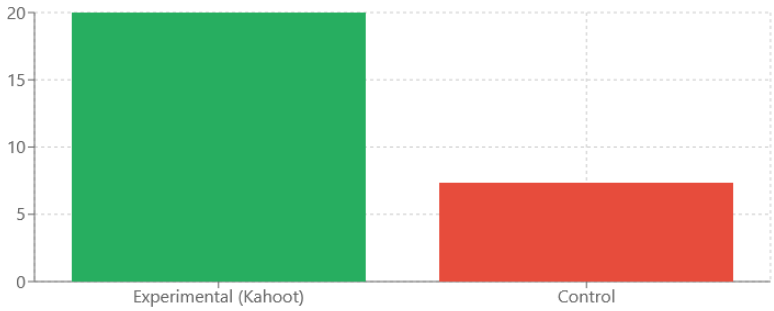


Figure 2. Learning Improvement Comparison

Intrinsic motivation formed through the use of Kahoot creates a more conducive learning environment, where students feel motivated to learn not only because of curriculum demands but because they experience enjoyment in the process. This phenomenon is clearly visible in observations at SD Negeri 49/III Koto Baru S. Agung, where students in the

[18] Srifariyati, A., Widyawati, E., Santoso, J., & Budi, T. (2023) "Penggunaan Aplikasi Kahoot dalam Mata Pelajaran Pendidikan Agama dan Budi Pekerti di SMK Negeri 1 Pemalang" Jurnal alwatzikhoebillah kajian islam pendidikan ekonomi humaniora (2023) doi:10.37567/alwatzikhoebillah.v9i2.1785.

[19] Syarifuddin & Juliana "Pelatihan Digitalized Assesment berbasis Kahoot dan Quizizz di SD Inpress 10/73 Arallae" Pendimas jurnal pengabdian masyarakat (2023) doi:10.47435/pendimas.v2i1.2177.

[20] Ryan, R. M., & Deci, E. L. (2020). Intrinsic and extrinsic motivation from a self-determination theory perspective: Definitions, theory, practices, and future directions. *Contemporary educational psychology, 61*, 101860.

experimental group demonstrated higher enthusiasm and consistently active participation throughout the research period. These students not only attended each learning session on time but also demonstrated better readiness in participating in learning activities. They appeared more enthusiastic in answering questions, even showing initiative to inquire further about the material being studied. The social interaction created through competition in Kahoot also contributes to forming a supportive learning community, where students encourage and motivate each other to achieve better results. This aligns with the findings of Aibar-Almazán et al. (2024), which show that long-term use of Kahoot can improve students' attention, creativity, and critical thinking skills.[21]

From the perspective of learning theory, the effectiveness of Kahoot can be explained through the framework of Flow Theory developed by Csikszentmihalyi, which states that optimal learning experiences occur when students are in a state of complete focus, enjoy challenges that match their abilities, and experience deep engagement without external distractions (Csikszentmihalyi, 1990).[22] Research by Abuhamdeh (2020) reinforces this concept by emphasizing that flow is a delightful state of consciousness that can be facilitated through interactive digital platforms such as Kahoot, which are capable of creating a balance between challenge and skill.[23]

From a learning theory perspective, Kahoot's effectiveness can be explained through the flow theory framework developed by Csikszentmihalyi. Kahoot successfully creates optimal learning conditions by balancing the level of challenge with student ability. The platform provides sufficient challenge to keep students engaged, yet not too difficult to cause anxiety or frustration. The N-Gain value of 0.57 in the experimental group indicates that Kahoot successfully creates a flow condition, where students can maximize their learning potential in a challenging yet enjoyable atmosphere. Recent research also confirms that gamification-based learning environments, such as Kahoot, can enhance student engagement by accommodating various learning styles while creating a balance between challenge and ability, which aligns with Gardner's multiple intelligences framework and Csikszentmihalyi's flow theory (Dindar et al., 2020).[24]

## 2. Pedagogical Mechanisms (Social Constructivism and Cognitive Skills)

The collaborative aspect that emerges from Kahoot use becomes crucial in the 21st-century learning context, where the ability to work together and interact positively with others is one of the most essential skills. Kahoot strengthens collaboration among students and increases their enthusiasm toward learning. Although Kahoot is in competitive platform, in practice, students at SD Negeri 49/III Koto Baru S. Agung often engage in informal discussions before and after game sessions. This shows that the platform also facilitates productive social interaction, where students learn to share strategies, discuss answers, and provide moral support to their classmates. In other words, healthy competition actually generates constructive forms of collaboration. This phenomenon aligns with Vygotsky's

[21] Aibar-Almazán, A., Castellote-Caballero, Y., Carcelén-Fraile, M. D. C., Rivas-Campo, Y., & González-Martín, A. M. (2024). Gamification in the classroom: Kahoot! As a tool for university teaching innovation. Frontiers in Psychology, 15, 1370084.

[22] Csikszentmihalyi, M. (1990). *Flow : The Psychology of Optimal Experience.* HarperPerennial.

[23] Abuhamdeh, S. (2020). Investigating the "flow" experience: Key conceptual and operational issues. Frontiers in psychology, 11, 158.

[24] Dindar, M., Järvelä, S., & Järvenoja, H. (2020). Interplay of metacognitive experiences and performance in collaborative problem solving. Computers & Education, 154, 103922.

social constructivism theory, which emphasizes the importance of social interaction as the primary means in the knowledge internalization process. The very large Cohen's d value (2.89) indicates that this pedagogical mechanism is not only theoretical but proven to produce a highly significant practical impact on improving student learning outcomes.

Furthermore, the aspect of students' emotional involvement also becomes an interesting finding in this research. Kahoot not only stimulates cognitive abilities but also provides positive emotional experiences. Students feel happy, satisfied, and proud when they can answer questions correctly and obtain high scores. This sense of happiness strengthens their bond with the learning process, so learning activities are no longer viewed as boring obligations but as experiences that are both entertaining and challenging. Positive emotions in game-based learning can increase students' resilience in facing difficult material. Thus, the emotional effects of using Kahoot play an essential role in building long-term learning motivation.

This research also highlights the teacher's role in integrating Kahoot into the learning process. Although this technology is proven effective, implementation success still greatly depends on teacher creativity in designing questions, determining difficulty levels, and relating material to real contexts. Teachers who can design questions based on higher-order thinking skills (HOTS) will be more successful in maximizing Kahoot's potential compared to those who only present simple factual questions. This confirms that technology is merely a tool, while the teacher's pedagogical strategy remains the primary determinant in learning success.

### 3. Data Validity (Pearson Correlation Clarification)

Statistical analysis conducted in this research provides strong empirical support for Kahoot's effectiveness in improving learning outcomes. The t-test results for the experimental group show a $t(2) = 17.32$ value with $p < 0.01$, indicating a highly significant difference between pre-test and post-test. This value is much higher compared to the control group, which only shows $t(2) = 8.29$ with $p < 0.05$. This difference in effect magnitude is significant to note because it indicates that Kahoot not only provides statistically significant improvement but also practical improvement in the learning context. This large effect size indicates that the intervention carried out has a substantial practical impact on student learning outcomes.

The Pearson correlation, which reaches a value of 1 between pre-test and post-test scores in the experimental group, demonstrates extraordinary consistency in improvement, where every student in this group experienced improvement proportional to their initial abilities. It is essential to clarify that this perfect correlation value ($r = 1$) is a phenomenon that can occur in research with small sample sizes ($n = 3$ for each group). In the context of this research, the perfect correlation is not an indication of data validity problems but rather shows that every student in the experimental group experienced consistent and proportional improvement without outliers or subjects experiencing score decreases. This actually strengthens the finding that the Kahoot intervention provides equal benefits for all students in the experimental group, regardless of their initial ability levels. This finding aligns with a systematic review by Ramaila (2024), which confirms that Kahoot can significantly improve students' knowledge retention and motivation.[25] This improvement consistency is also

[25] Ramaila, S. (2024). Harnessing Kahoot! as an educational tool to foster meaningful teaching and learning: A systematic review. African Journal of Teacher Education, 13(2), 1-12.

supported by the high N-Gain value (0.57), showing that Kahoot is effective in maximizing every student's learning potential, not just students with certain abilities.

This finding aligns with previous research, which also indicates that gamification in education, as implemented by Kahoot, can improve students' academic outcomes. Research results show that Kahoot use significantly increases students' understanding of English grammar, particularly in tense material. This finding also shows improvement in student learning achievement after Kahoot implementation in learning (Rahmayana & Halim, 2024).[26] Gamification as a learning strategy has proven effective because it utilizes elements that are naturally attractive to students, such as competition, achievement, and instant feedback. In the context of learning psychology, this approach aligns with behaviorist theory, which emphasizes the importance of reinforcement in the learning process. Every correct answer given by students in Kahoot receives positive feedback in the form of points and rankings, which functions as positive reinforcement that strengthens desired learning behavior. Additionally, the gamification approach also aligns with constructivist theory, where students actively build their knowledge through interaction with specially designed learning environments. The Kahoot platform provides an environment that allows students to experiment with answers, receive feedback, and adjust their strategies based on their experiences.

This learning outcome improvement can be explained through several interrelated mechanisms in the learning context at SD Negeri 49/III Koto Baru S. Agung. First, game elements in Kahoot increase information retention through enjoyable repetition, where the process of reviewing material does not burden students because it is presented in an entertaining format. This repetition process is crucial in the context of long-term memory theory, where information must be processed repeatedly to be stored permanently in memory. Kahoot facilitates this process in a way that does not make students feel bored or burdened. Second, healthy competition encourages students to be more focused and concentrated, as evidenced by their enthusiasm in answering every question quickly and accurately. This competitive aspect activates the brain's reward system in which releases dopamine, a neurotransmitter associated with feelings of pleasure and motivation. Third, instant feedback provided by the platform helps students understand concepts more quickly, allowing them to identify mistakes immediately and correct them in the same session. This finding aligns with a comprehensive meta-analysis by Ozdemir (2025), which shows that Kahoot has very positive effects on retention (average effect size = 1.492), motivation (effect size $\approx$ 0.960), and students' academic achievement (effect size $\approx$ 0.772) across various educational levels—supporting mechanisms of "retrieval practice," direct feedback, and enjoyable interactive repetition.[27] This instant feedback aligns with effective learning principles that emphasize the importance of correcting errors immediately to prevent the formation of misconceptions.

The use of Kahoot at SD Negeri 49/III Koto Baru S. Agung also proved to improve students' critical thinking skills, an aspect essential in developing elementary school-age children's cognitive abilities. The platform requires students to think quickly and make decisions based on the information they possess within a limited time. In each game, students must analyze questions and choose answers accurately within predetermined time limits,

[26] Rahmayana, L., & Halim, A. (2024). The impact of kahoot-based formative assessment on student learning outcomes at a Junior High School in Samarinda. EnJourMe (English Journal of Merdeka): Culture, Language, and Teaching of English, 9(1), 103-118.

[27] Özdemir, O. (2025). Kahoot! Game-based digital learning platform: A comprehensive meta-analysis. Journal of Computer Assisted Learning, 41(1), e13084.

effectively training their critical thinking abilities. This process involves several complex cognitive aspects, namely analyzing information presented in questions, evaluating various available answer options, synthesizing previously learned knowledge, and making decisions under time pressure situations. These skills are fundamental in the 21st-century learning context, where students are required not only to memorize information but also to analyze and apply it in different situations. Research by Mertayasa et al. in Husnawati & Carina (2023) supports this finding, showing that Kahoot use can have a positive impact on student motivation and their level of classroom engagement, while reducing boredom in conventional learning processes and encouraging students to think more actively and compete healthily with their peers.[28]

Observations during research at SD Negeri 49/III Koto Baru S. Agung show that students in the experimental group not only experienced improvement in test scores but also showed development in analytical thinking and problem-solving abilities. These students demonstrated better abilities in identifying patterns, making inferences, and connecting different concepts. They also showed improvement in metacognitive skills, specifically in their awareness of their own thinking processes. This is visible from their ability to evaluate strategies they used in answering questions and make adjustments when necessary. This metacognitive ability is critical in learning because it enables students to become more autonomous and self-regulated learners. Additionally, Kahoot use also helps develop students' abilities in managing time and pressure, two aspects that are very important in their academic and professional lives in the future. This finding aligns with those from studies by Mustofiyah et al. (2025), which demonstrate that the Kahoot-based Teams Games Tournament (TGT) model significantly enhances elementary school students' mathematical critical thinking abilities, with effects accounting for 17.4% of the variation in improvement (Partial Eta Squared = 0.174; p = 0.011).[29]

From a learning theory perspective, Kahoot's effectiveness can be explained through the Multiple Intelligences Theory framework developed by Howard Gardner. The platform not only accommodates students with linguistic and logical-mathematical intelligence but also involves visual-spatial intelligence through attractive interfaces, interpersonal intelligence through interaction with classmates, and intrapersonal intelligence through reflection on their own performance. This multi-modal approach enables students with various learning styles to access and process information in ways most suitable to their characteristics. This explains why Kahoot is effective for all students in the experimental group, not just for students with certain characteristics, as shown by perfect Pearson correlation and consistently high N-Gain values across all research subjects.

These research findings have significant implications for contemporary educational practice, particularly in the context of modernizing the learning process at the elementary school level. Kahoot use can be an effective alternative to replace or complement traditional assessment methods, which are often monotonous and less motivating for students, as evidenced by the significant difference in results between the experimental and control groups in this research. The integration of game-based learning technology, such as Kahoot, can help educators create learning environments that are more responsive to the

[28] Husnawati, Z., & Carina, A. (2023). Gamification (Kahoot) and Its Usage in Teaching and Learning Process for Primary Education of SD/MI. In SHEs: Conference Series 6 (Vol. 6, No. 3). Universitas Sebelas Maret.

[29] Mustofiyah, L., Sutama, S., Hidayati, Y. M., & Wulandari, M. D. (2024). Kahoot-Based Teams Games Tournament in Developing Students' Mathematical Critical Thinking. Profesi Pendidikan Dasar, 183-196.

characteristics of the digital native generation, which constitutes the majority of current elementary school students. This generation grows up in the digital era of technology and has different expectations regarding how information is presented and accessed. They tend to be more responsive to visual stimuli, have shorter attention spans for traditional learning methods, and expect interactivity in the learning process. Kahoot successfully meets these expectations by providing learning experiences that align with the preferences and characteristics of the digital native generation.

Research results at SD Negeri 49/III Koto Baru S. Agung indicate that students in the experimental group not only experienced improvement in academic aspects but also demonstrated development in engagement, motivation, and technology skills that will be highly beneficial in their future lives. Digital skills acquired through Kahoot use, such as navigating digital interfaces, responding quickly to visual information, and multitasking in digital environments, are increasingly essential skills in the current digital era. Additionally, their ability to adapt to new technology and learn autonomously in digital environments constitutes a very valuable provision for their continued education. Experience using digital platforms like Kahoot also helps students develop digital literacy, namely the ability to use digital technology effectively, critically, and responsibly.

Nevertheless, Kahoot implementation in the learning context also needs to consider several vital factors discovered during this research. First, educators need to ensure that platform use does not completely replace traditional learning interaction but functions as a complement that enriches the learning experience. Face-to-face interaction between teachers and students, as well as among students, still has value that cannot be replaced by technology. Second, educators require adequate training to maximize the potential of this platform in achieving established learning objectives. This training encompasses not only the technical aspects of platform use but also digital pedagogy, covering how to design effective learning content in digital formats, strategies for managing classrooms in digital environments, and methods for evaluating the effectiveness of digital learning. Third, supporting technological infrastructure, such as stable internet access and device availability for every student, becomes a vital prerequisite for implementation success. This is confirmed by a systematic study conducted by Rosdy & Yunus (2021), which found that unreliable internet connection and lack of technical training are significant challenges in Kahoot use by teachers and students in English language learning.[30] Fourth, learning content design in Kahoot format must be adapted to the curriculum and the characteristics of elementary students, ensuring that gamification elements do not divert attention from the main learning objectives.

This research also highlights the need for follow-up studies on a larger scale and a more extended time period to validate these findings in broader contexts. Longitudinal research will provide deeper insights into the long-term impact of Kahoot use on learning outcomes, knowledge retention, and student skill development. Additionally, a deeper exploration of specific gamification aspects most effective for various subjects and student ability levels will provide more comprehensive guidance for education practitioners in optimizing the use of digital technology, such as Kahoot, in elementary school learning. Future research should also explore factors that may influence Kahoot's effectiveness, such as individual student characteristics, teacher teaching styles, and the school's socio-cultural

[30] Rosdy, S. N. A., & Yunus, M. M. (2021). A systematic review of Kahoot: Perceptions and challenges among english learners and teachers. International Journal of Academic Research in Progressive Education and Development, 10(1), 377-391.

context, to provide a more comprehensive understanding of the implementation of digital technology in education.

## CONCLUSION

This research concludes that the implementation of Kahoot produces highly substantial practical impact on improving elementary school students' cognitive learning outcomes, confirmed through an average score increase in the experimental group from 65 to 85 (a difference of 20 points) with very high statistical significance ($t(2) = 17.32$, $p < 0.01$), far exceeding the control group which only increased from 68.33 to 75.67 (a difference of 7.34 points). This success is driven by psychological mechanisms aligned with Intrinsic Motivation Theory (Deci & Ryan), where Kahoot's gamification features—in the form of healthy competition, instant reward systems, and real-time feedback—are capable of increasing active engagement and creating optimal flow conditions for students. Thus, this research successfully fills the empirical gap by providing strong evidence regarding Kahoot's effectiveness in the cognitive learning outcomes domain at the elementary level, not just in the affective domain, such as motivation or engagement. These results suggest that integrating gamification technology should be a primary strategy for educators to modernize the learning process in the digital native era.

Kahoot has proven effective in creating a more engaging and interactive learning environment. The platform successfully transforms student attitudes from initially passive and tending to be bored to becoming active and enthusiastic in participating in learning. For example, a systematic review by Rusliana, Sufyadi, and Qomario (2024) found that Kahoot use creates interactive and engaging learning experiences, while simultaneously improving student engagement and motivation through gamification, such as real-time quizzes and interactive challenges. [31] Gamification elements in Kahoot, such as healthy competition, point systems, and instant feedback, can increase students' intrinsic motivation and encourage active participation in the learning process. Furthermore, Kahoot use not only improves academic results but also develops students' critical thinking skills through the process of analyzing questions, evaluating answer choices, and making decisions within a limited time. Research by Zuleha et al. (2025) shows a significant increase in students' vocabulary skills after using Kahoot, with average pre-test scores increasing from 72.50 to 79.17 on the post-test ($p < 0.05$).[32]

Kahoot's advantage also lies in its adaptability to various learning styles. The platform accommodates various types of intelligence, ranging from visual-spatial to interpersonal and intrapersonal, thus providing equal benefits for all students. The Pearson correlation, reaching a value of 1, shows extraordinary consistency in improvement, where every student in the experimental group experienced improvement proportional to their initial abilities. This indicates that Kahoot is effective for students with various ability levels.

Kahoot use is also highly relevant to the characteristics of Generation Alpha and Z students who grow up in the digital technology era. The platform meets students' expectations for interactive, visual, and responsive learning, while helping develop digital literacy that is very useful for their future lives. Research by Mahaseth et al. (2025)

[31] Rusliana, N. A., & Sufyadi, S. (2024). Kahoot Utilization! To Support Game-Based Learning. Jurnal Indonesia Sosial Teknologi, 5(10).

[32] Zuleha, R. N., Hartono, R., & Rozi, F. (2025). The Effectiveness of Kahoot! in Enhancing Vocabulary Skills Among Sixth-Grade Students. Acuity: Journal of English Language Pedagogy, Literature and Culture, 10(3), 184-195.

emphasizes that online quizzes, such as Kahoot, enhance student engagement, memory retention, and classroom collaboration—a modern educational approach well-suited to the demands of the current generation.[33] Kahoot's effectiveness can be explained through various learning theories, including intrinsic motivation theory, behaviorism, constructivism, and flow theory, which create optimal conditions for learning. Finally, Kahoot's effectiveness can be explained through various learning theories, including intrinsic motivation, behaviorism, constructivism, and flow theory, which create optimal conditions for learning. With enjoyable competition, direct feedback, and instant reward systems, Kahoot can create a mental flow that allows students to become completely immersed in their learning activities.

Overall, implementing Kahoot in elementary school learning provides a significant positive impact on student learning outcomes. Kahoot use not only improves academic results but also increases student motivation and engagement in the learning process. Statistical analysis revealed a significant increase in motivation, with mean scores rising from 62.125 (Pre-Test) to 83.25 (Post-Test) and a p-value of .000 confirming the intervention's effectiveness (Sohilait et al., 2024).[34] This demonstrates that digital technology, particularly gamification-based technology, can be an powerful tool in creating more engaging and interactive learning experiences. Therefore, it is recommended that more elementary schools integrate digital technology, such as Kahoot, into their curriculum to create more innovative and engaging learning experiences. This technology integration will not only improve learning quality but also prepare students to face challenges in an increasingly technology-driven world. However, its implementation needs to consider supporting factors such as adequate teacher training, robust technological infrastructure, and balanced integration with traditional learning methods to maximize the potential of digital technology in education.

Furthermore, this research also opens opportunities for further studies on gamification implementation in education. Although research results show Kahoot's effectiveness in improving learning outcomes, motivation, and student engagement, there is still room for development, for instance, by combining Kahoot with other learning strategies such as Problem-Based Learning (PBL) or Discovery Learning. This integrative approach is expected to enrich students' learning experiences by not only focusing on cognitive improvement but also on collaborative skills, problem-solving, and creativity. Thus, Kahoot can be utilized not only as an interactive quiz medium but also as part of a more comprehensive and sustainable learning ecosystem.

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[33] Mahaseth, H., Bajpai, A., & Gupta, A. (2025). Gamified Learning in Education: How Online Quizzes like Kahoot Transform Classroom Dynamics. Engineering Proceedings, 107(1), 41.

[34] Sohilait, M. S., Puspitasari, R. M., Pratama, M. R. F., & Fikri, A. N. (2024). Implementation of Kahoot as a digital-based assessment tool in elementary science education. Indonesian Research and Education Journal, 4(2), 215–227.

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