

Reimagining English Learning with Artificial Intelligence: Boosting Engagement and Achievement in Young Learners

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ABSTRACT: Learning engagement is an essential component of effective English language instruction, as it directly influences students' ability to achieve learning outcomes. This study aimed to investigate the impact of Artificial Intelligence (AI)-based learning on students' engagement and learning outcomes in elementary English classes. Employing a mixed-methods approach, qualitative data were collected through observations and questionnaires, while quantitative data were obtained from pre- and post-tests. The participants consisted of 42 fourth-grade elementary school students (18 males and 24 females), divided into two groups: a control group receiving conventional instruction and an experimental group utilizing AI-based learning. The findings revealed that AI-based learning significantly enhanced students' engagement across three dimensions—cognitive, emotional, and behavioral. Furthermore, AI integration effectively improved learning outcomes, as shown by a significant increase in post-test average scores from 72.88 to 83.29 in the control group and from 72.00 to 91.95 in the experimental group. The significance value ($\text{Sig.} = 0.00 < 0.05$) confirmed that the improvement was statistically significant. Therefore, the integration of AI in elementary English learning can serve as an effective alternative approach to promote greater learning engagement and enhance academic performance.

Keywords: *artificial intelligence, engagement, learning outcome*

ABSTRAK: Keterlibatan belajar merupakan komponen penting dalam pembelajaran bahasa Inggris yang efektif karena berpengaruh langsung terhadap pencapaian hasil belajar siswa. Penelitian ini bertujuan untuk mengkaji pengaruh pembelajaran berbasis Kecerdasan Buatan (Artificial Intelligence/AI) terhadap keterlibatan belajar dan hasil belajar siswa dalam pembelajaran bahasa Inggris di sekolah dasar. Penelitian ini menggunakan mixed-methods, yang mana data kualitatif diperoleh melalui observasi dan angket, sedangkan data kuantitatif diperoleh melalui tes awal (pre-test) dan tes akhir (post-test). Partisipan penelitian terdiri atas 42 siswa kelas IV sekolah dasar (18 laki-laki dan 24 perempuan) yang dibagi menjadi dua kelompok: kelompok kontrol (pembelajaran konvensional) dan kelompok eksperimen (pembelajaran berbasis AI). Hasil penelitian menunjukkan bahwa pembelajaran berbasis AI secara signifikan meningkatkan keterlibatan belajar siswa pada tiga dimensi, yaitu kognitif, emosional, dan perilaku. Selain itu, integrasi AI terbukti efektif dalam meningkatkan hasil belajar, yang ditunjukkan dengan peningkatan skor rata-rata post-test dari 72,88 menjadi 83,29 pada kelompok kontrol dan dari 72,00 menjadi 91,95 pada kelompok eksperimen. Nilai signifikansi ($\text{Sig.} = 0,00 < 0,05$) juga menunjukkan bahwa perbedaan tersebut signifikan secara statistik. Dengan demikian, penerapan AI dalam pembelajaran bahasa Inggris di sekolah dasar dapat menjadi alternatif yang efektif untuk meningkatkan keterlibatan belajar dan prestasi akademik siswa.

Kata Kunci: *kecerdasan buatan, keterlibatan siswa, hasil belajar.*

INTRODUCTION

In the contemporary era, proficiency in English language skills—comprising speaking, writing, reading, and listening—has become an essential competence for individuals across various sectors, particularly in education (Hamied & Musthafa, 2019). Possessing such linguistic proficiency enables individuals to further develop their potential and expand their knowledge base (Richard, 2017). This is largely due to the abundance of scholarly and educational resources that employ English as the primary medium of instruction. Accordingly, as emphasized by (Sulistiyo et al., 2020) and (S. Zein, 2016), mastery of English enhances one's opportunities to grow intellectually and compete in an increasingly globalized world. These perspectives collectively underscore the importance of English language mastery as a crucial element of modern education.

In Indonesia, English has been introduced at the elementary school level since the early 1990s as an elective subject (Lie, 2007; Lauder, 2008). A national survey conducted by Zein (2018) revealed that nearly all elementary schools in the country have incorporated English into their curricula, reflecting institutional commitment to fostering early exposure to the language. This initiative aims to prepare students for more advanced educational stages. Nevertheless, English instruction at the elementary level continues to encounter multiple challenges (Falah et al., 2023). One of the most pressing issues is low learning engagement—a factor that significantly influences learning outcomes. Empirical evidence suggests that students who actively engage in classroom activities exhibit greater comprehension and retention of learning materials.

Various factors contribute to the issue of low engagement among young learners. Beyond the shortage of qualified English teachers in Indonesian elementary schools, the use of monotonous and unappealing instructional designs often diminishes students' motivation to participate (Primary et al., 2023). Consequently, many students display passive behavior, boredom, or fear of making mistakes during lessons (Huang et al., 2022). These challenges demand pedagogical innovation and the adoption of effective strategies to enhance classroom engagement. Low engagement not only hampers participation but also negatively affects academic performance. A substantial body of research has established a strong correlation between engagement levels and learning outcomes, indicating that fostering engagement in English language learning can facilitate more meaningful and effective learning experiences.

One promising approach to enhancing engagement and learning outcomes is the integration of Artificial Intelligence (AI) tools into English language instruction at the elementary level. The emergence of AI-powered applications such as ChatGPT, ELSA, and Gemini has provided new avenues for teachers to deliver authentic, interactive, and contextually relevant language-learning experiences (Geroche & Guay, 2024). These technologies also offer engaging features that can increase students' motivation to learn (Zaharuddin et al., 2024). In the present study, *Duolingo* was selected as the AI tool due to its accessibility and comprehensive coverage of core language skills—listening, speaking, reading,

and writing—which align with the Teaching English to Young Learners (TEYL) framework (Kazu & Kuvvetli, 2025).

Previous research has demonstrated that AI integration in English Language Teaching (ELT) positively impacts language acquisition. (Hoang et al., 2023), for instance, found that AI tools improved learners' speaking and pronunciation skills by enabling realistic conversational practice. Similarly, Li et al. (2024) reported that AI-assisted tools effectively supported idea generation and organization in writing tasks, while (Annamalai & Bervell, 2025) highlighted the utility of AI in providing immediate feedback on grammar accuracy. Despite these encouraging findings, limited research has specifically explored the influence of AI integration on learning engagement, particularly in the context of primary-level English education.

Moreover, existing literature indicates that AI-based learning tools are predominantly utilized in secondary and tertiary education (Li et al., 2024; Hoang et al., 2023), where learners possess greater technological literacy and linguistic competence. In contrast, the application of such tools at the elementary level remains underexplored. This gap underscores the need for empirical investigation into how AI integration may enhance learning engagement and outcomes among young English learners. Accordingly, this study seeks to (1) examine the impact of AI-based learning integration on students' learning engagement in English instruction at the elementary school level, and (2) determine whether such integration contributes to improved learning outcomes.

METHOD

Research Design

The current study employed a convergent parallel mixed-methods design, in which qualitative and quantitative data were collected concurrently and integrated during the interpretation phase to provide a comprehensive understanding of the research problem (Creswell & Clark, 2017). This design was selected to enable the triangulation of findings, where qualitative insights regarding students' engagement complemented the quantitative data on learning outcomes, thereby enhancing the validity and depth of the results (Creswell, 2013). Qualitatively, the study explored students' learning engagement through classroom observations and structured questionnaires. These instruments were designed to capture behavioral, emotional, and cognitive dimensions of engagement during the learning process. Quantitatively, the study focused on measuring students' learning outcomes using a pretest–post-test design (Davison & Smith, 2018). Numerical data were gathered before and after the intervention to determine any significant improvements attributable to the treatment.

The participants were divided into two groups: an experimental group and a control group. The experimental group received AI-based English learning facilitated through the *Duolingo* application—an interactive language-learning platform integrating listening, speaking, reading, and writing tasks. The content delivered through Duolingo was adapted to align with students' English proficiency levels to ensure accessibility and relevance. Conversely, the control

group engaged in conventional learning activities that primarily emphasized memorization, songs, and video-based materials. This design allowed the researchers to compare and interpret both the statistical outcomes and the observed engagement patterns to draw comprehensive conclusions about the impact of AI-based learning on students' engagement and performance.

Participants

A total of forty-two fourth-grade primary school students participated in this study. The participants consisted of 18 males and 24 females, all of whom had previously received English instruction in grades 1, 2, and 3. Based on preliminary assessments and information obtained from the classroom teacher, their average English proficiency level was classified as beginner. The students were divided equally into two groups: an experimental group ($n = 21$) and a control group ($n = 21$). The experimental group received AI-based English learning facilitated through the *Duolingo* application, an interactive platform integrating listening, speaking, reading, and writing tasks. The materials presented through *Duolingo* were carefully adjusted to match the students' proficiency levels, ensuring accessibility, relevance, and engagement. Conversely, the control group participated in conventional learning activities, which primarily emphasized memorization, songs, and video-based materials. This group served as a benchmark to evaluate the relative effectiveness of the AI-based approach. The inclusion of both groups enabled the researchers to compare and interpret not only quantitative differences in learning outcomes but also qualitative variations in engagement patterns between students who learned through AI-based instruction and those who followed traditional learning methods. This design thus provided a rigorous basis for drawing comprehensive conclusions regarding the impact of AI-assisted English learning on elementary students' engagement and performance.

Data collection technique

As previously mentioned, this study employed multiple data collection techniques, namely observation, a questionnaire, and testing, to obtain comprehensive and complementary data. The observation process was conducted by two independent observers who closely monitored classroom activities throughout the intervention. The observation focused on three key dimensions of engagement—cognitive, affective, and behavioral—to capture how students interacted, participated, and responded during the learning process.

To supplement the observational data, a student engagement questionnaire was administered. The instrument was adapted from (Arndt, 2023) and designed to assess students' self-perceived engagement levels based on their feelings and learning experiences during the instructional sessions. The questionnaire allowed students to respond to items that reflected their emotional involvement, attention, and participation in class. In addition to qualitative data, the study collected quantitative data through a testing procedure consisting of a pre-test and a post-test. These tests aimed to measure students' learning outcomes and evaluate the effectiveness of integrating AI-based tools into English

learning. The test comprised 50 items relevant to the instructional material, including multiple-choice, fill-in-the-blank, and random-word types. All items were derived from the *Duolingo* application, which has been widely recognized as a reliable and valid platform for assessing English language proficiency (Jiang et al., 2021).

Data Analysis

In line with the convergent parallel mixed-methods design, both qualitative and quantitative analyses were conducted independently and later integrated during the interpretation stage to draw comprehensive conclusions (Creswell & Clark, 2017). Qualitative data analysis was performed using thematic analysis (Braun & Clarke, 2006) to identify recurring patterns and themes from classroom observations and questionnaire responses. The process involved six systematic phases: (1) data familiarization through repeated reading of observation notes and questionnaire comments; (2) generation of initial codes; (3) identification of potential themes; (4) reviewing and refining themes; (5) defining and naming the themes; and (6) producing the final narrative report.

For the quantitative analysis, descriptive and inferential statistics were employed using SPSS version 26. Initially, the data were tested for normality (via the Shapiro–Wilk test) and homogeneity of variances (via Levene’s test) to ensure that the assumptions for parametric analysis were met. Following these preliminary checks, an independent samples t-test was conducted to compare the mean scores of the experimental and control groups on both the pre-test and post-test results (Davison & Smith, 2018).

To assess the magnitude of the treatment effect, the study computed Cohen’s *d* effect size (Cohen, 2013), calculated as the difference between the two group means divided by the pooled standard deviation. The interpretation followed conventional thresholds, where $d = 0.20$ indicates a small effect, $d = 0.50$ a medium effect, and $d = 0.80$ a large effect. This measure provided a more meaningful understanding of the impact of AI-based instruction beyond mere statistical significance.

RESULT AND DISCUSSION

Students’ Engagement in AI-based learning

To explore how students engaged in AI-assisted English learning, data were obtained through classroom observations and engagement questionnaires. Students’ engagement was categorized into three domains—cognitive, emotional, and behavioral—as illustrated in Table 1 below

Table 1. Engagement Category

Domain	Students’ Engagement
Cognitive	Involve in learning
	Doing tasks
	Understand the material
	Remember the material

Emotional	Focus
	Appreciate
	Risk taking
	Pleasure/joyful
Behavioral	Raise hand
	Reply to others (peers and teacher)

Table 1 classifies engagement indicators that emerged during AI-based learning using *Duolingo*. The three domains collectively illustrate how AI facilitates multidimensional engagement—enhancing students’ cognitive processing, emotional involvement, and observable classroom participation.

To further examine engagement quantitatively, questionnaire results are summarized in Table 2. The items represent students’ responses toward AI-assisted learning activities.

Table 2. Result of Engagement Questionnaire

Question	AS	A	N	D	DS
I answered the question well	90%	6%	3%		
I do my task while learning	80%	15%	5%		
I enjoy the learning process	95%	5%			
I am involved in learning	76%	24%			
I appreciate my friends	97%	3%			
I understand the material	88%	10%		2%	
I try something new	75%	10%	10%	5%	
I focus on learning	75%	10%	5%	10%	
I am curious about the material	81%	15%	10%	1%	4%
I raise my hand when I do not understand	89%	7%	4%		

AS : Agree Strongly
A : Agree
N : Neutral
D : Disagree
DS : Disagree Strongly

As seen in Table 2, the majority of students strongly agreed that they actively participated and enjoyed AI-based learning. Particularly high responses were observed in emotional (95% enjoyment; 97% appreciation) and behavioral indicators (89% willingness to raise hands). These findings confirm that the use of AI tools like *Duolingo* fosters positive engagement and encourages active learning behaviors.

Student engagement in the learning process is reflected in their active participation when allowed to explore *Duolingo*, an AI tool used in learning. This was also confirmed by the results of the questionnaire, where 76% of students reported being highly engaged in AI-based learning. Student engagement in learning is also accompanied by enthusiasm for completing assignments, where students enjoy the work. Similarly, the questionnaire results show that 80% of

students stated that they work on assignments both individually and in groups. This certainly shows that AI provides more opportunities for students to be involved in the learning process.

Emotionally, students learning English using AI appear to have a strong focus. This is evident from observations and questionnaires, where 75% of them seriously work on assignments in front of their laptops. In fact, when in groups, students take turns and appreciate their peers (93%) by observing and not interrupting them while they interact with the Duolingo app. Furthermore, the use of AI also increases students' risk-taking. Students who were initially shy became more willing to take risks as learning progressed (75%), as evidenced by their willingness to complete available assignments, regardless of the correctness of their answers.

Behavioral engagement was also evident in the AI-based learning process. Observations showed that the majority of students were willing to come forward and raise their hands when allowed to express their opinions or answer questions. This was also confirmed by the questionnaire results, where 89% of students reported raising their hands either when they did not understand or wanted to answer a question.

Students' Learning Outcome

Prior to intervention, both experimental and control groups exhibited comparable English proficiency. The descriptive statistics of the pre-test and post-test results are presented in Table 3.

Table 3. Tests Result

Test	Average
Pre-test control Group	72.88
Pre-test experiment Group	72.00
Post-test control Group	83.29
Post-test experiment Group	91.95

Although the pre-test scores were similar, post-test results showed a substantial improvement in the experimental group (+8.66 points). This preliminary evidence indicates that AI-based learning contributes positively to learning performance compared to conventional instruction. Before conducting the main statistical test, assumptions of normality and homogeneity of variance were examined to ensure data validity.

Table 4. Tests of Normality

	Class	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Result	Pretest Cont	.142	21	.200*	.954	21	.407
	Postest Cont	.149	21	.200*	.929	21	.129
	Pretest Exp	.143	21	.200*	.960	21	.520
	Postest Exp	.113	21	.200*	.970	21	.744

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Table 4 shows that all significance values ($p > 0.05$) indicate normally distributed data, fulfilling the normality assumption for parametric analysis.

Table 5. Test of Homogeneity of Variance

		Levene Statistic	df1	Df2	Sig.
Result	Based on Mean	2.189	3	80	.096
	Based on Median	1.943	3	80	.129
	Based on Median and with adjusted df	1.943	3	61.990	.132
	Based on the trimmed mean	2.182	3	80	.097

Since all significance values are above 0.05, the data are homogeneous across groups. Thus, the conditions for conducting an independent samples t-test were met.

Table 6. Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Result	Equal variances assumed	.016	.901	40	.000	-8.667	.985		-10.657	-6.677
	Equal variances not assumed			8.801	39.566	.000	-8.667	.985	-10.657	-6.676

The independent samples t-test revealed a significant difference between the experimental and control groups ($t(40) = -8.801$, $p < .001$), indicating that AI-based learning had a statistically significant positive effect on students' English achievement. To assess the magnitude of this difference, the effect size (Cohen's d) was calculated. Using the mean difference (8.67) and pooled standard deviation (approx. 3.5), the estimated $d \approx 2.47$, representing a very large effect (Cohen, 1988). This suggests that the implementation of AI-assisted instruction not only yields statistically significant improvements but also produces a substantial practical impact on students' learning outcomes.

Discussion

The integration of Artificial Intelligence (AI) into English learning demonstrates a substantial impact on both students' engagement and academic achievement. The results of this study reveal that AI-assisted learning, implemented through Duolingo, not only improved students' learning outcomes significantly but also fostered multidimensional engagement—cognitive, emotional, and behavioral.

AI applications such as Duolingo promote engagement because they personalize learning, provide immediate feedback, and gamify learning experiences, which align with the motivational constructs proposed by (Fredricks & Paris, 2016). According to their engagement framework, engagement involves

three interrelated domains: cognitive (mental investment and effort), emotional (interest, enthusiasm), and behavioral (participation and persistence). So does in the current study where three of engagement dimension are interrelated. The findings also extend the previous study conducted Tan et al. (2025) which reported that AI can amplify engagement..

The data in Table 1 and Table 2 show clear evidence of engagement enhancement across these domains. Emotionally, 95% of students expressed enjoyment, and 97% showed appreciation toward peers, indicating a learning environment characterized by positive affect and mutual respect. AI systems often provide visual rewards, sound cues, and progress indicators that stimulate the brain's reward system, leading to intrinsic motivation and positive emotions (Liu & Reinders, 2025). As (Zaharuddin et al., 2024) found, such gamified reinforcement cycles sustain learners' interest and reduce boredom—a critical factor for maintaining engagement in younger learners.

Following the emotional domain, students also exhibited stronger cognitive persistence where 80% of students reported diligently completing their tasks, and 88% understood the material. This improvement can be attributed to AI's adaptive algorithms, which adjust difficulty levels and provide targeted scaffolding based on real-time performance data. As Goyal (2025) emphasizes, AI functions as a "cognitive partner" that dynamically adapts to learners' needs, enabling them to operate within their capability. In this sense, AI creates a feedback-rich learning environment where students can continuously monitor progress and correct errors independently, fostering self-regulation and deeper learning (Tan et al., 2025).

Not only emotional and cognitive, the integration of AI also affects students behaviorally. The data indicate that 89% of students raised their hands during discussions and actively interacted with teachers and peers. This behavioral shift suggests that AI integration reduced learning anxiety and increased confidence. The repetitive and low-stakes practice environment of *Duolingo* allows students to make mistakes safely, thus encouraging participation—a phenomenon supported by (Holmes et al., 2022), who noted that AI can "de-risk" classroom participation by providing non-judgmental feedback loops.

The quantitative findings reinforce the engagement data. As shown in Table 6, the independent samples t-test revealed a highly significant improvement in the experimental group ($t(40) = -8.801, p < .001$). The computed effect size (Cohen's $d = 2.47$) indicates a very large practical impact (Cohen, 2013). This substantial effect supports the argument that engagement serves as a mediating variable linking AI use and academic improvement. The consistent upward shift from pre-test to post-test (from 72.00 to 91.95) in the experimental group indicates not only knowledge gains but also heightened persistence and motivation—hallmarks of deep engagement.

Nevertheless, the study is subject to notable limitations. The relatively small sample size and brief intervention duration constrain the generalizability of the results and may limit robustness. Future research should endeavor to incorporate larger, more diverse samples and extend the treatment period to

assess longer-term effects. Additionally, examining variables such as motivation, digital literacy, and learner autonomy would deepen understanding of AI's educational impact.

CONCLUSION

This study concludes that the integration of Artificial Intelligence (AI) in English learning significantly enhances student engagement and learning outcomes. Based on the findings, the use of Duolingo fosters active participation, emotional involvement, and positive learning behaviors, while yielding notable improvements in student achievement. The results corroborate prior research affirming AI's positive role in both engagement and academic performance. Practically, these findings suggest that AI tools can serve as effective supports for educators in designing more interactive and personalized learning environments. It is recommended that educators integrate AI-based platforms to foster motivation and engagement, while upholding pedagogical oversight and ethical considerations. Furthermore, policymakers should incorporate AI in educational frameworks and develop professional training programs to improve teacher readiness. However, this study's limitations include a small sample size and brief intervention period, which may constrain the generalizability of the results. Future research should explore long-term effects of AI-assisted learning, involve larger and more diverse samples, and examine additional variables such as motivation, digital literacy, and learner autonomy to gain a comprehensive understanding of AI's educational impact. Overall, this research contributes to the expanding evidence positioning AI as a pedagogical innovation and transformative learning paradigm.

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