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Evaluation of the Effectiveness of Artificial Intelligence in Enhancing Students' Listening, Grammar, Vocabulary, Motivation, and Self-Regulation Skills Compared to Human Interaction

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Abstract

The use of modern technologies in education, particularly artificial intelligence (AI), has become a key focus in educational research. This study aims to evaluate the effectiveness of AI in enhancing students' listening, grammar, vocabulary, motivation, and self-regulation skills compared to human interaction. In this study, 40 students aged 14 to 18 were purposefully divided into two groups of 20. The first group received instruction through AI (Duolingo), while the second group interacted with a human partner. The training program lasted for twelve weeks. Listening, grammar, and vocabulary skills were assessed using pre-tests and post-tests, with data analyzed through the Wilcoxon test. A nonparametric covariance test was used to compare the two groups. Motivation and self-regulation were assessed via a questionnaire after the intervention, with differences between the groups analyzed using the Mann-Whitney test. The results indicated that both groups showed significant improvement in listening, grammar, and vocabulary skills compared to their baseline performance (P-value = 0). However, no statistically significant difference was observed between the two groups (P-value = 0). Additionally, students who interacted with a human partner demonstrated higher motivation levels than those trained with AI (P-value = 0). Conversely, students who received AI-based instruction exhibited greater self-regulation skills (P-value = 0). This study suggests that AI can be as effective as human interaction in improving listening, grammar, and vocabulary skills. However, its impact on motivation is lower than human interaction, whereas it is more effective in enhancing students' self-regulation abilities. These findings can be valuable in designing technology-based educational programs.

Keywords: Artificial Intelligence, Human Interaction, Listening Skills, Grammar and Vocabulary Skills, Motivation, Self-Regulation

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1. Introduction

The rapid integration of artificial intelligence (AI) into educational environments has significantly transformed traditional paradigms of language instruction, marking a shift toward more technologically mediated learning experiences (1). With the continuous evolution of digital learning platforms and AI-driven applications, educators and researchers are increasingly exploring the pedagogical possibilities that these innovations present (2). This interest is especially pronounced in the context of language learning, where AI technologies are being examined not only for their efficiency and scalability but also for their ability to supplement or even replace conventional methods rooted in human interaction (2-5).

Among the various competencies required for successful second language acquisition, listening comprehension, grammatical accuracy, and vocabulary knowledge remain central (6, 7). These linguistic elements serve as the foundational pillars of effective communication and are often the primary focus of instructional programs and language assessments (6, 7). However, beyond these cognitive dimensions, a growing body of research emphasizes the importance of non-cognitive factors—such as learner motivation, persistence, and self-regulatory behaviors—which have been shown to influence engagement levels, learning strategies, and ultimately, long-term academic success (8-11). These affective dimensions are particularly relevant in self-paced and digitally mediated learning environments, where learner autonomy is often a prerequisite for sustained progress (8, 9).

Earlier research shows various benefits of AI-mediated language learning platforms in developing students'

linguistic skills and subskills (28, 30). It has been shown that language learners' academic engagement and academic motivation correlate in AI-mediated language learning environments (27). In addition, it has been shown that using AI-mediated platforms can help increase learners' writing performance and task motivation (29), self-regulated learning strategies (30), and academic achievements (31).

AI-based tools, such as Duolingo and similar applications, have gained popularity by offering learners interactive, gamified platforms that aim to provide personalized instruction tailored to individual needs (12). These systems utilize real-time data analytics and adaptive algorithms to adjust content difficulty, deliver immediate feedback, and promote mastery learning in an engaging, user-friendly format (13-15). The incorporation of game-like elements, such as rewards, streaks, and progress tracking, is designed to enhance user motivation and maintain consistent usage over time (14, 16). As a result, AI-driven platforms are increasingly viewed as viable supplements or alternatives to traditional classroom instruction, especially in contexts where access to qualified language educators is limited (13-18).

Nevertheless, traditional methods that rely on human interaction—such as peer collaboration, group discussions, and teacher-guided instruction—continue to play an indispensable role in language education (19-22). Moreover, human instructors can offer nuanced feedback, scaffold learning based on real-time observation, and build affective rapport with learners—elements that AI systems have yet to fully replicate (19, 22-24).

Despite the growing interest in AI-enhanced language learning, there remains a relative scarcity of empirical studies that rigorously compare the effectiveness of AI-based instruction with that of traditional, human-mediated approaches. Specifically, there is a need for comprehensive investigations that examine both cognitive outcomes—such as improvements in listening, grammar, and vocabulary—and affective outcomes, including shifts in learner motivation and the development of self-regulatory strategies (6, 7, 10). Such comparative studies are essential for informing pedagogical best practices and guiding the integration of AI into language education in ways that are both effective and equitable.

Therefore, the present study aims to fill this gap by evaluating the effectiveness of AI-based instruction in comparison with human interaction among intermediate-level English learners. Specifically, the study examines how these two instructional methods affect students' listening comprehension, grammar, and vocabulary acquisition, as well as their motivation and self-regulatory behaviors. The research targets adolescents aged 14 to 18—a demographic known for both its adaptability to technology and its developmental need for structure and social interaction.

By employing a quasi-experimental design with pre- and post-testing and incorporating both standardized assessments and questionnaires, this study provides a comprehensive evaluation of language learning outcomes across multiple domains. Through the comparison of two distinct learning modalities, the study also aims to offer practical insights into how AI can be effectively integrated into language instruction without compromising the social and emotional dimensions of learning.

Ultimately, the goal of this research is not only to assess the efficacy of AI in promoting English language acquisition but also to explore how such technology affects learners' motivation and self-regulation—two key components of autonomous and lifelong learning. The findings are expected to inform educators, curriculum designers, and ed-tech developers on how best to balance innovation with pedagogical effectiveness in today's increasingly digital educational landscape.

2. Materials and Methods

Study Design

This research employed a quasi-experimental, pre-test–post-test design to evaluate the effectiveness of two instructional approaches—artificial intelligence (Duolingo) and human interaction—in enhancing students' listening, grammar, vocabulary, motivation, and self-regulation skills. The study spanned 12 weeks and involved two experimental groups: one received instruction through AI-based learning using Duolingo, while the other engaged in peer-based learning through direct interaction with a human partner. The design facilitated a comparative analysis of language and psychological outcomes before and after the intervention in both groups.

Participants and Sampling Method

The study initially recruited a total of 63 students, all between the ages of 14 and 18, from a local language institute. These students were at varying stages in their English language learning journey. To ensure that participants had relatively comparable levels of English proficiency, the Oxford Placement Test (OPT) was administered. The OPT

is a standardized and widely recognized assessment tool designed to evaluate learners' English language skills in grammar, vocabulary, and reading comprehension. It served as a screening instrument to select participants whose proficiency levels were appropriate for the study's instructional interventions.

Based on the OPT results, 40 students were selected from the initial pool. The inclusion criterion was having an average OPT score of approximately 30 with a standard deviation of 10, indicating an intermediate level of English proficiency. This criterion helped ensure a homogenous sample in terms of language ability, minimizing the likelihood that differences in learning outcomes could be attributed to disparities in initial proficiency.

After selection, the 40 students were randomly assigned to one of two experimental groups, each consisting of 20 participants. Random assignment was employed to control for potential confounding variables and to enhance the internal validity of the study by ensuring that both groups were statistically comparable at the outset.

- Group A received language instruction through an artificial intelligence-based learning platform, specifically Duolingo. This platform offers interactive lessons using gamified content and adaptive learning algorithms tailored to individual learners' progress and needs.
- Group B received instruction through traditional face-to-face sessions led by human instructors, focusing on communicative teaching methods, peer interaction, and guided practice, in which students interacted with a human partner (i.e., their classmates) during classroom activities.

The sampling approach used in this study was a combination of purposive sampling and random assignment. Purposive sampling was applied in the initial selection phase to include only those learners who fell within a specific proficiency range (based on OPT scores). This ensured that the instructional methods could be fairly compared within a relatively uniform group of learners. Random assignment was then used to allocate students into the two experimental groups, thereby eliminating selection bias and strengthening the study's experimental design.

Overall, this dual approach to sampling enhanced both the comparability and the validity of the experimental groups, enabling a more accurate evaluation of the effectiveness of AI-based versus traditional instruction methods on English language learning outcomes.

Instruments and Data Collection Methods

To gather comprehensive data for the purposes of this study, two main instruments were employed: the Oxford Placement Test (OPT) and a researcher-made questionnaire designed to assess learners' motivation and self-regulation. These tools were selected to capture both linguistic proficiency and psychological engagement with the learning process.

Oxford Placement Test (OPT): The OPT was utilized to determine participants' baseline proficiency in English prior to the intervention and to measure their progress at the end of the instructional period. The test includes components that assess listening comprehension, grammar, and vocabulary skills. Administered as both a pre-test and a post-test, the OPT ensured that changes in language performance over the course of the study could be quantified accurately. Its use is well-documented in second language acquisition research, and it is widely recognized for its validity and reliability in assessing English language proficiency (25).

Researcher-Made Questionnaire on Motivation and Self-Regulation: To explore the psychological dimensions of the participants' learning experiences, the researcher designed a questionnaire focusing on two key constructs: motivation, which refers to the learners' drive and willingness to engage in the learning process, and self-regulation, which pertains to the learners' ability to plan, monitor, and evaluate their own learning behaviors. The content validity of the questionnaire was established through expert review by faculty members from the Language Department at Ardabil Azad University, who examined the items for clarity, relevance, and alignment with the theoretical framework. In terms of reliability, Cronbach's alpha coefficient was calculated to assess internal consistency, resulting in a value of 0.743, which is considered acceptable for research purposes, indicating that the items measured the intended constructs consistently.

Data were collected at two critical points during the study: at the outset (Week 1) and at the conclusion (Week 12) of the instructional intervention, which took place over a three-month period in the year 2025. This pre- and post-testing design allowed for the measurement of both linguistic and psychological development among participants, facilitating a comparison between the experimental and control groups in terms of their progress and engagement.

Statistics and analyses

Statistical analyses were performed using SPSS version 30. The Wilcoxon signed-rank test was applied to compare pre- and post-test scores within each group, given the non-normal distribution of the data. A nonparametric analysis

of covariance was used to compare post-test results between the two experimental groups. Furthermore, the Mann-Whitney U test was employed to assess differences in motivation and self-regulation scores. All tests were conducted at a significance level of $p < 0.05$.

Research Findings and Results

The demographic information of the Students is presented in Table 1.

Table 1. Demographic information of of Students

		AI-Based Learning	Human-Led Instruction
Gender	Male	9	8
	Female	11	12
Age	Mean	16.05	15.80
	Std. Deviation	0.669	0.812

To evaluate the effectiveness of AI-based learning versus human-led instruction in developing students' language skills and psychological engagement, a series of statistical tests were conducted. The results of the Mann-Whitney U test and Wilcoxon signed-rank test are presented In table 2 and 3.

Table 2. Motivation and self-regulation scores

	Group	Mean	Std. Deviation	Mean Difference	P-Value
Motivation Score	AI-Based Learning	11.65	1.226	-5.150	0.000
	Human-Led Instruction	16.80	1.673		
Self-Regulation Score	AI-Based Learning	15.80	1.361	3.700	0.000
	Human-Led Instruction	12.10	1.252		

Table 2 highlights differences in psychological engagement between the two groups. Participants in the human-led instruction group reported significantly higher motivation scores ($M = 16.80$, $SD = 1.673$) compared to those in the AI-based group ($M = 11.65$, $SD = 1.226$), with a mean difference of 5.150 ($p = 0.000$). On the other hand, the AI-based learning group exhibited higher self-regulation ($M = 15.80$, $SD = 1.361$) than the human-led group ($M = 12.10$, $SD = 1.252$), with a mean difference of 3.700 ($p = 0.000$). These results suggest that while human interaction may better enhance learner motivation, AI-driven platforms like Duolingo may promote greater learner autonomy and self-regulation.

Table 3. Listening, grammar and vocabulary scores in pre- and post-test

AI-Based Learning	Time	Mean	Std. Deviation	Mean Difference	P-Value
Listening Score	Pre	30.85	6.141	9.15	0.000
	Post	40.00	7.160		
Grammar and Vocabulary Score	Pre	34.00	10.105	11.2	0.000
	Post	45.20	9.474		
Human-Led Instruction	**Time**	**Mean**	**Std. Deviation**	**Mean Difference**	**P-Value**
Listening Score	Pre	32.45	8.281	8.65	0.000
	Post	41.10	9.989		
Grammar and Vocabulary Score	Pre	30.25	5.330	8.15	0.000
	Post	38.40	9.081		

As shown in **Table 3**, both groups demonstrated significant improvement in listening, grammar, and vocabulary scores from pre-test to post-test ($p < 0.001$ for all comparisons). In the AI-based learning group, the mean listening score increased from 30.85 ($SD = 6.141$) to 40.00 ($SD = 7.160$), indicating a mean difference of 9.15. Similarly, grammar and vocabulary scores rose from a pre-test mean of 34.00 ($SD = 10.105$) to a post-test mean of 45.20 ($SD = 9.474$), with a mean difference of 11.2.

In the human-led instruction group, the mean listening score increased from 32.45 ($SD = 8.281$) to 41.10 ($SD = 9.989$), resulting in a mean difference of 8.65. Grammar and vocabulary scores improved from 30.25 ($SD = 5.330$) to 38.40 ($SD = 9.081$), with a mean difference of 8.15. These findings suggest that while both instructional approaches significantly enhanced language proficiency, the AI-based method resulted in slightly higher gains in grammar and vocabulary.

Combined effects of group and time on Listening, grammar and vocabulary scores were assessed. The results are summarized in Table 4.

Table 4. Evaluation of the comparison of groups in the post-test

	Mean Difference	P Value
Listening Score AI-Based Learning vs. Human-Led Instruction	0.615	0.619
Grammar and Vocabulary Score AI-Based Learning vs. Human-Led Instruction	-1.564	0.207

As shown in **Table 4**, the mean difference in post-test listening scores between the AI-based group and the human-led instruction group was 0.615, with a p-value of 0.619. This indicates that the observed difference was not statistically significant, suggesting that both instructional approaches had a similar effect on improving listening comprehension.

Similarly, the grammar and vocabulary scores showed a mean difference of -1.564 between the two groups, with a p-value of 0.207. Although the human-led group slightly outperformed the AI-based group in these components, the difference again was not statistically significant.

These findings suggest that while both instructional methods were effective in supporting learners' development in listening, grammar, and vocabulary, neither method demonstrated a significant advantage over the other in the measured language outcomes by the end of the 12-week intervention.

Discussion

The findings of this study offer compelling and multifaceted insights into the differential impacts of artificial intelligence (AI) and human interaction on core aspects of English language learning—specifically listening, grammar, vocabulary, motivation, and self-regulation. The analysis revealed that both instructional modalities—AI-based instruction and human-led teaching—contributed to statistically significant improvements in students' linguistic competencies, particularly in listening comprehension, grammatical accuracy, and vocabulary acquisition. However, the absence of statistically significant differences between the two groups in these domains suggests that AI-based instruction can be just as effective as traditional human-led approaches for facilitating certain cognitive language skills.

This outcome is consistent with the findings of Wei (2023) and Xu and Wang (2024), who emphasized the capacity of AI-mediated instruction to produce strong learning gains in discrete language skills (7, 17). Xu and Wang's recent meta-analysis, which synthesized data from multiple studies, reported a high overall effect size for AI-enhanced learning interventions (17). This robust finding reinforces the conclusion that AI technologies can serve as powerful pedagogical tools across diverse educational settings, especially in supporting the acquisition of vocabulary and grammar—two domains well suited to the adaptive, repetitive, and data-driven nature of AI algorithms.

Despite this equivalency in the acquisition of linguistic skills, a divergence emerged between the AI and human interaction groups with regard to non-cognitive and metacognitive outcomes—namely motivation and self-regulation. Students in the human interaction group reported significantly higher levels of learning motivation. This result underscores the enduring value of interpersonal engagement in educational contexts, particularly in language learning, where emotional resonance and social presence play central roles. This aligns with Shen et al. (2024), who emphasized that emotional and relational dynamics are integral to maintaining learner motivation (11). The physical or virtual presence of a human instructor likely introduces affective and empathetic stimuli—such as encouragement, tone modulation, and responsiveness to learners' affective states—that are difficult for AI systems to replicate with the same nuance.

Furthermore, the presence of a human teacher can create a psychologically safe and emotionally rich learning environment where students feel seen, supported, and connected. Wang et al. (2024) similarly found that learners who interacted with human-like avatars experienced increased emotional comfort and a stronger willingness to communicate, further validating the role of emotional presence—whether real or simulated—in shaping learner motivation (5). These results highlight that while AI can effectively facilitate the "what" of language learning (i.e., content), it still lags in delivering the "how" of human interaction (i.e., socio-emotional engagement).

Conversely, students in the AI-based instruction group outperformed their counterparts in self-regulation. This suggests that AI learning environments—often characterized by structured, self-paced, and learner-centered designs—encourage students to take greater ownership of their educational journey. AI platforms typically provide features such as real-time corrective feedback, individualized task progression, goal-setting prompts, and data dashboards that allow learners to track their own performance. These features, rooted in principles of educational psychology and adaptive learning, empower students to plan, monitor, and evaluate their progress more effectively, thus cultivating core self-regulatory behaviors.

This finding resonates with the work of Boudjedra and Khebbab (2024) and Wei (2023), who argued that AI tools not only personalize content but also promote autonomous learning by requiring learners to navigate their studies without continuous teacher direction (7, 10). In effect, AI serves as a "silent coach"—offering scaffolding, but ultimately placing the responsibility for learning in the hands of the student. Such digital environments encourage learners to develop executive functioning skills such as goal-setting, time management, and self-assessment—skills that are increasingly essential in today's self-directed and technology-mediated learning ecosystems.

The dual outcomes of this study—greater motivation under human interaction and stronger self-regulation under AI instruction—highlight the differing pedagogical affordances of each approach. Human instruction appears to excel in nurturing emotional and motivational factors, largely through affective scaffolding, while AI-based systems support cognitive and metacognitive development by promoting independence and strategic learning behaviors. Rather than viewing these modalities as mutually exclusive or competitive, the findings advocate for a blended approach that combines the strengths of both. As Lio et al. (2024) noted, robot-assisted language learning (RALL) systems tend to outperform humans in repetitive and structured tasks such as grammar drills, whereas human tutors remain more effective in communicative and affective areas where flexibility and emotional intelligence are critical (18).

Interestingly, the findings challenge the often-held assumption that AI-based learning environments are inherently less engaging or effective for higher-order language processing. Contrary to this belief, the observed equivalency in grammar, vocabulary, and listening performance between AI and human-led instruction suggests that well-designed AI platforms—particularly those employing gamification, adaptive sequencing, and multimedia inputs—can indeed foster deep cognitive engagement. Wei (2023) and Xu and Wang (2024) also highlighted that user experience design and interface personalization significantly influence learners' perceived engagement and actual performance in AI-mediated environments (7, 17). As such, the gap in engagement between AI and traditional instruction may be narrowing due to advancements in human-computer interaction, natural language processing, and emotionally intelligent algorithms.

Nevertheless, the study affirms the enduring value of human interaction for affective outcomes. Shen et al. (2024), using structural equation modeling, demonstrated that motivational beliefs and social-emotional learning (SEL) serve as key mediators of academic performance in language education (11). These elements—such as empathy, peer collaboration, and emotional resonance—are challenging to fully embed in AI systems. Although efforts like those of Wang et al. (2024) show that human-like avatars and affective computing may mitigate this gap, current AI technologies still fall short of replicating the subtle emotional and relational dynamics found in traditional teacher-student interactions (5).

Moreover, the findings also resonate with the broader literature on social and collaborative learning strategies. For example, Sinaga and Herman (2020) investigated the Partner Reading Strategy and found that structured peer interaction significantly enhances reading comprehension (22). Their work underscores how collaborative and dialogic practices—not merely individual exposure to content—contribute to deeper understanding and learner motivation. These insights further support the argument that while AI can optimize individual learning pathways, human interaction remains essential for cultivating socially embedded, emotionally meaningful learning experiences.

In synthesizing these findings, it becomes evident that AI and human interaction each offer distinct educational strengths. AI-based instruction effectively fosters self-regulatory habits and linguistic proficiency through individualized, scalable platforms. In contrast, human interaction enhances motivation through emotional presence, feedback responsiveness, and relational learning. As education moves increasingly toward hybrid models, integrating the strengths of both modalities may be the most effective pathway forward. Rather than positioning AI as a replacement for human instruction, the evidence suggests a synergistic model wherein AI augments and complements human teaching, creating a holistic, learner-centered educational ecosystem (26).

Implications for Practice and Policy

The findings of this study offer important implications for educational practitioners, curriculum designers, and policymakers. First, the comparable improvement in listening, grammar, and vocabulary skills among both AI-assisted and human-interaction groups suggests that AI technologies can be effectively integrated into language instruction without compromising learning outcomes. Educational institutions may therefore consider adopting AI-driven platforms as complementary tools to traditional teaching, especially in resource-limited settings where access to human tutors is constrained.

Moreover, the observation that AI-based instruction enhances self-regulation skills aligns with findings from Boudjedra and Khebbab (2024) and Wei (2023), indicating the utility of AI in promoting learner autonomy (7, 10). Educational policymakers may leverage this strength by embedding AI modules in self-paced learning environments, particularly in online and blended learning programs. Encouraging the use of AI tools for language learning tasks could empower students to take greater control of their learning process, fostering lifelong learning habits.

However, given the lower motivation levels found among students learning through AI systems, educators and policymakers should be cautious about wholly replacing human interaction with automated systems. As Shen et al. (2024) and Wang et al. (2024) emphasized, motivation and emotional engagement play critical roles in effective language acquisition (5, 11). Therefore, hybrid approaches that combine AI's strengths in personalization and self-regulation with the motivational benefits of human interaction should be prioritized in language education policy and practice.

Additionally, teacher training programs should be revised to include competencies in managing and integrating AI tools. Teachers should be equipped not only to use such tools but also to balance them with emotionally engaging human interaction to enhance both motivational and cognitive outcomes in learners.

Limitations and Future Research

Despite the robust design and insightful findings, this study has several limitations that warrant consideration. First, the research was limited to a specific population. As a result, the generalizability of the findings to other educational levels, regions, or demographic groups may be constrained. Future studies should replicate this research across diverse contexts to validate and extend the results.

Second, the study focused on a short-term intervention. While immediate improvements in listening, grammar, and vocabulary skills were observed, the long-term retention of knowledge and skills acquired through AI-based instruction remains unclear. Longitudinal studies are needed to examine the sustainability of these learning outcomes over extended periods.

Third, the measurement tools used—particularly for assessing motivation and self-regulation—were based on self-report data. While useful, self-reported measures are susceptible to biases such as social desirability or limited self-awareness. Future research should incorporate behavioral metrics and triangulate data sources, including observational or log-based data, to provide a more nuanced understanding of learners' engagement and regulatory strategies.

Finally, this study did not examine the potential differential effects of various AI applications (e.g., chatbots with avatars versus text-based platforms), nor did it explore the influence of learner characteristics such as age, prior exposure to technology, or learning styles. Investigating these moderating variables could yield valuable insights for tailoring AI applications to specific learner needs, as Xu and Wang (2024) suggested in their meta-analytic study (17).

Conclusion

This study evaluated the effectiveness of artificial intelligence in enhancing students' listening, grammar, vocabulary, motivation, and self-regulation skills in comparison to traditional human interaction. The results indicated that while both instructional approaches were effective in improving core language skills, they differed significantly in their impact on affective and metacognitive outcomes. Human interaction was more effective in fostering motivation, whereas AI-supported instruction demonstrated superiority in promoting self-regulated

learning behaviors.

These findings align with and extend previous literature, such as Wei (2023) and Boudjedra and Khebbab (2024), emphasizing the growing role of AI in fostering autonomous learning, while also reaffirming the irreplaceable role of human interaction in sustaining learners' emotional engagement, as highlighted by Shen et al. (2024) and Wang et al. (2024) (5, 7, 10, 11). Taken together, the study advocates for a balanced, integrative approach in language education—leveraging the respective strengths of AI technologies and human facilitators to optimize educational outcomes for diverse learners.

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