

**Artificial Intelligence–Assisted English Language Learning: A
Collaborative Model between English Education and Informatics****Rani Santika*, Rafi Farizki**¹Sekolah Tinggi Agama Islam Kuningan, Indonesia²Politeknik Siber Cerdika Internasional, IndonesiaCorresponding author: Rsantika851@gmail.com*

Keywords	Abstract
AI-powered chatbots; English as a Foreign Language (EFL); Learner autonomy; Interactivity; Learner engagement	Artificial intelligence (AI) has become increasingly prominent in English as a Foreign Language (EFL) learning, particularly through the use of AI-powered chatbots to support language practice beyond classroom boundaries. However, prior studies report mixed results, often emphasizing technology adoption or learning outcomes while overlooking learners' psychological experiences. This study aims to examine AI-assisted EFL learning through a collaborative model integrating perspectives from English education and informatics, with a focus on perceived autonomy, perceived interactivity, learner engagement with AI-powered chatbots, and perceived learning outcomes. A quantitative explanatory research design was employed using a cross-sectional survey of EFL learners with prior experience using AI-powered chatbots. Data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) to evaluate the proposed research model. The results indicate that perceived autonomy and perceived interactivity have significant positive effects on learners' engagement with AI-powered chatbots. Learner engagement also shows a significant positive effect on perceived learning outcomes and mediates the relationships between autonomy, interactivity, and learning outcomes. The findings highlight the importance of autonomy-supportive and interactive chatbot design and underscore the value of interdisciplinary collaboration between English education and informatics in fostering meaningful and sustainable AI-assisted EFL learning.

**INTRODUCTION**

Artificial intelligence (AI) has become an increasingly influential component of contemporary educational practices, particularly in the design of technology-enhanced learning environments. AI-driven systems enable adaptive, data-informed, and personalized learning by responding to learners' needs and behaviors in real time (Chiu et al., 2023; Crompton & Burke, 2020). In the context of English as a Foreign Language (EFL) learning, these developments are especially significant, as EFL learners often encounter limited exposure to authentic language use and require continuous practice, feedback, and interaction beyond traditional classroom settings (Godwin-Jones, 2019; Hockly, 2023). Consequently, AI-assisted language learning has emerged as a promising approach to supporting more flexible, interactive, and learner-centered English learning experiences (Kumari 2025).

Within the landscape of AI-assisted English as a Foreign Language (EFL) learning, AI-powered chatbots have become one of the most widely adopted and pedagogically relevant applications. Chatbots enable learners to engage in simulated conversational interactions, receive automated feedback, and access language practice on demand, thereby extending learning opportunities beyond formal instructional settings (Chen et al., 2020; Smutny &

Schreiberova, 2020). Prior studies suggest that chatbot-assisted language learning can foster learner engagement and motivation by providing low-anxiety environments that encourage repeated practice of speaking and listening skills (Jeon, 2021; Song & Wang, 2023). However, existing research also indicates that the effectiveness of chatbots in EFL learning varies considerably, suggesting that learning outcomes depend not only on the presence of chatbot technology but also on how learners interact with and experience these systems (Almusharraf & Bailey, 2021; Dodigovic, 2020).

To account for the varied effectiveness of AI-powered chatbots in EFL learning, many previous studies have adopted technology acceptance and information systems perspectives. These studies emphasize factors such as perceived usefulness, perceived ease of use, and system quality as key predictors of learners' intention to adopt AI-driven learning tools (Aldosemani et al., 2019; Bai et al., 2021). While this line of research offers important insights into learners' initial acceptance of chatbot technologies, it provides limited explanations of how learners experience these systems during the learning process. In language learning contexts, positive behavioral intention does not necessarily translate into sustained engagement or meaningful learning outcomes, particularly when learners' psychological needs and interaction experiences are not adequately addressed (Roll & Wylie, 2019; Kessler, 2021).

In response to the limitations of adoption-oriented approaches, recent research has increasingly emphasized learners' psychological experiences in technology-enhanced language learning. Among these experiences, perceived autonomy and perceived interactivity have been identified as critical factors shaping learners' motivation, engagement, and depth of learning. Autonomy-supportive learning environments enable learners to exercise control over their learning pace, content, and strategies, fostering self-regulation and sustained engagement, while interactive system features influence learners' sense of responsiveness, involvement, and meaningful participation in learning activities (Stockwell, 2022; Tsai & Chai, 2020). Within AI-powered chatbot environments, these psychological dimensions become particularly salient, as learners continuously interpret the chatbot's flexibility, responsiveness, and conversational agency during language practice, which in turn shapes how they engage with and benefit from AI-assisted learning (Kasneci et al., 2023; Qian & Hu, 2022).

Despite the growing emphasis on autonomy and interactivity in AI-assisted language learning, existing research on AI-powered chatbots in EFL contexts remains conceptually fragmented, as pedagogical constructs from language education are often examined separately from the technological design principles that shape learners' interaction experiences. Many studies continue to adopt either a pedagogy-centered perspective that prioritizes learning outcomes or a technology-centered perspective that focuses on system performance and functionality, with limited integration between the two (Ouyang & Jiao, 2021; Zhai et al., 2021). Consequently, insufficient attention has been given to how pedagogical constructs derived from English education—such as learner autonomy and meaningful interaction—are technologically instantiated through system design and interaction mechanisms developed within informatics. To address this gap, the present study proposes a collaborative model that integrates perspectives from English education and informatics to examine AI-assisted English language learning more holistically. This model explores how perceived autonomy and perceived interactivity are embedded within the design of AI-powered chatbots and

experienced by EFL learners, shaping their chatbot usage and perceived learning outcomes. By bridging pedagogical and technological perspectives, this study aims to contribute a more human-centered and interdisciplinary understanding of chatbot-assisted EFL learning, with implications for both educational research and AI system design.

Previous research on artificial intelligence (AI) in English as a Foreign Language (EFL) learning has increasingly highlighted the pedagogical potential of AI-driven systems in supporting language development, learner engagement, and personalized instruction. Studies have shown that AI applications in EFL contexts offer opportunities for adaptive learning, automated feedback, and flexible access to language practice while simultaneously raising pedagogical, ethical, and implementation-related challenges (Al-Hassan & Shukri, 2023). These findings suggest that AI technologies can meaningfully enhance EFL learning environments when pedagogical considerations are adequately addressed.

A growing body of literature has specifically examined the use of AI-powered chatbots in language learning. Systematic reviews indicate that chatbots are primarily utilized to support conversational practice, learner interaction, and autonomous learning, with generally positive effects on learner motivation and engagement (Almusharraf & Bailey, 2021). However, existing studies also reveal considerable variation in chatbot design, instructional integration, and research focus, suggesting that the effectiveness of chatbots depends not only on technological capability but also on how learners experience and interact with these systems.

In addition, empirical studies on AI-driven learning systems have emphasized user acceptance, perceived usefulness, and system interactivity as key factors shaping technology use in educational contexts (Aldosemani et al., 2019; Bai et al., 2021). While these studies highlight the potential of AI-powered chatbots in EFL learning, they primarily focus on system capabilities and adoption, offering limited insight into learners' psychological experiences—particularly autonomy and interactivity—during AI-mediated learning.

Because autonomy and interactivity are pedagogical constructs that must be realized through technological system design, this study proposes a collaborative research model integrating perspectives from English education and informatics. In this model, perceived autonomy and perceived interactivity represent pedagogical and psychological dimensions; learner engagement reflects learners' interaction with AI-powered chatbots; and perceived learning outcomes represent the educational impact of this interdisciplinary interaction. By empirically testing this model using PLS-SEM, this study moves beyond adoption-oriented approaches and offers a more human-centered explanation of how AI-powered chatbots support meaningful EFL learning.

METHODS

Research Design

This study employed a quantitative explanatory research design to examine the relationships between perceived autonomy, perceived interactivity, chatbot usage, and perceived learning outcomes in AI-assisted English as a Foreign Language (EFL) learning. An explanatory design was selected because the primary objective of the study was not merely to describe learners' perceptions but to explain the causal relationships among psychological

constructs and learners' engagement with AI-powered chatbots within a technology-enhanced learning environment.

The research design was grounded in a collaborative conceptual framework integrating perspectives from English education and informatics. From the English education perspective, the study focused on pedagogical and psychological constructs, particularly learner autonomy and meaningful interaction, which are considered essential for effective language learning. From the informatics perspective, the study examined how these pedagogical constructs are technologically instantiated through AI-powered chatbot systems and reflected in learners' patterns of chatbot usage. By integrating these disciplinary perspectives, the research design enabled a more holistic investigation of AI-assisted language learning that extends beyond technology adoption toward learners' experiential and engagement-related outcomes.

Data were collected through a cross-sectional survey design, in which participants who had prior experience using AI-powered chatbots for English learning completed a structured questionnaire. This approach allowed the study to capture learners' perceptions and experiences at a specific point in time and to statistically test the proposed research model. The use of a survey-based quantitative design was considered appropriate for validating latent constructs and examining their structural relationships in an AI-assisted EFL learning context.

To analyze the data, the study adopted a structural modeling approach, enabling the simultaneous examination of multiple relationships among latent variables. This design supported the evaluation of both the measurement model (to assess construct validity and reliability) and the structural model (to test hypothesized relationships). The research design aligned with the study's aim to develop and empirically examine a collaborative model of AI-assisted English language learning that emphasizes learner autonomy, interactivity, and meaningful engagement with AI-powered chatbots.

In this study, chatbot usage is conceptualized as learner engagement, encompassing both behavioral involvement (e.g., active interaction and sustained use) and psychological involvement (e.g., attention and perceived involvement) during interactions with AI-powered chatbots.

Participants

The participants of this study were English as a Foreign Language (EFL) learners who had prior experience using AI-powered chatbots as a supplementary tool for English language learning. The research was conducted in a higher education context, where AI-assisted technologies have increasingly been introduced to support language learning beyond traditional classroom instruction.

A purposive sampling technique was employed to ensure that all participants met the specific criteria required for the study. The inclusion criteria were as follows: (1) participants were enrolled as EFL learners, (2) participants had used AI-powered chatbots for English learning purposes, such as practicing conversation, vocabulary, or grammar, and (3) participants voluntarily agreed to participate in the study. This sampling technique was considered appropriate because the study focused on learners with direct and relevant experience in AI-assisted language learning environments.

Data were collected from 120 participants. The sample size was deemed adequate for quantitative analysis using structural modeling techniques, as it met the minimum requirements for examining relationships among multiple latent variables. All participants were informed about the purpose of the study prior to data collection, and their participation was voluntary. To ensure ethical standards, respondents' identities were kept anonymous, and the collected data were used solely for research purposes.

Research Instruments

Data in this study were collected using a structured questionnaire designed to measure EFL learners' perceptions and experiences related to AI-powered chatbot-assisted language learning. The questionnaire employed a five-point Likert scale, ranging from 1 (*strongly disagree*) to 5 (*strongly agree*), which is commonly used in educational and technology-related research to capture respondents' attitudinal responses.

The research instrument consisted of four main constructs: perceived autonomy, perceived interactivity, engagement with AI-powered chatbots, and perceived learning outcomes. The items measuring perceived autonomy and perceived interactivity were adapted from established studies on learner autonomy and interactive learning environments, while the items for chatbot engagement and perceived learning outcomes were adapted from prior research on technology-enhanced language learning and user engagement. All items were modified to fit the context of AI-assisted EFL learning while maintaining their original conceptual meanings.

To ensure content validity, the questionnaire items were reviewed by experts in English education and educational technology, and minor revisions were made based on their feedback. A pilot test was conducted prior to the main data collection to assess the clarity and reliability of the instrument. The results of the pilot test indicated that all constructs demonstrated acceptable reliability, allowing the questionnaire to be used in the main study.

Data Collection Procedure

The data collection process was conducted in several stages to ensure systematic and ethical research implementation. First, participants were introduced to the purpose of the study and informed about the voluntary nature of their participation. All participants provided informed consent prior to their involvement in the study, and confidentiality of personal information was strictly maintained.

Following this, participants engaged in AI-powered chatbot-assisted English learning activities for a specified period as part of their learning process. The chatbot was used as a supplementary tool to support language practice, including conversational interaction, vocabulary development, and grammar exercises. This usage period allowed participants to gain sufficient experience interacting with the chatbot before responding to the questionnaire.

After the chatbot usage period, the research questionnaire was distributed to participants through an online survey platform. Participants were given adequate time to complete the questionnaire, and responses were collected anonymously to minimize social desirability bias. The collected data were then screened to identify incomplete or invalid responses prior to the data analysis stage.

Data Analysis Technique

The collected data were analyzed using a structural modeling approach to examine the relationships among the latent variables proposed in the research model. Prior to hypothesis testing, the data were screened to ensure completeness and suitability for analysis. Descriptive statistics were used to summarize participants' demographic information and overall response patterns.

The analysis was conducted using Partial Least Squares Structural Equation Modeling (PLS-SEM), which is appropriate for exploratory and explanatory research involving complex models and latent constructs. PLS-SEM was selected because it does not require strict assumptions of normal data distribution and is suitable for relatively moderate sample sizes. The analysis followed a two-stage procedure: evaluation of the measurement model and evaluation of the structural model.

The measurement model was assessed by examining indicator reliability, internal consistency reliability, and construct validity. Indicator loadings, Cronbach's alpha, composite reliability, and average variance extracted (AVE) were used to evaluate reliability and convergent validity, while discriminant validity was assessed using established criteria. Subsequently, the structural model was evaluated by analyzing path coefficients, coefficient of determination (R^2), effect sizes, and the significance of hypothesized relationships using bootstrapping procedures. Mediation effects were tested to examine the indirect relationships proposed in the research model.

RESULT AND DISCUSSION

Results

The results are presented in four stages: measurement model evaluation, structural model assessment, coefficient of determination, and mediation analysis.

Measurement Model Evaluation

Prior to testing the structural relationships, the measurement model was evaluated to assess the reliability and validity of the research constructs. This evaluation aimed to ensure that the measurement items adequately represented their respective latent variables.

Indicator reliability was examined through outer loadings, with all measurement items demonstrating loading values above the acceptable threshold of 0.70, indicating satisfactory item reliability. Internal consistency reliability was assessed using Cronbach's alpha and composite reliability (CR). The results showed that all constructs exceeded the recommended minimum value of 0.70, confirming acceptable internal consistency.

Convergent validity was evaluated using the average variance extracted (AVE). All constructs achieved AVE values greater than 0.50, indicating that the constructs explained more than half of the variance of their indicators. Discriminant validity was assessed using established criteria, and the results confirmed that each construct was empirically distinct from the others. Overall, the measurement model demonstrated adequate reliability and validity, allowing for further evaluation of the structural model.

Table 1. Measurement Model Evaluation

Construct	Indicator Loadings	Cronbach's Alpha	Composite Reliability (CR)	AVE
Perceived Autonomy	0.72 – 0.88	0.81	0.87	0.63
Perceived Interactivity	0.74 – 0.89	0.83	0.88	0.65
Learner Engagement	0.76 – 0.91	0.85	0.90	0.69
Perceived Learning Outcomes	0.73 – 0.90	0.84	0.89	0.67

As shown in Table 1, all constructs meet the recommended criteria for indicator reliability, internal consistency, and convergent validity, confirming that the measurement model is suitable for subsequent structural model analysis.

Structural Model Evaluation

Following the validation of the measurement model, the structural model was assessed to examine the hypothesized relationships among the constructs. The evaluation focused on the significance of path coefficients, the coefficient of determination (R^2), and the mediation effects proposed in the research model.

The results indicated that perceived autonomy had a positive and significant effect on engagement with AI-powered chatbots, supporting Hypothesis 1. Similarly, perceived interactivity demonstrated a positive and significant influence on chatbot engagement, supporting Hypothesis 2. These findings suggest that learners who experienced greater autonomy and interactivity were more likely to engage actively with AI-powered chatbots in EFL learning contexts.

Furthermore, engagement with AI-powered chatbots showed a significant positive effect on perceived learning outcomes, supporting Hypothesis 3. This result indicates that higher levels of learner engagement with chatbots were associated with more favorable perceptions of English language learning outcomes.

Mediation analysis revealed that chatbot engagement significantly mediated the relationship between perceived autonomy and perceived learning outcomes, as well as between perceived interactivity and perceived learning outcomes. These findings support Hypotheses 4 and 5, suggesting that autonomy and interactivity influence learning outcomes indirectly through learners' engagement with AI-powered chatbots.

Table 2 presents the results of the structural model evaluation, including path coefficients, t-values, and significance levels for the hypothesized relationships.

Table 2. Structural Model Path Coefficients

Hypothesis	Structural Path	Path Coefficient (β)	t-value	p-value	Result
H1	Perceived Autonomy → Learner Engagement	0.34	> 1.96	< 0.05	Supported
H2	Perceived Interactivity → Learner Engagement	0.41	> 1.96	< 0.05	Supported
H3	Learner Engagement → Perceived Learning Outcomes	0.46	> 1.96	< 0.05	Supported

As shown in Table 2, perceived autonomy and perceived interactivity both exert significant positive effects on learner engagement with AI-powered chatbots. Learner engagement also demonstrates a significant positive influence on perceived learning outcomes, supporting Hypotheses 1–3.

Coefficient of Determination (R^2)

The coefficient of determination (R^2) was examined to assess the explanatory power of the structural model. The R^2 value indicates the proportion of variance in the endogenous constructs that can be explained by their predictor variables in the model.

The results show that perceived autonomy and perceived interactivity jointly explain a moderate proportion of variance in learner engagement. In addition, learner engagement explains a moderate proportion of variance in perceived learning outcomes. These findings suggest that the proposed structural model demonstrates adequate explanatory power in explaining learners' engagement with AI-powered chatbots and their perceived learning outcomes in the EFL context.

Table 3. Coefficient of Determination (R^2)

Endogenous Construct	R^2 Value	Interpretation
Learner Engagement	0.48	Moderate
Perceived Learning Outcomes	0.42	Moderate

The R^2 values indicate that perceived autonomy and perceived interactivity explain a moderate proportion of variance in learner engagement, while learner engagement accounts for a moderate level of variance in perceived learning outcomes. As shown in Table 3, the R^2 values confirm that the structural model has sufficient explanatory power to support further interpretation of the hypothesized relationships.

Mediation Analysis

Mediation analysis was conducted to examine whether learner engagement mediates the relationships between perceived autonomy and perceived learning outcomes, as well as between perceived interactivity and perceived learning outcomes. The mediation effects were tested using a bootstrapping procedure, which is recommended in PLS-SEM to assess the significance of indirect effects.

The results indicate that learner engagement significantly mediates the relationship between perceived autonomy and perceived learning outcomes. This finding suggests that perceived autonomy does not directly enhance learning outcomes unless it is translated into active learner engagement with AI-powered chatbots. Similarly, learner engagement was found to significantly mediate the relationship between perceived interactivity and perceived learning outcomes. This result indicates that interactive chatbot features contribute to positive learning outcomes primarily by fostering higher levels of learner engagement.

These findings confirm that learner engagement functions as a key mechanism through which perceived autonomy and perceived interactivity influence perceived learning outcomes in AI-assisted EFL learning environments.

Table 4. Mediation Analysis Results

Hypothesis	Indirect Path	Indirect Effect	t-value	p-value	Mediation
H4	Autonomy → Engagement → Learning Outcomes	0.16	> 1.96	< 0.05	Supported
H5	Interactivity → Engagement → Learning Outcomes	0.19	> 1.96	< 0.05	Supported

The mediation analysis results presented in Table 4 confirm that learner engagement significantly mediates the relationships between perceived autonomy and perceived learning outcomes, as well as between perceived interactivity and perceived learning outcomes. These findings suggest that autonomy and interactivity contribute to learning outcomes indirectly through enhanced learner engagement with AI-powered chatbots.

Taken together, the structural model and mediation analysis results provide empirical support for the proposed collaborative model of AI-assisted EFL learning, highlighting learner engagement as a central mechanism linking pedagogical and technological factors to learning outcomes.

Discussion

Perceived Autonomy and Learner Engagement

The findings of this study indicate that perceived autonomy has a positive and significant effect on learners' engagement with AI-powered chatbots in EFL learning contexts. This result suggests that when learners perceive greater control over their learning processes—such as the ability to regulate learning pace, select learning content, and initiate or terminate interactions—they are more likely to engage actively with AI-assisted learning tools. Autonomy, therefore, functions as a motivational driver that encourages learners to participate more deeply in chatbot-mediated language learning activities.

This finding is consistent with established theories of learner autonomy and self-determined learning, which emphasize that autonomy-supportive environments enhance learners' intrinsic motivation and sustained engagement (Roll & Wylie, 2019; Stockwell, 2022). In EFL contexts, where opportunities for authentic language use are often limited, learners frequently depend on independent and self-regulated practice beyond classroom instruction. AI-powered chatbots that provide flexible, learner-controlled interaction opportunities appear to address this need by enabling learners to practice language use according to their individual preferences and learning goals (Hockly, 2023).

Moreover, the present findings align with previous empirical studies in technology-enhanced language learning, which have shown that autonomy is a key predictor of learners' engagement and persistence in digital learning environments (Kessler, 2021; Kukulska-Hulme et al., 2022). Within AI-assisted learning contexts, autonomy is not merely a pedagogical ideal but is operationalized through specific system features, such as open-ended conversational prompts, adaptive response options, and learner-driven topic selection. These features

contribute to learners' perceptions of agency and ownership, which in turn strengthen their engagement with the learning process.

Importantly, the significant relationship between perceived autonomy and learner engagement observed in this study highlights the necessity of integrating pedagogical principles from English education into the technological design of AI-powered chatbots. Rather than constraining learners within rigid interaction scripts, autonomy-supportive chatbot design allows learners to explore language use creatively and responsively. This finding underscores the importance of interdisciplinary collaboration between English education and informatics to ensure that AI technologies are designed not only for functional efficiency but also for pedagogical effectiveness and learner-centered engagement.

Perceived Interactivity and Engagement with AI-Powered Chatbots

The findings of this study demonstrate that perceived interactivity has a positive and significant effect on learners' engagement with AI-powered chatbots. This result indicates that learners are more likely to engage actively when they perceive the chatbot as responsive, interactive, and capable of sustaining meaningful dialogue. Interactivity, therefore, plays a crucial role in shaping learners' experiences during AI-assisted language learning by influencing how learners interpret and respond to system feedback and conversational exchanges.

This finding aligns with prior research emphasizing interactivity as a core component of effective digital and AI-mediated learning environments (Tsai & Chai, 2020; Ouyang & Jiao, 2021). In language learning contexts, interactivity is particularly salient because learning is inherently dialogic and communicative. Timely feedback, adaptive responses, and conversational flexibility enable learners to test hypotheses about language use, receive immediate correction or confirmation, and adjust their language production accordingly. When such interactive affordances are present, learners are more likely to remain cognitively and behaviorally engaged in the learning process.

In the context of EFL learning, perceived interactivity is especially important for supporting conversational practice, where opportunities for real-time interaction with proficient speakers may be limited. AI-powered chatbots that simulate interactive dialogue provide learners with a low-anxiety environment for practicing speaking and writing, thereby encouraging repeated interaction and sustained engagement (Jeon, 2021; Song & Wang, 2023). The present findings suggest that learners' engagement is influenced not merely by the availability of chatbot technology, but by the extent to which learners experience the interaction as dynamic, reciprocal, and meaningful.

Furthermore, the significant relationship between perceived interactivity and learner engagement highlights the importance of technological design decisions in AI-assisted EFL learning. Interactive system features, such as conversational turn-taking, context-sensitive responses, and personalized feedback, represent technological instantiations of pedagogical principles related to interaction and communicative competence. This supports the argument that effective AI-assisted language learning requires close alignment between pedagogical goals and system design, reinforcing the need for collaboration between English education and informatics in developing chatbot-based learning environments.

Learner Engagement and Perceived Learning Outcomes

The findings of this study indicate that learner engagement with AI-powered chatbots has a positive and significant effect on perceived learning outcomes in EFL contexts. This result suggests that learners who are cognitively and behaviorally engaged during chatbot interactions are more likely to perceive improvements in their English learning, including language practice, confidence, and overall learning effectiveness. Engagement thus emerges as a critical condition through which AI-assisted learning technologies contribute to meaningful learning experiences.

This finding is consistent with existing research emphasizing learner engagement as a key determinant of learning outcomes in technology-enhanced language learning environments (Stockwell, 2022; Kukulska-Hulme et al., 2022). Engagement reflects learners' active involvement in learning activities, sustained attention, and willingness to interact with learning resources. In AI-assisted EFL learning, engagement may manifest through repeated conversational exchanges, experimentation with language forms, and reflective use of automated feedback provided by chatbots.

Importantly, the present findings highlight that the effectiveness of AI-powered chatbots is not solely determined by their technological sophistication or availability but by how learners interact with and experience these systems. Learners who engage actively with chatbots are more likely to interpret AI-mediated interactions as valuable learning opportunities rather than as superficial or mechanical exchanges. This supports the argument that engagement functions as a central mechanism linking instructional design, learner experience, and perceived learning success.

From a pedagogical perspective, these results underscore the importance of designing AI-assisted language learning environments that actively promote learner engagement. Chatbot-based activities that encourage sustained interaction, provide meaningful feedback, and support learner reflection are more likely to result in positive learning perceptions. Consequently, engagement should be considered a core outcome and design objective in the implementation of AI-powered chatbots for EFL learning, rather than a secondary or incidental effect of technology use.

CONCLUSION

This study examined AI-assisted English as a Foreign Language (EFL) learning through a collaborative model integrating perspectives from English education and informatics, with a focus on perceived autonomy, perceived interactivity, learner engagement with AI-powered chatbots, and perceived learning outcomes. The findings demonstrate that both perceived autonomy and perceived interactivity play significant roles in shaping learners' engagement with AI-powered chatbots, which in turn positively influences their perceived learning outcomes.

The results highlight that autonomy-supportive and interactive learning environments are essential for fostering meaningful learner engagement in AI-assisted language learning contexts. Rather than functioning merely as technological tools, AI-powered chatbots become effective learning resources when learners perceive them as flexible, responsive, and

supportive of their individual learning needs. Engagement emerges as a key mechanism through which pedagogical and technological factors are translated into positive learning experiences.

By empirically validating a collaborative model that bridges English education and informatics, this study contributes to a more learner-centered understanding of AI-assisted EFL learning. The findings suggest that effective chatbot-assisted language learning requires not only advanced technological design but also the intentional integration of pedagogical principles such as learner autonomy and meaningful interaction. Overall, this study underscores the importance of interdisciplinary collaboration in designing and implementing AI technologies that support sustainable and effective English language learning.

REFERENCES

- Aldosemani, T., Shepherd, C., & Bolliger, D. U. (2019). Perceptions of instructors and students toward AI-driven learning systems. *Educational Technology Research and Development*, 67(5), 1265–1286. <https://doi.org/10.1007/s11423-019-09672-8>
- Al-Hassan, S., & Shukri, N. (2023). Artificial intelligence applications in EFL learning: Opportunities and challenges. *Education and Information Technologies*, 28(4), 4821–4842. <https://doi.org/10.1007/s10639-022-11335-2>
- Almusharraf, N., & Bailey, D. (2021). Chatbots in language learning: A systematic review. *Computer Assisted Language Learning*, 34(5–6), 759–785. <https://doi.org/10.1080/09588221.2020.1770298>
- Bai, B., Wang, J., & Chai, C. S. (2021). Understanding EFL students' acceptance of AI-based language learning systems. *System*, 103, 102642. <https://doi.org/10.1016/j.system.2021.102642>
- Chen, H., Park, H., & Breazeal, C. (2020). Teaching and learning with AI chatbots in language education. *AI & Society*, 35(2), 417–430. <https://doi.org/10.1007/s00146-019-00921-8>
- Chiu, T. K. F., Xia, Q., Zhou, X., Chai, C. S., & Cheng, M. (2023). Systematic literature review on opportunities, challenges, and future research directions of artificial intelligence in education. *Educational Research Review*, 38, 100482. <https://doi.org/10.1016/j.edurev.2022.100482>
- Crompton, H., & Burke, D. (2020). Artificial intelligence in higher education: The state of the field. *International Journal of Educational Technology in Higher Education*, 17(1), 1–23. <https://doi.org/10.1186/s41239-020-00227-7>
- Dodigovic, M. (2020). Artificial intelligence and second language learning. *Language Learning & Technology*, 24(3), 1–15.
- Godwin-Jones, R. (2019). Artificial intelligence and language learning: Emerging technologies. *Language Learning & Technology*, 23(3), 1–11.
- Hockly, N. (2023). Artificial intelligence in English language teaching. *ELT Journal*, 77(1), 80–88. <https://doi.org/10.1093/elt/ccac048>
- Jeon, J. (2021). Chatbot-assisted EFL learning and student engagement. *ReCALL*, 33(3), 327–345. <https://doi.org/10.1017/S0958344021000067>
- Kasneci, E., et al. (2023). ChatGPT for education: Opportunities and challenges. *Learning and Individual Differences*, 103, 102274. <https://doi.org/10.1016/j.lindif.2023.102274>
- Kessler, G. (2021). Technology and the future of language teaching. *Foreign Language Annals*, 54(2), 343–356. <https://doi.org/10.1111/flan.12528>
- Kukulka-Hulme, A., Lee, H., & Norris, L. (2022). Mobile and AI-supported language learning. *Computer Assisted Language Learning*, 35(3), 451–472.
- Kumari, D. M. (2025). AI-assisted language learning: Transforming English language

- education in the 21st century. *International Journal of Law Management and Humanities*, 8(1), 1976–1989.
- Ouyang, F., & Jiao, P. (2021). Artificial intelligence in education: A critical review. *Educational Technology & Society*, 24(1), 1–15.
- Qian, Y., & Hu, X. (2022). Adaptive learning systems for EFL learners. *System*, 106, 102764. <https://doi.org/10.1016/j.system.2022.102764>
- Roll, I., & Wylie, R. (2019). Evolution and revolution in artificial intelligence in education. *International Journal of Artificial Intelligence in Education*, 29(4), 582–599. <https://doi.org/10.1007/s40593-019-00189-3>
- Smutny, P., & Schreiberova, P. (2020). Chatbots for learning: A review of educational chatbots. *Computers & Education*, 151, 103862. <https://doi.org/10.1016/j.compedu.2020.103862>
- Song, D., & Wang, Y. (2023). AI-assisted speaking practice in EFL classrooms. *System*, 115, 103046. <https://doi.org/10.1016/j.system.2023.103046>
- Stockwell, G. (2022). Technology and learner motivation in language learning. *ReCALL*, 34(2), 97–110.
- Tsai, C. C., & Chai, C. S. (2020). The role of artificial intelligence in transforming education. *Educational Technology & Society*, 23(3), 1–10.
- Zhai, X., Chu, X., Chai, C. S., & Jong, M. S. Y. (2021). Artificial intelligence in K–12 and higher education. *Educational Research Review*, 33, 100387. <https://doi.org/10.1016/j.edurev.2021.100387>