EDUCATIONAL SCIENCES: THEORY & PRACTICE eISSN: 2148-7561, ISSN: 2630-5984

Received: 03 March 2024
Revision received: 16 April 2024
Accepted: 18 May 2024

Copyright © 2024 **JESTP**
www.jestp.com

DOI 10.12738/jestp.2024.1.023♦ **January** 2024 ♦ 24(1) ♦ 306-322

Article

AI-Based Corrective Feedback in EFL Interactive Speaking: Insights from Interactionist SLA Theory

Haiyan Yan*
School of Languages, Civilisation and Philosophy, Universiti Utara Malaysia, Sintok, Malaysia.
School of Humanities,Shandong Management University, Jinan, China.
ORCID iD: https://orcid.org/0009-0005-3513-9410
Email: annieyan99@163.com

Manvender Kaur Sarjit Singh
School of Languages, Civilisation and Philosophy, Universiti Utara Malaysia, Sintok, Malaysia.
ORCID iD: https://orcid.org/0000-0002-1571-9312
Email: manvender@uum.edu.my

Rafizah Mohd Rawian
School of Languages, Civilisation and Philosophy, Universiti Utara Malaysia, Sintok, Malaysia.
ORCID iD: https://orcid.org/0000-0003-1407-3967
Email: rafizah@uum.edu.my

Abstract

This study explores the effectiveness of artificial intelligence (AI)-driven corrective feedback in enhancing the speaking accuracy and fluency of learners of English as a Foreign Language (EFL), drawing upon principles from Interactionist Second Language Acquisition (SLA) theory. The investigation seeks to understand the impact of AI technologies on learners within language education settings, particularly during oral task performance. The research involved 20 EFL students who engaged with varying levels of AI language tools. Data collection was conducted through semi-structured interviews and group discussions. A thematic analysis was performed using NVivo software. Findings indicate that participants showed notable improvements in grammatical accuracy and spoken fluency as a result of engaging with AI-based training. However, students identified limitations in the AI feedback, particularly the lack of tailored explanations and affective support, which are typically offered by human instructors. Although AI demonstrated considerable capability in delivering corrective input, learners continued to prefer teacher-led evaluations. This study contributes to the academic discourse in the EFL domain by critically examining both the advantages and shortcomings of incorporating AI into speaking instruction. It suggests that blending conventional pedagogical methods with AI tools may foster more effective spoken language development.

Keywords

AI-Based Corrective Feedback, EFL Speaking Instruction, Interactionist SLA Theory, Pronunciation and Fluency, Learner Perceptions.

Correspondence to Haiyan Yan, School of Languages, Civilisation and Philosophy, Universiti Utara Malaysia, Sintok, Malaysia. School of Humanities,Shandong Management University, Jinan, China. ORCID iD: https://orcid.org/0009-0005-3513-9410, Email: annieyan99@163.com

Citation: Yan, H., Singh, M. K. S., & Rawian, R. M. (2024). AI-Based Corrective Feedback in EFL Interactive Speaking: Insights from Interactionist SLA Theory. *Educational Sciences: Theory and Practice, 24*(1), 306 - 322.
http://dx.doi.org/10.12738/jestp.2024.1.023

Introduction

Recent advancements in AI have significantly influenced educational practices, particularly within the domain of language learning. EFL learners increasingly benefit from AI technologies that offer instant corrective feedback during interactive speaking activities, as these learners often encounter persistent difficulties in developing oral proficiency (Topping, 2023). AI-powered corrective feedback systems are designed to deliver real-time error identification along with targeted suggestions, thereby supporting learners in achieving greater accuracy in their spoken output. The convergence of AI technologies with language learning, especially within the context of Interactive Speaking, presents a fertile ground for scholarly inquiry and pedagogical innovation (Mindrescu et al., 2022). Incorporating AI into EFL speaking evaluations fosters a dynamic environment in which students receive personalised, immediate responses to their spoken performance.

Unlike traditional classrooms, where teachers face considerable constraints in providing prompt and extensive feedback to large groups of students, AI-based tools offer continuous and scalable correction capabilities (Khammat, 2022). These systems facilitate learner autonomy and encourage the independent refinement of speaking skills through accessible and efficient practice. The academic investigation of corrective feedback in SLA has grown, drawing upon various theoretical frameworks to assess its pedagogical value. According to Interactionist SLA Theory, meaningful communication among learners enhances language acquisition, with timely and appropriate feedback playing a crucial role in refining grammar, pronunciation, and fluency. While traditional methods have consistently demonstrated effectiveness, the integration of AI introduces new dimensions to feedback delivery that may complement existing pedagogical approaches (Makoelle, 2020). Empirical studies suggest that AI-generated feedback contributes to improved spoken language proficiency and increases learner motivation. However, there remains a gap in understanding how these AI systems can align with established SLA theories, particularly the Interactionist model, to optimise their impact in EFL speaking contexts. This study seeks to address this gap by examining the role of AI-driven corrective feedback in enhancing EFL learners' speaking competencies through an interactionist lens.

Objectives

The present study is guided by the following research objectives:

1. To examine the impact of AI-driven corrective feedback on the accuracy and fluency of spoken language among EFL learners.
2. To determine the most effective AI-generated feedback approaches that align with the principles of Interactionist Second Language Acquisition theory.
3. To investigate how EFL learners perceive and respond to AI-based corrective feedback during interactive speaking activities.
4. To assess the key challenges and constraints associated with the implementation of AI-supported corrective feedback in EFL speaking instruction.

Scope of the Study

This research examines the provision of corrective feedback by AI systems within interactive EFL speaking contexts, guided by the theoretical framework of Interactionist SLA Theory. The study evaluates the capacity of AI technologies to deliver immediate, targeted responses that align with key tenets of Interactionist SLA, particularly those concerning learner interaction, the negotiation of meaning, and feedback dynamics. It further aims to assess the influence of AI-based correction tools on learners' spoken accuracy, fluency, and overall performance in communicative tasks. Additionally, the investigation seeks to understand learners' experiences with AI-driven feedback mechanisms and to evaluate their potential in fostering increased engagement and motivation in the process of acquiring English as a foreign language.

Research Gap

Existing research on AI-driven corrective feedback in EFL interactive speaking has largely focused on outcome-based assessments using quantitative methodologies. However, there is a notable gap in the literature concerning learners' perceptions of AI-generated feedback, particularly in relation to their experiences and levels of engagement with such systems. Although Interactionist SLA theory underscores the significance of feedback

within meaningful communicative exchanges, there remains a shortage of qualitative studies that explore learners' responses to different types of AI feedback during real-time speaking tasks. Furthermore, limited attention has been paid to the influence of sociocultural factors on learner receptivity to AI-supported feedback, and the practical challenges associated with integrating such technology into instructional settings have not been adequately addressed. Employing qualitative research approaches could yield valuable insights into the strengths and limitations of AI-based corrective feedback systems within the context of EFL speaking instruction.

Literature Review

AI-Based Corrective Feedback

AI technologies facilitate automated, real-time correction of spoken errors through AI-based corrective feedback, increasingly recognised as a crucial element in contemporary language learning. This growing focus stems from the capacity of AI to offer continuous, tailored assistance to language learners. Within the EFL instructional context, AI feedback mechanisms enable instructors to address a wide range of linguistic components, including pronunciation, grammar, syntax, and fluency (Shcherbakova et al., 2021). These systems are capable of detecting errors and delivering immediate corrections along with actionable suggestions, thereby assisting learners in recognising their mistakes and monitoring their progress. The effectiveness of AI-generated feedback in improving the accuracy and fluency of EFL learners depends on several variables, such as the nature of the feedback (e.g., grammatical or phonetic), the timing of its delivery (immediate or delayed), and the manner in which learners engage with the feedback (Fitria, 2022).

AI-based systems provide direct correction for issues related to pronunciation, grammar, syntax, and overall spoken performance, offering learners a practical means of identifying linguistic errors and refining their communication skills (Koe, Kustandi, & Siregar, 2024). The impact of such feedback is largely influenced by the integration of feedback types, optimal timing, and the interaction strategies employed by students. These systems rely on machine learning (ML) and natural language processing (NLP) techniques for error identification and correction. Automatic Speech Recognition (ASR) enables the transcription of spoken input, which is then processed using NLP methods to assess grammatical structures and sentence construction (Shi & Aryadoust, 2024). Pronunciation is evaluated by comparing learner speech against native speaker models, while Grammatical Error Correction (GEC) systems apply transformation-based rules to refine syntax and grammar. Additional tools such as fluency scoring and prosodic analysis evaluate rhythm, stress, and intonation patterns to assess spoken language quality (Izadi & Forouzanfar, 2024). Nonetheless, AI feedback has limitations, particularly in its ability to comprehend contextual nuances, tone, and cultural aspects, which can impact the accuracy and relevance of its corrections.

Despite these limitations, data-driven AI systems create personalised learning opportunities that support the development of speaking proficiency and align with the broader objective of equipping learners with effective real-world communication skills (Afzaal et al., 2024). The accuracy and usefulness of feedback largely depend on the sophistication of the AI system, especially those integrated with NLP and speech recognition technologies. However, challenges persist as AI systems often struggle to interpret subtleties such as tone, context, and cultural cues (Tsang, 2022). The feedback mechanism used in this context is based on Google Cloud Platform's NLP libraries, incorporating OpenAI's GPT models, including GPT-3.5 Turbo, GPT-4, and GPT-4 (0613). These models were assessed for response speed, feedback depth, and relevance. Their integration enables the system to generate high-quality, instant feedback suitable for educational purposes. The system operates through a learning management system interface, providing learners with AI-generated language support (Koe et al., 2024). As such, AI-driven corrective feedback contributes significantly to language development by offering specialised, individualised practice that traditional instruction may struggle to deliver. A focused examination of this variable is essential to determine the extent to which such systems enhance speaking accuracy and fluency, thereby supporting the overarching aim of developing competent, real-world communication skills (Tan et al., 2023).

AI-Generated Feedback Strategies

The methods employed by AI systems to generate feedback for learners constitute what are referred to as AI-generated feedback strategies. These systems typically provide four key types of feedback: direct error corrections, suggestions for alternative sentence structures, corrective prompts, and personalised feedback based

on learners' prior performance records (Matsuzaka & Yashiro, 2023). By integrating past interaction data with performance analytics and linguistic principles, AI technologies are able to tailor feedback to meet the specific needs of individual learners. In EFL learning environments, such targeted feedback mechanisms contribute significantly to improvements in both linguistic accuracy and spoken fluency, thereby enhancing overall communicative competence (Wangsa et al., 2024).

Real-time feedback techniques, in particular, enable learners to make immediate adjustments to their spoken language, thus reinforcing correct usage patterns during active communication. Speech recognition systems offering instant feedback help identify issues in pronunciation, grammar, and vocabulary, which supports more responsive and engaging speaking activities. Alternatively, post-task feedback delivery provides learners with opportunities for reflection and deeper analysis of their errors, allowing for more thoughtful revision and learning (Pencheva, Esteve, & Mikhaylov, 2020). The strategic provision of personalised feedback—aligned with each learner's developmental trajectory—enhances both the effectiveness of correction and learner motivation. However, the success of these feedback approaches is influenced by multiple variables, including the complexity of the linguistic errors, the learners' proficiency levels, and the manner in which feedback is integrated into the instructional process (Long, Blunt, & Magerko, 2021).

The incorporation of SLA theories, particularly the Interactionist SLA Theory, strengthens AI feedback strategies by reinforcing the role of interaction in meaning-making. Learner-to-learner engagement is fundamental in fostering the negotiation of meaning and linguistic development, making it a critical element in the success of AI-supported instruction (Wang & Jiang, 2022). For AI-generated feedback to be truly effective in EFL contexts, it must be implemented in ways that support collaborative learning and promote interactive communication. The provision of context-sensitive, immediate feedback that facilitates peer dialogue and meaning negotiation ensures alignment with SLA principles, ultimately enhancing language learning outcomes (Afzaal et al., 2024).

EFL Learners' Perceptions and Responses

Understanding how language learners perceive and interact with AI-based corrective feedback systems offers valuable insights into the effectiveness and usability of these technologies. This aspect of the research focuses on examining learners' attitudes towards AI-generated corrections, as well as how these perceptions influence their motivation and language development (Dikilitaş, Bahrami, & Erbakan, 2023). EFL students may exhibit diverse reactions to AI feedback, shaped by various factors such as prior technological exposure, personal attitudes towards artificial intelligence, and their comfort with self-directed learning strategies (Khosravi, Sadiq, & Gasevic, 2020). Learners who view AI positively are more likely to demonstrate higher levels of motivation, as they perceive the system as a supportive and non-judgemental educational aid that allows independent practice. Conversely, students' engagement with AI-based platforms may decline if they hold sceptical or negative views about the technology's capabilities (Fitria, 2022).

Mistrust often arises when learners receive inaccurate or unclear feedback, leading to confusion and reduced confidence in the system. Moreover, learners' preferences for feedback style—whether they favour immediate correction or more reflective, delayed responses—significantly influence their acceptance and overall satisfaction with AI technologies (Mehrolia, Alagarsamy, & Sabari, 2021). These learner responses are critical in determining the long-term viability of integrating AI corrective systems into EFL speaking instruction. Accordingly, this study aims to explore learner perspectives to identify which aspects of AI-based feedback require refinement, ensuring alignment with user expectations and encouraging sustained engagement with the technology for future learning improvement (Muñoz et al., 2022).

Challenges and Limitations of AI-Based Feedback

The implementation of AI-based corrective feedback within EFL interactive speaking instruction presents a number of significant challenges and constraints that must be addressed to enhance its effectiveness. One of the primary issues lies in the inherent limitations of AI systems, particularly in their capacity to interpret the full complexity of human language (Bartlett, 2020). Despite technological advancements, AI still struggles with accurately processing idiomatic expressions, contextual meanings, and diverse linguistic accents, often resulting in feedback that may be imprecise or fail to address the underlying causes of learner errors (Wang & Jiang, 2022). A key shortcoming of these systems is their inability to replicate the depth of human interaction.

Although AI can provide instant responses, it lacks the empathetic engagement and context-sensitive judgement that human educators offer. Learners without direct teacher involvement may experience difficulties in achieving deeper comprehension or maintaining active participation in the learning process (Khan, Asgher, & Shah, 2025).

Moreover, the technological infrastructure required for maintaining and updating AI platforms imposes additional financial and logistical demands on institutions. Another barrier to the adoption of AI feedback tools is learner hesitancy, which often stems from a lack of trust in automated systems (Koe et al., 2024). Some students feel uneasy about receiving corrections from machines, favouring human instructors for their emotional support and interpretative guidance. Concerns over data privacy and security also contribute to resistance, as students may be reluctant to share personal information with AI systems (Liu, 2023). Trust in AI-based feedback tools can be improved through the implementation of transparent data policies, robust encryption measures, and user-controlled data access (Iqbal et al., 2020). It is essential to consider these technological and human-related limitations when integrating AI into EFL speaking instruction. Rather than replacing educators, AI systems should serve as complementary tools, supporting instructional goals while preserving the irreplaceable role of human guidance. Addressing these challenges is critical to enhancing the functionality of AI-based feedback systems and promoting their sustainable use in language learning environments (Moon, 2021).

Figure 1 presents a word cloud highlighting key concepts associated with feedback in educational settings. Prominent terms such as "feedback," "corrections," "human," and "based" underscore the emphasis placed on corrective input in learning contexts. The word cloud also features critical vocabulary such as "pronunciation," "grammar," "errors," and "interaction," reflecting the centrality of linguistic precision and communicative development. Additionally, frequently occurring terms like "teacher," "practice," "learning," and "speech" illustrate the close relationship between feedback processes and pedagogical practices. The variation in font sizes visually indicates the frequency and relative importance of these terms within the analysed data set.

Figure 1: *Word Cloud Representation of Feedback Themes.*

Methodology

This qualitative study investigates the influence of AI-based corrective feedback during EFL interactive speaking activities through the application of thematic analysis. The research involved 20 participants engaged in learning English as a foreign language, selected through purposive sampling to ensure a diverse range of fluency levels and familiarity with technology. This sampling strategy was chosen to capture a broad spectrum

of perspectives on AI-generated feedback, reflecting differences in language proficiency and digital competence. Data collection was conducted using a combination of semi-structured interviews and group discussions, offering participants the opportunity to articulate their experiences and opinions in both individual and collective settings. Semi-structured interviews enabled in-depth exploration of personal insights, while group discussions facilitated the identification of shared attitudes and collective responses toward AI feedback mechanisms. Thematic analysis was employed to systematically examine the qualitative data, focusing on three primary dimensions: learner interaction with AI feedback, the perceived effectiveness of the feedback, and the challenges encountered during its use. This methodological approach provides a comprehensive understanding of the impact of AI-driven corrective feedback on the speaking development of EFL learners.

Inclusion and Exclusion

Participants in this study were required to meet several specific conditions. They had to be EFL learners between the ages of 18 and 35, with English proficiency at an intermediate level or higher. Eligible individuals were those who had prior experience with AI-based feedback tools or expressed a willingness to engage with such tools in the context of language learning. Additionally, participants were expected to voluntarily consent to take part in both interviews and group discussions. The study excluded individuals not currently studying EFL, those with beginner-level English proficiency, and participants who lacked any exposure to AI-supported language tools. Furthermore, participants unwilling or unable to participate in both data collection formats or adhere to the established schedule were also excluded. Table 1 outlines the inclusion and exclusion criteria, offering a clear framework for identifying suitable participants and ensuring alignment with the study's objectives.

Table 1: *Inclusion and Exclusion Criteria.*

Criteria	Inclusion Criteria	Exclusion Criteria
Participant Type	EFL Learners Enrolled in Formal Language Learning Programs	Non-EFL Learners
Age	19-25 Years Old	Outside of the 19-25 Age Range
Proficiency Level	Intermediate or Above Level of English Proficiency	Beginner Level of English Proficiency
Experience with AI Tools	Prior Experience or Willingness to Engage with AI-Based Corrective Feedback Systems	No Prior Experience or Willingness to Use AI Tools for Language Learning
Participation Willingness	Voluntary Participation with Informed Consent for Semi-Structured Interviews and Group Discussions	Unwilling to Engage in Interviews or Group Discussions, or Unable to Commit to the Timeline
Language Ability	Able to Communicate in English at an Intermediate or Higher Level	Non-English Speakers or Those Unable to Communicate Effectively in English

The interview process provided in-depth insights into how EFL learners perceived the use of AI-based corrective feedback during interactive speaking activities. Complementing this, group discussions facilitated an evaluation of the effectiveness of AI feedback mechanisms while identifying potential areas for enhancement, guided by the principles of the Interactionist SLA framework. Data gathered from both interviews and discussions were transcribed and subsequently analysed to identify recurring themes and patterns in participant responses. Thematic analysis allowed the researchers to draw out key insights regarding learners' reactions and experiences. To ensure the study's validity, the findings were triangulated by integrating participant perspectives with existing literature on AI in language education, SLA theories, and established language acquisition frameworks. Ethical standards were upheld throughout the study, with all participants providing informed consent and strict confidentiality maintained during the research process. The outcomes of this study contributed to a deeper understanding of the role and effectiveness of AI-driven corrective feedback in supporting EFL speaking development, and offered practical recommendations for optimising AI integration in language instruction. Table 2 presents the demographic profile of the participants, detailing essential background characteristics and illustrating how their experiences informed the research findings.

Table 2: *Demographic Profile of Respondents.*

Participant ID	Age	Gender	Experience with AI-Based Feedback Tools	Experience in EFL Learning Contexts
1	20	Male	Familiar with AI Tools for Language Learning	2 Years of EFL Learning
2	22	Female	No Prior Experience with AI Tools	4 Years of EFL Learning
3	24	Male	Experienced with AI-Based Language Platforms	3 Years of EFL Learning
4	23	Female	Familiar with AI Tools for Language Learning	5 Years of EFL Learning
5	21	Male	No Prior Exposure to AI Feedback Systems	2 Years of EFL Learning
6	25	Female	Experienced with AI Feedback Tools	6 Years of EFL Learning
7	19	Male	Familiar with AI Tools for Language Learning	2 Years of EFL Learning
8	22	Female	No Prior Experience with AI Tools	4 Years of EFL Learning
9	20	Male	Familiar with AI Tools for Language Learning	3 Years of EFL Learning
10	23	Female	No Prior Exposure to AI Feedback Systems	3 Years of EFL Learning
11	24	Male	Experienced with AI-Based Language Platforms	5 Years of EFL Learning
12	22	Female	Familiar with AI Tools for Language Learning	4 Years of EFL Learning
13	21	Male	Experienced with AI-Based Corrective Tools	2 Years of EFL Learning
14	20	Female	No Prior Exposure to AI Feedback Systems	2 Years of EFL Learning
15	23	Male	Familiar with AI Tools for Language Learning	5 Years of EFL Learning
16	25	Female	Experienced with AI Feedback Tools	6 Years of EFL Learning
17	22	Male	No Prior Experience with AI Tools	4 Years of EFL Learning
18	24	Female	Familiar with AI Tools for Language Learning	3 Years of EFL Learning
19	21	Male	No Prior Exposure to AI Feedback Systems	2 Years of EFL Learning
20	23	Female	Experienced with AI-Based Feedback Tools	5 Years of EFL Learning

Data Collection

Table 2 presents detailed demographic information for the 20 participants, including their age, gender, prior experience with AI-based feedback systems, and their background in EFL learning. The sample comprises individuals aged between 19 and 25, offering a diverse representation across varying stages of language acquisition. This diversity enabled a comprehensive exploration of how learners with different levels of experience engage with and perceive AI-driven corrective feedback. Gender balance was maintained by including an equal number of male and female participants to ensure representational fairness. The selection process incorporated specific skill-based assessments designed to recruit individuals with varied interactions with AI tools and differing levels of English proficiency, thereby enabling researchers to gather broad and nuanced insights into learner engagement with AI feedback systems.

Data collection was conducted through semi-structured interviews and group discussions, which allowed for an in-depth examination of participant experiences and responses. A qualitative analytical approach was adopted to generate rich descriptions of learner interaction with AI in the EFL context. Thematic analysis was used to identify key patterns and emerging themes related to the perceived effectiveness of AI feedback and the challenges learners faced during its use. All data were transcribed to enable systematic analysis, uncovering a range of learning experiences associated with AI tools and their impact on language development. The analysis was further enhanced by the use of NVivo software, which facilitated efficient data organisation and supported structured exploration of participant perceptions and reactions. The interview guidelines are presented in Table 3.

Table 3: *Interview Guidelines.*

Theme	Interview Guidelines
Theme 1: Effectiveness of AI-Based Corrective Feedback in Enhancing EFL Learners' Accuracy and Fluency	1. How would you describe your experience with AI-based corrective feedback in improving your speaking accuracy (e.g., grammar, pronunciation)? 2. Can you share specific examples of how AI feedback has helped you identify and correct speaking errors? 3. Have you noticed any improvements in your speaking fluency (e.g., smoothness, coherence) since using AI-based corrective feedback? If yes, can you provide an example? 4. How do you feel about the immediacy of AI-based feedback? Does receiving instant corrections help you improve your speaking skills? 5. In your opinion, how does AI-based corrective feedback compare to traditional teacher feedback in improving your spoken language skills?
Theme 2: AI Feedback Strategies Aligned with Interactionist SLA Theory	1. In your view, how does AI feedback help facilitate interaction or negotiation of meaning during speaking tasks? 2. Do you believe that AI feedback systems provide opportunities for language learning interactions similar to those with human instructors? Why or why not? 3. How does AI feedback encourage you to engage more actively with your speaking practice? Can you provide an example? 4. How do you feel about the personalized nature of AI feedback? Does it cater to your individual needs and learning pace? 5. In your experience, how does AI feedback support or hinder the process of language learning through interaction?
Theme 3: Learners' Perceptions and Responses to AI-Based Corrective Feedback	1. What is your overall opinion on AI-based corrective feedback? Do you find it helpful or limiting? Why? 2. How do you feel about receiving corrective feedback from an AI system compared to a human instructor? Do you have any preferences? 3. Have you ever felt frustrated or discouraged by AI-based feedback? If so, what aspects of the feedback led to those feelings? 4. Do you trust the accuracy of AI-based feedback? Why or why not? 5. How motivated do you feel to continue practicing speaking after receiving AI feedback? Do you find it encouraging?
Theme 4: Challenges and Limitations of AI-Based Corrective Feedback in EFL Speaking Instruction	1. What challenges have you encountered when using AI-based corrective feedback in your speaking practice? 2. Do you think AI systems are accurate in identifying and correcting language errors, especially those involving pronunciation or grammar? 3. How do you feel about the lack of human interaction in AI-based corrective feedback? Do you miss the human touch in the correction process? 4. Have you encountered any technical difficulties when using AI tools for feedback (e.g., misrecognition of speech, slow feedback)? 5. In your opinion, what improvements would make AI-based corrective feedback more effective in EFL speaking instruction?

Thematic Analysis

The study applies thematic analysis using NVivo software to examine qualitative data obtained from semi-structured interviews and group discussions. NVivo serves as a comprehensive qualitative analysis tool, offering advanced functionalities for theme identification and pattern recognition, making it particularly well-suited for analysing interactions related to AI-based feedback in EFL interactive speaking contexts. The analytical process begins with familiarisation, during which transcribed interview and discussion data are reviewed in detail after being converted into textual format. These transcripts are then imported into NVivo's interface, enabling researchers to manage and navigate the data more effectively. Using NVivo's coding features, the researcher assigns descriptive labels (codes) to text segments relevant to the study, such as "accuracy improvement", "learner motivation", "AI feedback accuracy", and "challenges in AI usage". The software's query and visualisation functions assist in aggregating similar coded elements and identifying overarching themes emerging from participant responses. These themes are subsequently refined and interrelated to ensure they accurately reflect the underlying meanings conveyed in the data. Specific areas of interest, such as "learner engagement with AI feedback" and "technical challenges with AI tools", are examined in depth to assess the connection between AI use and learning experiences.

NVivo's visualisation capabilities, including the generation of word clouds, charts, and conceptual models, support the thematic analysis process by presenting findings in an accessible and interpretable manner. These tools enhance the interpretation of data by validating the identified themes against the study's objectives, thereby offering a well-rounded understanding of how AI-driven corrective feedback impacts EFL learners. Thematic analysis supported by NVivo offers a systematic and structured approach to explore learner interactions with AI tools, the role of such tools in improving speaking performance, and the difficulties encountered throughout the process. This is achieved through coding, categorisation, and pattern recognition techniques, including word frequency analysis, node classification, and sentiment analysis, all of which contribute to a comprehensive assessment of the learners' experiences.

Transcription and Data Preparation

The data analysis process commenced with the transcription of recorded interview audio. To ensure precision in capturing participants' responses and expressions, the research team engaged professional transcription services. A verbatim transcription approach was employed to preserve the authenticity and integrity of participant narratives. In adherence to ethical research standards, all identifying information was removed to maintain participant confidentiality. Anonymity was safeguarded through the assignment of pseudonyms to each participant. The transcripts were then systematically organised following structured data preparation procedures, enabling efficient management and analysis of the dataset. Table 4 presents an overview of the transcription and data preparation process.

Table 4: *Transcription and Data Preparation.*

Step	Description
Transcription	Verbatim transcription of the interview recordings, capturing participants' responses and expressions in a textual format.
Removal of Identifying Information	All identifiable information of participants (names, locations, etc.) was removed to ensure confidentiality. Participants were assigned pseudonyms for anonymity.
Organization	Transcripts were carefully organized and labeled to facilitate easy access and retrieval during data analysis.

Coding and Thematic Analysis

The analysis process in this study was rooted in a structured coding approach aimed at addressing the core research questions and objectives. The identification of key themes began with the application of an initial coding framework. Researchers re-listened to interview recordings to identify and extract relevant data points that corresponded with the emerging thematic categories. A systematic codebook was developed to ensure that individual data segments were consistently aligned with the appropriate themes or concepts. To ensure reliability and coherence across the coding process, inter-coder reliability was maintained through the participation of multiple researchers. Two independent coders analysed separate portions of the

interview transcripts, after which their coding decisions were compared and consolidated through coder triangulation. This collaborative approach helped ensure consistency and strengthened the validity of the thematic structure. An iterative refinement of the coding framework was conducted through reflective procedures and group discussions, which facilitated consensus and continuous enhancement of the coding scheme. This approach generated a comprehensive set of codes that encapsulated both participants' external contexts and their internal reflections. Following the refinement of the codes, thematic analysis was employed to uncover systematic patterns within the data. The relationships among various codes were evaluated based on their relevance to the study's research aims. The final themes and categories derived from this process are presented in Table 5.

Table 5: *Coding and Thematic Analysis.*

Step	Description
Preliminary Coding	Development of a coding framework based on research questions and objectives. Identifying meaningful segments in the interview data and assigning codes to represent themes or concepts.
Inter-Coder Reliability	Ensuring consistency in coding across multiple researchers. A subset of interviews was coded independently by different researchers, and any discrepancies were discussed and resolved to enhance the reliability of the coding process.
Refinement of Codes	Iterative process of refining and improving the coding framework based on discussions and consensus-building among the researchers.
Thematic Analysis	Systematic analysis of the coded data to identify recurring themes and patterns. Exploring relationships between different codes and understanding their relevance to the research objectives.
Organization	Organizing themes into meaningful categories for a comprehensive understanding of the data. Providing a basis for interpreting the data and drawing conclusions.

Thematic analysis led to the identification of four central themes, which collectively offer a comprehensive perspective on the integration of AI-based corrective feedback within EFL speaking instruction. These themes are: (1) the effectiveness of AI-driven feedback in improving learners' linguistic accuracy and fluency, (2) feedback strategies supported by principles of the Interactionist SLA framework, (3) learner perceptions and behavioural responses to AI-generated corrections, and (4) the challenges and constraints associated with implementing AI feedback in EFL speaking contexts. Together, these themes establish a coherent analytical structure for examining the pedagogical impact of AI, its potential advantages, inherent limitations, and the user experiences of participating learners.

Thematic Analysis Results

Participant experiences with AI-based corrective feedback for language learning were categorised into four primary thematic clusters, derived from a detailed analysis of the interview data. These clusters reflected both the challenges learners faced and their perspectives on the use of AI in their speaking development. The themes identified include: (1) the perceived effectiveness of AI feedback in supporting improvements in accuracy and fluency, (2) feedback approaches consistent with principles from the Interactionist SLA framework, (3) learners' attitudes and reactions to receiving AI-generated feedback, and (4) the limitations and obstacles associated with implementing AI systems in EFL speaking instruction.

Figure 2 illustrates the results of a matrix coding query, presented in the form of a three-dimensional bar chart. The x-axis displays individual participant identifiers (P1–P20), while the y-axis reflects the number of coding references, indicating the frequency with which each theme appeared across participant responses. The z-axis categorises the thematic dimensions identified in the study: AI Feedback Strategies Aligned with Interactionist SLA, Challenges and Limitations of AI-Based Corrective Feedback in EFL Speaking Instruction, Effectiveness of AI-Based Corrective Feedback in Enhancing Accuracy and Fluency, and Learners' Perceptions and Responses to AI-Based Corrective Feedback. Each bar is differentiated by height and colour, corresponding to the coding frequency, thereby offering a visual representation of how participants engaged with and responded to AI-supported feedback mechanisms.

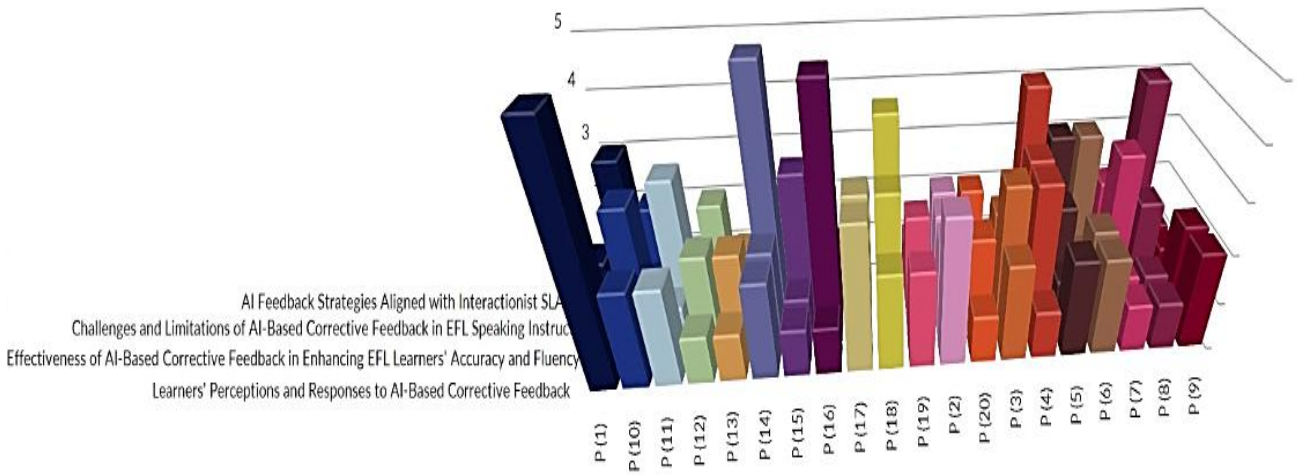

Figure 2: *Matrix Coding Query (Results Preview).*

Effectiveness of AI-Based Corrective Feedback in Enhancing EFL Learners' Accuracy and Fluency

AI-based feedback systems have demonstrated considerable effectiveness in enhancing the accuracy and fluency of EFL learners during speaking tasks. Their success lies in the ability to provide immediate, targeted assessments of linguistic features such as pronunciation, grammar, and sentence structure (Liu, 2023). The real-time nature of this feedback allows learners to promptly address their errors, reinforcing correct language use and boosting their confidence in spoken communication. AI systems are particularly adept at identifying frequent pronunciation and grammatical issues, offering alternative solutions that learners can apply immediately to improve their performance. Through integrated speech recognition functions, these tools evaluate pronunciation and guide learners in refining their vocal clarity and accent. AI's contribution to fluency development is evident in its capacity to sustain learner engagement in conversation by addressing disruptions such as pauses or hesitations (Qiao & Zhao, 2023). As learners progress, the system can adjust the complexity of feedback to match their evolving skill level, thereby supporting continued development (Bin-Hady & Al-Tamimi, 2021). This adaptive feedback mechanism contributes to more effective learning outcomes by personalising input based on individual proficiency. In large-scale educational contexts, AI systems offer scalable feedback solutions, overcoming the difficulties human instructors often face in delivering individualised support to numerous students. This technological capability positions AI as a transformative tool for enhancing the effectiveness and accessibility of EFL speaking instruction (Friedrichsen, 2020).

AI Feedback Strategies Aligned with Interactionist SLA Theory

According to the Interactionist SLA framework, interaction between learners and instructors, coupled with corrective feedback, plays a critical role in language acquisition. This theory can be effectively integrated into AI-based feedback systems by incorporating features that encourage learner engagement. Such engagement enables students to actively process corrective input while interacting with the feedback platform, thereby fostering deeper language comprehension (Chen, 2022). AI systems that provide contextualised, real-time feedback facilitate opportunities for meaning negotiation, aligning with the core tenets of the Interactionist SLA perspective. The use of immediate error detection and correction, particularly in relation to pronunciation, grammar, and vocabulary, represents a key operational function of AI systems (Khoiriyah, 2020).

The prompt delivery of corrective input enables learners to adjust their language use in real time, directly applying the principle of "negotiation of meaning" central to Interactionist SLA. This process allows learners to gradually refine their linguistic output, contributing to increased accuracy and confidence as they integrate each corrective instance into their spoken performance (Broad, 2020). AI tools also adapt feedback based on individual learner progression, supporting the interactionist notion of scaffolded learning. As learners advance, the system introduces more complex tasks and feedback, encouraging ongoing development in increasingly demanding communicative situations (Liu, 2023). Through this adaptive technological interface, students are exposed to an

interactive environment that mirrors the dynamics of human conversation, allowing them to enhance their speaking proficiency within meaningful contexts. Effective language acquisition in this model is strongly tied to AI systems that promote continuous negotiation and engagement between the learner and the feedback mechanism (Khoiriyah, 2020).

Learners' Perceptions and Responses to AI-Based Corrective Feedback

The effectiveness of AI-based corrective feedback is significantly influenced by how learners interpret and respond to it within language learning systems. While some learners view AI-generated feedback as a valuable tool for language development, others remain hesitant, citing concerns about the reliability of the technology and the absence of human guidance, which may lead to discomfort during use (Chen, 2022). Enhancing the functionality of AI feedback systems requires a thorough understanding of learner perceptions, as their expectations and preferences must be addressed to increase engagement. Many students appreciate the immediacy of AI feedback, which offers timely guidance and suggestions during speaking practice. This immediacy serves as an advantage over traditional classroom settings, where instructors may be unable to address every error in real time. Learners also favour AI feedback for its impartiality, as it allows them to make errors and receive corrections without the fear of judgement or criticism (Chen, 2022). Such a non-threatening environment encourages learners to participate more actively and speak with greater frequency. However, some learners express scepticism towards AI feedback, particularly in its capacity to analyse complex linguistic features accurately (Friedrichsen, 2020). These doubts often stem from perceptions that AI lacks the nuanced understanding of human communication necessary for effective feedback. Learner uncertainty regarding the accuracy and contextual awareness of AI systems can undermine their trust in the technology, thereby influencing how they respond to its input. To maximise the pedagogical potential of AI tools in language instruction, it is essential to address these concerns by improving system transparency and ensuring feedback reflects a deeper comprehension of human communication (Bin-Hady & Al-Tamimi, 2021).

Challenges and Limitations of AI-Based Corrective Feedback in EFL Speaking Instruction

AI-based corrective feedback systems encounter several challenges that hinder their overall effectiveness within EFL speaking instruction. A primary limitation lies in the systems' inconsistent accuracy in detecting and correcting subtle pronunciation, grammar, and syntactic errors (Chien, Hwang, & Jong, 2020). Despite technological advancements, AI still struggles with recognising various accents, dialectal variations, and non-standard linguistic expressions, often resulting in inaccurate or confusing feedback for learners (Yin, Varava, & Kragic, 2021). A critical shortcoming of AI-driven feedback is its lack of human interaction. Unlike educators, AI systems are inherently limited in replicating the pedagogical and emotional support that teachers provide in classroom settings (Yin et al., 2021). The absence of empathetic and adaptive communication creates a gap in learner engagement, as human instructors play a vital role in motivating students and responding to individual emotional and cognitive needs. AI operates on pre-programmed algorithms, which restrict its ability to tailor feedback to each learner's context, preferences, and learning style. Consequently, while some students view AI feedback as personalised, others perceive it as lacking the depth and nuance of human communication.

Technical issues such as failures in speech recognition, delayed system responses, and hardware limitations also disrupt the learning process. These interruptions may lead to disengagement, particularly among learners who have limited familiarity with digital tools (Yin et al., 2021). Furthermore, implementing and maintaining AI-based systems demands substantial infrastructure and financial resources, posing challenges for institutions operating under constrained budgets. Addressing these barriers is essential for maximising the pedagogical utility of AI feedback systems. Table 6 provides a structured overview of the main themes and their corresponding focus areas, aligned with the study's research objectives. The interplay among these components highlights that the effectiveness of AI-based feedback depends heavily on its compatibility with the Interactionist SLA framework, particularly in enhancing accuracy and fluency. The perceived quality of feedback and the level of learner engagement significantly influence both student satisfaction and performance. To achieve better educational outcomes, ongoing refinement and user-focused optimisation of AI feedback systems remain imperative.

Table 6: *Themes and their Description.*

Theme	Description
Effectiveness of AI-Based Corrective Feedback in Enhancing EFL Learners' Accuracy and Fluency	The investigation analyzes the influence of AI-based corrective feedback on student performance regarding grammar accuracy together with pronunciation and speaking fluency in verbalization tasks. The system enables live targeted responses which help students perfect their spoken skills while increasing their self-assurance.
AI Feedback Strategies Aligned with Interactionist SLA Theory	The researcher explores AI feedback methods regarding their compatibility with Interactionist SLA Theory through studies on dialog engagement and specific meaning development together with individualized instruction. The approach studies the mechanism where AI feedback creates language development by offering immediate correction and progressive learning tasks.
Learners' Perceptions and Responses to AI-Based Corrective Feedback	The theme focuses on how learners react emotionally and attitudinally to intelligent systems that provide feedback. The research investigates student views about AI feedback precision while analyzing its performance effectiveness and practical value as well as understanding its influence on learner commitment and interest.
Challenges and Limitations of AI-Based Corrective Feedback in EFL Speaking Instruction	The theme establishes the barriers and restrictions that AI encounters when offering corrective feedback in EFL speaking activities due to recognition inaccuracies and both insufficient teacher presence and technical system failures. The research both handles student apprehensions and seeks understanding regarding the future use of AI technology within traditional language educational frameworks.

Discussion

The findings of this study offer critical insights into how AI-based feedback systems contribute to the development of speaking proficiency among EFL learners. These systems demonstrated effectiveness in enhancing both accuracy and fluency by automatically identifying and correcting grammatical and pronunciation errors, as well as restructuring sentences. The provision of immediate feedback enabled learners to make real-time corrections while continuing their speech, thereby fostering an interactive learning environment and enhancing their confidence. The adaptive nature of the AI systems allowed feedback to be tailored to learners' proficiency levels, thus avoiding the risks of either insufficient or excessive challenge. When implemented in alignment with the principles of Interactionist SLA, AI feedback processes yielded favourable outcomes. The systems facilitated learner engagement in meaning negotiation through prompt correction, consistent with the core mechanisms of the Interactionist framework. This interactive feedback process supported the reinforcement of grammatical awareness and contributed to more precise language production. Learners benefitted from a learning environment that allowed instant adjustments to their spoken language, thereby promoting active skill development.

Although students expressed concerns regarding the accuracy of AI feedback and its inability to replicate complex speech tones or native-like expressions, their overall perception remained positive. Many appreciated the non-judgemental nature of the system, which offered a less intimidating context for practising speaking skills. Nonetheless, the advantages were accompanied by notable limitations. Issues such as inaccurate recognition of mispronunciations and dialectal differences negatively affected learner motivation due to the absence of personalised teacher interaction. Additionally, technical challenges—including system delays and software malfunctions—interrupted the learning process, detracting from the overall experience. Despite these constraints, the study confirms that AI-driven feedback mechanisms support language acquisition effectively. However, continued refinement of these technologies is necessary to enhance their functionality and reliability as instructional tools in EFL speaking education.

Implications

The findings of this study carry significant implications for EFL instructional practices and the broader integration of AI-based technologies in language education. AI-driven corrective feedback plays a pivotal role in supporting language development, particularly in classroom contexts where large student populations often hinder the delivery of individualised feedback. The precision and immediacy of AI-generated corrections offer substantial advantages by addressing linguistic errors in real time, thereby promoting improvements in both accuracy and fluency. Language educators are encouraged to incorporate AI tools as a means of providing supplementary instruction, thereby allowing learners to benefit from continuous feedback beyond the constraints of conventional classroom interactions. The integration of AI into language instruction also enables students to engage in speaking practice at flexible times and according to their own pace, thus supporting personalised learning trajectories. The findings suggest that AI systems should complement, rather than replace, the role of human instructors. A blended approach combining technological feedback with teacher-led guidance would provide learners with both affective support and technically accurate instruction. To ensure effective implementation, educational institutions must invest in the development and deployment of advanced AI feedback systems that are capable of addressing learner needs while overcoming technical limitations. Strategic funding and resource allocation are essential to facilitate the adoption of AI-supported learning environments that enhance EFL instruction through efficient and scalable feedback mechanisms.

Limitation of the Study

Although this study offers valuable insights into the role of AI-based corrective feedback in EFL speaking instruction, several limitations warrant consideration. While the sample of 20 participants satisfies the requirements of qualitative inquiry, it may not adequately represent the broader population of EFL learners. The limited sample size restricts the generalisability of the findings, particularly given the variation in language proficiency, learning strategies, and familiarity with AI technologies, which can significantly influence learner responses and experiences. Furthermore, the reliance on interview and group discussion data introduces potential biases, as participant responses may be affected by recall inaccuracies or the tendency to present themselves favourably. Although qualitative approaches such as thematic analysis enable in-depth investigation of learner perspectives, the interpretative nature of the method allows for multiple possible readings of the data, which may influence the consistency of conclusions. The study concentrated exclusively on AI feedback within EFL speaking contexts, thereby limiting its applicability to other educational environments or language skill areas. Additionally, the research did not assess the long-term impact of AI-based feedback on learners' speaking proficiency. As such, the sustainability of the observed improvements remains uncertain. Future research should explore whether the benefits associated with AI-supported feedback persist over extended periods and across diverse instructional settings to establish a more comprehensive understanding of its effectiveness in language education.

Suggestions for the Future Research

Further investigation into AI-based corrective feedback in EFL instruction necessitates the inclusion of more diverse participant profiles, encompassing variations in learner age, native language backgrounds, and cultural contexts. Broadening the scope of research in this way would enhance understanding of how AI feedback systems function across different learner demographics, thereby contributing to the development of globally applicable educational guidelines. It is essential that future studies examine the effectiveness of AI feedback for learners at varying proficiency levels to determine whether learner skill influences the success of these systems. Longitudinal research should also be conducted to assess the sustained impact of AI-driven feedback mechanisms. Time-series analyses could provide insights into whether improvements in speaking accuracy and fluency observed in short-term investigations are maintained over extended periods, and for how long AI feedback continues to support language development effectively. Additionally, future research should explore the integration of AI-based feedback with peer collaboration strategies to optimise pedagogical outcomes. Combining AI systems with conventional instructional approaches, such as in-person teaching, may help bridge the gap between technological and human-led feedback, fostering a more comprehensive learning environment. Investigating learners' emotional responses and motivational changes during extended engagement with AI tools would also yield important insights into how such systems influence persistence and commitment in language learning over time.

Conclusion

This study concluded its investigation into the impact of AI-based corrective feedback on EFL speaking proficiency by examining its effectiveness in improving accuracy and fluency, its alignment with Interactionist SLA Theory, learner perceptions, and the challenges associated with its implementation. The findings indicate that timely, automated corrections generated by AI systems contribute to enhanced linguistic accuracy and fluency among learners. Consistent with previous research, participants who received immediate feedback reported improved speaking confidence, underscoring the value of prompt correction in second language acquisition. The research further demonstrated that AI-based feedback supports key principles of the Interactionist SLA Theory by encouraging active interaction between learners and the feedback mechanism. Participants adjusted their language use in response to real-time corrections, resulting in more meaningful learning outcomes. While participants generally expressed favourable views towards AI feedback, some concerns were raised regarding its limitations in interpreting idiomatic expressions and tonal variations. These limitations underscore the need for ongoing refinement of AI systems to better address the complexities of natural language use. The study identified several implementation challenges, including speech recognition inaccuracies, absence of human interaction, and delays in processing spoken input. Although these issues present obstacles, the pedagogical advantages of AI-based feedback—particularly in offering scalable, individualised support—remain evident. Future research should focus on enhancing the precision and contextual sensitivity of AI tools, investigating their long-term impact on language development, and exploring optimal models for integrating human instruction with AI-driven feedback to maximise educational outcomes.

References

Afzaal, M., Zia, A., Nouri, J., & Fors, U. (2024). Informative Feedback and Explainable AI-Based Recommendations to Support Students' Self-regulation. *Technology, Knowledge and Learning, 29*(1), 331-354. https://doi.org/10.1007/s10758-023-09650-0

Bartlett, J. D. (2020). Screening for Childhood Adversity: Contemporary Challenges and Recommendations. *Adversity and Resilience Science, 1*(1), 65-79. https://doi.org/10.1007/s42844-020-00004-8

Bin-Hady, W. R. A., & Al-Tamimi, N. O. M. (2021). The use of technology in informal English language learning: evidence from Yemeni undergraduate students. *Learning and Teaching in Higher Education: Gulf Perspectives, 17*(2), 107-120. https://doi.org/10.1108/LTHE-09-2020-0037

Broad, D. (2020). Literature Review of Theories of Second Language Acquisition. *Journal of Applied Linguistics and Language Research, 7*(1), 80-86. https://www.jallr.com/index.php/JALLR/article/view/1080

Chen, Y. (2022). A Review of Research on Krashen's SLA Theory Based on WOS Database (1974-2021). *Creative Education, 13*(7), 2147-2156. https://doi.org/10.4236/ce.2022.137135

Chien, S.-Y., Hwang, G.-J., & Jong, M. S.-Y. (2020). Effects of peer assessment within the context of spherical video-based virtual reality on EFL students' English-Speaking performance and learning perceptions. *Computers & Education, 146*, 103751. https://doi.org/10.1016/j.compedu.2019.103751

Dikilitaş, K., Bahrami, V., & Erbakan, N. T. (2023). Bilingual education teachers and learners in a preschool context: Instructional and interactional translanguaging spaces. *Learning and Instruction, 86*, 101754. https://doi.org/10.1016/j.learninstruc.2023.101754

Fitria, T. N. (2022). A View of Personality a Good Language Learner: An Investigation of Non-EFL Students. *Abjadia: International Journal of Education, 7*(1), 24-41. https://doi.org/10.18860/abj.v7i1.15667

Friedrichsen, A. (2020). Second Language Acquisition Theories and What It Means For Teacher Instruction. *NWCommons*. https://nwcommons.nwciowa.edu/education_masters/200

Iqbal, R., Doctor, F., More, B., Mahmud, S., & Yousuf, U. (2020). Big data analytics: Computational intelligence techniques and application areas. *Technological Forecasting and Social Change, 153*, 119253. https://doi.org/10.1016/j.techfore.2018.03.024

Izadi, S., & Forouzanfar, M. (2024). Error Correction and Adaptation in Conversational AI: A Review of Techniques and Applications in Chatbots. *Ai, 5*(2), 803-841. https://doi.org/10.3390/ai5020041

Khammat, A. H. (2022). Investigating the Relationships of Iraqi EFL Teachers' Emotion Regulation, Resilience and Psychological Well-being. *Language Related Research, 13*(5), 613-640. https://doi.org/10.52547/LRR.13.5.22

Khan, N. W., Asgher, M., & Shah, A. (2025). Effectiveness of AI-Based Corrective Feedback in Improving Academic Writing Skills of IELTS Candidates. *Pakistan Languages and Humanities Review, 9*(1), 52-63. https://doi.org/10.47205/plhr.2025(9-I)06

Khoiriyah, K. (2020). CALL and SLA Theory: Developing A Framework to Analyze Web-based Materials for Teaching Listening Skills. *IDEAS: Journal on English Language Teaching and Learning, Linguistics and Literature, 8*(1), 80-92. https://doi.org/10.24256/ideas.v8i1.1296

Khosravi, H., Sadiq, S., & Gasevic, D. (2020). Development and Adoption of an Adaptive Learning System: Reflections and Lessons Learned. In *Proceedings of the 51st ACM Technical Symposium on Computer Science Education* (pp. 58-64). Association for Computing Machinery. https://doi.org/10.1145/3328778.3366900

Koe, L. S., Kustandi, C., & Siregar, E. (2024). AI-driven feedback system: Implementing advanced NLP and openAI for online learning. *Jurnal Inovasi dan Teknologi Pembelajaran, 11*(3), 137-148. https://doi.org/10.17977/um031v11i32024p137

Liu, Y. (2023). A Comparison of Automated Corrective Feedback and Traditional Corrective Feedback: A Review Study. *The Educational Review, USA, 7*(9), 1365-1368. https://doi.org/10.26855/er.2023.09.024

Long, D., Blunt, T., & Magerko, B. (2021). Co-Designing AI Literacy Exhibits for Informal Learning Spaces. *Proceedings of the ACM on Human-Computer Interaction, 5*(CSCW2), 1-35. https://doi.org/10.1145/3476034

Makoelle, T. M. (2020). Language, Terminology, and Inclusive Education: A Case of Kazakhstani Transition to Inclusion. *Sage Open, 10*(1), 2158244020902089. https://doi.org/10.1177/2158244020902089

Matsuzaka, Y., & Yashiro, R. (2023). AI-Based Computer Vision Techniques and Expert Systems. *Ai, 4*(1), 289-302. https://doi.org/10.3390/ai4010013

Mehrolia, S., Alagarsamy, S., & Sabari, M. I. (2021). Moderating effects of academic involvement in web-based learning management system success: A multigroup analysis. *Heliyon, 7*(5), e07000. https://doi.org/10.1016/j.heliyon.2021.e07000

Mindrescu, V., Simion, G., Turcu, I., Catuna, C., Paun, D. G., & Nechita, F. (2022). The multiplicative effect interaction between outdoor education activities based on the sensory system. *Sustainability, 14*(19), 11859. https://doi.org/10.3390/su141911859

Moon, D. (2021). Evaluating Corrective Feedback Generated by an AI-Powered Online Grammar Checker. *International Journal of Internet, Broadcasting and Communication, 13*(4), 22-29. https://doi.org/10.7236/IJIBC.2021.13.4.22

Muñoz, J. L. R., Ojeda, F. M., Jurado, D. L. A., Peña, P. F. P., Carranza, C. P. M., Berríos, H. Q., et al. (2022). Systematic Review of Adaptive Learning Technology for Learning in Higher Education. *Eurasian Journal of Educational Research, 98*(98), 221-233. https://doi.org/10.14689/ejer.2022.98.014

Pencheva, I., Esteve, M., & Mikhaylov, S. J. (2020). Big Data and AI–A transformational shift for government: So, what next for research? *Public Policy and Administration, 35*(1), 24-44. https://doi.org/10.1177/0952076718780537

Qiao, H., & Zhao, A. (2023). Artificial intelligence-based language learning: illuminating the impact on speaking skills and self-regulation in Chinese EFL context. *Frontiers in Psychology, 14*, 1255594. https://doi.org/10.3389/fpsyg.2023.1255594

Shcherbakova, I., Kovalchuk, N., Timashova, M., Konkin, B., & Soprantsova, J. (2021). Digitalization of Education and Its Impact on the Teaching of Foreign Languages to Students of Technical Universities. *E3S Web of Conferences, 273*, 12019. https://doi.org/10.1051/e3sconf/202127312019

Shi, H., & Aryadoust, V. (2024). A systematic review of AI-based automated written feedback research. *ReCALL, 36*(2), 187-209. https://doi.org/10.1017/S0958344023000265

Tan, M., Kilani, H., Markov, I., Hein, S., & Grigorenko, E. L. (2023). Assessing Cognitive Skills in Early Childhood Education Using a Bilingual Early Language Learner Assessment Tool. *Journal of Intelligence, 11*(7), 143. https://doi.org/10.3390/jintelligence11070143

Topping, K. J. (2023). Digital Peer Assessment in School Teacher Education and Development: A Systematic Review. *Research Papers in Education, 38*(3), 472-498. https://doi.org/10.1080/02671522.2021.1961301

Tsang, A. (2022). Examining the Relationship Between Language and Cross-Cultural Encounters: Avenues for Promoting Intercultural Interaction. *Journal of Multilingual and multicultural Development, 43*(2), 98-110. https://doi.org/10.1080/01434632.2020.1725526

Wang, L., & Jiang, N. (2022). Managing Students' Creativity in Music Education – The Mediating Role of Frustration Tolerance and Moderating Role of Emotion Regulation. *Frontiers in Psychology, 13*, 843531. https://doi.org/10.3389/fpsyg.2022.843531

Wangsa, K., Karim, S., Gide, E., & Elkhodr, M. (2024). A Systematic Review and Comprehensive Analysis of Pioneering AI Chatbot Models from Education to Healthcare: ChatGPT, Bard, Llama, Ernie and Grok. *Future Internet, 16*(7), 219. https://doi.org/10.3390/fi16070219

Yin, H., Varava, A., & Kragic, D. (2021). Modeling, learning, perception, and control methods for deformable object manipulation. *Science Robotics, 6*(54), eabd8803. https://doi.org/10.1126/scirobotics.abd8803