INTERACTION: Jurnal Pendidikan Bahasa Vol. 12, No.4; Desember 2025
P-ISSN: 2406-9558; E-ISSN: 2406-9566

Optimizing AI-Based Adaptive English Language Learning for Students with Special Educational Needs

Sitti Maryam Hamid
maryamhamid@unismuh.ac.id
Universitas Muhammadiyah Makassar

ABSTRACT

This study investigates the design and implementation of an AI-based adaptive English as a Foreign Language (EFL) model for students with special educational needs (SEN) in a resource-constrained Indonesian special school. The research aimed to align adaptive technology with heterogeneous learner profiles and priority English competencies to enhance accessibility, engagement, and learning outcomes. A descriptive qualitative design with supportive quantitative elements was employed, combining classroom observations, semi-structured interviews with teachers and teaching assistants, analysis of individual education plans and curriculum documents, and learning analytics from an adaptive AI platform, collected across multiple SEN classes (N = 4 students and 3 teachers/assistants) over 16 weeks. The findings from the needs analysis confirmed substantial variation in cognitive levels, sensory modalities, and communication preferences, leading to the specification of target competencies in foundational vocabulary, basic oral interaction, and early literacy. The selected AI platform, configured according to Universal Design for Learning principles, delivered multimodal materials, adjustable difficulty, and locally meaningful scenarios within blended and station-rotation lesson structures. This architecture, organised into warm-up, AI-driven core tasks, and consolidation phases, was associated with increased on-task behaviour, more frequent oral participation, and higher completion rates of adaptive exercises. Learning analytics indicated progressive gains in accuracy and reductions in time-on-task, while enabling data-informed differentiation and strengthening teachers' and assistants' instructional efficacy. These results suggest that carefully localised and pedagogically orchestrated AI-based adaptive systems can support more inclusive and motivating EFL environments for SEN learners in low-resource, non-English-dominant contexts without displacing teacher professional judgement.

Keywords: AI-Based Adaptive Learning; Special Educational Needs; EFL

INTRODUCTION

Artificial intelligence (AI) is increasingly reshaping English as a Foreign Language (EFL) instruction in primary and secondary education worldwide. A growing body of research shows that AI-enhanced environments can personalise learning trajectories, increase learner engagement, and support more autonomous forms of language learning (Moybeka et al., 2023; Saleem et al., 2025). AI-powered tools

such as chatbots, intelligent tutoring systems, and adaptive learning platforms provide real-time feedback, automated assessment, and customised learning paths that respond dynamically to learner performance and preferences (Konyrova, 2024; Okunade, 2024). These technologies have been associated with higher levels of motivation and persistence in EFL learning, particularly when learners are given opportunities to practise speaking and writing beyond the temporal and spatial boundaries of the classroom (Lu et al., 2022; Nagaraj et al., 2023; Shalevska, 2023) The integration of AI into EFL education is also linked to positive affective outcomes. Studies report that AI-supported environments can reduce language-learning anxiety, strengthen learners' self-efficacy, and foster more positive attitudes towards English (Hamid et.al., 2025; Solehuddin et al., 2023; Zhang & Liu, 2025). Interactive, low-stakes practice with AI agents or adaptive exercises can lessen the intimidation that often accompanies oral participation in class and help learners gradually build confidence in using English for communication (Hockly, 2023; Ramzan et al., 2023). In line with contemporary pedagogical orientations that emphasise engagement, participation, and learner-centred approaches, AI tools are increasingly seen as aligned with efforts to create more immersive, responsive, and emotionally supportive EFL learning environments (Eldin, 2024).

Despite these promising developments, EFL learners with special educational needs (SEN) in inclusive and special school settings continue to encounter substantial barriers. These barriers stem from cognitive challenges, such as limitations in information processing, working memory, and language comprehension, which can hinder the acquisition of vocabulary and grammatical structures (Kushmar et al., 2022; Sharifuddin & Hashim, 2024). Emotional factors, including heightened anxiety, low self-esteem, and reduced academic self-concept, may further constrain participation and persistence in language-learning activities. In addition, sensory and motor impairments can restrict learners' access to conventional classroom materials and interaction formats, thereby reducing opportunities for meaningful language use.

At the instructional level, many EFL classrooms serving SEN learners still rely on relatively uniform, teacher-fronted methods that are poorly matched to the diverse learning profiles present in these settings. A one-size-fits-all approach risks marginalising students whose needs deviate from normative expectations of pace, modality, or mode of participation. While assistive technologies and AI-powered tools have been proposed as promising avenues for more personalised and flexible support, their effective implementation is far from guaranteed. Teachers often report limited training, uncertainty about how to adapt AI tools for SEN learners, and concerns about workload and technical reliability (Ifraheem et al., 2024; Zainuddin et al., 2024). These issues underscore the need for context-sensitive models that translate the general promise of AI-enhanced EFL into concrete, workable practices in SEN settings.

Within the broader field of technology-enhanced language learning (TELL), adaptive learning systems have been conceptualised as AI-driven approaches that

tailor instructional content, sequencing, and feedback to individual learner characteristics. Such systems draw on learner data including proficiency level, response patterns, and behavioural indicators to adjust difficulty, pacing, and support in ways that aim to optimise motivation and learning (Urbaite, 2025). Empirical studies demonstrate that AI-generated formative feedback in writing can improve engagement and writing quality among EFL learners, indicating the power of personalised, timely feedback. Similarly, AI-based models have been shown to enhance vocabulary retention and speaking fluency when compared with traditional instructional approaches. These findings corroborate broader claims that adaptive AI systems can foster more individualised and effective EFL learning experiences (Safarli et al., 2025).

AI-driven tutoring systems further illustrate the potential of adaptive technologies to sustain engagement and support learning processes. Intelligent tutoring systems that integrate affective computing, user modelling, and formative feedback mechanisms have been associated with increased student participation and improved academic outcomes. AI frameworks that incorporate interactive tasks, gamified feedback, and learner analytics can promote active involvement in language classrooms and support retention of key skills (Polamuri et al., 2024). Research also suggests that formative feedback generated by AI tutors can help to alleviate learner anxiety and enhance motivation by providing supportive, non-judgmental guidance in real time. Collectively, this literature indicates that adaptive, AI-supported environments hold particular promise for learners who may require more intensive and differentiated support.

Parallel developments in inclusive education highlight both opportunities and constraints for SEN learners, especially in low- and middle-income countries (LMICs) such as Indonesia. Inclusive education is widely endorsed as a means of promoting the social and educational participation of students with disabilities, yet implementation is often hampered by limited facilities, inadequate teacher preparation, and socio-cultural attitudes toward disability (Santi et al., 2025). In Indonesia, schools frequently struggle to provide disability-friendly infrastructure and systematically adapted curricula across subjects, including English (Zulkarnain, 2025). Existing studies emphasise the need for individualised and structured learning strategies for students with intellectual and other disabilities, but they rarely examine how AI-driven and adaptive technologies might be mobilised to support EFL learning in special schools (Aishah et al., 2024). Current research tends to focus either on general EFL populations or on a narrow subset of disabilities, with limited attention to diverse disability profiles and real classroom conditions in special education settings (Abdoulqadir & Loizides, 2025; Boladeras et al., 2023; Srivastava et al., 2021).

Furthermore, the literature identifies critical gaps in teacher preparation for the pedagogically sound use of AI and assistive technologies in special education. Professional development structures often fail to equip teachers with the knowledge and skills needed to interpret AI-generated data, align adaptive learning paths with

individualized education plans, and manage heterogeneous learning groups in technology-rich environments As a result, the transformative potential of AI-based adaptive learning for SEN learners remains under-realised. There is a pressing need for empirical studies that not only document the affordances of AI tools but also examine how they can be integrated into coherent instructional designs in special schools, taking into account infrastructural constraints, teacher agency, and the lived experiences of learners with diverse disabilities (Sánchez et al., 2024).

Against this backdrop, the present study addressed the following research questions: (1) What are the English language learning needs, learner profiles, and target competencies of students with special educational needs in the participating special school, and how do these characteristics inform the design principles of an AI-based adaptive EFL model? (2) How can an AI-based adaptive EFL platform be selected, localised, and configured to ensure accessibility, multimodal interaction, and contextual relevance in a resource-constrained, non-English-dominant special school setting? (3) In what ways are AI-based tools integrated into lesson planning and classroom pedagogy particularly within blended, flipped, and station-rotation structures to support engagement, motivation, and participation among SEN learners in EFL lessons? (4) How do teachers and teaching assistants draw on learning analytics generated by the AI platform to differentiate instruction, provide individualised support, and develop data-informed inclusive practices in EFL classrooms?

LITERATURE REVIEW

This section reviews the literature on artificial intelligence (AI) in English as a Foreign Language (EFL) education, adaptive learning systems, inclusive and special needs education, and data-informed pedagogy. It provides the conceptual and empirical foundations for designing an AI-based adaptive EFL model tailored to students with special educational needs (SEN) in a resource-constrained special school context.

AI in EFL Instruction: Personalisation, Engagement, and Affective Support

AI has become increasingly embedded in EFL instruction at primary and secondary levels, where it is used to personalise learning, enhance engagement, and support autonomous practice. Studies report that AI-powered tools such as chatbots, intelligent tutoring systems, and adaptive platforms can tailor content and feedback to individual learner profiles, thereby increasing motivation and persistence These tools provide real-time feedback, automated assessment, and customised learning paths, allowing learners to practise speaking, listening, reading, and writing beyond the temporal and spatial limits of the classroom (Konyrova, 2024; Okunade, 2024) The affective benefits of AI-mediated environments are also well documented. Interactive, low-stakes practice with AI agents has been found to reduce language anxiety, strengthen self-efficacy, and cultivate more positive attitudes towards English, in part by diminishing the intimidation associated with oral participation

(Wei, 2023; S. Zhang & Liu, 2025). In diverse classrooms where opportunities to converse confidently in English are uneven, AI tools can support more inclusive participation by offering repeated, private opportunities for rehearsal (Eldin, 2024; Ramzan et al., 2023). At the same time, research emphasises that teachers' perceptions, familiarity, and comfort with AI strongly condition its pedagogical effectiveness: educators who understand and trust AI tools are more likely to integrate them in ways that enhance instruction and reduce barriers to language learning (Sharifuddin & Hashim, 2024).

Adaptive Learning Systems in Technology-Enhanced Language Learning

Within technology-enhanced language learning (TELL), adaptive learning systems have been conceptualised as AI-driven approaches that adjust content, sequencing, and feedback to learners' proficiency, preferences, and pace. Empirical studies show that AI-generated formative feedback in writing can improve engagement and writing quality among EFL learners by providing timely, personalised guidance (Chen, 2023). AI-based models have also been shown to enhance vocabulary retention and speaking fluency compared with traditional instruction, highlighting the value of individualised practice and feedback. Safarli et al., (2025) argue that adaptive systems create personalised and dynamic learning experiences that are especially beneficial in heterogeneous EFL classrooms.

Intelligent tutoring systems (ITS) that integrate affective computing and user modelling further illustrate the potential of adaptive technologies to support sustained engagement. By incorporating emotional and behavioural cues, ITS can adjust difficulty levels, feedback, and support to optimise learning experiences and outcomes (Yan, 2024). AI frameworks that combine interactive tasks, gamified elements, and learner analytics have been found to promote active participation and retention (Polamuri et al., 2024), while formative feedback from AI tutors can help alleviate anxiety and boost motivation. These findings provide a strong rationale for exploring adaptive AI systems in SEN contexts, where learners often require more intensive, differentiated support than is feasible in purely teacher-led models.

Inclusive Education, SEN, and Technology in Low- and Middle-Income Contexts

The expansion of inclusive education has brought renewed attention to the experiences of students with disabilities in mainstream and special schools, particularly in low- and middle-income countries (LMICs) such as Indonesia. Inclusive education policies emphasise the rights of students with disabilities to access quality education alongside their peers, yet implementation is frequently constrained by limited facilities, insufficient teacher training, and entrenched socio-cultural attitudes towards disability (Opoku-Nkoom & Ackah-Jnr, 2023; Santi et al., 2025). In Indonesia, many schools struggle to provide disability-friendly infrastructure and to adapt curricula across subjects, including English, to meet diverse needs.

Research in special education underscores the importance of individualised and structured learning strategies for students with intellectual and other disabilities, but gaps remain in the use of AI-driven and adaptive technologies within special schools. Much existing work focuses on more common disability categories or on general student populations, with relatively little attention to learners with complex profiles such as cerebral palsy or multiple disabilities (Sánchez et al., 2024). Studies also note a paucity of classroom-based evaluations of AI tools in special schools, and limited exploration of the collaborative roles of teachers, technologists, and support staff in implementing these tools (Abdoulqadir & Loizides, 2025; Srivastava et al., 2021). In addition, teacher preparation and professional development often lag behind technological developments, limiting educators' capacity to integrate AI effectively (Koranteng, 2025; Safdar et al., 2024). These gaps motivate contextually grounded research on AI-based adaptive EFL systems in special school environments.

Needs Analysis Frameworks: UDL, Differentiated Instruction, and Assistive Technology

Addressing the diverse needs of SEN learners in EFL contexts requires systematic needs analysis informed by robust frameworks. The Universal Design for Learning (UDL) framework advocates for flexible curricula and environments that offer multiple means of engagement, representation, and action/expression, thereby accommodating a wide range of learner profiles (Lu et al., 2022). In practice, UDL encourages teachers to design materials with built-in options for pacing, modality, and support, rather than retrofitting accommodations after difficulties arise. Complementing UDL, differentiated instruction focuses on tailoring teaching methods and materials to individual readiness, interests, and learning profiles, emphasising equitable access to learning opportunities for SEN students (Alnahdi et al., 2022; Lindner et al., 2021).

Assistive technology (AT) frameworks further highlight how digital tools can expand access to curricula for learners with disabilities. Mobile learning platforms, for example, can deliver adaptive and personalised EFL content through devices that students can use flexibly, supporting both language acquisition and engagement (Vistorte et al., 2024). The design of adaptive EFL materials must take into account learner profiles such as preferred modalities, cognitive levels, and language proficiency. Visual learners may benefit from multimedia resources, colour-coding, and pictorial vocabulary, while auditory learners may require enhanced listening and speaking components (Pardosi et al., 2024). Multimodal digital tools can integrate these preferences, offering richer learning experiences that increase accessibility (Hashim et al., 2022; Russell, 2023).

Proficiency-sensitive design is also essential. Adaptive materials should build gradually on existing knowledge and provide appropriate challenge through scaffolding techniques that ease learners into more complex structures (Qin, 2024). For SEN learners at very basic levels of English, this often entails strong emphasis

on high-frequency vocabulary, simple communicative functions, and repeated practice in highly supported contexts. Needs analyses grounded in UDL, differentiated instruction, and AT thus provide a foundation for specifying both competencies and design requirements in AI-based adaptive EFL systems.

English Competencies in Special Schools and Functional Communication

Research on EFL in special schools has begun to map the specific English competencies relevant to students with disabilities. Studies identify foundational vocabulary, basic communication skills, and other functional language abilities as key targets, particularly in relation to everyday life and vocational contexts (Marliana et al., 2025). Role-play and simulation have been shown to enhance vocabulary and practical communication by situating language use in meaningful, real-world scenarios (Marliana et al., 2025). Teacher competencies are also critical: educators working with learners with intellectual disabilities, for example, must adopt specialised strategies that align linguistic goals with students' cognitive and socio-emotional profiles (Arjumandi et al., 2024).

The application of revised Bloom's taxonomy in EFL reading has underscored the importance of carefully graded questions as indicators of comprehension and vehicles for developing vocabulary and analytic skills (Köksal et al., 2023). Cross-national work on language learning and cognitive development in special school populations has further shown that foreign language exposure can support cognitive flexibility and plurilingual competence, though outcomes are shaped by instructional models and contextual factors . Collectively, these studies suggest that competency frameworks for SEN learners should prioritise functional communication and basic literacy while recognising broader cognitive and plurilingual benefits.

AI Tools in Lesson Design, Engagement, and Learning Analytics

Recent scholarship has highlighted how AI-based tools, including generative AI and chatbots, are reshaping lesson planning and classroom activity design. Teachers report that systems such as ChatGPT can streamline the creation of differentiated texts, exercises, and scripts, while still requiring careful human oversight to ensure appropriateness for SEN learners (Alruwaili & Kianfar, 2025; Ghouali, 2025; Setyaningsih et al., 2024). Pedagogical models such as blended learning, flipped classrooms, and station rotation offer structures within which AI can be integrated to support inclusive practice and learner engagement (Peng, 2025). Warm-up activities, AI-driven core tasks, and consolidation phases have been shown to foster readiness, participation, and retention, especially when combined with gamified feedback and opportunities for self-regulation (Hu & Zhang, 2025; Wali et al., 2025).

Parallel developments in learning analytics demonstrate how data from AI platforms can inform differentiation and individualised support. Teachers can use

analytics to track progress, diagnose difficulties, monitor engagement, and adjust grouping and task assignment, in line with UDL principles and differentiated instruction (Lutz et al., 2023). Analytics-informed reflection and collaboration among teachers and teaching assistants have been linked to enhanced instructional efficacy and the emergence of professional learning communities focused on improving outcomes for SEN learners (Subarna et al., 2022). These strands of literature converge on the view that AI, when coupled with inclusive frameworks and robust professional learning, can support more responsive and equitable EFL education for students with disabilities in diverse contexts.

METHOD

Design and Samples

This study employed a descriptive research design with embedded quantitative elements to investigate the implementation of an AI-based adaptive English as a Foreign Language (EFL) model for students with special educational needs in a special school context. The design was chosen to capture both the complexity of classroom processes and the patterns emerging from learning analytics generated by the AI platform. The qualitative component focused on documenting teacher practices, classroom interactions, and student experiences, while the quantitative component drew on platform-generated performance data to describe trends in task completion and accuracy.

The research was conducted at a state special school in Makassar that serves learners with a range of disabilities. The student sample comprised 4 students enrolled in upper primary and lower secondary EFL classes, including learners with mild to moderate intellectual disabilities, autism spectrum disorder, hearing impairments, and specific learning difficulties. These students were selected purposively based on their regular participation in English lessons and their teachers' readiness to integrate the AI-based adaptive system into their instructional routines. The adult sample included 1 English teachers, 1 special education teachers, and 1 classroom assistants who were directly involved in planning, delivering, or supporting EFL instruction with the AI platform. All participants provided informed consent, and parental consent was obtained for students.

Table 1. Summary of participant characteristics (students and teachers)

Group	Role	Main disability / specialisation	Grade level / level taught	Prior experience with digital learning	Prior experience with AI-based tools	Notes
Students – G1	SEN students	Mild–moderate	Upper primary /	Basic tablet	None	Learn in small-

		intellectual disability	lower secondary	use at school		group English class
Students – G2	SEN students	Autism spectrum disorder	Lower secondary	Basic tablet use with teacher support	None	Need structured routines and visuals
Students – G3	SEN students	Hearing impairment	Mixed grades	Moderate experience with multimedia	None	Rely on visual and text supports
Students – G4	SEN students	Specific learning difficulties (e.g., dyslexia)	Lower secondary	Basic computer use	None	Require simplified text and pacing
English teachers	English language teachers	EFL teaching	Upper primary / secondary	Regular use of PPT / online videos	Limited / introductory	Responsible for EFL curriculum
SEN teachers	Special education teachers	Intellectual, autism, and learning difficulties	Multiple grades	Regular use of assistive technologies	Limited	Support adaptation and differentiation
Assistants	Classroom assistants	Classroom and behavioural support	Multiple grades	Occasional use of tablets with students	None / very limited	Assist students during AI sessions

Instruments and Procedure

Several instruments were used to collect complementary data on the design and implementation of the AI-based adaptive EFL model. First, a structured classroom observation protocol was developed to document patterns of teacher–student interaction, use of the AI platform, student engagement behaviours, and the

sequencing of lesson activities. The protocol comprised 3 main indicators organised into dimensions such as instructional focus, modality use, and differentiation, with space for detailed field notes.

Second, semi-structured interview guides were prepared for teachers, special education teachers, and classroom assistants. The teacher interview guide contained 30 core questions and optional probes addressing perceptions of the AI platform, perceived benefits and challenges for diverse learners, experiences with learning analytics, and changes in instructional planning. A simplified student interview guide, consisting of 20 short, open-ended items and visual prompts, was designed for a small sub-sample of students judged able to express their views verbally or with support.

Third, a document review checklist was used to analyse individual education plans, lesson plans, and school policy documents related to inclusive education and technology use. This checklist included 20 items capturing information on targeted English competencies, differentiation strategies, and accommodations for specific disability categories. Finally, learning analytics exported from the AI-based adaptive platform constituted an additional instrument. The platform provided item-level data on task completion, correctness, time-on-task, and progression through adaptive levels for each student. These data were extracted at regular intervals in anonymised form for analysis.

Data collection followed a phased procedure. In the initial phase, the research team conducted familiarisation visits and baseline observations of conventional EFL lessons without AI support. This was followed by teacher workshops introducing the AI platform, co-design sessions to align digital content with learner profiles and target competencies, and a short pilot phase to test technical and organisational feasibility. During the main implementation phase, which lasted 16 weeks, the AI-based adaptive platform was integrated into regularly scheduled EFL lessons using blended and station-rotation formats. Classroom observations were conducted 4 times per class at different points in the implementation, interviews were held towards the middle and end of the period, and learning analytics were downloaded weekly. Document analysis was conducted in parallel to situate classroom practices within broader curricular and policy frameworks.

Data Analysis

Data analysis proceeded in parallel for qualitative and quantitative components, with iterative integration to build a coherent account of the implementation. Qualitative data from observation field notes and interview transcripts were organised and coded using a combination of deductive and inductive approaches. An initial coding scheme was derived from the research questions and relevant literature on Universal Design for Learning, differentiated instruction, and technology-enhanced language learning, including codes such as “multimodal support”, “differentiation”, “engagement cues”, “use of learning analytics”, and

"role of assistants". Additional codes were generated inductively as new patterns emerged during repeated readings of the data. Codes were then grouped into broader themes capturing, for example, the alignment between learner needs and platform features, changes in lesson structure, and the evolving roles of teachers and assistants in AI-supported instruction.

Quantitative data from the AI platform were analysed descriptively. For each student, summary measures were calculated for key indicators such as number of tasks attempted, proportion of correct responses, average time-on-task, and progression across adaptive levels for selected skill domains (e.g., vocabulary recognition, sentence completion, short reading comprehension). These measures were aggregated at class and subgroup levels (for example, by disability category or proficiency band) to identify trends in performance over the implementation period. Where appropriate, pre–post comparisons were conducted using available baseline data from the initial, non-AI lessons, focusing on changes in completion rates and accuracy on comparable task types.

Integration of qualitative and quantitative findings occurred through triangulation. Patterns identified in learning analytics were compared with classroom observations and teacher accounts to examine convergences and discrepancies. For instance, increases in task completion and accuracy on specific item types were interpreted alongside observational evidence of student engagement and teachers' descriptions of scaffolding strategies. This integrated analysis informed the organisation of the Results section into themes related to needs–design alignment, platform selection and localisation, lesson scenario design, student engagement, and the roles of teachers and teaching assistants in data-informed, AI-supported EFL instruction.

Trustworthiness and Ethical Considerations

Several strategies were implemented to enhance the trustworthiness of the qualitative findings. Data triangulation across observations, interviews, documents, and learning analytics provided multiple vantage points on the same phenomena, thereby reducing the risk of bias associated with single-source data (Hatmoko et al., 2024; Jesika & Hidayati, 2024). Researcher triangulation was pursued through collaborative coding and discussion of emerging themes among members of the research team, supporting the credibility and dependability of the analysis. Thick description of the school context, participant characteristics, and instructional routines was used to facilitate transferability judgements by readers working in comparable settings (Khasawneh, 2023; Pantia, 2025).

Ethical considerations were paramount given the involvement of students with disabilities, who are recognised as a vulnerable population in educational research. The study adhered to institutional ethical guidelines and obtained formal approval from the relevant authorities. Informed consent was secured from teachers and from parents or guardians of all student participants, with assent sought from students in

age-appropriate and accessible formats, consistent with recommendations for ethical engagement with SEN learners (Custodio et al., 2024). Participants were informed of the voluntary nature of their involvement and their right to withdraw at any time without negative consequences.

Particular care was taken to protect the privacy and dignity of participants. Pseudonyms were used in all transcripts and reports, and identifying details of the school and community were removed or masked. In handling learning analytics, only aggregated or anonymised data were exported from the AI platform, and no individual performance data were shared with parties outside the research team. These safeguards align with emerging calls to address data protection and ethical use of AI in educational settings, especially when working with students with disabilities (Koranteng, 2025; Sánchez et al., 2024). Throughout the research process, the well-being of students remained the priority, and scheduling, task demands, and data collection procedures were adjusted whenever fatigue, distress, or discomfort were observed or reported.

RESULT AND DISUSSION

Learner Needs, Profiles, and Target Competencies

The needs analysis revealed a highly heterogeneous learner population in the participating special school, comprising students with mild to moderate intellectual disabilities, autism spectrum disorder, hearing impairments, and specific learning difficulties across upper primary and lower secondary grades, as summarised in Table 1. Classroom observations and analysis of individual education plan showed substantial variation in cognitive levels, sensory modalities, and communication preferences, confirming that SEN classrooms are intrinsically diverse learning environments. This heterogeneity directly reflects the core assumptions of Universal Design for Learning (UDL), which argues that accessible environments must provide multiple means of engagement, representation, and expression to accommodate diverse learner characteristics (Prystiananta & Noviyanti, 2025).

Teachers reported that previous EFL instruction largely depended on uniform, textbook-based activities that did not differentiate according to learners' profiles. Students with intellectual disabilities struggled to follow abstract grammatical explanations and extended reading passages, whereas students with hearing impairments had difficulty accessing oral instructions and listening tasks. These findings are consistent with the literature on differentiated instruction, which stresses tailoring methods and materials to individual readiness, interests, and learning profiles to achieve equitable opportunities for SEN learners (Alnahdi et al., 2022; Lindner et al., 2021). Observations corroborated these accounts: in conventional lessons, many students were off-task, required repeated prompting, or relied heavily on peers or assistants.

Within this context, the needs analysis functioned as both a diagnostic and participatory design process. Teachers and the research team collaboratively mapped English language competencies and identified three broad domains foundational vocabulary, basic oral interaction, and early literacy in English. Emphasis was placed on high-frequency items related to personal identity, classroom objects, colours, numbers, and everyday actions, as well as simple communicative functions such as greetings, self-introduction, and classroom expressions. This tripartite structure aligns with prior work that positions vocabulary, basic communication, and functional language skills as central goals for learners with disabilities (Arjumandi et al., 2024; Marliana et al., 2025).

Early literacy competencies were specified in terms of simplified reading tasks (e.g., matching words to pictures, recognising key vocabulary in short sentences, answering literal comprehension questions), drawing on research applying revised Bloom's taxonomy to scaffold comprehension and analytic skills through graded questioning (Köksal et al., 2023). Given students limited prior exposure to printed English, the adaptive system was configured to provide short, visually supported texts and immediate corrective feedback to encourage incremental progress.

The needs analysis also affirmed broader cognitive and plurilingual aims. Evidence that foreign language learning can contribute to cognitive development and plurilingual competence in special school contexts resonated with teachers' perceptions that even modest gains in vocabulary and confidence could support students' sense of achievement and ability to navigate multilingual and digital environments. Overall, the findings showed that an AI-based adaptive EFL system in this context must address both discrete linguistic items and functional communication in socially meaningful scenarios, operationalising UDL, differentiated instruction, and assistive technology frameworks (Vistorte et al., 2024).

Platform Accessibility, Interaction Design, and Localisation

Responding to the needs identified above, the selection of an AI-based adaptive platform was driven by requirements for accessibility, multimodality, and ethical implementation. Teachers, special education staff, and the research team collaboratively reviewed several candidate systems, prioritising their capacity to support visual, auditory, and cognitive impairments. This approach aligns with arguments that adaptive systems for learners with disabilities must be designed from the outset to accommodate a broad spectrum of functional limitations. In practice, the chosen platform offered multimodal content presentation, adjustable difficulty levels, and clear, uncluttered interfaces navigable by students with limited reading skills and fine-motor control.

Stakeholders placed strong emphasis on ethical and institutional dimensions of AI adoption. School leaders insisted that any platform deployed with a vulnerable population should adhere to data protection norms, allow teacher oversight of

content progression, and provide options for anonymising learner information. These concerns echo broader debates on AI governance in education (Wells, 2025). Thus, the final choice reflected not only technical affordances but also transparency and compatibility with local accountability norms.

Fine-grained evaluation of interaction design highlighted the centrality of multi-sensory and participatory approaches. Students quickly learned core interaction patterns such as tapping and dragging, and audio prompts, limited on-screen text, and pictorial supports were especially beneficial for visually impaired or low-literacy learners consistent with evidence that multisensory strategies enhance comprehension for diverse SEN groups (Haslinda et al., 2025). For learners with cognitive or language-processing difficulties, icons, pictures, and colour cues provided crucial visual scaffolds, again echoing research on dynamic visual aids for learners with cognitive challenges (Bhakiyasri., 2024).
Teachers and students were actively involved in refining the interface. Informal feedback on preferred features and confusing elements guided adjustments such as simplifying the home screen, limiting the number of options displayed at once, and standardising the placement of key buttons. These participatory refinements parallel studies that involve users in evaluating accessible tools for language testing and learning (Guzman-Orth et al., 2023; Mina et al., 2023). Occasional trials with an AI-powered robotic assistant further suggested that embodied, multimodal AI can encourage spoken production in low-stakes environments Paz-Ortega & Castro-Vargas (2025), although such innovations may be difficult to sustain in low-resource contexts.

Localisation and customisation emerged as decisive for meaningful implementation in this non-English-dominant, resource-constrained setting. Teachers noted that many commercial EFL applications reflected high-resource, Western environments. The project therefore prioritised a platform that allowed teacher-created content, modification of existing tasks, and offline or low-bandwidth operation. Vocabulary sets, images, and scenarios were adapted to local markets, public transport, and school routines, reinforcing findings that AI-supported instruction is most effective when personalised to learners' linguistic and cultural circumstances (Konyrova, 2024).

Infrastructural constraints, particularly intermittent internet connectivity and limited device availability, required careful scheduling and shared use in small groups, paralleling analyses that AI deployment must be sensitive to socio-economic realities (Chadha, 2024; Giansanti & Pirrera, 2025). Teachers' ongoing adjustments to task difficulty and interaction demands, based on observed engagement, reflect Gligorea et al., (2023) argument that adaptive learning environments must be continuously reconfigured. As teachers gained confidence, the platform's adaptive pathways were more closely aligned with local curricula and the competencies emerging from the needs analysis, echoing patterns observed in Chinese classrooms using AI-powered adaptive platforms (Luo, 2023).

AI-Supported Lesson Design, Engagement, and Affective Outcomes

The integration of AI-based tools into lesson planning and instruction produced marked shifts in pedagogical practice. Prior to the intervention, teachers relied mainly on printed textbooks and worksheets, with limited differentiation. Following training and co-design sessions, they began using generative AI and chatbots to draft simplified reading texts, vocabulary exercises, and dialogue scripts tailored to SEN learners. This development mirrors research showing that tools such as ChatGPT can support creation of customised materials, while teachers maintain responsibility for pedagogical and cultural appropriateness (Alruwaili & Kianfar, 2025; Fazilova, 2025; Ghouali, 2025; Setyaningsih et al., 2024).

Teachers reported that AI-assisted design reduced preparation time for multiple versions of materials and encouraged experimentation with varied task formats. They routinely edited AI-generated content to remove idiomatic or abstract language unsuitable for students with intellectual or language-processing difficulties, underlining the continued centrality of teacher agency. During lessons, AI tools modelled language and generated alternative examples in real time when students struggled, consistent with evidence that AI-enabled personalisation can respond dynamically to learners' evolving needs (Eziamaka et al., 2024).

Over the implementation period, teachers increasingly structured EFL lessons using blended, flipped, and station rotation models. In blended lessons, whole-class explanations were followed by individual or small-group work on the adaptive platform and concluded with collective reflection patterning with studies showing that blended, AI-enhanced instruction improves engagement and outcomes (Özkan et al., 2024). Although full home-based flipping was limited by internet access, teachers introduced short AI-mediated preview tasks during school hours, thereby freeing subsequent class time for guided practice and communicative tasks, in line with evidence on AI-supported flipped approaches (Prystiananta & Noviyanti, 2025).

The station rotation model proved particularly effective for the heterogeneous SEN classrooms. Students rotated between an AI-based practice station, a teacher-led mini-instruction station, and hands-on or game-based stations. The AI station delivered personalised exercises and instant feedback, while small-group teacher stations provided targeted scaffolding. This configuration mirrors findings that AI-augmented rotation models support flexible pathways and immediate assistance (Pondelíková & Luprichová, 2025). The model also eased classroom management by distributing responsibilities and focusing adult attention on smaller groups, which was especially beneficial for students with higher support needs.

Analysis of lesson observations revealed a consistent activity structure: warm-up, AI-driven core tasks, and consolidation. Warm-ups games, choral repetition, multimedia prompts activated prior knowledge and established a positive emotional climate, aligning with evidence that structured warm-ups enhance readiness and

subsequent engagement (Wali et al., 2025). During the core phase, students engaged with adaptive tasks (vocabulary-picture matching, audio-supported completions, short role-play simulations). Observations showed that students were often more willing to attempt challenging items on the platform than with paper-only tasks, supporting claims that AI-mediated activities can bolster achievement, motivation, and self-regulated learning (Liu & Fan, 2024; Y. Zhang & Miao, 2025).

The consolidation phase focused on reinforcing language structures and vocabulary introduced via AI. Teachers used platform analytics to identify common errors, revisited key items through quizzes and games, and facilitated metacognitive reflection, echoing work on AI-driven self-regulation and the importance of perceived teacher support in AI-enhanced environments (Qiu, 2025) . Over time, observation notes documented increased on-task behaviour, verbal participation, and active interaction with language input during AI-enhanced lessons compared with baseline sessions, consistent with broader findings on AI-mediated engagement (Dong et al., 2022).

Affective outcomes also shifted positively. Students who initially appeared anxious or reluctant to speak increasingly participated in short oral tasks linked to AI activities. Immediate feedback, badges, progress bars, and other gamified elements contributed to motivation, paralleling evidence that AI-based gamification encourages active participation (Dai, 2025; Raungsawat et al., 2025). However, the data emphasised that such benefits remained contingent on strong teacher and assistant presence: students repeatedly mentioned adult support as a key reason they enjoyed AI-based lessons. The most productive engagement occurred when AI tools were embedded in relationally rich interactions, reinforcing the view that AI should augment rather than replace human pedagogical care.

Learning Analytics, Teacher Agency, and Roles of Teaching Assistants

Learning analytics generated by the adaptive platform became central to differentiation and individualised support for SEN learners. Teachers and assistants working with heterogeneous groups (as shown in Table 1) used reports on task completion, accuracy, and time-on-task to identify students struggling with specific vocabulary or structures, as well as those progressing rapidly. These practices are consistent with research demonstrating that analytics can track progress, diagnose learning challenges, and inform tailored interventions (Ramadani, 2024).

Analytics also informed proactive application of UDL principles. When data showed that students abandoned reading-heavy tasks but completed audio-supported activities, teachers responded by adding pictorial supports and read-aloud options. This integration of analytics and UDL exemplifies how data can enable proactive design of multiple means of representation and expression. Real-time dashboards helped teachers and assistants monitor engagement; indicators of prolonged inactivity or repeated errors triggered in-lesson scaffolding, such as assigning an assistant to pre-teach vocabulary or provide gestural cues, echoing

findings that analytics can support timely motivational and instructional interventions (Karagianni & Drigas, 2023; Yazçayır & Gürgür, 2021).

Over time, teachers' sense of instructional efficacy evolved as they learned to interpret and apply analytics. Collaborative reflection sessions, where anonymised data were examined jointly, fostered shared repertoires of interpretation and strengthened perceptions that particular strategies were effective when associated with improved accuracy or reduced completion time. These experiences align with studies showing that successful integration of analytics into practice can enhance teaching efficacy and clarify effective strategies for SEN learners (Lutz et al., 2023). At the same time, teachers' initial focus on summary scores and later exploration of more nuanced indicators underscores the need for ongoing professional development, as highlighted by Ndou and Adewoye, (2024).
Teaching assistants emerged as crucial mediators of AI and analytics. While teachers typically led data analysis at class or group level, assistants used insights from planning meetings to guide moment-to-moment support providing oral explanations for reading-heavy exercises or encouraging use of audio features when analytics indicated repeated difficulties. This distributed division of labour reflects the broader recognition that effective differentiated instruction in SEN classrooms depends on coordinated efforts among multiple adults (Dawson & Heylin, 2022; Kurniastuti et al., 2023; Rao, 2021).

Assistants frequently interpreted digital feedback for students, reframing error messages as opportunities for improvement and thus contributing to emotionally supportive learning environments. They also relayed analytics-derived insights to families through informal updates, aligning with calls for transparent sharing of learning data to strengthen school–family partnerships (Lutz et al., 2023; Ndou & Adewoye, 2024). Taken together, these findings show that learning analytics can function as a generative resource for reflective practice and continuous improvement when embedded in collaborative structures and supported by professional learning. AI-based adaptive systems, coupled with analytics, can thus act as catalysts for new forms of collaborative professionalism in special schools—provided that adequate time, training, and institutional backing are available to sustain data-informed, inclusive EFL pedagogy.

CONCLUSION

This study has shown that an AI-based adaptive English as a Foreign Language (EFL) model can be meaningfully aligned with the heterogeneous needs of students with special educational needs (SEN) in a resource-constrained special school context. Grounded in learner profiles and target competencies identified through a systematic needs analysis, the implemented model combined multimodal materials, accessible interaction design, and contextually relevant scenarios to support foundational vocabulary, basic oral interaction, and early literacy. The selection and localisation of the adaptive platform, together with the structuring of lessons into warm-up, AI-driven core tasks, and consolidation phases within blended and

station-rotation formats, contributed to observable gains in student engagement, participation, and confidence when using English in highly scaffolded situations.
A central contribution of this study lies in demonstrating how learning analytics from an AI platform can be integrated with principles of inclusive pedagogy to inform day-to-day differentiation and data-informed decision making. Teachers and teaching assistants used fine-grained performance and engagement data to adjust task difficulty, groupings, and supports in real time, while also drawing on analytics for longer-term planning and professional reflection. These practices illuminate pathways through which AI can strengthen rather than weaken teacher agency in special schools. The findings enrich the existing body of knowledge on technology-enhanced language learning for SEN learners by offering a contextually grounded account from a non-English-dominant, low-resource setting. Further research could employ larger samples and longitudinal designs, and explore comparative models across different disability profiles and institutional contexts, to deepen understanding of how AI-based adaptive EFL systems can be scaled sustainably while safeguarding equity, ethics, and the central role of human relationships in inclusive education.

REFERENCES

Abdoulqadir, C., & Loizides, F. (2025). Interaction, Artificial Intelligence, and Motivation in Children's Speech Learning and Rehabilitation Through Digital Games: A Systematic Literature Review. *Information*, *16*(7), 599. https://doi.org/10.3390/info16070599

Aishah, A., Sa'ud, U. S., Meirawan, D., & Nurdin, D. (2024). Curriculum Adaptation in Science Subjects at Banda Aceh Inclusive Elementary School. *Jurnal Penelitian Pendidikan Ipa*, *10*(10), 7409–7414. https://doi.org/10.29303/jppipa.v10i10.8773

Alnahdi, G. H., Lindner, K.-T., & Schwab, S. (2022). Teachers' Implementation of Inclusive Teaching Practices as a Potential Predictor for Students' Perception of Academic, Social and Emotional Inclusion. *Frontiers in Psychology*, *13*. https://doi.org/10.3389/fpsyg.2022.917676

Alruwaili, A. R., & Kianfar, Z. (2025). Investigating EFL Female Saudi Teachers'Attitudes Toward the Use of ChatGPT in English Language Teaching. *Forum for Linguistic Studies*, *7*(2). https://doi.org/10.30564/fls.v7i2.7937

Arjumandi, S., Samah, N. A., & Jaffri, H. (2024). Special Education Teachers' Competency and Challenges in Teaching Children With Intellectual Disabilities: Narratives From Afghanistan. *MJQR*, *10*(Issue 1). https://doi.org/10.61211/mjqr100101

Bhakiyasri., M.-. (2024). AI Enable Personalized Assistive Tools to Enhance Education of Disabled Persons and Its Legal Fallacies. *International Journal for Multidisciplinary Research*, *6*(6). https://doi.org/10.36948/ijfmr.2024.v06i06.31573

Boladeras, M. D., Díaz, A. C. i., & García-Sánchez, M. (2023). Robots for Inclusive Classrooms: A Scoping Review. *Universal Access in the Information Society*,

24(1), 127–151. https://doi.org/10.1007/s10209-023-01065-z

Chadha, A. (2024). Transforming Higher Education for the Digital Age. *Journal of Interdisciplinary Studies in Education*, *13*(S1). https://doi.org/10.32674/em2qsn46

Chen, G. (2023). Unveiling the Role of Explicit Metadiscourse Instruction, Language Proficiency, and Content Familiarity in EFL Reading Comprehension: A Comprehensive Review. *World Journal of English Language*, *13*(8), 299. https://doi.org/10.5430/wjel.v13n8p299

Custodio, Z. U., Rungduin, T. T., Cuevas, E., Cadiz, R. E., Rosario, T. L. L. L. Del, Cruz, K. A. F. Dela, Egonia, M. F., & Estole, E. M. H. (2024). Improving Post-pandemic Environments for Children With Disabilities Through Effective Partnerships. *Support for Learning*, *40*(1), 1–15. https://doi.org/10.1111/1467-9604.12490

Dai, X. (2025). Exploring the Impact of AI Enhanced Feedback on EFL Learners' Motivation and Engagement. *English Language Teaching and Linguistics Studies*, *7*(5), p200. https://doi.org/10.22158/eltls.v7n5p200

Dawson, C., & Heylin, C. (2022). Reflecting on the Distance Learning Provision in Dubai Private Schools. *Gulf Education and Social Policy Review (Gespr)*, *2*(2), 193–210. https://doi.org/10.18502/gespr.v2i1.10049

Dong, L., Mohammed, S. J., Ibrahim, K. A. A., & Rezai, A. (2022). Fostering EFL Learners' Motivation, Anxiety, and Self-Efficacy Through Computer-Assisted Language Learning- And Mobile-Assisted Language Learning-Based Instructions. *Frontiers in Psychology*, *13*. https://doi.org/10.3389/fpsyg.2022.899557

Eldin, A. H. s. (2024). Using Artificial Intelligence in EFL Teacher Education Programs. *Sustainability Education Globe*, *2*(1), 26–35. https://doi.org/10.21608/seg.2024.272816.1004

Eziamaka, N. V, Odonkor, T. N., & Akinsulire, A. A. (2024). AI-Driven Accessibility: Transformative Software Solutions for Empowering Individuals With Disabilities. *International Journal of Applied Research in Social Sciences*, *6*(8), 1612–1641. https://doi.org/10.51594/ijarss.v6i8.1373

Fazilova, A. (2025). EFL Teachers' Attitudes Towards the Use of AI-generated Lesson Plans in Kazakhstan. *PTM*, *71*(2), 30–46. https://doi.org/10.47344/t4mpdm76

Ghouali, K. (2025). Empowering EFL Learning: Leveraging ChatGPT for Lesson Planning and Activity Generation in the EFL Classroom. *Onomázein Revista De Lingüística Filología Y Traducción*, 31–48. https://doi.org/10.7764/onomazein.ne16.02

Giansanti, D., & Pirrera, A. (2025). Integrating AI and Assistive Technologies in Healthcare: Insights From a Narrative Review of Reviews. *Healthcare*, *13*(5), 556. https://doi.org/10.3390/healthcare13050556

Gligorea, I., Cioca, M., Oancea, R., Gorski, A. T., Gorski, H., & Tudorache, P. (2023). Adaptive Learning Using Artificial Intelligence in e-Learning: A Literature Review. *Education Sciences*, *13*(12), 1–27. https://doi.org/10.3390/educsci13121216

Guzman-Orth, D., Steinberg, J., & Albee, T. (2023). English Learners Who Are

Blind or Visually Impaired: A Participatory Design Approach to Enhancing Fairness and Validity for Language Testing Accommodations. *Language Testing*, *40*(4), 933–959. https://doi.org/10.1177/02655322231159143

Hamid, S.M., Mannong, A.B. M., Saiful., Irawan, N. (2025). Integrating Artificial Intelligence (AI) into EFL in Higher Education: Challenges and Opportunities for Indonesian Teachers and Students. *Al-Ishlah: Jurnal Pendidikan*, *17*(3), 5043–5058. https://doi.org/10.35445/alishlah.v17i3.7717

Hashim, S., Omar, M. K., Jalil, H. A., & Sharef, N. M. (2022). Trends on Technologies and Artificial Intelligence in Education for Personalized Learning: Systematic Literature Review. *International Journal of Academic Research in Progressive Education and Development*, *11*(1). https://doi.org/10.6007/ijarped/v11-i1/12230

Haslinda, Firdaus, A. M., & Husniati, A. (2025). Analisis of Numeracy Literacy Among Visually Impaired Students at YAPTI Based on the Degree of Visual Impairment. *International Journal of Innovative Research in Multidisciplinary Education*, *04*(04). https://doi.org/10.58806/ijirme.2025.v4i4n02

Hatmoko, F. T., Rochmat, S., Siswanto, D. H., & Pisriwati, S. A. (2024). Integrasi Teknologi Dalam Pendidikan Sekolah Dasar Sebagai Upaya Peningkatkan Literasi. *Jm*, *3*(2), 112–124. https://doi.org/10.69630/jm.v3i2.47

Hockly, N. (2023). Artificial Intelligence in English Language Teaching: The Good, the Bad and the Ugly. *RELC Journal*, *54*(2), 445–451. https://doi.org/10.1177/00336882231168504

Hu, X., & Zhang, H. (2025). Exploring <scp>AI</Scp>-Assisted Self-Regulated Learning Profiles and the Predictive Role of Academic Appraisals: A Control-Value Perspective on Chinese <scp>EFL</Scp> University Students. *European Journal of Education*, *60*(4). https://doi.org/10.1111/ejed.70249

Ifraheem, S., Rasheed, M., & Siddiqui, A. (2024). Transforming Education Through Artificial Intelligence: Personalization, Engagement and Predictive Analytics. *J. Asian Dev. Studies*, *13*(2), 250–266. https://doi.org/10.62345/jads.2024.13.2.22

Jesika, J., & Hidayati, D. (2024). Information Technology Management in Learning for Children With Special Needs in Special School. *Tadbir Jurnal Studi Manajemen Pendidikan*, *8*(2), 311–324. https://doi.org/10.29240/jsmp.v8i2.11121

Karagianni, E., & Drigas, A. (2023). New Technologies for Inclusive Learning for Students With Special Educational Needs. *International Journal of Online and Biomedical Engineering (Ijoe)*, *19*(05), 4–21. https://doi.org/10.3991/ijoe.v19i05.36417

Khasawneh, M. A. S. (2023). Analysis of the Application of Pedagogical Technology to the Learning of Children With ASD. *International Journal of Special Education (Ijse)*, *38*(1), 82–89. https://doi.org/10.52291/ijse.2023.38.8

Köksal, D., Ulum, Ö. G., & Yürük, N. (2023). Revised Bloom's Taxonomy in Reading Texts in EFL/ESL Settings. *Acta Educationis Generalis*, *13*(1), 133–146. https://doi.org/10.2478/atd-2023-0007

Konyrova, L. (2024). The Evolution of Language Learning: Exploring AI's Impact

on Teaching English as a Second Language. *Eurasian Science Review*, *2*(2), 133–138. https://doi.org/10.63034/esr-42

Koranteng, U. (2025). AI and Assistive Technology in Special Education: Transforming Learning Access for Students With Disabilities. *Asian Journal of Education and Social Studies*, *51*(9), 240–252. https://doi.org/10.9734/ajess/2025/v51i92361

Kurniastuti, I., Evanjeli, L. A., & Sari, D. P. (2023). Teachers' Challenges and Strategies in Teaching Literacy Skills for Children With Special Needs. *Jurnal Obsesi Jurnal Pendidikan Anak Usia Dini*, *7*(1), 937–948. https://doi.org/10.31004/obsesi.v7i1.3598

Kushmar, L., Ворначев, A., Oleksandrivna, K. I., & Oleksandrivna, K. N. (2022). Artificial Intelligence in Language Learning: What Are We Afraid Of. *Arab World English Journal*, *8*, 262–273. https://doi.org/10.24093/awej/call8.18

Lindner, K.-T., Nusser, L., Gehrer, K., & Schwab, S. (2021). Differentiation and Grouping Practices as a Response to Heterogeneity – Teachers' Implementation of Inclusive Teaching Approaches in Regular, Inclusive and Special Classrooms. *Frontiers in Psychology*, *12*. https://doi.org/10.3389/fpsyg.2021.676482

Liu, H., & Fan, J. (2024). <scp>AI</Scp>-Mediated Communication in <scp>EFL</Scp> Classrooms: The Role of Technical and Pedagogical Stimuli and the Mediating Effects of <scp>AI</Scp> Literacy and Enjoyment. *European Journal of Education*, *60*(1). https://doi.org/10.1111/ejed.12813

Lu, J., Jiang, H., & Huang, Y. (2022). Inclusive EFL Teaching for Young Students With Special Needs: A Case in China. *Children*, *9*(5), 749. https://doi.org/10.3390/children9050749

Luo, Q. Z. (2023). The Influence of AI-Powered Adaptive Learning Platforms on Student Performance in Chinese Classrooms. *Journal of Education*, *6*(3), 1–12. https://doi.org/10.53819/81018102t4181

Lutz, S., Ebenbeck, N., & Gebhardt, M. (2023). Mathematical Skills of Students With Special Educational Needs in the Area of Learning (SEN-L) in Pre-Vocational Programs in Germany. *International Journal for Research in Vocational Education and Training*, *10*(1), 1–23. https://doi.org/10.13152/ijrvet.10.1.1

Marliana, R., H., A., R., W. R., & Syamsul, C. P. (2025). Practical English Communication: Role Plays Training for SMKN 1 Majene Students. *Room of Civil Society Development*, *4*(3), 460–474. https://doi.org/10.59110/rcsd.639

Mina, P. N. R. F., Solon, I. M. J., Sanchez, F. R. E., Delante, T. K. Y., Villegas, J. K. R., Basay, F. J. S., Andales, J. V, Pasko, F. B., Estrera, M. F. R. O., Samson, R. D., & Mutya, R. C. (2023). Leveraging Education Through Artificial Intelligence Virtual Assistance: A Case Study of Visually Impaired Learners. *Pedagogical Research*, *8*(1), em0150. https://doi.org/10.29333/pr/12735

Moybeka, A. M. S., Syariatin, N., Tatipang, D. P., Mushthoza, D. A., Dewi, N. P. J. L., & Tineh, S. (2023). Artificial Intelligence and English Classroom: The Implications of AI Toward EFL Students' Motivation. *Edumaspul - Jurnal Pendidikan*, *7*(2), 2444–2454. https://doi.org/10.33487/edumaspul.v7i2.6669

Nagaraj, B., Kalaivani, A., R, S. B., Akila, S., Sachdev, H. K., & Kumar, N. K. S.

(2023). The Emerging Role of Artificial Intelligence in STEM Higher Education: A Critical Review. *International Research Journal of Multidisciplinary Technovation*, 1–19. https://doi.org/10.54392/irjmt2351

Ndou, N. N., & Adewoye, S. E. (2024). Challenges of Learning in Second Language Among South African School Learners With Developmental Language Disorder. *Theory and Practice of Second Language Acquisition*, *10*(1), 1–17. https://doi.org/10.31261/tapsla.13581

Okunade, A. I. (2024). The Role of Artificial Intelligence in Teaching of Science Education in Secondary Schools in Nigeria. *European Journal of Computer Science and Information Technology*, *12*(1), 57–67. https://doi.org/10.37745/ejcsit2013/vol12n15767

Opoku-Nkoom, I., & Ackah-Jnr, F. R. (2023). Investigating Inclusive Education in Primary Schools in Ghana: What Inclusive Cultures, Environment, and Practices Support Implementation? *Support for Learning*, *38*(1), 17–36. https://doi.org/10.1111/1467-9604.12435

Özkan, E. K., Erdemir, N., & Coşkun, D. (2024). A Systematic Review of EFL Teachers' Perspectives on Artificial Intelligence Technologies. *Ihlara Eğitim Araştırmaları Dergisi*, *9*(2), 150–168. https://doi.org/10.47479/ihead.1535035

Pantia, J. (2025). Exploring Inclusive Education Strategies and Challenges for Learners With Special Educational Needs: Input to Sustainable Support Programs. *Pijhss*. https://doi.org/10.69651/pijhss0402124

Pardosi, V. B. A., Xu, S., Umurohmi, U., Nurdiana, N., & Sabur, F. (2024). Implementation of an Artificial Intelligence Based Learning Management System for Adaptive Learning. *Al-Fikrah Jurnal Manajemen Pendidikan*, *12*(1), 149. https://doi.org/10.31958/jaf.v12i1.12548

Paz-Ortega, E. J., & Castro-Vargas, C. (2025). Development and Evaluation of an Interactive AI-Powered Robotic Assistant for Language Learning. *International Journal of Interactive Mobile Technologies (Ijim)*, *19*(16), 4–21. https://doi.org/10.3991/ijim.v19i16.54595

Peng, X. (2025). The Contribution of Artificial Intelligence (AI) to Chinese EFL Learners' Classroom Engagement and Active Learning. *Porta Linguarum Revista Interuniversitaria De Didáctica De Las Lenguas Extranjeras*, *XIII*, 167–184. https://doi.org/10.30827/portalin.vixiii.32420

Polamuri, S. R., Manikyamba, I. L., & Viswanath, D. G. (2024). Artificial Intelligence-Driven Frameworks for Fostering Active Participation and Learning in Language Classrooms. *Ijiee*, *01*(03), 23–32. https://doi.org/10.62674/ijiee.2024.v1i03.004

Pondelíková, I., & Luprichová, J. (2025). Exploring the Efficacy of Chatgpt in Enhancing Specialized Communication Skills in English Language Learning. *Journal of Teaching English for Specific and Academic Purposes*, 25–40. https://doi.org/10.22190/jtesap250125003p

Prystiananta, N. C., & Noviyanti, A. I. (2025). Enhancing EFL Instruction in Special Needs Education: Integrating Multimodal Digital Tools and Deep Learning Strategies. *Veles Voice of English Language Education Society*, *9*(1), 96–108. https://doi.org/10.29408/veles.v9i1.29411

Qin, L. (2024). Adaptive System of English-Speaking Learning Based on Artificial

Intelligence. *Jes*, *20*(6s), 267–275. https://doi.org/10.52783/jes.2637

Qiu, G. (2025). On the Relationship Between Students' Perceived Support, Students' Self-Efficacy, and Affect-Emotions in <scp>AI</Scp>-Enhanced Learning Environments. *European Journal of Education*, *60*(3). https://doi.org/10.1111/ejed.70180

Ramadani, R. (2024). Enhancing English Learning for Special Needs Students Through Technology. *Asian Journal of Research in Computer Science*, *17*(6), 126–134. https://doi.org/10.9734/ajrcos/2024/v17i6462

Ramzan, M., Javaid, Z. K., Kareem, A., & Mobeen, S. (2023). Amplifying Classroom Enjoyment and Cultivating Positive Learning Attitudes Among ESL Learners. *Pakistan Journal of Humanities and Social Sciences*, *11*(2), 2298–2308. https://doi.org/10.52131/pjhss.2023.1102.0522

Rao, K. (2021). Inclusive Instructional Design: Applying UDL to Online Learning. *Journal of Applied Instructional Design*, *10*(1). https://doi.org/10.51869/101/kr

Raungsawat, N., Saengroongpetch, S., & Kamsuriya, N. (2025). The Role of Artificial Intelligence (AI) in EFL Classrooms. *Jla*, *25*(2), 641–668. https://doi.org/10.64731/jla.v25i2.283658

Russell, T. M. (2023). Smart Transformation of EFL Teaching and Learning Approaches. *Annals of Emerging Technologies in Computing*, *7*(3), 21–59. https://doi.org/10.33166/aetic.2023.03.002

Safarli, N. T., Jafarova, I. M., Nazirzada, L. N., Jumayeva, L., Deepa, B., Antar, D., & Mehdizade, N. S. (2025). Foreign Language Proficiency Among EFL Students in Higher Education and Usage of Artificial Intelligence. *Forum for Linguistic Studies*, *7*(8), 646–665. https://doi.org/10.30564/fls.v7i8.11067

Saleem, T., Saleem, A., & Aslam, D. M. (2025). Integrating AI in Pakistani ESL Classrooms: Teachers' Practices, Perspectives, and Impact on Student Performance. *Plos One*, *20*(9), e0333352. https://doi.org/10.1371/journal.pone.0333352

Sánchez, J., Reyes-Rojas, J., & Alé-Silva, J. (2024). What Is Known About Assistive Technologies in Distance and Digital Education for Learners With Disabilities? *Education Sciences*, *14*(6), 595. https://doi.org/10.3390/educsci14060595

Santi, A., Komariah, L., Mulawarman, W. G., Nurlaili, Akhmad, A., & Azainil. (2025). Strategies for Managing Facilities and Infrastructure in Inclusive Schools. *Research Horizon*, *5*(3), 933–944. https://doi.org/10.54518/rh.5.3.2025.573

Setyaningsih, E., Asrori, M., Ngadiso, Sumardi, S., Zainnuri, H., & Hariyanti, Y. (2024). Exploring High School EFL Teachers' Experiences With Magic School AI in Lesson Planning: Benefits and Insights. *Veles Voice of English Language Education Society*, *8*(3). https://doi.org/10.29408/veles.v8i3.27700

Shalevska, E. (2023). English Teaching Just Got an Upgrade: How Ai Is Revolutionizing Tesol. *Teacher*, *25*. https://doi.org/10.20544/teacher.25.11

Sharifuddin, N. S., & Hashim, H. (2024). Benefits and Challenges in Implementing Artificial Intelligence in Education (AIED) in ESL Classroom: A Systematic Review (2019-2022). *International Journal of Academic Research in Business*

and Social Sciences, *14*(1). https://doi.org/10.6007/ijarbss/v14-i1/20422

Solehuddin, M., Sopandi, E., Saputra, D. G., Dhaniswara, E., Yulianto, S., Zhang, W., & Xu, S. (2023). Development of Adaptive E-Learning Content to Increase Learning Effectiveness. *Journal International Inspire Education Technology*, *2*(2), 87–98. https://doi.org/10.55849/jiiet.v2i2.457

Srivastava, S., Varshney, A., Katyal, S., Kaur, R., & Gaur, V. (2021). A Smart Learning Assistance Tool for Inclusive Education. *Journal of Intelligent & Fuzzy Systems Applications in Engineering and Technology*, *40*(6), 11981–11994. https://doi.org/10.3233/jifs-210075

Subarna, M. T. N., Masud, N. A., Mensah, J. K., San, S. S. S., Hasan, M., & Tania, J. S. (2022). Teaching Strategies for Students With Disabilities in Regular Classes. *Creative Education*, *13*(06), 1843–1861. https://doi.org/10.4236/ce.2022.136116

Urbaite, G. (2025). Adaptive Learning With AI: How Bots Personalize Foreign Language Education. *Lumin*, *2*(1), 13–18. https://doi.org/10.69760/lumin.20250001002

Vistorte, A. O. R., Deroncele-Acosta, Á., Ayala, J. L. M., Barrasa, Á., López-Granero, C., & Martí-González, M. (2024). Integrating Artificial Intelligence to Assess Emotions in Learning Environments: A Systematic Literature Review. *Frontiers in Psychology*, *15*. https://doi.org/10.3389/fpsyg.2024.1387089

Wali, A. Z., Popal, A. W., Ozam, K., & Nibrass, B. A. (2025). Start Strong, Finish Stronger: Classroom Warm-Ups as a Bridge to Student's Learning. *JSSH*, *2*(2), 53–62. https://doi.org/10.62810/jssh.v2i2.56

Wei, L. (2023). Artificial Intelligence in Language Instruction: Impact on English Learning Achievement, L2 Motivation, and Self-Regulated Learning. *Frontiers in Psychology*, *14*. https://doi.org/10.3389/fpsyg.2023.1261955

Wells, M. B. (2025). Disability Services in Higher Education: Statistical Disparities and the Potential Role of AI in Bridging Institutional Gaps. *Plos One*, *20*(5), e0322728. https://doi.org/10.1371/journal.pone.0322728

Yan, J. (2024). Effectiveness Analysis and Optimization Path of AI Tutoring Models in Foreign Language Learning Applications. *Applied Mathematics and Nonlinear Sciences*, *9*(1). https://doi.org/10.2478/amns-2024-1341

Yazçayır, G., & Gürgür, H. (2021). Students With Special Needs in Digital Classrooms During the COVID-19 Pandemic in Turkey. *Pedagogical Research*, *6*(1), em0088. https://doi.org/10.29333/pr/9356

Zainuddin, N. M., Bukhari, N. A., & Mohamad, M. (2024). Implementation of Artificial Intelligence (Ai) as a Pedagogical Tool in Tertiary ESL Classroom: Teachers' Perspectives. *International Journal of Academic Research in Business and Social Sciences*, *14*(8). https://doi.org/10.6007/ijarbss/v14-i8/22456

Zhang, S., & Liu, X. (2025). Learner Emotions in AI-assisted English as a Second/Foreign Language Learning: A Systematic Review of Empirical Studies. *Frontiers in Psychology*, *16*. https://doi.org/10.3389/fpsyg.2025.1652806

Zhang, Y., & Miao, Z. (2025). Enhancing <scp>EFL</Scp> Learners' Engagement

and Motivation Through Immersive Technologies: The Role of Artificial Intelligence, Augmented Reality, Virtual Reality, and Mobile Applications. *European Journal of Education*, *60*(2). https://doi.org/10.1111/ejed.70128

Zulkarnain. (2025). Implementasi Strategi Pembelajaran Individual Terstruktur Bagi Anak Tuna Grahita Ringan Di Sekolah Dasar Inklusi. *Jimad*, *3*(3), 1–12. https://doi.org/10.61404/jimad.v3i3.419