

Generative AI to Enhance Learning Outcomes in K-12 Education

تحسين مخرجات التعلم في اللغة الإنجليزية لدى الطالبات باستخدام تطبيقات الذكاء الاصطناعي

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Abstract:

The critical importance of differentiated learning in English as Foreign Language (EFL) classrooms is grounded on the need to meet the diverse requirements of K-12 students. Traditional classroom instructions fail to accommodate individual differences in learning skills, preference choices, and thinking capabilities. Integration of generative AI technologies that include emergency systems, for example, ChatGPT, GPT-4, and additional natural language processing models allows teachers to develop customized educational experiences at full efficiency. Generated AI content meets personalized student needs, as AI tools deliver immediate feedback and help students to practice English in suitable contextual environments. The aim of this research is to examine the implementation of generative AI technology in EFL teaching environments with special emphasis on its potential to improve student learning adaptation effectiveness. This study leverages the mixed-methods research to analyze the existing literature and explore theoretical frameworks with presentation of empirical findings. Generative AI technology offers numerous educational possibilities, yet researchers explore implementation barriers including educator skill development needs and technological access challenges alongside ethical standards. Student participation and learning success improves fundamentally when generative AI becomes widely accessible despite the unresolved deployment hurdles.

Keywords: AI applications – learning Outcomes – Differentiated learning.

المستخلص:

تتبع الأهمية الكبيرة للتعلم المتميز في فصول اللغة الإنجليزية كلغة أجنبية من الحاجة إلى تلبية المتطلبات المتنوعة لطلاب التعليم الأساسي (الصف الثاني عشر). إن أساليب التدريس التقليدية تفشل في مراعاة الفروق الفردية في مهارات التعلم وتفضيلات الطلاب وقدراتهم على التفكير. إن دمج تقنيات الذكاء الاصطناعي التوليدي، مثل الأنظمة المتقدمة كـ ChatGPT و GPT-4 وغيرها من نماذج معالجة اللغة الطبيعية، يمكن المعلمين من تطوير تجارب تعليمية مخصصة بكفاءة عالية. ينتج الذكاء الاصطناعي محتوى يتماشى مع احتياجات الطلاب الفردية، إذ توفر أدوات الذكاء الاصطناعي تغذية راجعة فورية كما تساعد الطلاب على ممارسة اللغة الإنجليزية في بيئات سياقية مناسبة. يهدف هذا البحث إلى دراسة تطبيق تقنيات الذكاء الاصطناعي التوليدي في بيئات تدريس اللغة الإنجليزية كلغة أجنبية، مع التركيز على قدرتها على تحسين فعالية تكيف

الطلاب مع التعلم. تعتمد هذه الدراسة على منهجية البحث المختلط لتحليل الأدبيات القائمة واستكشاف الأثر النظرية إلى جانب عرض نتائج تجريبية. يوفر الذكاء الاصطناعي التوليدي إمكانيات تعليمية عديدة، ومع ذلك يستكشف الباحثون عوائق التطبيق مثل الحاجة إلى تطوير مهارات المعلمين وتحديات الوصول إلى التكنولوجيا بالإضافة إلى المعايير الأخلاقية. يتحسن تفاعل الطلاب ونجاحهم التعليمي بشكل كبير عندما يصبح الذكاء الاصطناعي التوليدي متاحًا على نطاق واسع، رغم العقبات التي لم تُحل بعد في تطبيقه.

الكلمات المفتاحية: تطبيقات الذكاء الاصطناعي – مخرجات التعلم – التعليم المتميز

Introduction:

The method of language acquisition is a multilayered active process for learners undergoing English as Foreign Language (EFL) courses. K-12 educators must simultaneously respond to the needs of multiple student ranges, while meeting the requirements of the official curriculum contents. Differentiated learning serves as an essential pedagogical approach because instruction adapts to students' unique learning profiles alongside their readiness and individual interests (Benzerroug, 2021). Generative AI applications offered by education create new customizable opportunities for supporting distinct student learning needs. Through machine learning algorithms generative AI tools first analyze student performance data to produce personalized educational content and execute authentic language model procedures. Machine learning algorithms help produce language exercises that use student learning progress to provide specific problem-oriented feedback (Cheah et al., 2025). The current research shows generative AI technology is transforming with innovative capabilities to individualize educational approaches for K-12 EFL learners. The following discussion investigates differentiated instruction fundamentals, explores the practical uses of AI in education, and examines the implementation advantages and technical challenges educators face when utilizing these technologies. Generative AI has the potential to revolutionize differentiated learning in K-12 EFL education by enhancing learning outcomes, fostering engagement, and supporting teachers, though addressing challenges related to infrastructure, training, and ethical considerations is still essential for its effective implementation.

Importance of the Problem:

The student composition in classes teaching EFL demonstrates wide variation within K-12 education settings. Students present distinct combinations of linguistic skills alongside cultural origins combined with varying learning styles and motivational levels. Student diversity calls for distinction-based instruction (Demartini et al., 2024). The inability of conventional teaching methods to adjust to student differences remains a pervasive issue. The educational needs of

advanced students present difficulties for teachers, who must also direct remedial support, because many classrooms contain many students and constrained resources. Generative AI systems solve these educational challenges through their automated systems, which create personalized learning solutions for teaching and student development (Tafazoli, 2024). For example, an AI-driven platform can:

- Generate vocabulary lists tailored to a student's existing knowledge.
- Simulate conversational practice with immediate corrective feedback.
- Provide diverse resources, such as audio, visual, and textual materials, to cater to different learning styles.

Generative AI solutions help to create equitable EFL learning environments by resolving current instructional drawbacks. Each student possesses the ability to receive the learning-focused instruction that suits their individual needs, while producing maximal educational achievements.

AI Tool	Functions
ChatGPT	Facilitates conversational English practice with immediate feedback.
GPT-4	Generates tailored learning materials for varying proficiency levels.
AI-Driven Pronunciation Tools	Improves phonology training and builds speech confidence.
AI-Based Gamification Platforms	Enhances vocabulary and grammar retention through interactive games.

Table 1: Generative AI Tools and Their Functions in K-12 EFL Education

Research Objectives:

This study seeks to achieve the following objectives:

1. **Explore generative AI's potential:** The research focuses on the best generative AI tools to help teachers to implement different methods of learning in K-12 EFL classrooms.
2. **Assessing Impact:** There is a need to establish the effect of AI-driven instructional tools on K-12 EFL students through outcome assessments and evaluations of their learning efficiency and academic motivation levels.
3. **Identifying Challenges:** Barriers to generative AI implementation in education should be investigated, which arise from technological limitations together with learning constraints and ethical boundaries.
4. **Providing Recommendations:** Actionable recommendations will help to integrate AI technology with EFL education, which educators, policy makers, and stakeholders should implement.
- 5.

Research Gap:

Research into AI usage in education has gained momentum, yet exploration of AI applications for EFL students to address their learning needs remains scarce. Studies assessing AI's language learning capabilities mainly examine its contribution to vocabulary development and grammar improvement, while there is no profound understanding of how these tools could service K-12 diverse learners (Abernathy, 2024). Few empirical studies have demonstrated the sustained contribution of generative AI to improve differentiated teaching methods in the education system. Relevant literature reveals several obstacles, such as teacher preparedness and insufficient infrastructure alongside privacy concerns about data, that require further investigation (Cheah et al., 2025). Therefore, the current research examines generative AI's impact on differentiated learning for EFL students by presenting both analytical findings and practical solutions for successful implementation despite the existing impediments.

Research Questions:

This study is guided by the following research questions:

- How can generative AI tools support differentiated learning strategies in K-12 EFL classrooms?
- What impact does the integration of generative AI have on student engagement, motivation, and learning outcomes?
- What challenges do educators face in adopting generative AI for differentiated instruction in EFL education?
- How can generative AI be implemented effectively to accommodate diverse learner profiles?

Theoretical Background:

Differentiated learning has constructivist origins, specifically from Vygotsky's construct known as Zone of Proximal Development (ZPD). According to ZPD theory, instruction aimed at the little-stepped distance between independent performance capabilities and abilities with guidance support produces optimal learner development (Fani & Ghaemi, 2011). The scaffold tools provided by generative AI match this instructional model, because they fit students with their specific level of skills. Another key theoretical approach originated with Gardner's Multiple Intelligences theory postulates that learners possess different types of intelligence, including linguistic operation, visual-spatial patterns, and logical-mathematical capacities. The capabilities of generative AI adapt to diverse learning needs through multimodal education formats, namely dialogue systems, visual materials, or

game-based assignments. This research builds its foundation on the Universal Design for Learning (UDL) framework. Under UDL principles, educators must implement adaptable learning spaces that enable students to work with different forms of representation, engage using diverse strategies, and express their ideas through various methods (Almeqdad et al., 2023). Through generative AI, students can access varied educational materials along with customizable learning timelines, which matches the UDL principles.

Flow Diagram: Implementation of Generative AI in K-12 EFL Education

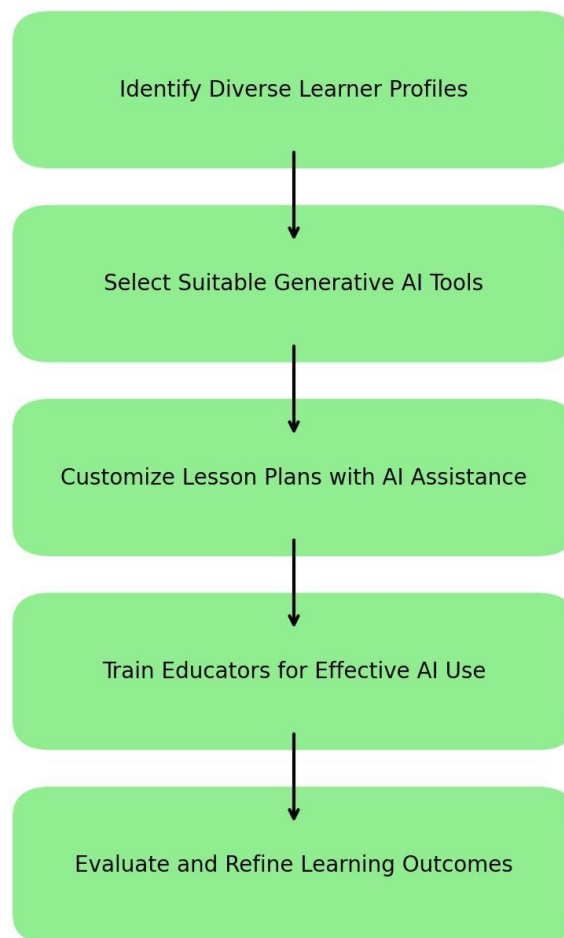


Figure 1: Implementation of Generative AI in K-12 EFL Education

Literature Review:

The implementation of AI systems in EFL education has become a major focus of recent educational developments. Indeed, AI improves education through customized practice assignments, automated real-time feedback, and interactive educational components. Multiple academic investigations prove AI's potential to improve teaching outcomes. According to Cheah et al. (2025) personalized flashcards and practice activities helped EFL students retain words better yet Song

and Song (2023) showed AI-based feedback increased the percentage of writing accuracy in EFL learners. According to Lai and Lee (2024), the implementation of conversational AI platforms showing real-time feedback in simulated scenarios produced improvement of oral proficiency among learners. According to Vančová (2023), AI tools for pronunciation show great effectiveness for teaching students correct phonology training and developing their speech confidence. The research demonstrates that artificial intelligence provides solutions which enhance important language acquisition elements.

The integration of AI technology to deliver differentiated instruction in K-12 EFL classrooms has not received sufficient attention in academic research. Differentiated learning with student-specific instruction requires particular attention to diverse learners who differ in their language proficiency and learning preferences. The investigation by Demartini et al. (2024) demonstrates that adaptive learning platforms have resolved this challenge by developing dynamic mechanisms to adapt task difficulty based on student performance. Hidayat (2024) showed AI-generated personalized reading programs led students to achieve 40% better results on reading comprehension tests. These tools present accessibility issues in limited-resource areas which reduces their practical value according to both research projects.

AI integration remains problematic for achieving effective differentiated learning implementation. According to Mustafa et al. (2024) rural students face exclusion from AI-driven tools because their schools lack fundamental technological infrastructure. The adoption of technological solutions faces obstacles because of ethical factors involved. According to Rusmiyanto et al. (2023) some AI algorithms deliver better outcomes to students whose first language is English while Dakakni and Safa (2023) pointed out that many AI tools lack sufficient data protection for storing students' private information. Ayanwale et al. (2022) found that educational tools needed for AI implementation require better teacher readiness since numerous instructors lack both the technical competence and self-assurance required to utilize AI tools correctly even though specialized training has achieved promising effects on teacher skill development.

Additional scholarly investigations primarily study teaching methods used among adult learners and university students which creates unclear gaps regarding AI applications for K-12 EFL education. The research by Lee et al. (2024) demonstrated AI applications boost grammar accuracy for university students yet such benefits need further testing with elementary-level learners. According to Yu

(2023), students experienced increase in vocabulary retention from gamified AI tools but the authors noted a need for long-term research. According to Saptiany et al. (2024), generative AI models such as ChatGPT possess the ability to develop individualized lesson plans and practice dialogues for K-12 students yet proper research is needed to verify their practical classroom success. Future research demands longitudinal assessments of generative AI tools to monitor enduring student learning results after tool implementation. To effectively integrate teaching tools research must reveal proper methods of implementation which protect the workload of educators while enhancing traditional instruction methods. K-12 EFL education requires a partnership between teachers and technologists along with policymakers to resolve ethical matters and training needs and accessibility barriers so AI technology can efficiently enhance individual learning approaches.

Methodology:

The research design focuses on investigating generative AI effects on differentiated learning across K-12 EFL classrooms. Through a structured methodology different research approaches come together to achieve dependable and valid findings with deep insights. Each research-stage component exists to fulfill the research questions and objectives design.

Research Design:

The study implements a mixed-methods research method which combines quantitative methods with qualitative research to establish a complete understanding of generative AI's educational implications for learner differentiation. The design leverages the strengths of both data types: Measurements from quantitative techniques produce objective results which complement the deeply descriptive findings obtained through qualitative assessment of student and teacher experiences. The research combines quantitative and qualitative methods to produce strong conclusions about how AI affects educational teaching and learning behavior. The data collection includes pre- and post-tests together with standardized questionnaires. These research tools enable educators to measure shifts in student learning effects together with their level of engagement and AI tool acceptance. Teachers along with students participate in semi-structured interviews which help researchers understand contextual challenges of integrating AI with classroom observation data. The study combines numerical evidence with human experiences to create a complete investigation thanks to its mixed-methods approach.

Sample:

Data for the research involves 200 K-12 EFL students alongside 30 teachers who come from different types of educational institutions located in urban, suburban and rural areas. Students participating in the study exhibit educational proficiencies from beginning through advanced stages while maintaining diverse socioeconomic profiles to match different school settings. The diverse access levels among participating students makes this research directly relevant to educational systems ranging from wealthier to resource-limited schools. Thirty teachers joined the study with differing AI tool expertise which spanned from absolute beginners through educators who demonstrated extensive proficiency. The study benefits from diverse teacher preparation levels which enables researchers to investigate how preparedness impacts the outcome of generative AI-based differentiated learning. Through a combination of students and teachers the study obtains broad-ranging perspectives and outcomes.

Sampling Strategy:

Study uses stratified sampling to guarantee adequate inclusion of diverse learning profiles between participants. The research divides students into three groups beginning, intermediate, and advanced according to their initial language testing results. To prevent biased findings the researcher selects an equal number of students from each ability range. The research framework uses stratification to study generative AI's effects on students from all proficiency levels. Purposeful stratification produces the schools the researchers select for study. Study participants are selected from schools which vary according to location type (urban, suburban and rural) and possess differing levels of technological resources between high-tech and low-tech facilities. Through such approach researchers can understand the relationship between technology availability and AI-driven learning implementation and learning outcomes.

Sample Validity:

Sample validity remains a fundamental requirement in this research project. Research validity grows stronger through participant selection that brings together people representing multiple geographic locations together with varied socioeconomic levels and technological access to generate findings which can apply across various educational settings. The research team focuses on equal representation and enrolls participants who represent multiple cultures together with students from different language background groups to improve research data diversity. The study obtains broader applicability by studying both public

educational institutions and private educational institutions. A representative sampling methodology eliminates biases while creating results which precisely portray the multiple educational situations found within K-12 EFL settings.

Methods of Data Collection:

Multiple research methods help to evaluate the full scope of generative AI effects by combining quantitative measurements with qualitative data assessments. Four primary methods are used: surveys, interviews, classroom observations, and pre- and post-tests. The research collects data through surveys alongside teacher interviews together with classroom observations and pre- and post-tests. Students and teachers' complete surveys where questions assess their views about AI technology tools and their level of interest alongside identified advantages and difficulties experienced during usage. The standardized question formats in surveys collect numerical information which researchers analyze through statistical methods to discover regularities in the data set. educational insight into how artificial intelligence impacts learning emerges from structured teacher interviews. Teachers receive guidance about sharing their AI tool classroom experience along with descriptions of encountered obstacles and noted positive effects and acquired expertise. Participants can freely explore topics regarding AI integration through the adaptable framework of the semi-structured design which researcher failed to foresee initially. AI tool implementation in classrooms is documented through observational studies conducted in real-time. The observations examine the integration of AI tools by educators into their lessons and students' interactions with these tools and virtual learning platform configurations. Qualitative information collects important situational details which supplement the quantitative research results. Researchers apply pre- and post-tests which allow them to track the academic developments of their participating students during the research period. The standardized assessments measure vocabulary development with grammar skills alongside reading skill comprehension abilities and writing frameworks to provide accurate markers of AI-assisted differentiated learning effects.

Methods of Data Analysis:

The research method uses quantitative methods together with qualitative techniques for obtaining a full picture of the research data findings. Precise data collected during pre-and post-assessments together with survey results undergo statistical evaluation methods. Student learning outcome changes become significant through paired t-tests while regression analysis demonstrates the

connections between AI usage together with proficiency level and engagement measurement. The researchers organized interview and classroom observation data through thematic coding methods. The research method utilizes identified regular patterns and significant themes and professional experiences which reveal insights into the lives of both students and teachers. Thematic analysis delivers benefits by studying both AI tool influencing aspects and individual human realities in educational settings. Study reliability and validity improve through triangulation which integrates quantitative alongside qualitative results. Multiple data sources used for comparison within this study create robust data support and precise documentation of the complex educational settings. Integrating different research approaches within the design provides powerful evidence regarding how generative AI modifies K-12 EFL classrooms' varied student environments. The resulting fundamental educator and policy insights develop from researchers who collect multiple data types then utilize extensive analytic methods to ensure trustworthy measurement of both data results and participant experiences.

Results and Discussion:

Key Findings:

AI tools helped students perform better on tests than traditional teaching approaches produced. AI educational tools customized instructional content and performance assessments to help students master vocabulary while improving their grammar skills and writing capabilities. Educational value for beginner-level students was most significant because of the procedural instruction offered by these technological systems. The research discovered that AI systems drove student participation through interactive teaching features such as quizzes and simulations and game-based activities. Educational technology systems that integrate multiple engagement features enhance performance excellence and boost confidence factors by elevating classroom engagement levels. Students who avoided participating in classroom work before displayed better commitment after implementation of these technological systems. The teachers recognized how AI technology allowed both grading time and lesson preparation time which then released them for student-focused assistance. The analytic data features enabled educators to gain crucial academic development metrics allowing them to pinpoint learning gaps within each student.

Challenges:

Various hindering elements stopped the effective implementation of artificial intelligence systems within FLE framework. Lack of accessible AI tools

remained difficult for rural schools because their existing infrastructure included outdated technology combined with broken internet connectivity. Teachers demonstrated insufficient training coupled with technical competence for delivering successful results using these technologies. AI tool deployment generated resistance because of concerns about student privacy along with algorithmic bias and technical skill levels of users and poorly structured implementation frameworks. Systemic investments alongside specialized training must be made to implement AI tools under standard ethical precautions because of existing barriers to implementation.

Discussion:

The research demonstrates that generative AI can transform EFL education through its adaptive learning qualities alongside individual student needs fulfillment. When properly implemented AI tools serve students of different learning abilities while actively increasing student involvement and offering substantial educational assistance to instructors. To achieve the greatest benefits from these technologies we must fix infrastructure shortcomings and teach teachers thoroughly and hold strong ethical standards across all operations. The correct assistance for generative AI systems generates better student achievement results while constructing educational settings that welcome diverse learners.

Limitations:

Results are constrained by the study sample which does not capture the whole range of educational settings particularly those experiencing severe resource shortages. Current study content has neglected to investigate the future consequences of AI integration which includes how it affects student retention and critical thinking abilities. The research assumption about universal tool access and infrastructure depends on the opportunity for teachers to use such tools and systems because these tools may not be available to all educational environments. The study reveals multiple constraints that require research into AI engagement's extended educational impact in FLE framework.

Challenges	Recommendations
Insufficient technological infrastructure in rural schools.	Develop equitable access to technology and internet connectivity.
Teachers lacking training and confidence in using AI tools.	Organize regular training workshops for educators on AI integration.
Ethical concerns regarding student data privacy and security.	Implement strict data protection policies and ethical guidelines.
Biases in AI models favoring specific linguistic profiles.	Ensure AI tools are inclusive for diverse student needs and backgrounds.

Table 2: Challenges and Recommendations for Implementing Generative AI in Education:

Conclusion:

The application of generative AI technology creates powerful prospects for customized educational practices along with individualized feedback opportunities and interactive student participation in K-12 EFL learning. AI tools demonstrate substantial potential to raise student performance on multiple facets of the foreign language curriculum including vocabulary mastery and grammar rules and oral communication abilities. AI technology supports teachers by reducing their responsibilities and creating a more inclusive learning environment which serves students with diverse learning needs. Generative AI needs successful integration through complete teacher training programs together with technology access for all students while developing ethical standards to protect user privacy and reduce program bias. The successful implementation of curriculum requires built infrastructure development projects to focus on schools lacking resources. Long-lasting student achievement results from generative AI need investigation through extensive research along with exploration regarding how to maintain AI system integration across educational curricula. The appropriate funding for generative AI implementation will establish learning environments which provide better achievement alongside equitable educational experiences for diverse students.

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