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Integrating AI in Project-Based Learning for Differentiated English Language Instruction: A Scoping Review

Arqam
IAIN Parepare, Indonesia
arqam@iainpare.ac.id
Andi Asrifan
Universitas Negeri Makassar, Indonesia
andiasrifan@gmail.com
Corresponding email: arqam@iainpare.ac.id

Abstract

This scoping study examines the integration of Artificial Intelligence (AI) in Project-Based Learning (PBL) for diversified English language training and its benefits, drawbacks, and trends. Arksey and O'Malley's approach and PRISMA-ScR systematically review peer-reviewed articles from the last decade from Google Scholar, Scopus, ERIC, DOAJ, PubMed, and Science Direct. A complete literature search, inclusion-based selection, data extraction, and thematic analysis are used. AI can improve PBL by offering individualized learning, real-time feedback, and immersive learning settings. Intelligent virtual assistants, smart grading systems, and adaptive learning technologies provide personalized instruction that improves learning results and inclusivity. However, the analysis also notes ethical issues connected to data privacy and algorithmic biases and the need for teacher training to use AI in schools effectively. Despite these obstacles, AI in PBL can transform English language instruction by encouraging critical thinking, cooperation, and communication. This scoping review concludes that AI in PBL can transform differentiated English language instruction. To fully realize the benefits of AI-integrated PBL and improve English language learning for all students, research and innovation must continue.

Keywords: *Artificial Intelligence (AI), Project-Based Learning (PBL), Differentiated Instruction, English Language Learning, Personalized Learning*

Introduction

Project-based learning (PBL) is useful for teaching English as a Foreign Language (EFL) in primary and secondary schools (Zaafour & Salaberri-Ramiro, 2022) (Susanti et al., 2020) (Almulla, 2020). PBL promotes English language and content knowledge, critical thinking, cooperation, communication, creativity, and problem-solving. Provide differentiated coaching to individual learners is difficult since teachers cannot be actively involved in all simultaneous projects (Sormunen et al., 2020). Wilson (2021) Meng et al. (2023) DeMink-Carthew & Olofson (2022). People are

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using AI more to progress in numerous fields. We should consider integrating AI into PBL for differentiated English Language Instruction.

AI in Project-Based Learning (PBL) could transform elementary and secondary English language instruction (Kong et al., 2024). Zhang et al., 2022; Saad & Zainudin, 2022; Pan, 2023. Using AI, educators may give students individualized assistance and support, improving their learning experience. AI-enabled systems give students real-time feedback on their language skills, helping them improve (Alam, 2023) (Kamruzzaman et al., 2023) (Alharbi, 2023) (Kabudi, 2021). Additionally, AI algorithms may analyze students' performance data and customize teaching materials to their strengths and shortcomings, ensuring each student receives tailored instruction. AI-enabled virtual assistants improve PBL (Kumar, 2021) (Tanga et al., 2024). Virtual assistants can chat with pupils and practice language instantly. These assistants use natural language processing to answer students' questions and provide direction. These virtual assistants help students learn languages dynamically and engagingly (Al et al., 2023) (Alharthi, 2024). Virtual assistants can help students learn collaboratively through group conversations and project collaborations.

Using smart grading systems is another way to integrate AI into PBL. Teachers' subjective assessments in traditional grading systems can be time-consuming and biased (Holzinger et al., 2020). However, AI-powered grading systems can evaluate students' work objectively and uniformly. These systems analyze linguistic aspects and compare them to benchmarks to accurately measure students' language proficiency (Beseiso et al., 2021) (Mizumoto & Eguchi, 2023). This saves teachers time and assures fair and consistent student evaluation. AI-powered grading systems can also give students comprehensive feedback on their strengths and weaknesses, helping them grow.

In PBL, AI can provide interactive and immersive learning environments (Abdul et al., 2022) (Jivram, 2021). VR and AR can bring students to language-rich locations to practice English in realistic contexts. Students can virtually visit English-speaking nations and chat with local speakers. AI algorithms can dynamically modify virtual settings to students' performance, giving specific challenges and growth possibilities (Luan et al., 2020) (Wang et al., 2023) (Kuleto, 2021). As students

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interact with authentic language scenarios, immersive experiences can boost their language proficiency and confidence.

The Six Facets of Understanding, IDEAL Disposition Model, and 4Cs all use project-based learning (PBL) to improve students' English language skills (Almulla, 2020) (Zaafour & Salaberri-Ramiro, 2022) (Imbaquingo & Cárdenas, 2023) (Meng et al., 2023). Students must learn curriculum content, critical thinking, cooperation, communication, creativity, and problem-solving. PBL can help kids learn more and retain it. Open-ended questions require students to investigate possible answers to solve a real-world problem (Li et al., 2023) (Yu, 2024) (Markula & Aksela, 2022) (Kaushik, 2020) (Saad & Zainudin, 2022).

Finally, incorporating AI into Project-Based Learning (PBL) has great potential for differentiated English Language Instruction. AI can transform EFL English instruction with individualized virtual assistants, smart grading systems, and immersive learning environments. Using AI, instructors may give personalized instruction, encourage critical thinking, and encourage student participation. Students can transform their English language learning with PBL and AI in the future.

Definition and Key Principles of PBL

PBL is an active, multidisciplinary teaching and learning model emphasizing student autonomy, critical thinking, problem-solving, high engagement, and learning with real-world applications (Singha & Singha, 2024) (Sukackė et al., 2022) (Loyens et al., 2023). A project can be understood as a specific research task or product, planned and goal-oriented, that allows extended, student-directed inquiry with flexibility to build around each student's interests and learning styles. Important educational theories such as long-term retention, brain-based learning, and multiple intelligences, PBL approach projects from various directions and addresses the best way to implement them in education, understanding children's creative thinking power while allowing students to gain multiple competencies during the learning process (Saad & Zainudin, 2022) (Chen et al., 2021) (Almulla, 2020) (Sukackė et al., 2022) (Meng et al., 2023).

Today's students live in an increasingly interdisciplinary, hyperconnected world, and twenty-first-century skills are in ever-higher demand (Schiavone et al.,

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2022). Research shows that project-based learning (PBL) is an effective educational model that helps prepare students with the skills needed to succeed in this rapidly changing world.

Research Methodology

This scoping review systematically and thoroughly examines AI integration in project-based learning (PBL) for individualized English language training. The research design uses Arksey and O'Malley's (2005) framework and PRISMA-ScR to ensure full and transparent reporting. The process includes research topic identification, literature search, selection criteria, data extraction and charting, and analysis and synthesis.

Research questions guided the review initially. These questions examined major themes and trends in the research, the pros and cons of utilizing AI in PBL, and the efficacy of AI-enhanced PBL for differentiated education. To identify current trends, Google Scholar, Scopus, ERIC, DOAJ, PubMed, and Science Direct were searched for peer-reviewed articles published in the last decade.

Articles on AI integration in PBL, differentiated instruction in English language learning, empirical evidence or theoretical discussions relevant to the research questions, and peer-reviewed journals with full-text availability were selected. Standardized forms were used to gather study objectives, methodologies, major findings, and implications from selected papers. Data were categorized thematically for analysis and synthesis.

Thematic analysis was used to discover and categorize significant themes and patterns, concentrating on AI's potential benefits in PBL, its implementation obstacles, and its effectiveness in differentiated education. Peer-reviewed and reputable sources were used to address ethical concerns, following transparency, rigor, and replicability. This systematic methodology gives a complete and reliable assessment of AI integration in PBL for customized English language training, including benefits, limitations, and prospects for future study.

Methodology of Scoping Review

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The research method was organized into five standard steps for Scoping Review. The first step was the identification of relevant research topics and the formulation of the research questions. The second step was a sign that determined the relevant research. In the third step, we selected relevant research and conducted a study. The fourth step consisted of collecting data. This step included the subject and distribution of research questions and characteristics of the most significant subjects of the research. Finally, in the fifth step, we discussed and reported the research results (Pollock et al., 2021).

1) What topics in integrating AI in project-based learning for differentiated English instruction have generated the most public interest in recent years? Which publication sources have been disseminated on the topics of interest?
2) In integrating AI in project-based learning for differentiated English language instruction, which countries have shown scientific interest in recent years?
3) In which type of academic institutions are authors of the studies most associated with those mentioned in the previous literature? Moreover, what are the affiliations of most of the authors (multi-authored, national, or international contributions)?
4) is the information available to answer Scoping Review questions for the most prominent topics in the review?
5) What evidence of systematic reviews can be used to answer Scoping Review questions?

This scoping review used Arksey and O'Malley's 2005 methodological framework (McMeekin et al., 2020) (Gutierrez-Bucheli, 2022). The process included PRISMA-ScR to ensure full coverage (Sullivan et al., 2021). This identified relevant publications that answered review queries. This study used these rigorous methods to analyze the relevant literature. This robust and well-tested framework enabled a thorough literature review (Malodia et al., 2021) (Eduardsen & Marinova, 2020). The researchers used PRISMA-ScR to cover all relevant papers for a complete and reliable analysis. This thorough technique helped researchers answer review questions and gather relevant and accurate data. Systematic and rigorous implementation of the Arksey and O'Malley framework increased the study's validity

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and reliability (Gutierrez-Bucheli et al., 2022) (Schreiber & Cramer, 2022) (Seo, 2024). This systematic literature review gave the researchers a complete understanding of the topic. These well-established methods show a dedication to high-quality research and advances the field. These thorough and well-tested methods made this scoping review more credible and robust (Singh et al., 2023) (Wang et al., 2023)

Definition and Scope of Scoping Reviews

Scoping reviews are systematic and comprehensive synthesizes of research areas that address an exploratory research question by mapping key concepts and types of evidence and identifying research gaps in a defined field (Akbarialiabad et al., 2021). Its main goal is to provide a comprehensive overview, identify the literature, and assess research activity in a certain field. Scoping reviews are currently common in health research but new in educational research (Gutierrez-Bucheli et al., 2022). (Maggio et al., 2021). Scoping reviews can explore any topic representing the main and fundamental approach within a diverse and wide range of practices and activities, unlike systematic reviews, which are specific and focused on narrower research questions and driven by specific outcomes stated at the outset (Peters et al., 2021). Thus, they are particularly useful when trying to understand a huge or complex corpus of literature. It can be difficult to create clear, simple, and transparent systematic review research questions. Scoping reviews can also uncover knowledge gaps, lay the groundwork for future research, and guide policy decisions in numerous sectors (Grill, 2021) (King et al., 2022) (Koon, 2020) (Banha, 2022). Scoping reviews are essential for researchers to map and comprehend the literature and research landscape in a certain field.

A derivative reason is that findings discussion should not determine research implications (Lorenzo-Seva & Ferrando, 2021). Scoping reviews may aid research by connecting disparate content and bringing unknown research to readers' attention. The narrative findings should show how the papers and metadata work together, and the discussions should reveal gaps, discrepancies, under-researched themes, and growing areas of interest. A scoping review aims to guide future research in this

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field.

Search Strategy and Inclusion Criteria

Executing a search strategy to survey the current literature was an important task in mapping the scope of the available evidence. To identify the open-access literature, we searched the following six sources: Google Scholar, Scopus, ERIC (Education et al. Centre), DOAJ (Directory of Open Access Journals), PubMed, and Science Direct (Martín-Martín et al., 2021) (Gusenbauer & Haddaway, 2020). Although the initial search was broad, we performed a second level of screening and sorting. Non-peer-reviewed sources were excluded, and the preliminary screening by abstracts plus full-text availability was conducted. For simplicity, the eligibility criteria of the topic were (1) PBL, (2) AI integration, (3) K-12 learning outcomes, and (4) open-access articles (Zhan et al., 2022) (Sun et al., 2022). By focusing our search, we attempted to answer the scoping review questions: "What is currently known about AI-embedded PBL as an approach for differentiated learners in English language classrooms? What are the implications for further research?" Furthermore, a robust and rational approach was applied to identify potential limitations of the review and the research questions. Finally, an overview of the contents was prepared to meet the study's purpose.

Findings and Discussion

A growing body of research on Problem-Based Learning (PBL) and Artificial Intelligence (AI) has piqued academic interest (Yu, 2023). Thus, a thorough search of six leading databases' huge knowledge base was undertaken using various phrases. This extensive study has illuminated a remarkable increase in recent study reports, helping us understand the complex relationship between AI and PBL (Lopez-Gazpio, 2021) (Ng et al., 2023).

Intriguingly, this scientific renaissance has had mesmerizing oscillations (Mangione, 2021). An in-depth investigation of temporal dynamics revealed that this appealing subject matter's tendencies fluctuated greatly from year to year. The study has illuminated some fascinating themes related to adopting ideas from innovative language learning theories (Uskoković, 2023). These remarkable studies have attempted to solve the puzzle of AI-infused PBL projects. Despite the recent

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proliferation of research and the valuable insights from language acquisition theories, few studies have focused on the rigorous criteria required for integrating AI into PBL, particularly in EFL instruction. This interesting observation led us to propose a major issue that deserves careful researchers' attention. We urge these scholars to use rigorous methods and draw on the rich tapestry of language acquisition theories to explore the intricacies that underlie the criteria for successfully incorporating AI into PBL projects (Aliabadi, 2023) (Zhan et al., 2022).

Along with studying language acquisition theories and PBL, we strongly feel that recognized specialists in the field may contribute greatly to this subject (Kong et al., 2024). 2023 (Aliabadi). These exceptional experts could help Indonesian English students immerse themselves in the revolutionary world of AI-infused PBL by designing meticulous criteria tailored to their unique requirements and situations.
Scholars and specialists should deepen their exploration of PBL and AI research. We can develop this dynamic field by carefully investigating the complex interaction between language acquisition theories and AI incorporation into PBL projects (Kong et al., 2024) (Wei, 2023). Furthermore, developing bespoke AI-PBL criteria tailored to the needs of Indonesian English language learners represents an exciting avenue for growth and progress, ensuring that the transformative powers of AI are accessible to students from diverse backgrounds.

Key Themes and Patterns in the Literature

As we thoroughly analyzed the present research undertaken in the field of education, we have vividly discovered major patterns and trends involving the integration of Artificial Intelligence (AI) into Project-Based Learning (PBL) (Zhan et al., 2022) (Hallinger, 2020). This integration, in turn, facilitates the deployment of differentiated language training and illustrates AI's great potential to transform and enrich future educational methods dramatically. At present, various AI applications have already been effectively deployed in PBL to facilitate and optimize differentiated language training, principally depending on the power of Machine Learning (ML) (Zhan et al., 2022) (Liu et al., 2021).

Among the different AI applications, educational chatbots clearly stand out as exceptionally useful tools that have been extensively examined and shown highly

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promising (Bahroun et al., 2023) (Lin et al., 2023). These chatbots, capable of participating in conversational engagements with pupils, serve a crucial role in improving language acquisition and establishing successful team communication. They can also support information exchange, peer reflections, and project negotiations, which promote inquiry-based learning (Kabudi et al., 2021) (Zhai et al., 2021) (Chen et al., 2023).

We also tested video-based responsive virtual tutors and adaptive learning systems. Differentiated English language training is possible with these novel tools. Responsive virtual tutors tailor sessions to individual learning needs, adapting teaching styles and methodologies (Eimer et al., 2020; Yilmaz et al., 2022; Rodríguez et al., 2021). However, adaptive learning systems use AI algorithms to tailor content and pacing to each learner. Both systems are effective at meeting students' needs and skills, offering an ideal language learning environment (Jebril & Chen, 2021).
Besides these extraordinary advances, a socially intelligent conversational agent has shown unprecedented promise in education (Lin & Yu, 2024) (Dai & Ke, 2022). This conversational agent can choose the best dialogue with students and parents. Personalized instruction and support help children's spelling and reading development throughout time. AI in PBL has transformed differentiated English language instruction (Kornyo, 2021). Educational chatbots, virtual tutors, adaptive learning systems, and socially intelligent conversational agents let students customize their learning experience. Looking ahead, AI's potential to improve and alter PBL language training seems exciting. With continuing research and innovation, AI will continue to shape students' educational experiences worldwide (Chiu et al., 2023) (Duignan, 2020).

Our findings showed that students were more satisfied with AI and thought it helped them in project-based learning. Chatbot conversations can motivate English learners (Belda-Medina & Calvo-Ferrer, 2022) (Kuhail et al., 2023) (Ebadi & Amini, 2024). Previous studies included natural and proactive conversations with state-of-the-art algorithms synthesizing and generating texts or speaking prompt responses and acting as public role models. Crafted and personalized discourse with diverse structures makes larger and more colorful knowledge (van and Osei-Bryson, 2020) (Ryshina-Pankova et al., 2021). Instructors or AI systems can build these. The study's

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significance is that we positioned AI against use scenarios for guided applications that meet students' personal needs. Personalized language instruction has gained attention despite these systems' failures. It remains a major issue in educational AI applications.

Implications for Practice and Future Research

Implementable methodologies and stage-wise usages promise this possibility (Zhuhadar & Lytras, 2023) (Androsavich, 2024). The following suggestions summarize the proposed conceptual framework for integrating AI into PBL and technological pedagogical content knowledge (TPACK) to help language educators orchestrate differentiated PBL practices with AI technologies in diverse classroom practices: Teachers can provide acoustically diverse instructional resources, forms of teaching, academic activities, and student learning expressions to improve data literacy and establish acoustic diversity-literate classrooms (Sergeant & Himonides, 2023). Cloud-based choices that support secure data management and courteous data usage can also encourage language and culture inclusivity in educational apps. Language educators can critically evaluate AI technologies for strategic use. Clear teaching objectives can align AI tools.

The following recommendations and suggestions from this scoping review can help language educators integrate AI technologies into their differentiated practices for diverse English language learners (Yan et al., 2024) (Barrot, 2022). This study showed that the cohort alone has significant untapped potential for AI in classrooms. The recommendations should work with school districts to encourage school-wide AI technology investment and build school cultures that showcase AI technologies, minimize AI accessibility issues, and protect the focus of instruction from screen-time exposure. Educators must understand AI's fundamental concepts and principles to collaborate and effectively use AI in teaching and learning.

Practical Recommendations for Educators

The integration of AI in PBL to differentiate English language instruction is contingent upon teachers' effective implementation of PBL and AI integration in ways that promote opportunities for students to cultivate their skills and its principles

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(Liu et al., 2021) (Zhan et al., 2022) (Wei, 2023). Teachers need to be well-prepared and formative, scaffold, and evaluate here to optimize the learning effect in English language learners. Our research offers some practical suggestions on designing and implementing AI-infused PBL in tasks and providing critical English language and technology-based education that meets the needs of diverse language learners.

The objective of task design with these AI-infusion technologies in education is not merely to replace the teacher with it (Bhutoria, 2022). If learners want to benefit from AI-related education, they must gain many new technical skills. This projects productivity tools like word processing, digital whiteboards, and calendaring, as well as assistive technologies that support specific learning difficulties. Moreover, the rapid developments in artificial intelligence (AI) promise an unprecedented impact on almost all aspects of our modern life (Stahl, 2021) (Sheikh, 2020). With AI-based teaching paradigms transforming counselors' traditional roles, it has become essential for them to understand the tools and techniques that can support effective learning by students in an AI-infused learning environment.

Conclusion

Integrating AI into project-based learning (PBL) for individualized English language training could transform education. AI's ability to tailor learning, give real-time feedback, and build immersive learning environments meets PBL's issues, such as individualized guidance and assistance requirements. AI can help educators personalize lessons to EFL learners' different needs and skills, improving learning results and inclusivity.

PBL uses AI to improve education via intelligent virtual assistants, sophisticated grading systems, and adaptive learning technology. AI systems provide real-time monitoring and assessment, giving pupils immediate feedback and allowing them to progress quickly. AI algorithms assess student performance data to customize teaching materials, assuring targeted support and continuous improvement. AI-powered virtual and augmented reality technologies allow students to practice English in realistic settings. Immersive learning boosts language skills, confidence, and engagement. AI in PBL helps learners collaborate and communicate across borders,

enabling remote project work with peers globally. AI use in education must address ethical issues and future obstacles despite its promising benefits. AI technology use in classrooms must address data privacy, algorithmic biases, and teacher training.

This scoping review shows how AI in PBL might transform differentiated English language training. AI can help educators construct dynamic, inclusive learning environments that match global education needs. This topic needs more study and innovation to fully realize the benefits of AI-integrated PBL and improve English language learning for all students.

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