

A Configurational Exploration on the Promise and Perils of Generative AI in Project-Based Language Learning

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ABSTRACT

This study employs fuzzy-set Qualitative Comparative Analysis to investigate how generative artificial intelligence (GAI) integration affects English as a Foreign Language development in project-based learning (PjBL) contexts. This study examined configurations of learner autonomy, collaborative learning, GAI-supported language learning, and GAI-supported project-based learning among 43 undergraduate students engaged in a 12-week intervention. Results identified four pathways to enhanced language development: autonomy with GAI language support, synergistic integration of autonomy and collaboration with GAI in projects, comprehensive GAI integration with collaborative practices, and an individualistic pathway combining autonomy with GAI tools. Necessity analysis revealed that absence of GAI-supported language learning consistently predicted failure. These findings demonstrate the configurational nature of effective GAI integration in language education and provide guidance for implementing these tools across diverse instructional settings.

KEYWORDS

Generative Artificial Intelligence, Project-Based Language Learning, fsQCA, Learner Autonomy, Collaborative Learning, EFL Development, Configurational Analysis, Necessity Analysis

1. INTRODUCTION

The rapid advancements in generative artificial intelligence (GAI) are creating a transformative shift in language education, particularly by offering new horizons for Project-Based Language Learning (PjBLL). With its capacity to produce human-like text, simulate dialogue, provide personalized feedback, and generate tailored materials, GAI can significantly enhance PjBLL by fostering deeper learner engagement and addressing diverse needs within dynamic, real-world-like projects (Bahroun et al., 2023; Chan & Hu, 2023; Huang et al., 2022; Kohnke et al., 2023; Ogunleye et al., 2024; Pack & Maloney, 2023; Samala et al., 2024). PjBLL itself, grounded in constructivist principles such as Piaget's cognitive developmental theory and Vygotsky's sociocultural framework, emphasizes authentic problem-solving and critical thinking, where GAI can further amplify learner autonomy and collaborative knowledge construction by personalizing tasks and scaffolding project activities (Grubaugh, 2023; Kim & Adlof, 2024; Rahman et al., 2024; Shi et al., 2024; Zhang & Ma, 2023).

However, the integration of GAI into PjBLL is not without its complexities and potential perils. Effectively balancing the profound promise of GAI against its risks—including ethical issues like biases in AI-generated content, data privacy vulnerabilities, and threats to student-teacher

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trust—requires careful consideration and systematic approaches (Galaczi, 2023; Pack & Maloney, 2023). While the potential benefits are clear, there is a discernible gap in understanding the specific configurations of pedagogical strategies and contextual factors that lead to successful and responsible GAI implementation in PjBLL environments (Alshumaimeri & Alshememry, 2023; Kim & Adlof, 2024; Kim & Su, 2024; Liu & Ma, 2024). Much of the existing research has yet to adopt a holistic, configurational lens to unravel these multifaceted interactions.

To address this gap, the present study aims to explore effective pathways for integrating GAI in PjBLL within the context of English as a Foreign Language (EFL). We employ fuzzy-set Qualitative Comparative Analysis (fsQCA), a methodological approach well-suited for examining how different combinations of conditions lead to specific outcomes, moving beyond simplistic linear relationships. This study investigates how various configurations of key conditions—namely learner Autonomy, Collaborative Learning, and the nature of GAI integration, all operating within the overarching PjBL context—combine to influence learner success. A concise preview of the findings of this present study indicates that no single condition is solely responsible for optimal outcomes; rather, several distinct configurational pathways emerge. These pathways, characterized by different alignments of the aforementioned conditions, are shown to foster high EFL proficiency and robust learner engagement. Understanding these configurations offers a clearer roadmap for educators seeking to design and implement effective GAI-assisted PjBLL.

2. LITERATURE REVIEW

2.1 AI-supported Language Learning (AILL)

Integrating AI into language education shows off a growing area of research with implications for educational practice. While early implementations have yielded mixed results, research continues to clarify when and how AI can most effectively support language learning. Godwin-Jones (2019) observes that despite promises of personalized learning experiences, current AI systems often struggle to address the contextual nature of language acquisition because AI tools are usually used as supplementary tools rather than comprehensive learning solutions. This limitation is echoed by Huang et al. (2022), who found that AI chatbots, while effective for vocabulary acquisition, often fail to capture the sociocultural nuances critical for fluency in real-world communication. Additionally, Wang et al. (2024) highlight that AI's effectiveness in language learning depends on its ability to adapt to individual learner profiles, suggesting a need for more sophisticated algorithms to handle diverse linguistic demands.

The effectiveness of AILL varies significantly across different language skills. In their examination of AI-supported speech recognition and synthesis for pronunciation practice, Liakin et al. (2017) found that AI tools can provide immediate feedback, which is not available in traditional classrooms. However, Liakin et al. (2017) also noted that such systems sometimes oversimplified phonological features or missed subtle aspects of accent and intonation. Recent studies, such as Kim et al. (2024), support this finding, noting that AI-driven pronunciation tools often require human oversight to address errors in intonation detection, particularly for tonal languages. Furthermore, Ogunleye et al. (2024) argue that while AI can enhance listening and speaking skills through interactive simulations, its impact on writing skills remains limited unless paired with teacher-led interventions. These findings suggest that AI support is most beneficial when designed diligently to specific, clearly defined language learning objectives rather than attempting to replace broader instructional approaches.

Meanwhile, learner autonomy emerges as another critical factor in deciding the success of AI integration in language courses. Lai and Zheng (2018) discovered that AI-enhanced mobile applications supported language acquisition most effectively when AI-enabled learners' self-directed learning. Specifically, their research (Lai & Zheng, 2018) demonstrated that optimal outcomes occurred when learners actively controlled their engagement with AI tools; in other words, learners should use them strategically rather than passively consuming AI-generated content or feedback. This perspective is

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