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AI-BASED PROJECT-BASED LEARNING TO IMPROVE SPEAKING SKILLS AND CONFIDENCE IN ECC

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Abstract

This study aims to analyze the implementation of AI-based Project-Based Learning (PjBL) to enhance students' speaking confidence in English. The study employed a qualitative case study design involving senior high school students aged 15–18 years participating in the English Conversation Club (ECC). Data were collected through classroom observations, semi-structured interviews, questionnaires, and documentation of students' project videos and AI conversation transcripts. The data were analyzed using thematic analysis to identify patterns related to students' speaking development and confidence improvement. The findings indicate that the use of AI-based PjBL contributed significantly to students' speaking confidence by providing a supportive, interactive, and low-pressure learning environment. Students showed greater enthusiasm, improved pronunciation and fluency, and increased willingness to practice speaking English without fear of making mistakes. In addition, AI-based interaction enabled students to receive immediate feedback and to practice independently at their own pace. The study concludes that integrating AI into Project-Based Learning effectively fosters students' speaking confidence and engagement. This research implies that AI-based PjBL can serve as an innovative approach to creating adaptive and student-centered English speaking instruction in senior high school contexts.

Keywords: *AI-based learning, EFL, English learning, project-based learning, speaking confidence*

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Introduction

The rapid advancement of digital technology has fundamentally transformed educational practices across the globe, particularly in the field of language education. The emergence of the Fourth Industrial Revolution and the transition toward Education 5.0 have encouraged educational institutions to integrate advanced technologies into teaching and learning processes to foster students' digital competence, creativity, collaboration, and critical thinking (Luckin & Cukurova, 2022; UNESCO, 2023). Among these technological innovations, Artificial Intelligence (AI) has become one of the most transformative tools in education due to its ability to simulate human intelligence, personalize learning experiences, and provide immediate feedback. AI-powered applications such as ChatGPT, Google Gemini, Microsoft Copilot, Duolingo Max, and speech recognition systems have increasingly been adopted in English language learning because they enable learners to engage in authentic communication, receive instant corrective feedback, and practice language skills autonomously regardless of time and location (Kasneci et al., 2023; Zhai et al., 2024). Consequently, AI has shifted language learning from a teacher-centered paradigm toward a more learner-centered and adaptive environment that supports continuous language practice.

In English as a Foreign Language (EFL) contexts, the integration of AI has attracted considerable attention because it addresses one of the most persistent challenges in language learning—developing students' communicative competence. English is widely recognized as an international language used for communication in academic, professional, and intercultural settings. Therefore, students are expected not only to understand English grammar and vocabulary but also to communicate effectively through spoken interaction. However, despite years of English instruction, many EFL learners continue to struggle with speaking. Unlike reading or writing, speaking requires learners to produce language spontaneously while simultaneously managing pronunciation, grammar, vocabulary, fluency, and interactional competence (Derakhshan, 2022). This complexity makes speaking the most demanding language skill for many learners and often results in low classroom participation and limited communicative performance.

Speaking difficulties are not solely caused by linguistic limitations but are also influenced by psychological factors. Numerous studies have demonstrated that EFL students frequently experience speaking anxiety, fear of making grammatical or pronunciation mistakes, low self-confidence, and apprehension about negative evaluation from teachers or peers (Dewaele et al., 2022; MacIntyre et al., 2020). These affective barriers discourage students from participating actively in oral communication activities, even when they possess sufficient linguistic knowledge. Students often prefer to remain silent rather than risk making mistakes, thereby reducing opportunities for meaningful language practice. Since speaking proficiency develops primarily through frequent communication, limited participation inevitably hinders students' language development. Therefore, improving students' confidence

is equally important as improving their linguistic competence because confidence determines learners' willingness to communicate in English.

The importance of confidence in speaking has been widely emphasized in language education research. Confidence influences students' motivation, engagement, persistence, and overall speaking performance. Learners with higher confidence are generally more willing to initiate conversations, ask questions, express opinions, and interact with others using the target language. Conversely, students with low confidence tend to avoid speaking tasks, which can result in slower language development (Lee & Drajati, 2024). Building confidence requires supportive learning environments where students can practice without fear of criticism, receive constructive feedback, and gradually develop positive perceptions of their speaking abilities. Consequently, English teachers are challenged to create learning environments that reduce anxiety while simultaneously encouraging authentic communication.

One learning environment designed to promote authentic communication is the English Conversation Club (ECC). Unlike conventional English classrooms that often emphasize grammar instruction and examination preparation, ECC provides students with opportunities to practice English in more relaxed, collaborative, and communicative settings. Through various speaking activities such as discussions, debates, storytelling, role-playing, interviews, presentations, and problem-solving tasks, students are encouraged to use English for meaningful communication rather than merely completing classroom exercises. ECC emphasizes fluency development, interaction, and confidence building, making it an appropriate context for improving speaking skills. Nevertheless, many ECC participants still experience hesitation and anxiety when speaking English because they fear making mistakes or being negatively evaluated by their peers. This indicates that merely providing speaking opportunities may not sufficiently address students' psychological barriers. Innovative instructional strategies are therefore needed to maximize the effectiveness of ECC activities.

One pedagogical approach that aligns well with communicative language teaching is Project-Based Learning (PjBL). PjBL is a student-centered instructional model that engages learners in solving authentic problems and producing meaningful products through collaborative projects. Instead of passively receiving information from teachers, students actively investigate real-world issues, conduct research, collaborate with peers, and present their findings using the target language. This approach promotes deeper learning because students learn by doing rather than by memorizing isolated language forms (Guo et al., 2020). In English language education, PjBL provides meaningful contexts for communication while simultaneously developing higher-order thinking skills, creativity, teamwork, and learner autonomy. More importantly, project presentations, group discussions, and collaborative activities provide repeated opportunities for students to practice speaking in authentic situations, thereby contributing to improvements in both speaking proficiency and confidence.

The emergence of AI offers new possibilities for enhancing the effectiveness of Project-Based Learning. Rather than replacing teachers, AI serves as an intelligent learning assistant that supports students throughout the learning process. AI-powered chatbots and conversational systems allow students to practice dialogues repeatedly without fear of embarrassment. Speech recognition technologies provide immediate pronunciation feedback, while generative AI assists students in brainstorming project ideas, organizing presentations, improving grammar, expanding vocabulary, and refining spoken language before delivering presentations (Kasneci et al., 2023; Zhai et al., 2024). The combination of AI and PjBL creates an adaptive learning ecosystem where students receive continuous support both inside and outside the classroom. Furthermore, AI enables individualized learning because students can practice at their own pace, at their proficiency level, and according to their learning needs, thereby increasing learner autonomy and reducing dependence on teacher supervision.

Recent empirical studies have demonstrated the positive contribution of AI to English language learning. AI-assisted speaking applications have been reported to improve learners' pronunciation accuracy, fluency, vocabulary acquisition, and communicative competence through interactive conversations and automated corrective feedback (Derakhshan, 2022; Lee & Drajati, 2024). Similarly, generative AI tools such as ChatGPT have shown considerable potential in facilitating language practice by providing authentic conversational experiences, personalized learning materials, and immediate responses that encourage sustained interaction (Kasneci et al., 2023). Students generally perceive AI-assisted learning as enjoyable, flexible, and motivating because it allows unlimited opportunities for practice without the social pressure commonly experienced during face-to-face communication. These findings suggest that AI can effectively supplement traditional language instruction by creating more engaging and learner-centered speaking environments.

Despite these promising developments, several research gaps remain. First, much of the existing literature primarily investigates the technical capabilities and pedagogical effectiveness of AI in improving measurable speaking performance, such as pronunciation, vocabulary, and fluency. Comparatively fewer studies have examined AI's influence on learners' affective variables, particularly speaking confidence, self-efficacy, and communication anxiety, which are equally essential for successful language acquisition. Second, previous studies often investigate AI as a standalone instructional tool without integrating it into established pedagogical frameworks. Consequently, limited evidence exists regarding how AI can complement Project-Based Learning to create more authentic, collaborative, and meaningful language learning experiences. Third, research exploring AI-supported PjBL in extracurricular settings such as English Conversation Clubs remains scarce, especially within Indonesian senior high schools. Since ECC emphasizes communicative practice and learner interaction, it provides

a unique context for investigating how AI can support students in developing both speaking competence and confidence simultaneously.

Considering these gaps, the present study seeks to investigate the implementation of AI-based Project-Based Learning in the English Conversation Club (ECC) as an innovative instructional approach to improving students' speaking skills and confidence. Specifically, this study aims to examine how the integration of AI into project-based speaking activities facilitates students' oral communication development, enhances their confidence in using English, and shapes their learning experiences throughout the instructional process. The findings are expected to contribute both theoretically and practically to the growing body of literature on AI-assisted language learning by extending current understanding of the relationship between AI, Project-Based Learning, speaking competence, and learner confidence. Furthermore, this research is expected to provide English teachers, curriculum developers, and educational policymakers with practical insights into designing technology-enhanced speaking instruction that supports meaningful communication, learner autonomy, and positive affective development in the era of digital education.

Research Methods

Design

This study employed a qualitative approach using a case study design to investigate the implementation of Artificial Intelligence (AI)-based Project-Based Learning (PjBL) in enhancing students' speaking skills and confidence in an English Conversation Club (ECC). A qualitative approach was considered appropriate because it enables researchers to gain a deep understanding of participants' experiences, perceptions, and interactions within their natural learning environment (Creswell & Poth, 2018; Merriam & Tisdell, 2016). Rather than measuring the effectiveness of the intervention through numerical data, this study focused on exploring how students experienced AI-supported project-based learning, how they perceived its influence on their speaking performance, and how the learning process contributed to the development of their confidence in using English.

The case study design was selected because it provides an in-depth examination of a contemporary educational phenomenon within its real-life context (Yin, 2018). In this study, the case consisted of a group of students participating in an AI-based PjBL program during ECC activities. The design allowed the researcher to examine the complex interactions between students, teachers, learning tasks, and AI technologies throughout the project implementation. By focusing on a bounded system—a particular group of learners within a specific educational setting—the study was able to capture the contextual factors that influenced students' speaking confidence and language development.

Participants

The participants of this study were senior high school students aged 15–18 years who were involved in English speaking activities using AI-based Project-Based Learning. The selection criteria included students who actively used AI technology to learn English, participated in project-based activities, and experienced challenges speaking English, particularly in confidence. The study focused on students in the English Conversation Club (ECC). Instrument (Cambria, 12 pt, bold, italicized, sentence case)

Explains the tools or techniques used by researchers to gather data. Depending on the sort of data being collected, the methodology being used, and the nature of the research, these tools might differ greatly. Interviews, tests, questionnaires, and observations are examples of instruments.

Instrument

This study employed multiple qualitative research instruments to obtain comprehensive and credible data on the implementation of AI-based Project-Based Learning (PjBL) to improve students' speaking skills and confidence in the English Conversation Club (ECC). The primary instrument was the researcher, who was responsible for planning the study, conducting classroom observations, interviewing participants, collecting relevant documents, interpreting the data, and drawing conclusions. In qualitative research, the researcher serves as the key instrument because data collection and interpretation depend largely on the researcher's ability to understand participants' experiences and the context in which the phenomenon occurs (Creswell & Poth, 2018; Merriam & Tisdell, 2016).

To support the researcher in gathering rich and trustworthy data, several supporting instruments were utilized. The first instrument was an observation checklist accompanied by field notes, which was used during the implementation of AI-based PjBL activities. The observation focused on students' participation, interaction with peers and teachers, use of AI tools during project completion, speaking performance, willingness to communicate, and indicators of speaking confidence such as eye contact, fluency, initiative, and participation in discussions and presentations. Field notes were written to record classroom events, students' behavior, and unexpected situations not captured in the checklist.

The second instrument was a semi-structured interview guide designed to explore participants' perceptions and experiences of learning English through AI-based PjBL. The interview questions encouraged students to describe how AI-assisted learning influenced their speaking practice, pronunciation, vocabulary development, confidence, motivation, collaboration, and overall learning experience. The semi-structured format

provided the researcher with flexibility to ask follow-up questions and obtain deeper insights while maintaining consistency across participants. Interviews were conducted after the completion of the learning projects and were audio-recorded with participants' consent to ensure the accuracy of the collected data.

Data Collection

Data were collected through multiple techniques to ensure data validity. First, observations were conducted during four learning sessions to examine how students interacted with AI in PjBL activities. Second, semi-structured interviews were carried out with students and teachers to gather in-depth information about their experiences and perceptions. Third, questionnaires were distributed to obtain additional data regarding students' responses to AI-based learning. Finally, documentation, including students' project videos and AI conversation transcripts, was collected to provide concrete evidence of students' speaking performance and confidence levels.

Data analysis

The data collected in this study were analyzed using thematic analysis, a qualitative data analysis method that aims to identify, organize, interpret, and report recurring patterns or themes within the data. Thematic analysis was selected because it provides a systematic and flexible approach for understanding participants' experiences, perceptions, and responses toward the implementation of AI-based Project-Based Learning (PjBL) in improving their English speaking skills and confidence. This method enabled the researcher to explore the meaning behind students' experiences while identifying common patterns across multiple data sources.

The analysis process followed the interactive model of qualitative data analysis proposed by Miles, Huberman, and Saldaña (2014), which consists of data condensation (data reduction), data display, and conclusion drawing and verification. These stages were conducted continuously throughout the research process to ensure that the findings accurately represented the participants' experiences. The first stage, data reduction, involved selecting, simplifying, coding, and organizing the raw data obtained from classroom observations, semi-structured interviews, and supporting documents. The second stage, data display, involved organizing the coded data into descriptive narratives, matrices, tables, and thematic categories to facilitate interpretation. The final stage, conclusion drawing and verification, focused on identifying the major themes that emerged from the data and interpreting their meanings in relation to the research questions. Themes were developed by examining similarities, differences, and recurring patterns across

participants' responses. These themes included students' perceived improvement in speaking fluency and pronunciation, increased self-confidence when communicating in English, enhanced motivation to participate in speaking activities, collaborative learning experiences, and the role of artificial intelligence as a learning facilitator during project completion.

Results and Discussion

Results

1. Improvement of Students' Speaking Skills

The findings of this study demonstrate that the implementation of AI-based Project-Based Learning (PjBL) positively influenced students' speaking skills in the English Conversation Club (ECC). The data obtained from classroom observations, semi-structured interviews, and project documentation consistently revealed that integrating Artificial Intelligence (AI) into project-based speaking activities created meaningful learning experiences that encouraged students to communicate more actively in English.

Based on four classroom observation sessions, students showed progressively greater participation throughout the learning process. During the initial meeting, many students hesitated to speak English, often responding with short answers or relying on Indonesian to express their ideas. Some students paused frequently, mispronounced unfamiliar vocabulary, and lacked confidence in maintaining conversations. However, after being introduced to AI-assisted speaking practice and engaging in project-based activities, noticeable improvements emerged in subsequent meetings.

The observation data indicated that students became increasingly active during brainstorming sessions, group discussions, script preparation, and project presentations. AI applications served as learning partners that provided pronunciation models, vocabulary suggestions, grammar corrections, and speaking simulations. Students repeatedly practiced their speaking tasks using AI before presenting them to their peers. This repetitive practice enabled them to identify and correct pronunciation errors, improve sentence structures, and organize their ideas more coherently.

Several aspects of speaking competence improved throughout the implementation of the project. First, students' pronunciation became clearer and more accurate after receiving immediate feedback from AI tools. Words that were initially pronounced incorrectly were gradually

articulated more naturally after repeated practice. Observation notes showed that students frequently compared their pronunciation with the AI model until they felt satisfied with their performance.

Second, improvements were evident in fluency. Students demonstrated fewer pauses, fillers, and hesitations during conversations and presentations. As they practiced multiple times with AI before recording their project videos, they became more familiar with the content and could speak more smoothly. Their speech also became more spontaneous, indicating that they were relying less on memorization and more on genuine language production.

Third, students expanded their vocabulary through AI-generated suggestions. When preparing project scripts, they frequently asked AI for alternative expressions, more appropriate vocabulary, or examples of natural conversations. Consequently, their presentations included a wider range of lexical items and more varied sentence structures compared to their initial speaking performances.

Another improvement was found in students' interactive communication skills. During group discussions, students became more willing to ask questions, respond to peers' opinions, and maintain conversations in English. Rather than relying entirely on the teacher, students increasingly collaborated with classmates and used AI as a resource to solve language-related problems. This learning process reflected one of the essential characteristics of Project-Based Learning, where students actively construct knowledge through collaboration and authentic tasks.

The interview findings strengthened the observation results. The ECC instructor explained that AI had transformed the students' learning process by providing opportunities for independent speaking practice outside classroom hours. According to the teacher, students who were previously reluctant to participate gradually became more active because AI allowed them to practice privately without fear of receiving negative evaluations from classmates.

Similarly, students expressed positive perceptions regarding the use of AI in learning to speak. Most participants stated that AI served as a supportive learning companion that could answer questions instantly, provide pronunciation examples, and correct language mistakes. They appreciated the opportunity to repeat speaking practice as many times as necessary before completing their projects. Several students mentioned that they no longer felt embarrassed when making mistakes because AI responded patiently without criticism. Consequently, they

became more motivated to improve their speaking ability through continuous practice.

Overall, the triangulation of observation, interview, and documentation data indicates that AI-based Project-Based Learning successfully improved students' speaking skills. The combination of authentic project activities and AI-assisted practice created a student-centered learning environment that facilitated continuous speaking practice, immediate feedback, and independent learning, ultimately contributing to better speaking performance.

2. *Enhancement of Students' Speaking Confidence*

Besides improving speaking skills, the findings also reveal that AI-based Project-Based Learning substantially enhanced students' confidence in speaking English. The integration of AI into project-based activities created a supportive learning environment where students could practice without fear of making mistakes or receiving negative judgments. This condition reduced speaking anxiety and encouraged students to communicate more frequently both inside and outside the classroom.

The observation data demonstrated significant changes in students' speaking behavior throughout the four observation sessions. At the beginning of the study, many students avoided speaking voluntarily. They tended to lower their voices, avoided eye contact with the teacher, and often declined opportunities to present their ideas in front of the class. Several students relied heavily on written notes while speaking and frequently switched to their native language whenever they encountered unfamiliar vocabulary.

As the implementation of AI-based PjBL progressed, students gradually displayed greater confidence during classroom interactions. They became more willing to answer questions, initiate conversations, and contribute opinions during group discussions. Students no longer waited for direct instructions from the teacher but actively sought opportunities to communicate in English while completing their projects. During collaborative activities, they confidently discussed ideas, divided responsibilities, and solved language-related problems with assistance from AI applications.

A particularly noticeable improvement was observed during project presentations. Compared to their initial performances, students delivered their final project videos with greater confidence, clearer voices, better facial expressions, and more natural body language. Many

students maintained eye contact with the audience and spoke without relying excessively on written scripts. These behavioral changes indicated that students had become more comfortable using English as a medium of communication.

The interview results provided further evidence of increased confidence. Students consistently reported that practicing with AI helped them overcome fear and anxiety when speaking English. They explained that AI created a non-judgmental learning environment where mistakes were viewed as opportunities for improvement rather than reasons for embarrassment. Since AI provided immediate corrections without criticism, students felt psychologically safe experimenting with new vocabulary, practicing difficult pronunciations, and repeating speaking exercises until they achieved satisfactory performance.

Several students also stated that AI reduced their fear of being laughed at by classmates. Instead of worrying about making grammatical or pronunciation errors, they concentrated on expressing their ideas more effectively. This positive learning experience gradually strengthened their self-confidence and encouraged them to participate more actively during classroom discussions.

The ECC instructor confirmed these observations by explaining that students who were initially passive gradually transformed into more confident speakers throughout the implementation of AI-based PjBL. According to the teacher, students demonstrated greater initiative in asking questions, volunteering for presentations, and interacting with peers in English. The teacher also observed that students became less dependent on teacher guidance because AI enabled them to practice independently before classroom activities.

Another important finding was that increased confidence extended beyond classroom learning. Interview data revealed that many students voluntarily continued practicing English with AI outside scheduled ECC meetings. Some participants used AI to simulate conversations, practice pronunciation, prepare presentations, or learn new expressions at home. Because AI was accessible anytime and anywhere, students developed consistent speaking habits that reinforced both their language competence and self-confidence.

Discussion

The findings of this study demonstrate that implementing AI-based Project-Based Learning (PjBL) significantly improved students' speaking skills and confidence in the English Conversation Club (ECC). Classroom observations, interview data, and documentation consistently showed that

students became more active, confident, and capable of expressing their ideas in English after participating in AI-assisted project activities. These findings support the view that speaking is not merely the production of language forms but a communicative process that develops through meaningful interaction and authentic language use. Brown (2004) argues that speaking competence requires learners to integrate pronunciation, grammar, vocabulary, fluency, and comprehension simultaneously in real communication. Similarly, Thornbury (2005) explains that speaking proficiency develops when learners are provided with frequent opportunities to produce language in authentic contexts rather than through isolated grammar practice. The AI-based PjBL implemented in this study provided such opportunities by engaging students in collaborative projects, script preparation, AI-assisted feedback, and oral presentations, enabling them to practice English in meaningful situations.

The improvement in students' speaking performance also supports the communicative perspective proposed by Nunan (2003) and Bygate et al. (2013), who emphasize that speaking skills develop most effectively through meaningful interaction and the negotiation of meaning. Throughout the four learning sessions, students were required to discuss project ideas, revise scripts generated with AI assistance, rehearse presentations, and communicate their final products before their peers. These collaborative activities encouraged students to use English for genuine communication rather than memorizing isolated expressions. The integration of AI tools further enriched the learning process by providing immediate language suggestions, pronunciation models, and vocabulary alternatives, allowing students to focus on improving both language accuracy and communicative effectiveness. Consequently, students demonstrated noticeable progress in fluency, vocabulary usage, grammatical accuracy, and pronunciation, indicating that AI functioned as a learning scaffold rather than a replacement for teacher guidance.

The findings are also consistent with previous studies highlighting the effectiveness of Artificial Intelligence in English language learning. Recent research has shown that AI-powered applications provide personalized feedback, adaptive learning experiences, and continuous speaking practice, all of which contribute positively to learners' oral proficiency. During the implementation of AI-based PjBL, students reported that AI tools helped them identify grammatical mistakes, improve pronunciation, enrich vocabulary, and organize ideas before speaking. These findings indicate that AI reduced cognitive barriers commonly experienced by EFL learners, enabling them to prepare more effectively before engaging in oral

communication. Instead of relying solely on teacher correction, students became more autonomous in revising and improving their speaking performance, which is an essential characteristic of learner-centered instruction.

The increase in students' confidence represents another important finding of this study. Before the implementation of AI-based PjBL, many students hesitated to speak English because they were afraid of making grammatical or pronunciation errors. However, repeated practice using AI-generated feedback gradually reduced this anxiety and encouraged students to participate more actively during classroom discussions and presentations. This finding supports Harianto (2020), who argues that speaking competence develops when students are given opportunities to exchange ideas freely in supportive learning environments. AI-based PjBL created such an environment by allowing students to practice privately with AI before performing publicly, thereby reducing fear of negative evaluation while increasing self-confidence. The project-based nature of the learning activities also promoted collaboration among students, making speaking practice less intimidating than traditional teacher-centered instruction.

Furthermore, the results reinforce the principles of Project-Based Learning, which emphasize active learning, collaboration, creativity, and authentic problem solving. Throughout the project cycle, students were not passive recipients of knowledge but active participants who planned, created, revised, and presented meaningful products using English as the primary medium of communication. AI technology served as a cognitive support tool, facilitating brainstorming, language editing, pronunciation practice, and content development. This combination of AI and PjBL encouraged students to become more independent learners while simultaneously improving their communication skills. The findings therefore suggest that AI should not be viewed merely as a technological innovation but as an instructional tool that can strengthen the effectiveness of student-centered pedagogical approaches.

Nevertheless, the findings also reveal several limitations. Although students' speaking skills and confidence improved considerably, some participants still had difficulty maintaining spontaneous conversations without relying on AI-generated suggestions. This indicates that while AI effectively supports language preparation and practice, communicative competence still requires continuous interaction with teachers and peers in authentic communicative settings. Therefore, AI should complement rather than replace human interaction in English language learning. Teachers remain responsible for designing meaningful communicative tasks, monitoring students' progress, and providing contextual feedback that AI cannot fully deliver. Future research may involve larger participant groups,

longer implementation periods, and comparisons among different AI platforms to investigate their long-term effects on speaking proficiency, learner autonomy, and communicative confidence.

Conclusion

This study concludes that implementing AI-based Project-Based Learning (PjBL) effectively enhances students' speaking skills and confidence in learning English. The findings show that students experienced significant improvement in speaking skills, including pronunciation, fluency, vocabulary, and interaction. In addition, students demonstrated increased confidence, as they felt more comfortable and less anxious when practicing speaking with AI in a supportive and non-judgmental environment.

The integration of AI in PjBL provides students with opportunities to practice independently, receive immediate feedback, and engage in meaningful communication activities. This approach not only improves technical speaking skills but also helps students overcome psychological barriers, such as fear of making mistakes and lack of confidence.

However, this study has some limitations. The research was conducted in a limited context with a specific group of senior high school students, which may not represent all learning environments. In addition, students' initial unfamiliarity with AI tools may affect the effectiveness of the implementation.

Therefore, it is recommended that future research explore the use of AI-based PjBL in different educational contexts and involve a larger number of participants. Teachers are also encouraged to integrate AI into language learning with proper guidance to maximize its potential. The findings of this study imply that AI-based PjBL can be used as an innovative and effective approach to create a more interactive, adaptive, and student-centered learning environment in English language teaching.

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