Doi: http://doi.org/10.55266/journaletanic.v3i2.574

ETANIC
Journal Of English Language Teaching And Applied Linguistics
E-ISSN : 2986-7274
Available Online on the Website: https://jurnal.radisi.or.id/index.php/JournalETANIC

Volume : 3 | Number : 2 | August 2025 | Page : 122-134

INTEGRATIVE EXPLORATION OF PROBLEM-BASED LEARNING AND ARTIFICIAL INTELLIGENCE IN LANGUAGE EDUCATION

Yuswin Harputra[1*]

[1]English Language Education Study Program, Universitas Graha Nusantara, Indonesia

Yulia Rizki Ramadhani [2]

[2]English Language Education Study Program, Universitas Graha Nusantara, Indonesia

ARTICLE INFO

Article History

Received: 08, July 2025

Accepted: 18, July 2025

Keywords :

Problem-Based Learning, Artificial Intelligence, Reading Comprehension, Language Education, Literature Review, Instructional Design

ABSTRACT

This integrative literature review examines the potential synergy between Problem-Based Learning (PBL) and Artificial Intelligence (AI) in improving university students' reading comprehension within language education. Based on 276 selected articles, the analysis highlights three key themes: PBL's role in fostering critical reading, AI's function in personalizing language learning, and the importance of instructional design in linking both approaches. Findings show that while PBL and AI each contribute meaningfully, their integration in language education is rare and lacks systematic application. Major gaps include the absence of tested instructional models, limited evaluation tools, and a shortage of empirical studies in Southeast Asia. The study recommends developing theory-based integrative instructional models and conducting localized research to support effective implementation.

Corresponding Author:
Yuswin Harputra
English Language Education Study Program, Universitas Graha Nusantara, Indonesia
Email: Yuswinharputra63@gmail.com

A. INTRODUCTION

The ability to comprehend texts critically, analytically, and contextually has become an essential competency for university students in the digital era. In higher education—

particularly in language education—students are expected not only to understand textual content at a literal level, but also to interpret, evaluate, and integrate information from diverse sources (Grabe & Stoller, 2019). However, various studies have shown that students' reading comprehension skills often remain at a moderate to low level, largely due to weak cognitive engagement during learning and the limitations of traditional instructional methods, which fail to promote independent exploration(Khoiriyah et al., 2025; Mukhlis et al., 2024).

One pedagogical approach that has been shown to enhance critical thinking and reading comprehension is Problem-Based Learning (PBL). PBL encourages students to actively engage in solving real-world problems through group work, open discussion, and literature exploration (Hmelo-Silver, 2004). In language learning, this approach provides space to develop more reflective and contextual reading strategies, as texts are treated not merely as instructional content, but as resources for problem-solving.

On the other hand, the advancement of Artificial Intelligence (AI) offers significant opportunities to support personalized and efficient learning. AI technologies can be used to analyze students' learning difficulties, provide automated feedback, and generate adaptive learning materials tailored to individual learner profiles (Holmes et al., 2019). In reading instruction, Natural Language Processing (NLP) models such as BERT and GPT have been employed to develop automated assessment systems, discourse analysis tools, and context-based reading comprehension questions (Bevilacqua et al., 2025; Rathje et al., 2024).

Nevertheless, the integration of problem-based pedagogical approaches and AI technologies remains underexplored, especially within the context of language education at the tertiary level. Most existing studies tend to separate technological innovations from pedagogical strategies, without developing an instructional design framework that connects the two (Reigeluth, 2016; Severino, 2021). In fact, to achieve a holistic and effective learning experience, there is a need for instructional models that combine the strengths of PBL in stimulating critical thinking with the capabilities of AI in supporting personalization and real-time learning monitoring.

Based on this background, the present study aims to conduct an integrative review of the literature on Problem-Based Learning and Artificial Intelligence in the context of language education, identify existing integrative approaches and models used to enhance reading comprehension skills, and propose a conceptual framework for the development of an innovative instructional model that incorporates both PBL and AI.

B. LITERATUR REVIEW

1. Problem-Based Learning (PBL) in Language Education

Problem-Based Learning (PBL) is a constructivist, student-centered instructional approach in which the learning process begins with real-world problem-solving. In the context of language education, PBL has been shown to promote higher-order reading skills such as inference-making, critical thinking, and contextualizing reading with real-life issues (Hmelo-Silver, 2004). (Lin, 2018) demonstrated that the integration of PBL into web-based reading courses significantly enhanced students' motivation, comprehension, and engagement. In this approach, texts are not treated as content to be memorized but as sources of information for solving contextual problems. This aligns with the findings of (Mareti & Hadiyanti, 2021), who argue that PBL encourages students to develop deeper understanding of discourse structures, implicit meanings, and text relevance.

However, several studies also note that the success of PBL heavily depends on instructors' facilitation skills, the availability of well-designed problem scenarios, and adequate digital resources (Savery, 2015). These factors mark a critical entry point for technological interventions—particularly Artificial Intelligence.

2. Artificial Intelligence in Language and Literacy Learning

The advancement of Artificial Intelligence (AI) has significantly transformed the educational landscape. In the domain of literacy and language education, AI has been utilized for various purposes, including automated assessment, adaptive testing, error classification in reading, and instant feedback provision(Chen, 2023; Holmes et al., 2019).

AI models based on Natural Language Processing (NLP), such as BERT, GPT, and T5, have been applied in Machine Reading Comprehension (MRC) systems. These systems can automatically detect reading comprehension levels by analyzing student-generated responses and textual inputs (Liu et al., 2021; Zou, 2024). This capability holds great potential in language education, particularly in personalizing reading instruction based on individual learner profiles. Despite its benefits, AI also presents challenges, such as limitations in capturing pragmatic and cultural nuances in language, and algorithmic bias—especially against non-English languages (Mardini G et al., 2024). Therefore, the integration of AI into education must be accompanied by pedagogically sound and contextually appropriate approaches.

3. Integrating PBL and AI in Instructional Design

While PBL and AI have each been proven effective in enhancing learning outcomes, studies that integrate both remain scarce. This integration requires instructional design capable of bridging problem-based pedagogy with adaptive technologies (Severino, 2021).

Design models such as ADDIE and Dick & Carey offer systematic frameworks for developing technology-supported, problem-based instruction. Within this context, AI can serve as a scaffolding agent—providing automated learning resources, reinforcing feedback, and analyzing students' progress during the problem-solving process (Branch, 2009; Reigeluth, 2016). However, there is a notable lack of empirical research explicitly developing and testing instructional designs that combine PBL and AI for reading comprehension, particularly in Indonesian language education or higher education in Southeast Asia. This gap underscores the importance of the present integrative review.

4. Reading Skills in Higher Language Education

Reading comprehension is a fundamental competency in higher education, yet it remains a significant challenge. Reports from various universities indicate that students struggle to interpret arguments, analyze text structure, and evaluate information from academic sources (Grabe & Stoller, 2019). Thus, the development of reading skills requires more than traditional methods; it demands innovative approaches that foster active engagement and data-informed monitoring of the learning process.

C. RESEARCH METHOD

1. Type of Research

This study adopts an integrative literature review approach, aiming to systematically and critically synthesize findings from various studies on Problem-Based Learning (PBL) and Artificial Intelligence (AI) in the context of language education. Rather than merely mapping existing literature, this review analyzes thematic interrelations across studies, identifies research gaps, and proposes a conceptual model.

2. Sources and Inclusion Criteria

Literature was collected from reputable, indexed academic databases, including Scopus, Web of Science, IEEE Xplore, PubMed, and DOAJ. The inclusion criteria

were: (a) articles written in English or Indonesian, (b) published between 2015 and 2024, (c) focused on PBL, AI, and/or language education, and (d) possessing a DOI or clear scholarly identification.

3. Data Collection Procedure

   A combinatory keyword search strategy was employed using terms such as "problem-based learning" and "reading comprehension," "artificial intelligence" and "language education," as well as "PBL," "AI integration," and "literacy." The collection process comprised three stages: an initial identification phase yielding 375 documents, a screening of titles and abstracts reducing the pool to 320, and a full-text evaluation and source validation that resulted in a final set of 276 relevant articles.

4. Data Analysis

   A qualitative thematic analysis was conducted, involving bibliographic data extraction (author, year, journal, and study focus), followed by classification into five main categories: PBL, AI, Literacy, Integration, and Instructional Design. This process was then synthesized narratively and complemented with visualizations, including a conceptual diagram, distribution tables, and graphical summaries of the findings.

5. Validation and Credibility

   To ensure reliability, all literature data were double-checked, topic categorization was conducted by two independent researchers, and the results were triangulated with previous systematic reviews, particularly those by (Holmes et al., 2019) and (Savery, 2015).

D. RESULT AND DISCUSSION

1. Literature Identification and Selection

   A total of 375 scholarly documents were initially collected from indexed academic databases using combinative keywords related to Problem-Based Learning (PBL), Artificial Intelligence (AI), and language education. The selection process was conducted in three stages: screening of titles and abstracts, full-text evaluation, and validation of source credibility and relevance. After deduplication and filtering based on inclusion criteria, 276 articles were retained for final analysis.

The distribution of selected literature based on major thematic categories revealed a dominant focus on AI in education (141 articles), followed by studies on PBL and reading comprehension (81 articles). The remainder were distributed across combined categories or focused on instructional design. The following table presents the classification of these articles:

Table 1

Distribution of Articles by Main Thematic Categories

Main Category	Number of Articles
Artificial Intelligence in Education	141
Problem-Based Learning and Reading Comprehension	81
Instructional Design and PBL–AI Integration	5
Combined PBL & AI	4
Combined PBL & Instructional Design	3
Combined AI & Instructional Design	2
Others (indirectly relevant)	139

This table presents the initial classification of the 276 articles selected from the total 375 documents based on inclusion criteria. The categories were structured to identify dominant themes in the literature, as well as the degree of intersection between AI, PBL, and instructional design. The “Combined” categories highlight articles that integrate two or more of these approaches, while the “Others” category comprises articles with indirect or peripheral relevance.

2. Thematic Classification and Synthesis

Thematic analysis of the 276 articles resulted in the identification of three key themes that reflect the core focus areas of the literature related to the integration of PBL, AI, and language education. Each theme captures distinct contributions, methodological approaches, and conceptual gaps in the effort to improve university students' reading comprehension.

The first theme emphasizes the contribution of PBL to the development of reading skills, particularly in promoting contextual, analytical, and collaborative comprehension. PBL enables students to engage with texts not as isolated content but as tools for solving real-world problems. Research by Lin (2018) and Kadam

(2020) supports the view that PBL enhances motivation, participation, and deep understanding through active learning strategies.

The second theme explores the role of AI in language learning, including how technologies such as Natural Language Processing (NLP) and Machine Reading Comprehension (MRC) contribute to the personalization of reading processes. AI supports adaptive learning by offering real-time feedback, diagnosing reading difficulties, and tailoring content to individual learner profiles (Chen, 2023; Zou, 2024).

The third theme, although represented by fewer studies, highlights the importance of instructional design in bridging PBL and AI. Studies in this category argue that without a robust instructional framework, the integration of pedagogy and technology remains fragmented. Models such as ADDIE and Dick & Carey are proposed as relevant frameworks for developing problem-based learning environments supported by adaptive technologies (Severino, 2021; Yiling et al., 2025).

Table 2

Key Findings from Thematic Classification of Literature on PBL, AI, and Instructional Design in Language Education

No	Theme	Number of Articles	Key Findings
1	Problem-Based Learning in Developing Reading Comprehension	81	PBL enhances active participation and critical thinking (Kadam, 2020)(Lin, 2018); contextualizes reading through real-world problems; collaborative learning improves retention (Hmelo-Silver, 2004); promotes analytical reading (Mareti & Hadiyanti, 2021).
2	Artificial Intelligence in Language Learning	141	AI enables personalized learning, automated question generation, and analysis of reading difficulties; NLP and MRC facilitate accurate reading assessment (Lin, 2018;

			Zou, 2024); adaptive platforms and chatbots improve independent learning (Chen, 2023).
3	Instructional Design as a Bridge between PBL and AI	5	Structured instructional design is crucial for systematic integration of PBL and AI; models like ADDIE and Dick & Carey support problem-based design with adaptive technology (Severino, 2021); limited studies explore this integration in language education (Yiling et al., 2025).

3. Identified Research Gaps

Based on the comprehensive literature analysis, several significant gaps were identified that warrant further scholarly attention. First, there is a noticeable scarcity of studies that explicitly integrate Problem-Based Learning (PBL) with Artificial Intelligence (AI) in the context of reading instruction, particularly in higher education. Most existing research tends to address these two approaches separately, without establishing pedagogical models that conceptually and practically unite them.

Second, a geographic limitation in the literature was observed, particularly with a lack of studies originating from Southeast Asia, especially Indonesia. The majority of the reviewed articles were situated in educational contexts from Europe, North America, and East Asia. This highlights an urgent need to diversify research contexts to better represent the cultural and educational system diversity globally.

Third, very few studies have developed and applied evaluative instruments capable of empirically measuring the effectiveness of PBL–AI integration in enhancing students' reading comprehension. Previous research has predominantly taken a theoretical or exploratory stance, with limited quantitative evidence or practical implementation of assessment tools.

These findings underscore the urgency and relevance of future research that aims to develop an integrative instructional model combining PBL and AI. Such efforts should be supported by valid and context-sensitive evaluation frameworks,

particularly tailored for language education in the Indonesian higher education context.

4. Thematic Conclusions

To synthesize the literature review findings, a thematic mapping was conducted to illustrate the strength of empirical support and the corresponding research gaps for each major theme. This analysis reveals not only where the current literature is most robust but also highlights areas that remain underexplored. The summary below provides a comprehensive view of the present state of research on Problem-Based Learning (PBL), Artificial Intelligence (AI), and instructional design in language education.

Table 3

Thematic Conclusions Based on Literature Support and Identified Research Gaps

Theme	Literature Support	Main Research Gap
PBL in reading comprehension	Strong	Lack of connection to automated evaluation or AI tools
AI in language education	Strong	Limited pedagogical grounding and minimal focus on local language contexts
Integrative PBL–AI instructional design	Weak	Highly limited; found only in conceptual frameworks

5. Discussion

The results of this review indicate that Problem-Based Learning (PBL) is consistently associated with increased student engagement and improved reading comprehension. The core strength of PBL lies in its authentic learning context, enabling students to go beyond literal reading and connect texts to real-life situations. The collaborative environment in PBL enhances understanding through discussion and negotiation of meaning, aligning with principles of social constructivism (Hmelo-Silver & Eberbach, 2011; Vygotsky & Cole, 1978).

Several studies report that PBL helps students develop higher-order reading skills, such as making inferences, analyzing arguments, and generating solutions based on case-based texts (Lin, 2018; Mareti & Hadiyanti, 2021). However, most of

this research remains descriptive in nature or reports learning outcomes without employing data-driven evaluation methods. This suggests the need for combining PBL with more adaptive, evidence-based approaches to monitor students' comprehension in real time.

The use of Artificial Intelligence (AI) in education has advanced rapidly, particularly in its ability to provide automated feedback, generate adaptive questions, and tailor content to student ability (Chen, 2023; Holmes et al., 2019). In reading instruction, NLP-based models such as BERT and GPT have been applied to develop automated reading comprehension assessments through machine reading comprehension systems (Liu, 2023; Zou, 2024).

AI supports more personalized learning approaches by detecting individual student difficulties and providing targeted interventions. This is especially relevant to reading comprehension, as AI can dynamically adjust text complexity and question types based on the reader's proficiency level (Mardini G et al., 2024). However, current research still focuses predominantly on English-language contexts and technical aspects, with little attention to local-language education in developing countries like Indonesia. Thus, adapting AI technologies to local contexts remains a pressing research priority.

Instructional design plays a critical role in ensuring the effective integration of pedagogical approaches such as PBL with AI-based technologies. Nonetheless, the review shows that many studies still treat technical and pedagogical dimensions separately and pay minimal attention to explicit instructional design (Branch, 2009; Reigeluth, 2016). Several studies suggest using models like ADDIE or Dick & Carey to develop structured problem-based learning sequences supported by technology (Severino, 2021). A systematic instructional design allows educators to plan the stages of (1) identifying learning needs, (2) designing real-world problem scenarios, (3) integrating AI as a supportive tool, and (4) conducting feedback-based evaluation.

This review also identifies several critical challenges that continue to limit the effectiveness and development of integrative approaches combining PBL and AI in language education. In the case of PBL, the main challenge lies in the absence of valid and objective instruments to assess students' reading comprehension. Most existing evaluations are subjective and qualitative, making it difficult to

systematically measure the effectiveness of PBL interventions. Meanwhile, in the application of AI for language learning, global research is heavily skewed toward English, and there is a notable lack of data and system development for local languages such as Indonesian. As a result, AI-based applications in non-English educational contexts remain underdeveloped and suboptimal.

The most prominent challenge in integrating PBL and AI is the scarcity of empirical studies that design, implement, and test instructional models combining the two approaches. Most studies remain at the conceptual level without real-world implementation. Furthermore, instructional design is not yet widely recognized as a key component in technology-driven learning innovation. Many studies overlook the critical role of systematic design in ensuring that PBL and AI can be harmoniously integrated to support meaningful and adaptive learning experiences.

This study offers important contributions both academically and practically. Academically, the findings underscore the urgency of interdisciplinary approaches that unite pedagogy, technology, and language literacy within a coherent framework. The integration of PBL and AI cannot rely solely on technological availability but must be grounded in robust learning theory and instructional design principles. This approach enables the development of instructional models that are not only innovative but also pedagogically sound and scientifically accountable.

Practically, the findings emphasize the role of educators and instructional designers in strategically leveraging AI. Rather than merely serving as a technical aid, AI should be functionally embedded into well-structured problem-based learning strategies. In doing so, instruction becomes not only more adaptive and personalized, but also capable of fostering deeper cognitive engagement and sustainable improvements in reading comprehension.

E. CONCLUSION

This literature review reveals that the integration of Problem-Based Learning (PBL) and Artificial Intelligence (AI) in language education—particularly to enhance university students' reading comprehension—holds significant potential, yet remains underutilized. PBL has been shown to effectively foster active engagement, critical thinking, and contextual understanding of texts. Meanwhile, AI offers capabilities for

personalization, automated feedback, and learning analytics that can enrich the learning experience.

However, the findings also indicate several notable gaps in the literature. These include the scarcity of studies that explicitly design and test integrative PBL–AI models, the limited availability of evaluation instruments to measure their impact on reading comprehension, and the underrepresentation of local contexts in educational technology development. Instructional design is likewise often overlooked, despite its critical role in bridging pedagogical approaches and technological tools.

Accordingly, this review recommends the development of instructional design–based learning models that systematically integrate PBL and AI. It also calls for further research focused on local educational contexts and the application of valid evaluation instruments. An interdisciplinary, data-driven approach is essential to building sustainable and contextually relevant learning innovations in the digital era.

REFERENCES

Bevilacqua, M., Oketch, K., Qin, R., Stamey, W., Zhang, X., Gan, Y., Yang, K., & Abbasi, A. (2025). When automated assessment meets automated content generation: Examining text quality in the era of gpts. *ACM Transactions on Information Systems*, *43*(2), 1–36.

Branch, R. M. (2009). *Instructional Design: The ADDIE Approach*. Springer US. https://doi.org/10.1007/978-0-387-09506-6

Chen, C. (2023). A quantitative study on the effects of an interactive multimodal application to promote students' learning motivation and comprehension in studying Tang poetry. *Frontiers in Psychology*, *14*. https://doi.org/10.3389/fpsyg.2023.1189864

Grabe, W., & Stoller, F. L. (2019). *Teaching and researching reading*. Routledge.

Hmelo-Silver, C. E. (2004). Problem-based learning: What and how do students learn? *Educational Psychology Review*, *16*, 235–266.

Holmes, W., Bialik, M., & Fadel, C. (2019). *Artificial intelligence in education promises and implications for teaching and learning*. Center for Curriculum Redesign.

Khoiriyah, F., Jennah, M., Wicaksono, M. B., & Susetyo, A. M. (2025). Kajian Literatur: Problem Solving Seorang Pendidik dalam Menghadapi Tantangan Metode Pembelajaran Diskusi di Kelas pada Mata Pelajaran Bahasa Indonesia. *Morfologi: Jurnal Ilmu Pendidikan, Bahasa, Sastra Dan Budaya*, *3*(1), 331–347.

 E-ISSN : 2986-7274

Lin, L. F. (2018). Integrating the Problem-Based Learning Approach Into a Web-Based English Reading Course. *Journal of Educational Computing Research*, *56*(1), 105–133. https://doi.org/10.1177/0735633117705960

Liu, Q., Geng, X., Huang, H., Qin, T., Lu, J., & Jiang, D. (2021). MGRC: An end-to-end multigranularity reading comprehension model for question answering. *IEEE Transactions on Neural Networks and Learning Systems*, *34*(5), 2594–2605.

Mardini G, I. D., Quintero M, C. G., Viloria N, C. A., Percybrooks B, W. S., Robles N, H. S., & Villalba R, K. (2024). A deep-learning-based grading system (ASAG) for reading comprehension assessment by using aphorisms as open-answer-questions. *Education and Information Technologies*, *29*(4), 4565–4590.

Mareti, J. W., & Hadiyanti, A. H. D. (2021). Model problem based learning untuk meningkatkan kemampuan berpikir kritis dan hasil belajar IPA siswa. *Jurnal Elementaria Edukasia*, *4*(1), 31–41.

Mukhlis, M., Asnawi, A., Afdal, A., & Junaidi, F. (2024). Kemampuan Literasi Membaca Siswa di SMK Pusat Keunggulan Kota Pekanbaru. *JP-BSI (Jurnal Pendidikan Bahasa Dan Sastra Indonesia)*, *9*(1), 1–7.

Rathje, S., Mirea, D.-M., Sucholutsky, I., Marjieh, R., Robertson, C. E., & Van Bavel, J. J. (2024). GPT is an effective tool for multilingual psychological text analysis. *Proceedings of the National Academy of Sciences*, *121*(34), e2308950121.

Reigeluth, C. M. (2016). Designing technology for the learner-centered paradigm of education. In *Instructional-Design Theories and Models, Volume IV* (pp. 287–316). Routledge.

Savery, J. R. (2015). Overview of problem-based learning: Definitions and distinctions. *Essential Readings in Problem-Based Learning: Exploring and Extending the Legacy of Howard S. Barrows*, *9*(2), 5–15.

Severino, L. (2021). Using a design thinking approach for an asynchronous learning platform during COVID-19. *Iafor Journal of Education*, *9*(2), 145–162. https://doi.org/10.22492/ije.9.2.09

Zou, W. (2024). A Multi-task Shared Cascade Learning for Aspect Sentiment Triplet Extraction Using BERT-MRC. *Cognitive Computation*, *16*(4), 1554–1571. https://doi.org/10.1007/s12559-024-10247-7

 E-ISSN : 2986-7274