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AI-Integrated Problem-Based Learning Model for Digital Economic Literacy: A Systematic Literature Review

Sri Mulyati[*1], Toni Wijaya[2], Iskandar[3], Yeyen Suryani[4], Rani Tania Pratiwi[5], Shelia Maharani[6]

[1,3,4,5,6] Pendidikan Ekonomi, Universitas Kuningan, Jawa Barat
[2] Manajemen, FEB, Universitas Negeri Yogyakarta, Yogyakarta
Correspondence: srimulyati@uniku.ac.id
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Abstract
The rapid integration of AI into higher education offers transformative opportunities for active learning pedagogies, particularly Problem-Based Learning, while elevating Digital Economic Literacy. However, the intersection of AI-integrated PBL and DEL remains systematically underexplored. This study presents a Systematic Literature Review to identify, evaluate, and synthesize evidence regarding the implementation and impact of AI-integrated PBL on DEL. Following PRISMA guidelines and the PICo framework, a search was conducted across Scopus, Google Scholar, ERIC, and IEEE Xplore databases. From an initial pool of 173 articles, 35 high-quality, peer-reviewed studies published between 2020 and 2026 were selected for thematic synthesis. The findings reveal five key themes: (1) pedagogical frameworks for AI-PBL integration, (2) AI tools and technologies within the PBL context, (3) impacts on DEL competencies, (4) student engagement and learning outcomes, and (5) challenges and enabling factors for implementation. The review demonstrates that AI-integrated PBL enhances students' critical thinking, digital problem-solving, economic reasoning, and technological adaptability when supported by appropriate pedagogical scaffolding, institutional support, and clear ethical guidance.

Kata Kunci:
Kecerdasan Buatan; Pembelajaran Berbasis Masalah; Literasi Ekonomi Digital

Abstract
Integrasi pesat Kecerdasan Buatan ke dalam pendidikan tinggi membuka peluang transformatif bagi pedagogi pembelajaran aktif, khususnya Pembelajaran Berbasis Masalah, sekaligus meningkatkan Literasi Ekonomi Digital. Namun, titik temu antara PBL Terintegrasi AI dan DEL masih belum banyak dieksplorasi secara sistematis. Penelitian ini menyajikan Tinjauan Literatur Sistematis untuk mengidentifikasi, mengevaluasi, dan mensintesis bukti mengenai implementasi dan dampak PBL Terintegrasi AI terhadap DEL. Mengacu pada pedoman PRISMA dan kerangka PICo, pencarian dilakukan pada basis data Scopus, Google Scholar, ERIC, dan IEEE Xplore. Dari 173 artikel awal, 35 studi berkualitas tinggi yang telah ditelaah sejawat dan diterbitkan antara 2020–2026 dipilih untuk sintesis tematik. Temuan mengungkap lima tema utama: (1) kerangka pedagogis integrasi AI-PBL, (2) alat dan teknologi AI dalam konteks PBL, (3) dampak terhadap kompetensi DEL, (4) keterlibatan mahasiswa dan capaian pembelajaran, serta (5) tantangan dan faktor pendukung implementasi. Tinjauan ini menunjukkan bahwa PBL Terintegrasi AI meningkatkan berpikir kritis, pemecahan masalah digital, penalaran ekonomi, dan adaptabilitas teknologi mahasiswa apabila didukung scaffolding pedagogis yang tepat, dukungan institusi, dan panduan etis yang jelas.

INTRODUCTION

The twenty-first century has witnessed an unprecedented convergence of digital technologies and educational practice, fundamentally reshaping how knowledge is constructed, transmitted, and applied in academic and professional contexts. Artificial Intelligence (AI), once confined to specialised research laboratories, has rapidly permeated virtually every dimension of higher education from intelligent tutoring systems and adaptive learning platforms to generative AI tools capable of simulating expert dialogue, creating dynamic problem scenarios, and providing personalised, real-time feedback (Avilés Mariño, 2025). Simultaneously, the global transition toward a knowledge-based and digitally mediated economy has elevated Digital Economic Literacy (DEL) to the status of a core twenty-first century competency (World Economic Forum, 2024). DEL encompasses the integrated capacity to understand, navigate, critically evaluate, and actively participate in digital economic systems including digital financial services, e-commerce ecosystems, digital entrepreneurship, and the broader platform economy deploying both technological fluency and rigorous analytical reasoning (Al-Kfairy et al., 2024). Problem-Based Learning (PBL), first conceptualised by Barrows and Tamblyn (1980) as a response to the limitations of traditional didactic instruction, has evolved into one of the most extensively validated active learning pedagogies in global higher education, characterised by its student-centred, inquiry-driven structure that presents learners with authentic, ill-structured problems demanding collaborative inquiry, critical synthesis, and iterative solution development (Nnamdi et al., 2026). The integration of AI tools into PBL environments represents a compelling pedagogical frontier, offering the potential to deepen authentic inquiry, provide adaptive scaffolding, simulate complex real-world economic scenarios, and generate data-rich learning analytics (Hmelo-Silver, 2004).

Nevertheless, the convergence of AI, PBL, and Digital Economic Literacy comes with significant questions regarding the quality and effectiveness of AI-integrated pedagogical approaches. The issue of DEL development in higher education cannot be reduced to a technical question of tool selection but is part of a broader challenge of competency formation for an AI-mediated global economy. The DEL competencies that learners require including the ability to critically evaluate digital economic information, make informed decisions in digital financial contexts, and participate productively in digital economic ecosystems demand more than passive knowledge transmission; they require contextualised, authentic, and inquiry-based learning experiences (Hmelo-Silver, 2004). It is therefore imperative that the pedagogical frameworks, AI tools, and implementation conditions governing AI-Integrated PBL are thoroughly understood to ensure that DEL development is genuinely achieved rather than merely approximated. Drawing from the reviewed literature, this study further identifies that AI-Integrated PBL introduces distinct pedagogical opportunities including adaptive scaffolding, personalised feedback, and authentic simulation as well as distinct challenges, including academic integrity risks, digital divide concerns, and instructor competency gaps, that existing frameworks do not fully address (Omeh et al., 2025a; Rashid et al., 2026).

Though the body of literature addressing AI in education, PBL outcomes across disciplines, and digital and financial literacy development has grown considerably in recent years, most of the existing scholarship was formulated in settings that do not simultaneously address all three domains (Zawacki-Richter et al., 2019). Such prior studies were predominantly designed to examine AI literacy broadly, PBL efficacy in domain-specific subjects, or financial literacy

interventions in isolation without the integrated, contextualised approach that effective DEL development requires (Ng et al., 2021; Boud & Feletti, 1997). Consequently, they lack the conceptual and empirical tools to address the specific mechanisms through which AI-Integrated PBL influences DEL competencies, the pedagogical frameworks most effective for implementation, and the enabling and constraining factors most relevant to practice. Furthermore, many prior reviews were conducted using narrative approaches that lack methodological rigour and reproducibility (Varsha et al., 2024). To address this limitation, the present study employs a systematic literature review methodology, which provides a transparent, replicable, and evidence-grounded process for identifying, appraising, and synthesising the existing body of knowledge on AI-Integrated PBL for Digital Economic Literacy.

Based on the research questions, this review is guided by two key objectives. The first objective is to identify and synthesise the evidence on the implementation and impact of AI-Integrated PBL on Digital Economic Literacy, grounded in a comprehensive review of existing academic literature. The second objective is to develop thematic categories of the identified factors and outcomes through qualitative analysis, thereby enhancing conceptual clarity and guiding future investigations and model development within the context of AI-supported higher education for the digital economy.

This study makes several significant contributions. From an academic perspective, it advances theoretical insights by revisiting pedagogical frameworks for AI-PBL integration in light of the emerging capabilities and constraints of AI in higher education contexts. For policymakers, it highlights critical competency indicators and implementation conditions that can strengthen the quality, equity, and effectiveness of AI-mediated educational delivery. For practitioners, including curriculum designers, instructors, and institutional administrators, the findings offer practical guidance for assessing, designing, and improving AI-Integrated PBL programmes in DEL-focused learning environments. Ultimately, this review addresses the urgent need to ensure that as higher education systems continue to evolve through the adoption of AI, the pedagogical approaches employed genuinely cultivate the digital economic competencies that learners and the twenty-first century economy require.

METHODS

This study employed a Systematic Literature Review (SLR) guided by the PRISMA guidelines (Moher et al., 2009) and structured according to the seven-phase framework proposed by Shaffril et al. (2021) covering protocol development, research questions, search strategy, quality evaluation, data extraction, synthesis, and presentation to identify, evaluate, and synthesise existing research on AI-Integrated Problem-Based Learning and its impact on Digital Economic Literacy in higher education, with the article selection process documented through a PRISMA 2009 flow diagram (Fig. 1) and further informed by methodological guidance from Kitchenham and Charters (2007), Petticrew and Roberts (2006), and Hong et al. (2018).

a. Review Protocol

This systematic review adopted the PRISMA 2020 reporting protocol (Moher et al., 2009) to ensure transparent and complete literature reporting, supplemented by educational and social

science review guidelines given the study's interdisciplinary scope across education technology, artificial intelligence, and economics education.

b. Formulation of Research Questions

Research questions were formulated using the PICo framework (Joanna Briggs Institute, 2017). Population (learners and educators in higher education), Interest (key factors, mechanisms, and outcomes of AI-Integrated PBL for Digital Economic Literacy), and Context (AI tools and technologies within formal higher education PBL settings) to ensure clear, targeted questions guiding the review. Table 1 presents the research questions formulated using this framework.

Table 1. Research Questions

No.	Question
RQ1	What AI tools and technologies are integrated into Problem-Based Learning to support Digital Economic Literacy development?
RQ2	What pedagogical frameworks govern the effective integration of AI into PBL for Digital Economic Literacy development?
RQ3	What are the documented impacts of AI-Integrated PBL on students' Digital Economic Literacy competencies and learning outcomes?
RQ4	What challenges and enabling factors influence the effective implementation of AI-Integrated PBL for Digital Economic Literacy?

c. Systematic Searching Strategies

A systematic search was conducted across four databases Scopus, Google Scholar, ERIC, and IEEE Xplore chosen for their strong coverage of education technology, AI, and economics education literature, following established PRISMA-based stages of identification, screening, eligibility, and quality appraisal (Moher et al., 2009; Shaffril et al., 2021).

1) Identification: Core keywords and related terms were developed using academic thesauri, domain dictionaries, and prior studies (Shaffril et al., 2021; Kitchenham & Charters, 2007), then combined with Boolean operators (search strings in Table 2). The initial search yielded 173 articles: 151 from Scopus, 14 from Google Scholar, 5 from ERIC, and 3 from IEEE Xplore.

Table 2. The Search Strings

Keywords	Artificial Intelligence, Problem-Based Learning, Digital Economic Literacy
Database	**Search String**
Scopus	TITLE-ABS-KEY(("Artificial Intelligence" OR "AI" OR "Generative AI") AND ("Problem-Based Learning" OR "PBL" OR "Project-Based Learning") AND ("Digital Literacy" OR "Digital Economic Literacy" OR "Economic Literacy" OR "Digital Competence") AND ("Higher Education" OR "e-Learning")) AND PUBYEAR > 2019 AND DOCTYPE(ar OR re) AND LANGUAGE(english)
Google Scholar	"AI-integrated" OR "AI-enhanced" OR "AI-based" AND "problem-based learning" AND "digital literacy" OR "economic literacy" (2020–2026)
ERIC	"Artificial Intelligence" AND "Problem-Based Learning" AND "Digital Literacy" AND "Higher Education" Date: 2020–2026
IEEE Xplore	"All Metadata":"Artificial Intelligence" AND "Problem-Based Learning" AND "Digital Literacy" | Publication Year: 2020–2026 AND Content Type: Journals AND Language: English

2) Screening: After removing 14 duplicates, records were screened using predefined inclusion/exclusion criteria restricted to English-language, final-stage journal articles published between 2020–2026 yielding 70 eligible articles for further assessment.
3) Eligibility: Full texts of the 70 screened articles were assessed against the review's inclusion criteria study objectives, context, and relevance to AI integration, PBL implementation, and Digital Economic Literacy in higher education resulting in 35 articles excluded and 35 articles advancing to quality assessment.

d. Quality Assessment of the Selected Articles

Using Hong et al.'s (2018) criteria (Table 2) and Petticrew and Roberts' (2006) high/moderate/low classification, the author and co-author independently rated each article on five questions (Yes/No/Can't tell): 4–5 criteria met = high quality, 3 = moderate, 1–2 = low. Only high- and moderate-quality articles (35 in total) were retained for synthesis (Nnamdi et al., 2026; Omeh et al., 2025a), ensuring methodological rigour and reliability.

Table 3. Quality Assessment Criteria

No.	Assessment Criteria
1	Are the main objectives of the article aligned with the investigation of AI integration in Problem-Based Learning for Digital Economic Literacy development?
2	Does the article clearly describe its research design and methodological approach?
3	Are the AI tools, PBL frameworks, and DEL constructs well-defined and contextually appropriate?
4	Is there sufficient justification for the selection and use of AI technologies within higher education PBL settings?
5	Does the article provide practical insights or implications that contribute to the development or measurement of Digital Economic Literacy through AI-Integrated PBL?

a reflective log captured interpretive differences and emerging insights throughout analysis (Braun & Clarke, 2006), with conceptual inconsistencies resolved jointly to ensure coherence, while an expert review confirmed the suitability, relevance, and clarity of the subthemes (Hong et al., 2018).

e. Data Extraction

Data were extracted systematically using a structured form covering author, year, country, journal, study design, AI tools/technologies, PBL model, DEL competency domains, sample characteristics, findings, and limitations (Albanese & Mitchell, 1993; Norman & Schmidt, 1992), with the lead author extracting independently and the co-author validating for consistency (Shaffril et al., 2021). A systematic integrative analysis synthesised the 35 selected articles (Hong et al., 2018), with themes developed inductively around AI integration in PBL and its intersection with Digital Economic Literacy (George & Wooden, 2023; Rahiman & Kodikal, 2024).

f. Thematic Analysis

Using Braun and Clarke's six-step thematic analysis of the 35 articles, five main themes emerged: (1) pedagogical frameworks for AI-PBL integration (AI as scaffolding, collaborator, and assessor), (2) AI tools and technologies used in PBL, dominated by Large Language Models, (3) impact on DEL competencies (problem-solving, critical evaluation, decision-

making, technological adaptability, digital collaboration), (4) student engagement and outcomes (motivation, self-efficacy, critical thinking, academic achievement), and (5) implementation challenges and enablers (academic integrity, digital divide, instructor competency, technical infrastructure) together forming a framework for developing effective, evidence-based AI-Integrated PBL environments.

RESULTS AND DISCUSSION

This section presents the findings derived from a systematic review and thematic analysis of 35 selected journal articles that focus on the implementation and impact of AI-Integrated Problem-Based Learning on Digital Economic Literacy in higher education contexts. The results are synthesised through two key outputs. Table 4 provides an overview of the selected articles, detailing the types of AI technologies examined, the PBL frameworks employed, and the corresponding Digital Economic Literacy competency domains addressed. This table establishes the empirical foundation for the thematic synthesis.

Table VI presents the descriptive characteristics and thematic distribution of the 35 included studies. Themes 1 and 2 (pedagogical frameworks and AI tools) were addressed universally (100%), while Theme 3 (impact on DEL competencies, 88.6%) was dominated by digital economic problem-solving (89%) and critical evaluation (74.3%). Theme 4 (student engagement, 80.0%) was supported by experimental evidence of improved critical thinking and academic achievement (Ergezen Sahin, 2025; Tong et al., 2025), while Theme 5 (implementation challenges, 74.3%) highlighted academic integrity (74%), digital divide (60%), and instructor competency gaps (54%) as the most prevalent barriers (Omeh et al., 2025a; Rashid et al., 2026; Jin et al., 2025). Notable co-occurrence patterns emerged between academic integrity and digital divide issues as interrelated systemic barriers (Al-Kfairy et al., 2024; Jin et al., 2025), and between AI scaffolding effectiveness and student engagement, reflecting a strong link between adaptive AI support and learner motivation (Lan & Zhou, 2025; Divito et al., 2024) together illustrating the diversity of AI-PBL implementation patterns across higher education contexts.

Table 4. AI Tools, PBL Frameworks, and DEL Context Of Selected Articles

Author(s)	Title	Type of AI	PBL Model	DEL Context
Avilés Mariño (2025)	AI-Enhanced PBL and Experiential Learning for Communication and Career Readiness	AI-Enhanced Tools	PBL + Experiential Learning	Digital Competence
Kazadi Tshikolu (2025)	AI-Enhanced Problem-Based Learning for Sustainable Engineering Education	AI-Based Tools	Project-Based Learning	Digital Literacy
Lavado-Anguera et al. (2025)	Implementing Artificial Intelligence in Higher Education: A Pathway to Effective Project-Based Learning	Generative AI	Project-Based Learning	Digital Literacy
Omeh et al. (2025b)	Fostering Programming Skill and Critical Thinking Through AI-Assisted PBL Integration	AI-Assisted Tools	Problem-Based Learning	Critical Thinking
Nnamdi et al. (2026)	Advancing Problem-Based Learning in Biomedical Engineering in the Era of Generative AI	Generative AI, LLM	Problem-Based Learning	Digital Competence
Ergezen Sahin (2025)	Effects of Artificial Intelligence-Based Physiotherapy Educational Approach in	ChatGPT	Problem-Based Learning	Digital Literacy

Author(s)	Title	Type of AI	PBL Model	DEL Context
	Developing Problem-Based Learning Competencies			
Omeh et al. (2025a)	Artificial Intelligence Meets PBL: Transforming Computer-Robotics Programming Motivation and Engagement	AI Robot	Problem-Based Learning	Digital Competence
Naamati-Schneider (2024b)	Enhancing AI Competence in Health Management: Students' Experiences with ChatGPT in Problem-Based Learning	ChatGPT	Problem-Based Learning	AI Digital Literacy
Jaramillo-Fierro et al. (2026)	Integrating Generative Artificial Intelligence and Augmented Reality within a STEM Problem-Based Learning Framework	Generative AI, AR	STEM PBL Framework	Digital Economic Skills
Ruiz Viruel et al. (2025)	The Role of Artificial Intelligence in Project-Based Learning: Teacher Perceptions and Pedagogical Implications	AI Tools	Project-Based Learning	Digital Literacy
Divito et al. (2024)	The Tools of the Future are the Challenges of Today: The Use of ChatGPT in Problem-Based Learning	ChatGPT, LLM	Problem-Based Learning	Digital Competence
Nadziroh et al. (2025)	Enhancing Conflict Resolution Skills Through Artificial Intelligence-Based Problem-Based Learning	AI Tools	Problem-Based Learning	Digital Literacy
Keith et al. (2025)	Harnessing Generative AI in Chemical Engineering Education: Implementation and Evaluation within Problem-Based Learning	LLM, Generative AI	Problem-Based Learning	Digital Literacy
Kristina et al. (2025)	Multidimensional Pedagogical Framework for Interprofessional Education: Blending AI with Problem-Based Learning	AI, XR	Interprofessional PBL	Digital Literacy
Scholkmann (2025)	Towards a Theory of Generative AI in Problem-Based Learning: Insights from a Design Experiment	ChatGPT	Problem-Based Learning	Digital Literacy
Abouzeid et al. (2026)	AI-Assisted Case Builder: Making Problem-Based Learning More Scalable and Adaptable	ChatGPT	Problem-Based Learning	Digital Competence
Chen et al. (2026)	How Chinese as a Foreign Language Learners Use Generative AI for Oral Script-Writing in a Problem-Based Learning Context	Generative AI	Project-Based Learning	Digital Literacy
Kushwah et al. (2025)	Innovative Pedagogical Strategies in Science Education: Leveraging AI in Problem-Based Learning	AI Tools	Problem-Based Learning	Digital Literacy
Naamati-Schneider (2024b)	Beyond Digital Literacy: The Era of AI-Powered Assistants and Evolving User Skills in Problem-Based Learning	ChatGPT	Problem-Based Learning	Digital Literacy
Rashid et al. (2026)	The Active Learning–GenAI Synergy Framework: Ethical Integration of Generative AI in Higher Education	Generative AI	Active Learning PBL	21st Century Skills
Tong et al. (2025)	The Application of Problem-Based Learning Guided by ChatGPT in Clinical Education	ChatGPT	Problem-Based Learning	Digital Literacy
Pellas et al. (2025)	The Impact of AI-Generated Instructional Videos on Problem-Based Learning in Science Education	AI Instructional Videos	Problem-Based Learning	Digital Literacy
Mool et al. (2026)	Using Generative AI to Simulate Patient History-Taking in a Problem-Based Learning Environment	Generative AI	Problem-Based Learning	Digital Competence
Kejingyun et al. (2025)	Randomized Controlled Study on the Impact of Problem-Based Learning Combined with	LLM, AI Tools	Problem-Based Learning	Critical Thinking

Author(s)	Title	Type of AI	PBL Model	DEL Context
	AI on Critical Thinking in Nursing Education			
Raja Subramanian et al. (2024)	SHAPE: Design and Evaluation of a Transformative Model for Engineering Education Using AI-Integrated PBL	AI Tools	PBL + SHAPE Model	Digital Competence
Syahri et al. (2025)	AI-PBL Framework: Innovative Problem-Based Learning Model Supported by Artificial Intelligence (ADDIE Approach)	AI Tools	Problem-Based Learning	Critical Thinking
Shatila et al. (2025)	The Role of Artificial Intelligence in Shaping Digital Literacy: Enhancing Higher Education Learning Outcomes	ChatGPT, Generative AI	Problem-Based Learning	Digital Literacy
Sanz et al. (2025)	ChatGPT Simulated Patient: Use in Clinical Training in Psychology	ChatGPT (Simulated Patient)	Case-Based PBL	Digital Literacy
Nasri et al. (2025)	Integrating Artificial Intelligence into Problem-Based Learning Modules in Medical Professional Education	ChatGPT	Problem-Based Learning	Digital Literacy
Bansal et al. (2025)	Transforming Digital Signal and Image Processing Education: An AI-Driven Problem-Based Learning Approach	AI-Driven Tools	Project-Based Learning	Digital Literacy
Hou et al. (2025)	Application of DeepSeek-Assisted Problem-Based Learning in Hematology Residency Training	DeepSeek, LLM	Problem-Based Learning	Digital Literacy
Li et al. (2025)	The Role of Generative AI Tools in Case-Based Learning and Teaching Evaluation of Medical Biochemistry	Generative AI	Case-Based Learning	Digital Literacy
Hui et al. (2025)	Application of ChatGPT-Assisted Problem-Based Learning Teaching Method in Clinical Courses	ChatGPT	Problem-Based Learning	Digital Literacy
Sánchez-Redroban et al. (2025)	A Comprehensive Framework for Integrating Modern Educational Technologies with Problem-Based Learning	AI Educational Tech	Problem-Based Learning	Digital Literacy
Melián Ortiz et al. (2026)	Artificial Intelligence-Mediated Reasoning in Higher Education: A Pedagogical Framework	AI Tools	Problem-Based Learning	Digital Reasoning

The themes identified in this review, as depicted in Fig. 3, are strongly supported by recurring patterns across the selected studies on AI-Integrated Problem-Based Learning in higher education contexts. The need for adaptive scaffolding, authentic problem contexts, and pedagogically aligned AI frameworks is repeatedly emphasised in AI-Integrated PBL applications deployed across diverse disciplines such as engineering, medical education, and economics (Al-Kfairy et al., 2024; Nnamdi et al., 2026; Boud & Feletti, 1997; Divito et al., 2024). These studies reinforce the critical role of factors under the theme of pedagogical frameworks for AI-PBL integration in ensuring the effectiveness and authenticity of AI-mediated learning experiences. The perceived effectiveness of AI-Integrated PBL decreases when pedagogical alignment is absent, and this factor can adversely affect students' genuine competency development and engagement with Digital Economic Literacy tasks.

Likewise, the theme of AI tools and technologies deployed in PBL contexts is supported by findings that document the dominance of Large Language Models particularly ChatGPT (GPT-4) and DeepSeek as the primary AI platforms integrated within PBL environments (Dwivedi et al., 2023; Divito et al., 2024; Rudolph et al., 2023). Such technological diversity is

especially significant in higher education contexts, where the selection of appropriate AI tools directly determines the quality of scaffolding, the authenticity of simulated economic scenarios, and the depth of student engagement with digital economic problem-solving tasks.

Moreover, the theme of measured impact on Digital Economic Literacy competencies is complemented by findings that emphasise the necessity of authentic, contextualised problem scenarios to make DEL development meaningful and transferable (Nnamdi et al., 2026; Lusardi & Mitchell, 2014; Fernandes et al., 2014). AI-Integrated PBL environments that embed genuine digital economic challenges consistently produce stronger DEL outcomes, particularly in digital economic problem-solving and critical evaluation of digital economic information, compared with conventional instructional approaches (Dochy et al., 2003; Savery, 2006). A similar pattern emerges in the theme of student engagement and learning outcomes, supported by the literature that documents the role of AI personalisation, immediate feedback, and authentic problem contexts in driving student motivation, self-efficacy, and academic achievement (Omeh et al., 2025a; Ergezen Sahin, 2025; Tong et al., 2025). These are key elements in sustaining productive engagement with AI-Integrated PBL and in ensuring that learners develop the genuine Digital Economic Literacy competencies that twenty-first century economic participation demands (World Economic Forum, 2024; Venkatesh et al., 2012).

Furthermore, the theme of implementation challenges and enabling factors is confirmed by studies addressing academic integrity and AI over-reliance, digital divide and inequitable access, and instructor competency gaps as the most consistently reported barriers to effective AI-Integrated PBL deployment (Omeh et al., 2025a; Rashid et al., 2026; Jin et al., 2025). Such implementation challenges are especially of concern in diverse higher education contexts, where equity of access to AI tools and digital infrastructure is not uniformly guaranteed, and where institutional policy and professional development frameworks have not yet kept pace with the rapid proliferation of AI-Integrated pedagogical approaches (Al-Kfairy et al., 2024; Adiguzel et al., 2023). Collectively, the results indicate that the effectiveness of AI-Integrated PBL in developing Digital Economic Literacy plays an important role in influencing initial student engagement as well as the intention to sustain participation in AI-enabled higher education environments (Avilés Mariño, 2025; George & Wooden, 2023). Based on the synthesised evidence, the authors propose the following design guidelines for AI-Integrated PBL practitioners. First, for Pedagogical Frameworks, platforms should incorporate clearly defined AI roles scaffolding, collaboration, or assessment that are explicitly aligned with the PBL cycle and DEL competency objectives (Barrows & Tamblyn, 1980; Hmelo-Silver, 2004). Second, for AI Tools and Technologies, developers and educators are advised to select and deploy LLMs that are pedagogically appropriate, ethically governed, and accessible to diverse learner populations (Al-Kfairy et al., 2024; Dwivedi et al., 2023). Third, for DEL Competency Development, knowledge-grounding mechanisms and authentic digital economic problem scenarios should be adopted to strengthen the relevance, depth, and transferability of DEL outcomes (Lusardi & Mitchell, 2014; Fernandes et al., 2014). Fourth, for Student Engagement, personalisation-by-design principles including adaptive feedback, differentiated scaffolding, and real-world economic contexts should be applied to sustain motivation and maximise learning gains across diverse student populations (Lan & Zhou, 2025; Pellas et al., 2025). Fifth, for Implementation, institutions should invest in dedicated professional development programmes, clear ethical guidelines for AI use, and equitable digital infrastructure to ensure

that the benefits of AI-Integrated PBL are accessible to all learners regardless of socioeconomic background or institutional context (Rashid et al., 2026; Jin et al., 2025; George & Wooden, 2023).

The evidence synthesised in this review affirms that the question confronting higher education is no longer whether AI should be integrated into Problem-Based Learning, but how that integration can be designed and sustained in ways that genuinely serve Digital Economic Literacy as a transformative human competency. Effective AI-Integrated PBL is not merely a technological achievement it is a pedagogical, ethical, and institutional commitment. It demands that educators move beyond deploying AI as a content generator and embrace the more purposeful role of designing learning environments in which AI functions as a genuine cognitive partner in authentic economic inquiry. It requires institutions to recognise that equitable access to AI tools is a precondition for democratic participation in the digital economy, not a peripheral concern. Above all, it challenges the scholarly community to resist technological determinism and to insist that the human dimensions of learning critical judgement, collaborative sense-making, and ethical reasoning remain irreducibly at the centre of any genuinely transformative educational innovation. AI-Integrated PBL for Digital Economic Literacy is therefore best understood not as a solution to be implemented, but as a practice to be continuously interrogated, refined, and held accountable to the learners it is designed to serve.

CONCLUSION

This systematic review synthesised 35 peer-reviewed studies (2020–2026) on AI-Integrated PBL and Digital Economic Literacy (DEL) in higher education, identifying five themes pedagogical frameworks, AI tools (dominated by LLMs like ChatGPT and DeepSeek), impact on DEL competencies, student engagement, and implementation challenges. Findings show AI-Integrated PBL significantly enhances DEL, particularly digital economic problem-solving and critical evaluation, when supported by pedagogical scaffolding, institutional support, and ethical governance, though academic integrity, digital divide, and instructor competency gaps remain key barriers.

Limitations include the English-language-only corpus, interpretive elements in thematic analysis, and heterogeneous study designs limiting cross-study comparison. Future research should prioritise: validating the five DEL competency domains through context-specific instruments, developing domain-specific AI-Integrated PBL models, and most critically addressing the absence of purpose-built AI systems for DEL, through developing an AI-Based Adaptive Learning system for information bias and a UTAUT2-grounded AI-Integrated PBL model for senior secondary students, together forming a coherent agenda for advancing responsible AI-Integrated PBL in higher education.

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