Jurnal Santiaji Pendidikan (JSP)
Vol. 16, 2 (September, 2026),ISSN: 2087 – 9016, eISSN: 2685 – 4694
https://e-journal.unmas.ac.id/index.php/jsp/index

DIGITAL TECHNOLOGY-SUPPORTED PROBLEM SOLVING IN ECONOMICS EDUCATION: A SYSTEMATIC REVIEW OF EVIDENCE FROM 2021–2025

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ARTICLE INFORMATION

Keywords:

Digital Literacy; Economic Education; Problem Solving; Technology Integration

Article history:

Received:
July 3, 2026
Revised:
August 7, 2026
Accepted:
August 7, 2026

ABSTRACT

This study synthesises evidence on the integration of digital technology and problem-solving strategies in economics education, with a particular focus on developing countries, especially Indonesia. A systematic literature review was conducted in accordance with the PRISMA 2020 guidelines. Articles were retrieved from ScienceDirect and Scopus published between 2021 and 2025. A total of 20 eligible studies were selected through the PRISMA 2020 screening process and analyzed using thematic synthesis, supported by NVivo 12 Plus for coding, word frequency analysis, and thematic mapping. The review identified three main findings: First, the reviewed studies indicate that integrating digital technology with problem-solving strategies supports the development of interactive, adaptive, and contextual learning environments through gamification, artificial intelligence, augmented reality, and interactive e-learning platforms. Second, limitations in digital infrastructure and low technological literacy among educators remain major implementation challenges. Third, pedagogical reform is needed through teacher training, curriculum modernization, and digital transformation policies. These findings provide recommendations for educators and policymakers in supporting Sustainable Development Goal 4 on inclusive and quality education. This study contributes by presenting the latest evidence on technology-supported problem-solving approaches in economics education and offers practical implications for educators and policymakers seeking to strengthen digital transformation in developing countries.

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INTRODUCTION

Rapid advances in digital technology have transformed educational practices in various aspects, one of which is education. This transformation not only

improves students' access to learning resources but also promotes meaningful learning and supports the creation of a positive learning environment (Balalle, 2024). However, the implementation of digital technology in Indonesia's education sector still faces several challenges. Evidence reported in recent literature suggests that teachers continue to encounter obstacles when incorporating digital technologies into classroom instruction, particularly due to limited digital competence and institutional support (Cabellos et al., 2024; Dai, 2023; Schmitz et al., 2023). These challenges indicate that technology alone is insufficient to improve learning outcomes; effective pedagogical strategies are equally necessary to maximise the educational benefits of digital technology.

One relevant strategy is problem-based learning. This approach has been reported to support developing students' critical, analytical, and reflective thinking competencies, as well as encouraging their active involvement in finding solutions to real-world problems (Hidayati et al., 2024; Lu & Xie, 2024; Trismaya & Admoko, 2025). When the problem-solving strategy is aligned with the use of digital technology, the potential to enhance students' cognitive, affective, creativity, and intrinsic motivation aspects can be maximized (Calderón, Merono, & MacPhail, 2020; Chaiyarat, 2024). Furthermore, interactive digital learning activities have been reported to enhance students' motivation, interaction, and perceived learning in economics education (Sánchez, 2023).

Although previous studies have highlighted the importance of technology integration and problem-solving strategies in education, several important research gaps remain. First, most studies only focus on one aspect, namely the integration of technology or problem-solving strategies, so there are still few that specifically test the connection between the two in economics learning (Haleem et al., 2022). Secondly, Existing studies mainly focus on short-term cognitive outcomes, while affective outcomes and sustainable technology integration remain underexplored. Third, previous studies tend to focus on short-term cognitive learning outcomes, while affective impacts such as intrinsic motivation, creativity, and the sustainability of technology-based learning are still rarely explored. Existing studies have not yet provided a comprehensive conceptual synthesis integrating digital technology and problem-solving strategies within economics education.

In line with this, the aim of this study is to analyze the patterns of approaches and best practices for integrating technology with problem-solving strategies in economics learning and the study specifically examines how technology-supported economics learning environments can enhance students' critical

thinking, engagement, and problem-solving competencies in economics learning contexts.

This study offers three main novelties. First, it synthesises evidence from twenty peer-reviewed articles indexed in ScienceDirect and Scopus. Second, it integrates technology integration and problem-solving strategies into a single analytical framework for economics education. Third, it proposes a contextual conceptual framework applicable to developing countries, particularly Indonesia.

Based on the research gaps that have been identified, this study addresses the following research questions: (1) How is digital technology integrated with problem-solving strategies in economics learning? (2) What are the main challenges and opportunities in implementing technology-based problem-solving learning in economics education? and (3) What best practices can support effective and sustainable digital transformation in economics learning?

The contributions of this study are expected to cover two aspects. First, theoretical contributions in the form of developing a conceptual framework that fills the gap in the literature regarding the integration of technology and problem-solving strategies in the field of economics education. Second, practical contributions in the form of policy recommendations and implementation guidelines for educators, as well as teacher training, to be prepared for the challenges of the digital era and support the achievement of Sustainable Development Goal 4 (Quality Education).

METHOD

This study employed a SLR following the PRISMA 2020 guidelines to systematically identify, screen, evaluate, and synthesise evidence regarding the integration of digital technology and problem-solving strategies in economics education. A thematic synthesis approach was adopted to integrate findings from multiple studies into broader analytical themes while identifying recurring themes, research gaps, and best practices related to technology integration and problem-solving strategies in economics education. This approach enabled the researchers to synthesise evidence from multiple studies into coherent analytical themes relevant to the research objectives. The review data were obtained from scientific articles published in international journals indexed in ScienceDirect and Scopus between 2021 and 2025. The literature search was conducted using the keywords "technology integration," "problem-solving," "economics education," and "digital learning" with the help of Boolean operators (AND and OR).

The inclusion criteria included: (1) Articles that discuss the integration of technology in economics learning, (2) Articles that examine problem-solving-based learning strategies, (3) Articles that discuss challenges or implementation practices of technology-based learning. Tthe exclusion criteria included: (1) Articles that are not fully available, (2) Articles that have not undergone a peer review process, (3) Articles that are merely opinions without strong empirical or conceptual evidence. The search yielded 200 articles from ScienceDirect and Scopus. After removing 75 duplicate articles, 125 articles were screened based on their titles and abstracts. Subsequently, 100 articles were eliminated because they were irrelevant or did not meet the publication criteria. A total of 25 articles underwent full-text evaluation, of which 5 articles were excluded after eligibility evaluation because they did not satisfy the inclusion criteria. Consequently, 20 articles were included in the final review. The complete study selection process followed the PRISMA 2020 guidelines, as presented in Figure 1. Data analysis was conducted through four systematic stages, (1) identification and selection of literature, (2) data extraction, (3) thematic synthesis of the main research findings, and (4) interpretation of results.

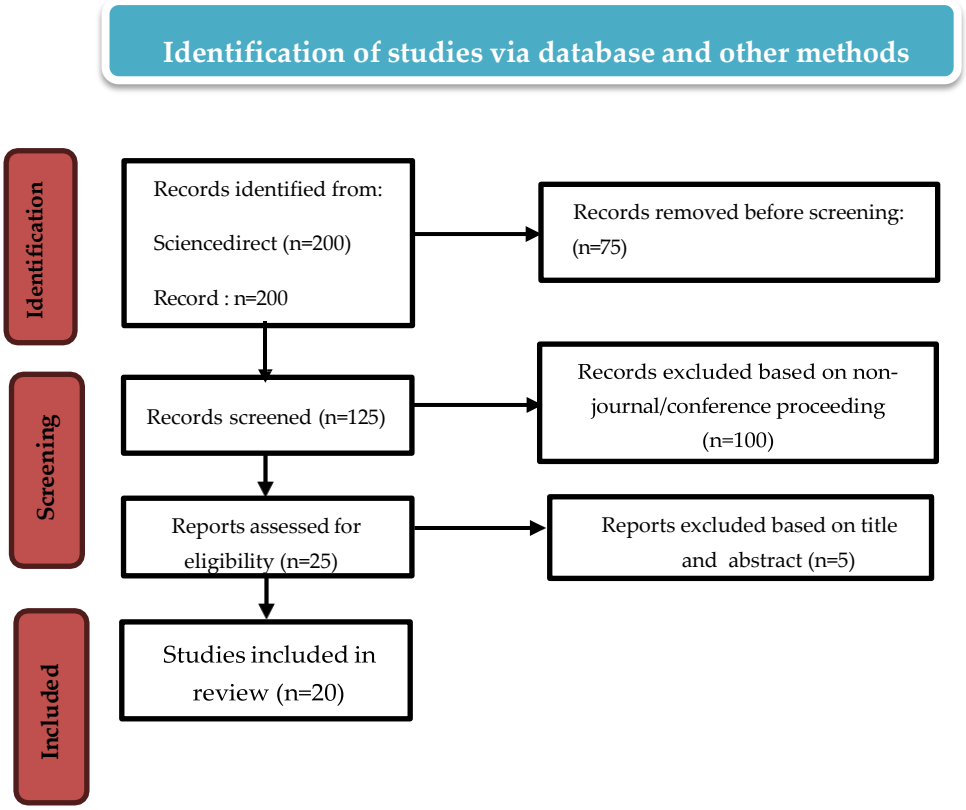

Figure 1 Step of the SLR Process based on PRISMA 2020 Flow Diagram

RESULT AND DISCUSSION

Result

Based on the synthesis of 20 articles that met the inclusion criteria, four main themes were found regarding the integration of technology and problem-solving strategies in economics learning, namely: (1) the effectiveness of technology integration on learning outcomes, (2) the development of critical thinking and problem-solving skills, (3) challenges in implementing technology-based learning, and (4) pedagogical implications for economics education. These four themes were obtained through a coding and thematic analysis process using NVivo 12 Plus.

Technology Integration and Problem-Solving Strategies in Economics Education

Table 1 summarises the findings of the twenty selected studies. Overall, the reviewed literature indicates that technology integration positively influences students' problem-solving skills, critical thinking, creativity, engagement, and learning outcomes. However, successful implementation depends on teachers' digital competence, institutional support, and adequate technological infrastructure. In economic education, the integration of technology not only serves as a teaching aid, but also facilitates students in understanding complex economic concepts through real-world simulations, case-based learning, and collaborative problem-solving activities (Kageyama, Zamudio, & Barton, 2022). Here is table 1:

Table 1 Relevant Literature Technology Integration and Problem-Solving Strategies

No.	Name Researcher	Results Research
1.	(Berkat, Setinawati, & Basrowi, 2025)	Education management supported by technology can boost students' innovation, critical thinking, creativity, and problem-solving.
2.	(Pimdee et al., 2024)	Enhancing Thai student-teacher problem-solving skills and academic achievement through a blended problem-based learning approach in online flipped classrooms
3.	(Y. Li, Kim, & Palkar, 2022)	The use of technology encourages teachers to create more interactive economics learning, which can increase students' creativity and learning effectiveness.
4.	(Johnson & Meder, 2024)	Empirical research shows that technology-based economics learning, including online, hybrid, and flipped classrooms, effectively improves student learning outcomes.
5.	(Platz, 2022)	Game-Based Learning (GBL) improves mastery of the material and learning engagement, although its effect on motivation is still inconsistent.

6.	(Promma, Imjai, Usman, & Aujirapongpan, 2025)	Integrating artificial intelligence (AI) into learning can boost students' digital literacy and problem-solving skills in facing challenges of the digital era.
7.	(Wang et al., 2024)	The use of artificial intelligence (AI) supports adaptive learning, smarter assessments, and more effective learning management.
8.	(Cheruvalath & Chandrakant, 2024)	The creative problem-solving approach helps prospective teachers develop critical thinking, reflection, and ethical decision-making skills.
9.	(Aslan, 2021)	The Problem-Based Learning (PBL) model in online learning can boost students' problem-solving skills and active participation.
10.	(Chueh & Kao, 2024)	Exploring the impact of integrating problem based learning and agile in the classroom on enhancing professional competence
11.	(Zeng, Sun, Looi, & Fan, 2024)	A meta-analysis in this study shows that gamification consistently has a positive impact on students' academic performance.
12.	(Ratinho & Martins, 2023)	The results of this study show that having technology-based learning strategies provenly gives students intrinsic motivation.
13.	(Manzano-León et al., 2021)	The success of technology-based gamification has proven to be effective in actually encouraging students to solve problems.
14.	(Lee, 2025)	Changes in Learning Outcomes of Students Participating in Problem-Based Learning for the First Time: A Case Study of a Financial Management Course
15.	(Velez & Alonso, 2025)	Business Simulation Games for the Development of Decision Making: Systematic Review
16.	(Celik, 2023)	Teachers who have intelligent TPAC competence are able to integrate AI effectively and ethically into learning.
17.	(Hidayat et al., 2023)	Data from 14 provinces in Indonesia show that the digital competence of prospective teachers is still below the standard needed to effectively integrate technology into teaching practice.
18.	(D. Liu & Zhang, 2022)	Proving that digital-based learning significantly boosts HOTS (Higher Order Thinking Skills) and student achievement.
19.	(Mathrani, Sarvesh, & Umer, 2022)	The gap in access to digital infrastructure, internet connections, device availability, and technical support can be a major factor in the success of learning in developing countries..
20.	(Krath, Schürmann, & von Korflesch, 2021)	The effectiveness of gamification in theory relies on Self-Determination Theory, with well-designed game elements meeting students' basic needs and social connections, thus encouraging engagement in learning.

To further identify dominant themes and patterns across the ten selected articles, a word frequency query analysis was conducted using NVivo 12 Plus. The results of this word frequency analysis are visualized in the word cloud below.

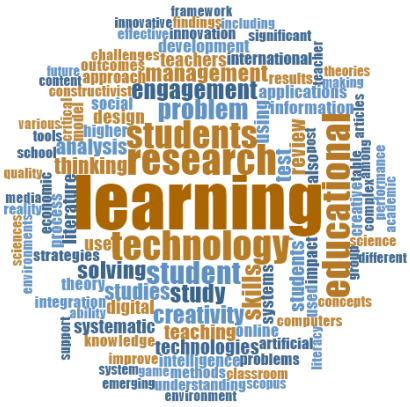

Figure 2 Word Frequency Query Wordcloud

Figure 2 shows that learning, technology, and problem-solving are the most frequently occurring terms across the reviewed literature. This indicates that current studies mainly focus on technology-supported economics learning designed to improve students' problem-solving competencies. Other frequently occurring terms, including creativity, thinking, and engagement, suggest that these concepts are also commonly addressed in studies on technology integration in education. It should be noted that the word frequency analysis describes the prevalence of concepts rather than the relationships or effects among them.

To map the hierarchical relationships and the relative level of prominence of each theme identified in ten selected articles, a hierarchy chart was created using Nvivo 12 Plus. This visualization was produced by coding the full text of all articles into thematic nodes, where the size of each block reflects the frequency and weight of the theme within the overall dataset.

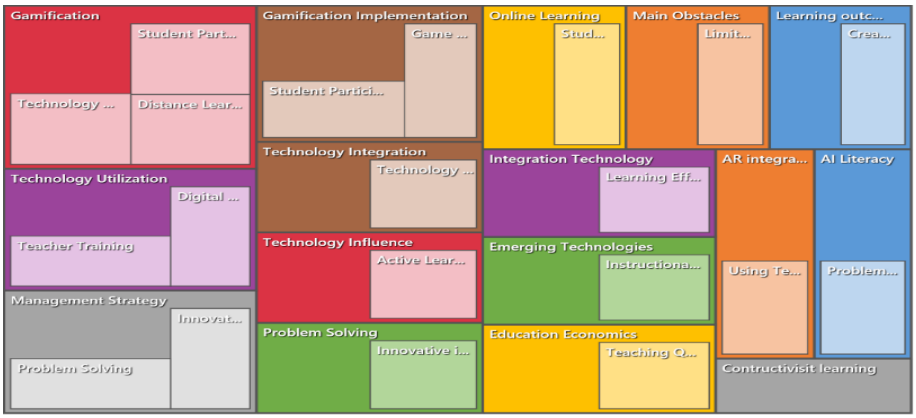

Figure 3 Hierarchy Chart

This section indicates that there is a significant level in each theme. "Gamification" and "technology utilization" show that these two concepts are the most discussed and have the widest connections compared to others. "Problem-solving" also holds a significant position as it can reinforce the finding that this strategy becomes the backbone in the integration of economic education. Through the coding process include 'Teacher Training,' 'Management Strategies,' 'Online Learning,' 'AI Literacy,' and 'Constructivist Learning,' which, although smaller in size, indicate that the literature also addresses the supporting conditions and pedagogical foundations required for effective technology-based learning.

To complement the thematic analysis, a treemap visualization was created using Nvivo 12 Plus to display the diversity of themes comprehensively in the ten selected articles. The larger the size of each block indicates a more dominant concept. The treemap visualization is presented in the following figure.

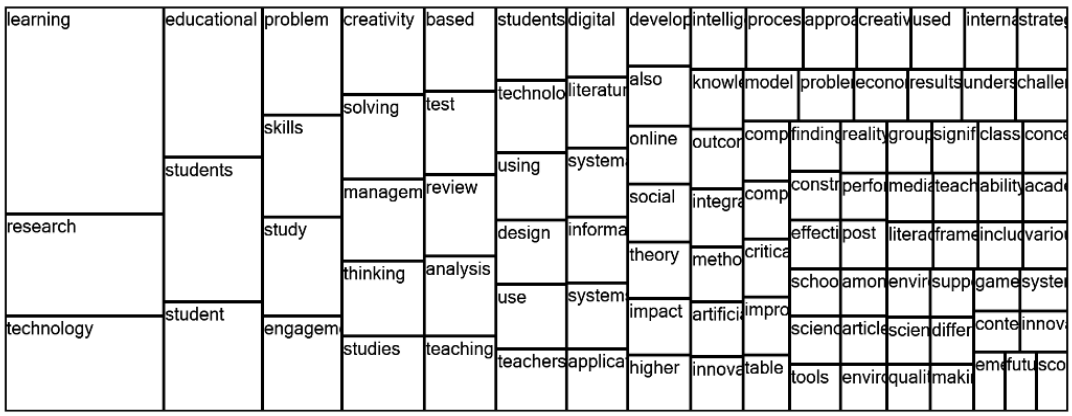

Figure 4 Treemap

Figure 4 confirms the diversity of themes identified in the reviewed literature. Technology, learning, and problem-solving remain the dominant concepts, while creativity, critical thinking, innovation, and teacher readiness emerge as complementary themes supporting technology-based economics learning.learning, from conceptual foundations to practical implementation strategies.

Discussion

These findings are consistent with the principles of the TPACK framework, suggesting that technology becomes pedagogically meaningful when integrated with appropriate instructional strategies. The reviewed studies suggest that digital technologies are more likely to support learning when combined with appropriate

instructional strategies such as problem-based learning. Furthermore, from a constructivist perspective, integrating technology into problem-solving activities creates opportunities for students to participate more actively construct knowledge through contextual and collaborative learning experiences suggesting that technology integration can facilitate collaborative, contextual, and experiential learning processes. In economics learning, digital tools such as Learning Management Systems (LMS), gamification, Artificial Intelligence (AI), and Augmented Reality (AR) enable students to understand economic concepts more concretely through simulations, digital case studies, and interactive economics learning activities.

These findings are also consistent with several studies reviewed in Table 1. Across several reviewed studies (Balalle, 2024; Wang et al., 2024) gamification and online learning were consistently associated with higher student engagement and participation in technology-supported economics learning. These findings also emphasise that AI-based education systems support an adaptive learning environment and can improve students' analytical and problem-solving skills (Liu & Israel, 2022; Platz, 2022). In addition, the emergence of terms such as “creativity”, “thinking”, and “student engagement” indicates a pedagogical shift towards a constructivist learning approach supported by technology (Chaiyarat, 2024). In economic education, the integration of technology and problem-solving can assist students in analysing real-world economic issues, such as inflation, unemployment, and market dynamics (Lu & Xie, 2024).

The word frequency analysis presented in Figure (2) show dominant terms such as “gamification,” “technology utilization,” and “problem-solving,” which are dominant words reflecting frequently discussed concepts in this literature. For example, gamification is often used to increase student participation and motivation, especially in teaching economics, by transforming difficult learning concepts into more engaging and interactive experiences (Ratinho & Martins, 2023; Sikkink, 2025). The frequent occurrence of the term "technology utilization" indicates that technology integration is one of the dominant topics discussed across the reviewed studies. The thematic synthesis further suggests that digital tools such as AR and AI were frequently reported as supporting problem-solving activities in economics learning. These findings suggest that digital technology may provide opportunities for economics education, especially in creating a learning environment that is adaptive, flexible, and collaborative, supporting 21st-century competencies.

Although digital technology offers potential opportunities, this research has also identified several major challenges in implementing technology-based problem-solving learning in economics education. The analysis of these key issues relates to infrastructure limitations, teacher readiness, digital literacy and institutional support (Garzón et al., 2021). Mustafa et al. (2024) explaining that unequal access to digital infrastructure and adequate technological resources remains one of the main obstacles in implementing technology-supported economics learning, especially in developing countries. Rasimin et al (2024) also reported that the implementation of technology-based learning in Indonesia still faces multidimensional challenges related to internet accessibility, educational facilities, and management systems. Another significant challenge identified in the reviewed literature is the low level of digital competence and pedagogical readiness of teacher (Chiu et al., 2024). According to research results from Mazı & Yıldırım (2025) they argue that although technologies such as AI and digital platforms can support problem-solving learning, their effectiveness is highly dependent on the teacher's ability to integrate technology into teaching practice.

Therefore, the implementation of technology-supported problem-solving learning that succeeds requires teachers to not only have technological skills but also pedagogical understanding of how technology can support economic learning objectives. Mukul & Büyüközkan (2023) explaining that he reviewed evidence indicates that successful implementation depends on systemic adjustments involving redesigning the curriculum, management strategies, and institutional commitment. Without adequate policy support and curriculum adaptation, technology integration may only operate at a technical level without significantly changing learning practices. Furthermore, uneven access to technology can create gaps in students' learning experiences, particularly among schools with limited educational resources (Bawa & Bawa, 2025). As a result, digital transformation in economics education has the potential to enhance students' critical thinking, creativity, collaboration, and digital literacy skills required in the 21st century. Overall, these findings address the second and third research questions by highlighting the challenges and opportunities in implementing technology-based problem-solving learning in economics education. The findings indicate that sustainable digital transformation requires comprehensive collaboration between educators, educational institutions, and policymakers through teacher training, curriculum modernisation, infrastructure development, and long-term institutional support. Therefore, the integration of technology in economics education should not be seen merely as the adoption of technology, but as a

systemic pedagogical transformation aimed at improving the quality and sustainability of learning in the digital era.

CONCLUSION

Evidence compliled from the reviewed studies suggest of a systematic literature review of 20 studies published between 2021 and 2025, this review indicates that the integration of digital technology with problem-solving strategies can support economics learning in the educational contexts examined, particularly in research conducted by developing countries. In general, several of the reviewed studies reported that technologies such as Learning Management Systems (LMS), gamification, Artificial Intelligence (AI), digital simulations, and e-learning platforms often support student engagement, conceptual understanding, critical thinking, and problem-solving skills in economics education. However, the implementation of technology-based learning still faces several challenges, such as limited digital infrastructure, low teacher digital competence, gaps in technology access, and less than optimal support from curriculum and institutional policies. The evidence reviewed indicates that the success of technology integration depends not only on the availability of digital technology, but also on the alignment of that technology with appropriate pedagogical strategies, teacher competencies, and institutional support. Therefore, within the contexts represented in the reviewed studies, strengthening teacher profesional development, developing adaptive curricula, and improving equitable access to digital technologies appear to be important considerations for supporting technology based economics learning. Future research should examine the effectiveness of specific technology-supported problem-solving approaches, such as AI, gamification, and digital simulations, across different educational levels, economics learning settings, and regional contexts to generate stronger empirical evidence.

SUGGESTION

Based on the results of this study, educators and educational institutions are advised to make the most of digital technology combined with problem-solving strategies to create economics learning that is more interactive, contextual, and student-centered. These efforts need to be supported by improving teachers' digital skills, providing adequate infrastructure, and developing a curriculum that can sustainably accommodate technology-based learning. In addition, future research is recommended to test the implementation of technology-based and problem-solving learning models across different education levels, student characteristics,

and regional contexts to obtain more comprehensive empirical evidence on their effectiveness in improving the quality of economics learning.

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