JURNAL ABSIS
Jurnal Pendidikan Matematika dan Matematika
Vol. 8 No. 1, April 2025

TECHNOLOGY INTEGRATION IN PROBLEM-BASED CULTURALLY RESPONSIVE MATHEMATICS LEARNING: A SYSTEMATIC LITERATURE REVIEW IN THE ERA OF INDUSTRY 5.0

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ABSTRACT The Industry 5.0 era demands mathematics learning models that are not only technology-enhanced but also culturally responsive and competence-oriented. This systematic literature review investigates the integration of technology-supported problem-based learning (PBL) with culturally responsive teaching (CRT) in mathematics education. Following the PRISMA 2020 protocol, 24 records were retrieved from Scopus, ScienceDirect, and Google Scholar; five met the inclusion criteria and were thematically analyzed. Results show that PBL supported by technology improves students' problem-solving skills, mathematical literacy, motivation, and self-regulated learning. However, explicit integration of CRT within these models remains limited. Compared to conventional approaches, a combined PBL-CRT-technology framework holds greater potential to promote meaningful, inclusive, and future-oriented mathematics learning. This review recommends the development of a comprehensive instructional model that aligns cultural relevance, digital innovation, and inquiry-based learning. Implications for research and practice are outlined to support mathematics education in diverse and digitally connected learning environments.

Keywords: culturally responsive learning, educational technology, problem-based learning, mathematical literacy

ABSTRAK Era Industri 5.0 menuntut model pembelajaran matematika yang tidak hanya ditingkatkan oleh teknologi tetapi juga responsif secara budaya dan berorientasi pada kompetensi. Tinjauan pustaka sistematis ini menyelidiki integrasi pembelajaran berbasis masalah (PBL) yang didukung teknologi dengan pengajaran yang responsif secara budaya (CRT) dalam pendidikan matematika. Mengikuti protokol PRISMA 2020, 24 catatan diambil dari Scopus, ScienceDirect, dan Google Scholar; lima memenuhi kriteria inklusi dan dianalisis secara tematis. Hasil penelitian menunjukkan bahwa PBL yang didukung oleh teknologi meningkatkan keterampilan pemecahan masalah, literasi matematika, motivasi, dan pembelajaran mandiri siswa. Namun, integrasi eksplisit CRT dalam model ini masih terbatas. Dibandingkan dengan pendekatan konvensional, kerangka kerja gabungan PBL-CRT-teknologi memiliki potensi yang lebih besar untuk mempromosikan pembelajaran matematika yang bermakna, inklusif, dan berorientasi ke masa depan. Tinjauan ini merekomendasikan pengembangan model pengajaran komprehensif yang menyelaraskan relevansi budaya, inovasi digital, dan pembelajaran berbasis penyelidikan. Implikasi untuk penelitian dan praktik diuraikan untuk mendukung pendidikan matematika dalam lingkungan pembelajaran yang beragam dan terhubung secara digital.

Kata-kata kunci: pembelajaran responsif budaya, teknologi pendidikan, pembelajaran berbasis masalah, literasi matematika

INTRODUCTION

The changing educational paradigm in the Industrial 5.0 era demands innovation in learning that is not only knowledge based, but also pays attention to social, cultural and technological contexts. In the realm of mathematics education, learning approaches that place students at the center of learning and encourage critical thinking and problem solving skills are becoming increasingly relevant (Apriliana et al., 2019; Siahaan et al., 2023). One approach that has been widely studied and proven effective in developing these abilities is Problem Based Learning.

PBL is a constructivism-based learning model that emphasizes the active involvement of students in solving authentic problems. This approach has been proven to improve problem-solving skills and motivate students to learn more independently and meaningfully (Cetin et al., 2019; Yaniawati et al., 2019). However, in its practical implementation, problem-based learning (PBL) is often not optimally integrated with students' cultural contexts and the use of modern educational technologies that could enhance its effectiveness. Recent studies highlight that while PBL has been widely adopted to promote active learning and problem-solving, its alignment with students' socio-cultural backgrounds remains underdeveloped (Marvi, 2023; Semião et al., 2023). Similarly, the incorporation of digital learning tools into PBL is frequently fragmented, lacking coherent instructional frameworks that connect pedagogy with technology use Anyichie et al., (2023); Bergdahl et al., (2024). These gaps indicate that although each component PBL, technology, and cultural responsiveness has shown individual benefits, their combined and systematic integration remains a critical challenge in current mathematics education design.

Recent studies have shown that the integration of technology such as e-learning, visual applications such as Geogebra, and learning management systems can strengthen the effectiveness of PBL. Wardono et al., (2018) showed that the development of a PBL model based on PMRI (Indonesian Realistic Mathematics Approach) and a scientific approach supported by ICT succeeded in improving students' mathematical literacy and learning independence. Similarly, Yaniawati et al., (2019) proved that the use of e-learning assisted PBL can significantly improve students' problem solving skills and self-regulated learning.

The study by Cetin et al., (2019) added that the use of interactive visual platforms such as Geogebra within the PBL framework not only improved academic achievement, but also positive attitudes towards mathematics. This shows that technology does not only act as a medium, but as an integral part in the construction of students' mathematical knowledge. Meanwhile, in the context of developing creativity and learning engagement, Ardiansyah & Asikin, (2020) emphasized the importance of integrating the Challenge Based Learning model as a more adaptive PBL alternative in improving mathematical creativity through Multiple Solution Tasks.

Furthermore, mathematics learning also needs to be adapted to the diversity of students' cultural backgrounds in order to create meaningful and equitable learning experiences. Culturally Responsive Teaching (CRT) is a pedagogical framework that recognizes the importance of including students' cultural references in all aspects of learning. Rooted in the work of Gay, (2018) CRT emphasizes instructional practices that are responsive to students' cultural experiences, prior knowledge, and values, with the goal of improving engagement, motivation, and academic achievement. In the context of mathematics education, CRT encourages educators to design learning activities that are contextually relevant and reflective of students' sociocultural realities. By bridging the gap between home culture and school learning, CRT serves not only as a foundation for inclusivity but also as a strategic means to foster critical thinking and deepen conceptual understanding. The integration of CRT is particularly essential in multicultural classrooms, where student diversity must be embraced as an educational asset.

Although the literature on the explicit integration of CRT within PBL remains limited, studies employing contextual and reflective teaching approaches indicate promising directions (Sari et al., 2022a). However, many existing studies have focused on either PBL supported by digital technologies or on culturally contextualized instruction, but few have comprehensively assessed the combined and synergistic effects of these three elements problem-based learning, cultural responsiveness, and technological support within a unified instructional framework. This gap is especially critical in the context of Industry 5.0, which demands both technological adaptability and human centered innovation through the development of essential skills such as problem-solving and self-directed learning. Based on this background, this review aims to systematically synthesize empirical literature on the implementation of problem-based mathematics learning that integrates culturally responsive approaches with technological support. In response to the identified research gap in integrating technology, problem based learning (PBL), and culturally responsive teaching (CRT), this study seeks to address the following research questions:

RQ1: How is culturally responsive teaching integrated into technology-supported problem-based learning in mathematics education?

RQ2: What are the effects of technology-supported and culturally responsive PBL on students' problem-solving skills and learning motivation in the context of Industry 5.0?

METHODS

This study applied the Systematic Literature Review approach as the main design to answer the research question on the effectiveness of integrating Problem-Based Learning, Culturally Responsive Teaching, and technology support in mathematics learning in the Industry 5.0 era. This approach was chosen for its ability to synthesize empirical findings comprehensively and critically, as well as to provide an in-depth understanding of the trends and effectiveness of previously researched interventions. The entire SLR process was designed and implemented based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines, utilizing the R package and Shiny application to produce interactive and digitally transparent flowcharts (Haddaway et al., 2022).

Eligibility and Exclusion Criteria

Inclusion and exclusion criteria were strictly set to maintain consistency of focus and validity of the review. Articles included had to fulfill several requirements: (1) in the context of mathematics learning at the primary or secondary education level, (2) explicitly using PBL approaches, either in the form of experiments or model development, (3) involving learning technology support such as digital platforms, interactive applications, Learning Management Systems, or other Information and Communication Technology tools, (4) evaluate at least one outcome variable such as math problem solving ability, learning motivation, student engagement, or 21st century competencies, (5) be published between 2015 and 2025, (6) be written in English for international access, and (7) be published in an accredited journal or peer-reviewed scientific proceedings.

Articles excluded from the review included studies that were not relevant to mathematics learning, did not explicitly use PBL approaches, did not involve learning technologies, did not evaluate relevant outcome variables, and were editorials, opinion pieces or non-systematic reviews. Duplicate articles were also eliminated at the initial selection stage to avoid data redundancy.

Data Sources and Search Strategy

The literature search strategy was implemented through reputable scientific databases, namely Scopus, ScienceDirect, and Google Scholar. Two main query formulations were designed based on the PICOS framework (Population, Intervention, Comparison, Outcome, Study Type). The first query combined the keywords: “problem based learning”, “mathematics education”, “technology”, ‘ICT’, “problem solving”, and “motivation” to reach studies that integrate PBL and technology. The second query focuses on the integration of cultural aspects by using a combination of: “problem based learning”, “culturally responsive teaching”, “mathematical problem solving”, ‘motivation’, and “technology”. The search results were then exported and filtered using the predefined inclusion and exclusion criteria.

 https://doi.org/10.30606/absis.v8i1.3340

Data Management

Data management was done with the help of Covidence software to support online collaboration in the screening and reference management process. This process included removal of duplicate articles, review of abstracts and full text, and extraction of key data. Information collected from each article included the educational context, research design, form of PBL intervention, type of technology used, and outcome variables measured (Haddaway et al., 2022). The categorized data were then organized in a spreadsheet for further analysis.

Study Selection

To maintain methodological rigor and consistency of focus, strict inclusion and exclusion criteria were applied in the selection of articles. Studies were included if they met the following criteria: (1) focused on mathematics learning at the primary or secondary education level, (2) explicitly implemented problem-based learning (PBL) either as experimental interventions or model development, (3) incorporated learning technology such as digital platforms, interactive applications, or learning management systems (LMS), (4) measured at least one outcome related to 21st century competencies namely problem-solving ability, learning motivation, student engagement, or mathematical literacy, (5) were published between 2015 and 2025, (6) were written in English, and (7) were published in peer-reviewed journals or accredited scientific proceedings.

The selection of the 2015–2025 publication range was intentionally chosen to capture a decade of accelerated digital transformation in education, aligned with the growing influence of Industry 4.0 and the emergence of Industry 5.0 paradigms. Starting from 2015, educational technology began to be more systematically embedded in PBL research, while awareness of cultural responsiveness gained traction in global discourse. Including studies up to 2025 also allowed the review to consider early access or in press articles, ensuring that the synthesis remained forward looking and comprehensive.

The initial database search yielded 24 records (18 from databases and 6 from registers). As illustrated in the PRISMA 2020 flow diagram, a total of 6 records were removed prior to screening 3 due to duplication, 2 flagged by automation tools, and 1 for unrelated content. The remaining 18 articles were screened, resulting in the exclusion of 4 papers that did not meet the inclusion criteria. From the remaining pool, 2 articles were retrieved for full-text access, but 1 could not be obtained.

Of the 11 full text articles assessed for eligibility, 6 were excluded: 2 due to language (not in English), 3 for irrelevance to the research topic, and 1 due to the absence of an abstract. Finally, 5 articles met all inclusion criteria and were included in the systematic review. These studies were then subjected to thematic analysis to identify patterns, outcomes, and research gaps relevant to the integration of PBL, technology, and cultural responsiveness in mathematics education.

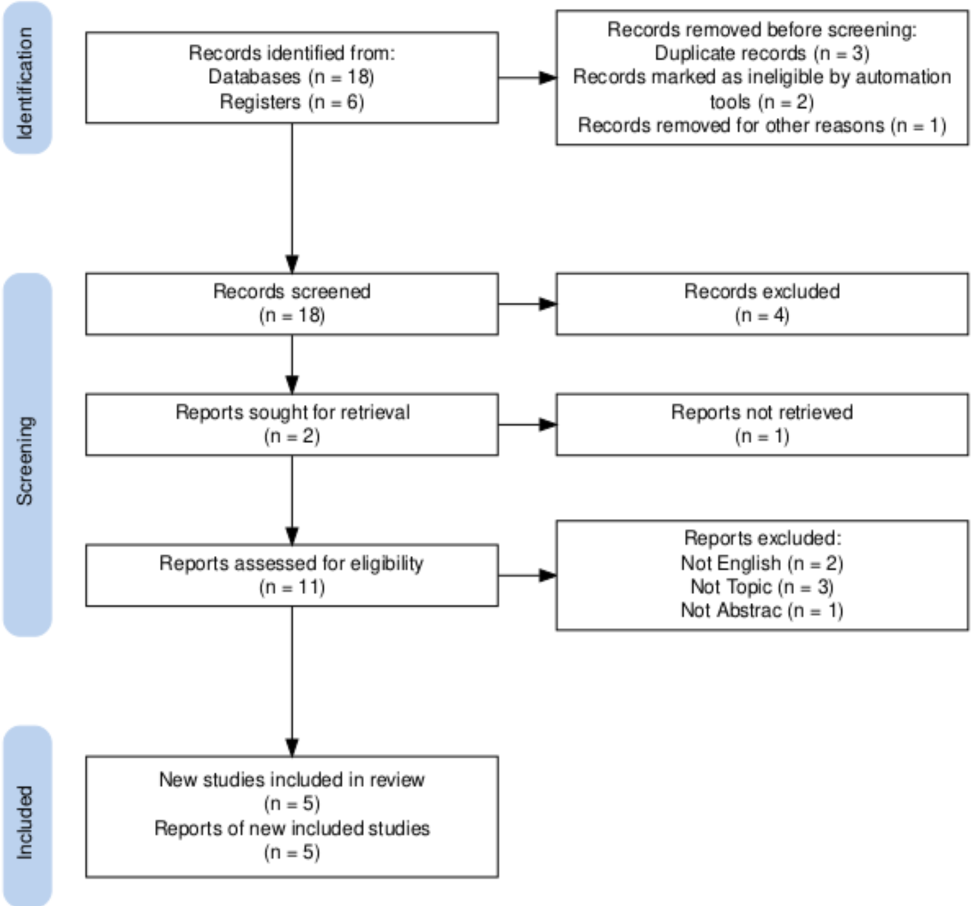

Figure 1. PISMA Flow Diagram from Covidence

Data Extraction and Analysis

Although ideally, data extraction would be carried out by two independent reviewers, due to constraints in time and resources, the task was predominantly performed by one author. However, in adherence to the Cochrane systematic review guidelines (Higgins et al., 2024), at least two independent reviewers extracted the reported outcome data. In cases of discrepancies, discussions were held until a consensus was achieved. Study characteristics were identified by conceptually analyzing the studies based on components such as publication year, education level, geographical location, and learning outcome domains. The data were then analyzed using a thematic coding approach, focusing on several key dimensions including the context of implementation, type of PBL intervention, technology used, and outcome variables measured.

Thematic coding was conducted manually by two independent reviewers. Both reviewers independently assigned codes and themes to each article, based on a coding framework developed inductively and deductively. To ensure analytical rigor, inter-rater reliability was assessed using Cohen's Kappa, with a coefficient of 0.79, indicating substantial agreement. Discrepancies were resolved through joint discussion until full agreement was reached. This process enabled the identification of both recurring patterns and distinctive characteristics across studies, contributing

 https://doi.org/10.30606/absis.v8i1.3340

to a nuanced synthesis of how culturally responsive and technology-supported PBL is implemented in mathematics education.

FINDING AND DISCUSSION

Table 1 presents a comparative summary of the five studies included in this review, highlighting their country of origin, educational level, research methods, types of technology and PBL models employed, the extent of culturally responsive teaching (CRT) integration, and the reported learning outcomes. This structured overview provides an empirical foundation for the thematic synthesis that follows.

As seen in Table 1, all selected studies applied variations of problem-based learning (PBL) supported by educational technologies, ranging from e-learning platforms and learning management systems (LMS) to blended and challenge-based learning environments. However, only a limited number of studies explicitly incorporated CRT principles, with most offering only implicit references to students' cultural contexts or local relevance. This gap signals the need for a more deliberate integration of culturally responsive pedagogies within technology-enhanced PBL frameworks.

Table 1. Summary of Five Selected Studies in the Systematic Review

Author	Method	Technology Used	PBL Form	CRT Element	Findings
Ardiansyah & Asikin (2020). Indonesia. Junior Secondary	Quasi-Experimental (Pretest–Posttest)	Multimedia-supported (CBL)	Challenge Based Learning	Contextually embedded through MST tasks	Enhanced mathematical creativity in solving multiple-solution tasks in CBL settings.
Cetin et al. (2019) Turkey. Secondary	Qualitative Case Study	TEPLA (Technology-Enhanced PBL)	TE-PBL	Not explicitly addressed	Positive impact on attitudes and achievement; revealed underlying reasons for engagement.
Sari et al. (2022a). Indonesia. Senior Secondary	Quasi-Experimental	Project-based blended LMS	Blended Project-Based PBL	Reflective through cognitive conflict tasks	Improved spatial mathematical literacy via cognitive conflict in project-based blended learning.
Wardono et al. (2018). Indonesia. Junior Secondary	Research and Development (R&D)	ICT-based tools, PMRI platform	PMRI-based PBL	Implicit via local context	Increased mathematical literacy and student independence using contextualized PBL design.

Author	Method	Technology Used	PBL Form	CRT Element	Findings
Yaniawati et al. (2019). Indonesia. Undergraduate	Mixed Methods (Embedded Design)	E-learning, LMS	E-learningassisted PBL	Not explicitly addressed	Improved self-regulated learning and problem-solving skills compared to conventional instruction

Technology Integration in PBL: Pathway to Literacy and Adaptability

The integration of technology within problem-based learning (PBL) has been consistently recognized as a driving force for advancing mathematical literacy, learner autonomy, and adaptability key competencies for the 21st century and the demands of Industry 5.0 (Hallinger, 2021; Jimenez-Pitre et al., 2022). The reviewed studies illustrate a clear shift in the role of technology from a mere instructional aid to a transformative pedagogical agent that enables conceptual exploration, collaborative inquiry, and independent problem-solving (see Table 1).

Interactive platforms such as GeoGebra and LMS based tools empower students to visualize abstract mathematical objects dynamically and engage with mathematical representations in real-time. These tools enhance spatial reasoning and support concept construction, particularly when embedded within digital PBL environments (CIPTA et al., 2024; Tong et al., 2021; Jazuli et al, 2024). For example, Yaniawati et al., (2019) demonstrated that students engaged in e-learning assisted PBL exhibited significantly higher gains in self-regulated learning and mathematical problem-solving compared to those in conventional settings. These outcomes reflect the ability of technology-enhanced PBL to foster both metacognitive strategies and deeper learning engagement.

Similarly, Hudha et al., (2023) provided further empirical confirmation for the effectiveness of project-based blended learning supported by digital LMS platforms. Their findings emphasize how strategic use of such platforms particularly when aligned with cognitive conflict strategies can promote mathematical spatial literacy and conceptual clarity. These approaches allow learners to experiment with geometric transformations and numeric patterns, thereby enhancing adaptability and logical reasoning.

Taken together, these studies affirm that technology-supported PBL enables a paradigm shift from passive knowledge transmission to active, inquiry-based, and student-centered mathematical learning. This model is aligned with the ethos of Industry 5.0, which emphasizes digital fluency, adaptability, and meaningful engagement with complex learning environments.

https://doi.org/10.30606/absis.v8i1.3340

Cultural Relevance in PBL Design: Innovation Gap in Adaptive Learning

While technology integration in problem-based learning has demonstrated substantial progress, the incorporation of culturally responsive teaching within these frameworks remains considerably limited. Although some studies in this review acknowledged learners' cultural backgrounds and local contexts, only a few explicitly applied CRT as a defined pedagogical framework. This finding indicates a critical innovation gap in developing holistic instructional designs that integrate culture, technology, and problem-based inquiry as a unified model.

For instance, Purnaningtyas & Safa'atullah, (2023); Wardono et al., (2018) incorporated elements of cultural relevance through contextualized mathematics tasks and student experiences, particularly via the Indonesian Realistic Mathematics Education (PMRI) approach. While these models enhanced engagement and mathematical literacy, CRT was referenced more as a contextual influence than as a formal instructional foundation. This distinction highlights a broader trend in the literature: cultural dimensions are often acknowledged but remain under-theorized and inconsistently embedded in pedagogical design.

CRT, as conceptualized by Gay, (2018), places emphasis on affirming students' sociocultural identities, lived experiences, and values within the learning process. Yet, the review found that many studies lacked explicit strategies aligned with CRT principles, such as instructional scaffolds rooted in cultural perspectives or participatory decision-making. Even studies that referenced inclusion or contextualization such as Siswanto et al., (2025) and Sari et al., (2022a) did not articulate how these elements translated into responsive teaching practices or addressed issues of equity and relevance across diverse student populations.

This limited operationalization of CRT in technology-supported PBL underscores the need for further empirical and design-based research. There is a growing imperative to explore models that systematically combine cultural relevance, active inquiry, and digital mediation to support inclusive and meaningful learning experiences, particularly in pluralistic and digitally mediated educational settings. Without such integration, the potential of PBL frameworks to truly empower diverse learners in the context of Industry 5.0 will remain underutilized.

PBL and the Strengthening of Problem-Solving Skills

Problem-based learning has long been established as a pedagogical strategy that promotes mathematical problem-solving abilities. Across the reviewed studies, PBL consistently contributed to students' capacity to construct, test, and refine solution strategies while fostering metacognition, flexibility, and mathematical reasoning.

The study by Yaniawati et al., (2019) revealed that undergraduate students who engaged in e-learning assisted PBL significantly outperformed their peers in conventional classrooms. This performance gain was attributed to greater learner independence, improved problem-solving accuracy, and stronger metacognitive regulation. Similarly, Sari et al., (2022b) implemented a PBL model enriched with cognitive conflict strategies, which encouraged students to reason conceptually, explore multiple perspectives, and justify their thinking skills strongly aligned with higher-order mathematical competencies.

Further evidence of PBL's impact was found in the work of Abidin et al., (2020), who highlighted how iterative problem-solving structures supported through structured e-learning enabled students to transition from surface-level understanding toward more abstract and adaptive reasoning. These findings reinforce the role of guided exploration, hypothesis testing, and multi-representational tasks in cultivating mathematical fluency.

In addition, Ardiansyah & Asikin, (2020) emphasized that Challenge-Based Learning, as a form of PBL, encourages divergent thinking through authentic, real-world problems. Students were guided to evaluate alternative solutions and shift from "answer-getting" to "possibility-finding," fostering creativity and mathematical inquiry. This conceptual pivot aligns with contemporary calls for problem-solving models that embrace uncertainty and complexity skills highly valued in the context of Industry 5.0.

Collectively, these studies suggest that PBL, particularly when combined with contextual support and digital mediation, not only enhances procedural fluency but also deepens conceptual understanding and cognitive engagement. By enabling students to navigate complex, ill-structured problems, PBL provides a robust foundation for preparing mathematically literate individuals who are capable of flexible and adaptive reasoning in dynamic learning environments.

Psychological Effects of Technology-Based PBL

In addition to cognitive and academic gains, the reviewed studies also demonstrate the psychological benefits of integrating technology within problem-based learning (PBL). These benefits are reflected in students' improved learning motivation, engagement, and sense of agency factors that are critical for sustaining meaningful learning in dynamic and technology-driven educational contexts.

Yaniawati et al., (2019) found that students involved in e-learning assisted PBL exhibited significantly higher levels of motivation compared to those in conventional learning environments. This motivational boost was linked to the interactive nature of the digital platforms, which provided students with greater autonomy, timely feedback, and opportunities for self-paced exploration. The digital scaffolds helped reduce anxiety and increased students' confidence in tackling complex mathematical problems.

Similarly, Sari et al., (2022a) observed that learners participating in a PBL model embedded with cognitive conflict strategies became more resilient in addressing academic challenges. Rather than viewing struggle as failure, students interpreted cognitive dissonance as an opportunity for deeper learning. This shift in mindset, fostered through structured inquiry and digital tools, led to increased perseverance and emotional engagement.

 https://doi.org/10.30606/absis.v8i1.3340

In the case of Romero-Rodriguez et al., (2019), students' positive affect was supported by the structured digital environment, which enabled them to track their learning progress and feel a sense of achievement. The combination of PBL and technology helped establish a psychologically safe learning space, where experimentation and error were normalized parts of the problem-solving process.

These findings suggest that technology-based PBL not only enhances cognitive performance but also strengthens psychological factors that contribute to long-term academic persistence. Motivation, resilience, and emotional engagement are not merely by-products but essential outcomes of well-designed instructional ecosystems that blend inquiry, culture, and technology.

Limitations of Reviewed Studies

While the selected studies offer valuable insights into the integration of technology, PBL, and culturally responsive teaching (CRT), several limitations must be acknowledged to contextualize the findings of this review. First, the scope and methodological diversity of the included studies pose challenges for generalization. The reviewed articles employed varied designs ranging from experimental to quasi-experimental and design-based approaches making it difficult to establish consistency across measured outcomes and learning environments.

Second, most studies were conducted in localized or single-institution contexts, such as individual schools or universities in Indonesia, which may limit the broader applicability of their findings to other cultural or educational systems. For instance, while PMRI-based models Purnaningtyas & Safa'atullah, (2023); Wardono et al., (2018) provided culturally rich frameworks, their relevance outside specific sociocultural settings remains uncertain.

Third, few studies operationalized CRT as a structured and measurable pedagogical component. Although cultural context was often referenced, the absence of clearly defined CRT indicators such as student agency, community involvement, or identity affirmation limits the ability to evaluate the depth and effectiveness of culturally responsive practices (Sari et al., 2022b; Siswanto et al., 2025).

Finally, the use of digital tools across studies, while promising, varied significantly in complexity and alignment with PBL principles. Some technologies were integrated as peripheral support rather than as core mediators of inquiry, thereby affecting the intensity and fidelity of the PBL experience (Romero-Rodriguez et al., 2019; Yaniawati et al., 2019).

Recognizing these limitations highlights the importance of future research adopting more standardized design criteria, cross-cultural validation, and deeper integration of CRT principles within technology-enhanced PBL frameworks. Such efforts are essential to advance equitable and contextually grounded mathematics education in line with the demands of Industry 5.0.

CONCLUSIONS AND RECOMMENDATIONS

This review synthesized empirical literature on the integration of problem-based learning, educational technology, and culturally responsive teaching in mathematics education. Through a systematic selection process using PRISMA guidelines, five studies were thematically analyzed to identify patterns of effectiveness and research gaps. The results consistently show that technology supported PBL improves students' problem-solving abilities, mathematical literacy, motivation, and self-regulated learning. Digital platforms such as GeoGebra and e-learning environments enhance flexibility, engagement, and the development of higher-order thinking skills.

However, despite the increasing adoption of PBL and digital tools, the explicit integration of CRT within technology based PBL models remains limited. Cultural context approaches such as PMRI demonstrate potential for strengthening relevance and student engagement, yet are often disconnected from broader CRT principles. Compared to traditional methods or PBL alone, a unified PBL–CRT–technology model offers a more inclusive, adaptive, and meaningful learning experience one that addresses both cognitive and affective dimensions of 21st-century competencies.

In light of these findings, this study highlights the need for further development of comprehensive instructional frameworks that explicitly combine CRT, technology, and PBL. Such models are especially relevant in multicultural contexts like Indonesia, where cultural diversity and access to digital resources present unique opportunities and challenges. Future research should explore the effectiveness of such models through empirical studies, examining variables such as the type of technology used, levels of cultural responsiveness, and the specific competencies targeted.

For educational practitioners, the findings suggest that designing mathematics instruction should go beyond procedural fluency to embrace social relevance and learner agency. Teachers are encouraged to align content with students' cultural identities, leverage technology to personalize learning, and create environments that support autonomy, resilience, and critical thinking. Such reflective practice can cultivate students who are not only proficient in mathematics but also empowered to navigate the complexities of a digital and culturally pluralistic world.

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