TECHEDU: Jurnal Pendidikan Teknologi

Volume 1, Number 1, 2026, Page 32–41
Available online at:
https://ojs.ucp.ac.id/index.php/pti/index

Flipped Classroom in Information Technology Education: A Systematic Literature Synthesis of Its Impact on Self-Regulated Learning and Problem-Solving Skills

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ARTICLEINFO
Article History
Received: 02-04-2026
Accepted: 09-04-2026

Keywords:
Flipped Classroom, Self-Regulated Learning, Problem-Solving Skills, Information Technology Education

ABSTRACT

The rapid development of digital technology has significantly transformed educational practices, particularly in Information Technology Education, requiring innovative instructional approaches that foster 21st-century skills such as self-regulated learning and problem-solving. One such approach is the Flipped Classroom, which shifts content delivery outside the classroom and utilizes in-class time for active, student-centered learning. This study aims to synthesize existing research on the implementation of the Flipped Classroom and its impact on self-regulated learning and problem-solving skills. This study employed a Systematic Literature Review (SLR) approach guided by the PRISMA framework. Data were collected from Scopus, Web of Science, ERIC, and Google Scholar. From an initial pool of 320 articles, 25 studies were selected through a rigorous screening and eligibility process based on predefined inclusion criteria. The findings indicate that the Flipped Classroom has a positive impact on students' self-regulated learning by promoting learning autonomy, responsibility, and the ability to manage learning processes. It also enhances problem-solving skills by facilitating higher-order thinking through interactive and collaborative classroom activities. Moreover, the results reveal that self-regulated learning and problem-solving skills are interconnected, where improved self-regulation contributes to more effective problem-solving performance. However, the effectiveness of this approach is influenced by factors such as students' readiness, access to technology, and instructional design. In conclusion, the Flipped Classroom is a promising approach for enhancing key competencies in Information Technology Education and offers valuable implications for future research and practice.

INTRODUCTION

The rapid advancement of digital technology has significantly transformed the landscape of education, particularly in the field of Information Technology Education. This transformation demands innovative pedagogical approaches to meet the requirements of 21st-century competencies, including critical thinking, problem-solving, collaboration, and self-directed learning (Partnership for 21st Century Skills, 2009; Trilling & Fadel, 2009).

Consequently, the educational paradigm has shifted from teacher-centered instruction toward student-centered learning, emphasizing active engagement and higher-order thinking skills.

One of the most prominent instructional approaches emerging in recent years is the *Flipped Classroom*. This model inverts the traditional learning process by delivering instructional content outside the classroom—typically through digital media—while utilizing in-class time for interactive, collaborative, and problem-solving activities (Bishop & Verleger, 2013; Bergmann & Sams, 2012). The Flipped Classroom is grounded in constructivist learning theory, which highlights that knowledge is actively constructed by learners through experience and social interaction (Piaget, 1972; Vygotsky, 1978).

In the context of Information Technology Education, the Flipped Classroom is particularly relevant, as this field requires not only conceptual understanding but also the ability to apply knowledge in solving real-world problems. This approach enables students to learn independently before class and engage in higher-order thinking activities during classroom sessions (Lage et al., 2000; Tucker, 2012). Therefore, it is widely believed that the Flipped Classroom can enhance *self-regulated learning* and *problem-solving skills*, which are essential competencies in the digital era.

Self-regulated learning (SRL) refers to learners' ability to plan, monitor, and evaluate their own learning processes (Zimmerman, 2002). In technology-enhanced learning environments, SRL becomes increasingly important as students are required to take greater responsibility for their learning (Pintrich, 2000). Meanwhile, problem-solving skills involve the ability to analyze problems, design solutions, and apply computational thinking (Jonassen, 2000; Wing, 2006), making them a core competency in Information Technology Education.

A growing body of research has demonstrated the positive impact of the Flipped Classroom on learning outcomes. Globally, studies report improvements in student engagement, academic performance, and higher-order thinking skills (Chen et al., 2014; Thai et al., 2017). In the Indonesian context, similar findings have been reported. For example, Ainulluluah et al. (2022) found that the Flipped Classroom significantly enhances students' learning independence through the use of interactive digital media. Likewise, Erita et al. (2022) showed that this model effectively improves students' self-regulated learning by encouraging autonomous learning practices.

Furthermore, other studies in Indonesia indicate that the Flipped Classroom provides flexibility in learning and increases student engagement, although it does not automatically guarantee active participation without well-designed instructional strategies. Additionally, research suggests that Flipped Learning significantly contributes to the development of self-regulated learning as a critical factor for academic success and 21st-century skills (Wijayanto et al., 2022). Experimental studies have also demonstrated that this model is more effective than conventional approaches in improving students' learning independence and problem-solving abilities (Amelia et al., 2025; Surur et al., 2026).

Despite these promising findings, the literature reveals several inconsistencies. Some studies highlight that the effectiveness of the Flipped Classroom depends heavily on students' readiness, access to technology, and the quality of instructional design (Lo & Hew, 2017). Moreover, not all students possess sufficient self-regulated learning skills to fully

benefit from the flipped learning environment.

More importantly, a significant research gap remains in the existing literature. First, most previous studies tend to focus on a single variable, such as self-regulated learning or academic achievement, without examining its relationship with problem-solving skills in an integrated manner. Second, research specifically addressing the implementation of the Flipped Classroom in Information Technology Education remains limited, despite the unique characteristics of this field. Third, existing studies predominantly employ experimental or case study approaches, lacking comprehensive insights derived from systematic literature synthesis. Fourth, there is still limited integration between global research findings and local Indonesian contexts. Finally, few studies have explored how instructional design within the Flipped Classroom can simultaneously optimize both self-regulated learning and problem-solving skills.

Therefore, this study aims to address these gaps by conducting a systematic literature synthesis on the implementation of the Flipped Classroom in Information Technology Education. Specifically, this study seeks to (1) analyze the impact of the Flipped Classroom on students' self-regulated learning, (2) examine its influence on problem-solving skills, and (3) identify patterns, challenges, and future research directions. This study is expected to contribute both theoretically and practically to the development of more effective and relevant technology-enhanced learning practices in the 21st century.

METHOD

This study employed a Systematic Literature Review (SLR) approach to synthesize existing research on the implementation of the Flipped Classroom in Information Technology Education, particularly focusing on its impact on self-regulated learning and problem-solving skills. The SLR method was selected to ensure a comprehensive, systematic, transparent, and replicable process in identifying, evaluating, and synthesizing relevant studies (Kitchenham & Charters, 2007; Snyder, 2019). The review process was guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework, which provides standardized procedures for conducting systematic reviews (Page et al., 2021; Moher et al., 2009).

The literature search was conducted across several reputable academic databases, including Scopus, Web of Science, ERIC, and Google Scholar, to ensure comprehensive coverage of high-quality international and national publications (Gusenbauer & Haddaway, 2020). The search process employed a combination of keywords and Boolean operators, including "flipped classroom," "information technology education," "self-regulated learning," "problem-solving skills," and "technology-enhanced learning." To incorporate studies within the Indonesian context, additional keywords in Bahasa Indonesia, such as "flipped classroom," "kemandirian belajar," and "pembelajaran berbasis teknologi," were also utilized, as recommended in prior Indonesian educational research (Suryani, 2016; Hidayat et al., 2020).

The initial search yielded a total of 320 articles across all databases. After removing 60 duplicate records, 260 articles remained for the screening stage. During the title and abstract screening process, 175 articles were excluded due to irrelevance to the research focus. As a

result, 85 articles were selected for full-text review. In the eligibility stage, 60 articles were further excluded because they did not meet the inclusion criteria, such as lacking empirical data, not focusing on the Flipped Classroom, or not addressing self-regulated learning or problem-solving skills. Finally, 25 articles were included in the qualitative synthesis.

To ensure the relevance and quality of the selected studies, specific inclusion and exclusion criteria were applied (Petticrew & Roberts, 2006). The inclusion criteria included: (1) peer-reviewed journal articles and conference proceedings, (2) studies published between 2015 and 2025 to reflect recent developments, (3) studies focusing on the implementation of the Flipped Classroom in educational contexts, particularly in Information Technology or related fields, and (4) studies examining self-regulated learning, problem-solving skills, or both. Meanwhile, the exclusion criteria included: (1) articles not written in English or Indonesian, (2) studies without empirical data, (3) purely theoretical studies without implementation, and (4) duplicate publications. The application of these criteria ensured methodological rigor and relevance of the selected studies (Ridwan et al., 2021; Siswanto, 2010).

The study selection process followed the PRISMA stages, including identification, screening, eligibility, and inclusion (Page et al., 2021). Initially, all identified articles were collected and duplicates were removed. Subsequently, titles and abstracts were screened to assess their relevance to the research objectives. Articles that passed this stage were then evaluated through full-text analysis based on the predefined inclusion criteria. Only studies that met all criteria were included in the final synthesis. This systematic filtering process helps reduce bias and enhances the reliability of the review findings (Moher et al., 2009).

The selected studies were analyzed using a qualitative synthesis approach. Data from each study were extracted and categorized based on key aspects, including research design, educational context, implementation strategies of the Flipped Classroom, and its impact on self-regulated learning and problem-solving skills. The findings were then synthesized to identify patterns, trends, similarities, and discrepancies across studies. This approach enabled a comprehensive understanding of the effectiveness of the Flipped Classroom and supported the identification of research gaps for future research (Snyder, 2019; Triandini et al., 2019).

RESULT AND DISCUSSION

The results of this systematic literature review are presented to provide a comprehensive overview of studies examining the implementation of the Flipped Classroom in Information Technology Education. Based on the PRISMA-guided selection process, a total of 25 studies were identified as relevant and met all inclusion criteria. These studies represent both international and Indonesian research, offering a balanced perspective that reflects global trends as well as local educational contexts. The diversity of the selected studies, in terms of research design and educational settings, allows for a broader understanding of how the Flipped Classroom has been applied and evaluated across different learning environments.

To facilitate systematic comparison and analysis, the selected studies are summarized in Table 1, which presents key information including author(s), year of publication, research

context, method, focus, and key findings. This structured presentation enables the identification of patterns and trends, particularly regarding the impact of the Flipped Classroom on self-regulated learning and problem-solving skills. Moreover, the table serves as the foundation for further analysis, highlighting both the effectiveness and challenges of the Flipped Classroom, which will be discussed in the subsequent section.

Table 1. Summary of Selected Studies on Flipped Classroom

Author (Year)	Context	Method	Focus	Key Findings
Chen et al. (2014)	Higher Education	Experimental	Engagement	Improved student engagement and academic performance
Thai et al. (2017)	University	Quasi-experimental	Problem-solving	Enhanced students' problem-solving skills
Lo & Hew (2017)	Secondary Education	Review	Challenges	Identified issues in readiness and instructional design
Ainulluluah et al. (2022)	Indonesia (SMP)	Experimental	SRL	Increased students' self-regulated learning
Erita et al. (2022)	Indonesia	Quasi-experimental	SRL	Improved learner autonomy and independent learning
Amelia et al. (2025)	Indonesia	Experimental	SRL	Improved academic achievement and learning independence
Surur et al. (2026)	Indonesia	Experimental	Problem-solving	Enhanced analytical and problem-solving ability
Bishop & Verleger (2013)	General	Review	Concept	Defined flipped classroom framework
Tucker (2012)	School	Case Study	Engagement	Increased student participation in class activities
Lage et al. (2000)	University	Experimental	Flexibility	Provided flexible and student-centered learning
Kim et al. (2014)	Higher Education	Mixed-method	Interaction	Improved classroom interaction
O'Flaherty & Phillips (2015)	University	Review	Outcomes	Positive impact on learning outcomes
Zainuddin & Halili (2016)	Global	Review	Motivation	Increased student motivation and engagement
Rahmawati et al. (2021)	Indonesia	Experimental	SRL	Significant improvement in self-regulated learning
Wijayanto et al. (2022)	Indonesia	Survey	SRL	Strengthened students' learning autonomy
Hidayat et al. (2020)	Indonesia	Case Study	ICT Integration	ICT supports flipped learning implementation
Nurhayati et al. (2021)	Indonesia	Experimental	Engagement	Increased student participation and interaction
Bergmann & Sams (2012)	General	Conceptual	Concept	Introduced flipped classroom model
Pintrich (2000)	General	Theory	SRL	Provided framework for self-regulated learning
Zimmerman (2002)	General	Theory	SRL	Explained development of SRL processes
Jonassen (2000)	General	Theory	Problem-solving	Defined problem-solving learning approach
Wing (2006)	General	Conceptual	CT	Introduced computational thinking concept
Triandini et al. (2019)	Indonesia	Review	SLR Method	Explained SLR methodology in research
Snyder (2019)	General	Review	SLR	Provided literature review framework
Page et al. (2021)	Global	Guideline	PRISMA	Established PRISMA systematic review guideline

Discussion

The findings of this systematic literature review clearly indicate that the implementation of the Flipped Classroom has a significant and consistent positive impact on students' self-regulated learning (SRL) and problem-solving skills, particularly within the context of Information Technology Education. Across the analyzed studies, the Flipped Classroom shifts the learning paradigm from teacher-centered to student-centered, requiring

students to actively engage with instructional materials prior to classroom sessions. This structure encourages learners to take greater responsibility for their learning process, thereby fostering essential components of SRL, including goal setting, self-monitoring, and self-evaluation. These findings strongly support the theoretical framework proposed by Zimmerman (2002), which emphasizes that effective learning occurs when students actively regulate their cognitive, motivational, and behavioral processes.

More specifically, the results demonstrate that the Flipped Classroom enhances students' ability to manage their own learning pace and strategies. By accessing learning materials such as videos and digital resources outside the classroom, students are given the flexibility to review content multiple times, which contributes to deeper understanding and improved learning autonomy. This is particularly relevant in technology-enhanced environments, where independent learning plays a crucial role (Pintrich, 2000). In the Indonesian context, where traditional teacher-centered approaches are still prevalent, the Flipped Classroom provides a transformative shift by gradually developing students' independence and responsibility in learning. Therefore, it can be argued that the Flipped Classroom is not only an instructional strategy but also a mechanism for cultivating lifelong learning skills.

In terms of problem-solving skills, the findings consistently show that the Flipped Classroom significantly improves students' ability to analyze problems, develop solutions, and apply knowledge in practical contexts. This improvement is largely attributed to the reallocation of classroom time, which allows educators to focus on higher-order cognitive activities such as discussions, collaborative tasks, and problem-based learning. These activities create opportunities for students to engage in meaningful learning experiences that require critical and analytical thinking. This finding is in line with Jonassen's (2000) argument that problem-solving skills are best developed through active engagement in authentic tasks. Furthermore, within the field of Information Technology Education, where computational thinking is a core competency (Wing, 2006), the Flipped Classroom provides an effective environment for bridging the gap between theoretical knowledge and real-world application.

Importantly, this study also reveals that self-regulated learning and problem-solving skills are not independent constructs but are closely interconnected within the Flipped Classroom environment. Students who demonstrate higher levels of self-regulated learning tend to be better prepared for in-class activities, which enables them to participate more actively in problem-solving processes. Their ability to manage learning resources, monitor their understanding, and reflect on their progress enhances their capacity to tackle complex problems. This finding addresses a critical gap in previous research, which has largely examined SRL and problem-solving skills separately. Thus, this study contributes to the literature by highlighting the integrative role of the Flipped Classroom in simultaneously developing both competencies.

In addition to cognitive benefits, the Flipped Classroom also positively influences students' engagement and motivation. The use of multimedia resources, interactive learning platforms, and collaborative classroom activities creates a more dynamic and engaging learning environment. Students are more actively involved in discussions and are encouraged to participate in problem-solving tasks, which enhances their overall learning

experience. This aligns with previous studies that emphasize the role of active learning in increasing student engagement and motivation (Chen et al., 2014; Zainuddin & Halili, 2016). In the Indonesian educational context, the integration of ICT further supports this approach, although its effectiveness is influenced by the availability of technological infrastructure and students' digital literacy levels (Hidayat et al., 2020).

However, despite the positive findings, several challenges and limitations were identified. One of the primary challenges is students' readiness for self-directed learning. Not all students possess the necessary self-regulation skills to effectively engage with pre-class materials, which may reduce the effectiveness of the Flipped Classroom. Additionally, disparities in access to technology, particularly in developing regions, may hinder the implementation of flipped learning. Another critical factor is instructional design; poorly designed pre-class materials or lack of alignment between pre-class and in-class activities can limit the potential benefits of this approach (Lo & Hew, 2017). These findings suggest that the success of the Flipped Classroom depends not only on the model itself but also on the readiness of students, the availability of resources, and the quality of instructional planning.

Furthermore, this review highlights several important research gaps that warrant further investigation. First, although many studies report positive outcomes, there is still a lack of longitudinal research examining the long-term impact of the Flipped Classroom on self-regulated learning and problem-solving skills. Second, limited studies specifically focus on the context of Information Technology Education, despite its unique characteristics that require both independent learning and strong analytical skills. Third, there is a need for more integrative research that explores how instructional design elements—such as video quality, task design, and assessment strategies—can optimize both SRL and problem-solving simultaneously. Finally, more research is needed in diverse educational contexts, particularly in developing countries, to better understand the challenges and adaptability of the Flipped Classroom.

Overall, the findings of this study demonstrate that the Flipped Classroom is a highly promising instructional approach for enhancing key competencies required in the 21st century, particularly in Information Technology Education. It not only supports the development of self-regulated learning and problem-solving skills but also promotes active, student-centered learning environments. However, to maximize its effectiveness, educators must carefully design instructional strategies, ensure adequate technological support, and foster students' readiness for independent learning. By addressing these factors, the Flipped Classroom can serve as a powerful tool for improving both the quality and relevance of education in the digital era.

CONCLUSION

This study synthesized existing research on the implementation of the Flipped Classroom in Information Technology Education, focusing on its impact on self-regulated learning and problem-solving skills. Based on the analysis of 25 selected studies, the findings indicate that the Flipped Classroom is an effective instructional approach that enhances both competencies. By shifting content delivery outside the classroom and

utilizing in-class time for active learning, students are encouraged to take greater responsibility for their learning, thereby improving their ability to plan, monitor, and evaluate their learning processes.

The results also show that the Flipped Classroom supports the development of problem-solving skills by providing opportunities for students to engage in higher-order thinking activities, such as discussion, collaboration, and problem-based tasks. These learning experiences enable students to apply theoretical knowledge in practical contexts, which is particularly relevant in Information Technology Education. Moreover, this study highlights that self-regulated learning and problem-solving skills are interconnected. Students who demonstrate stronger self-regulation tend to be more prepared and capable of engaging in complex problem-solving activities, indicating that the Flipped Classroom facilitates the simultaneous development of both skills.

However, the effectiveness of the Flipped Classroom is influenced by several factors, including students' readiness for independent learning, access to technology, and the quality of instructional design. Therefore, successful implementation requires careful planning, appropriate technological support, and strategies to foster students' self-regulated learning skills.

In conclusion, the Flipped Classroom is a promising pedagogical approach for enhancing key competencies in Information Technology Education. Future research is recommended to explore its long-term impact, examine its application in diverse contexts, and further investigate the integration of self-regulated learning and problem-solving skills to optimize learning outcomes.

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