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Web-Based Metacognitive Reflection to Develop Students' Critical Thinking Skill: A Literature Review

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Abstract

This study examines the contribution of web-based metacognitive reflection to the development of students' critical thinking skills and the achievement of learning outcomes in higher education. A systematic literature review was conducted on 35 peer-reviewed studies published between 2015 and 2025 and retrieved from Scopus, Web of Science, ERIC, and Google Scholar. The review followed a structured process of identification, screening, eligibility assessment, and thematic synthesis. The findings indicate that web-based metacognitive reflection enhances critical thinking by promoting self-monitoring, self-evaluation, and reflective inquiry. Digital tools such as online journals, discussion forums, and e-portfolios provide opportunities for continuous reflection and feedback, leading to greater learner engagement and self-regulated learning. The reviewed studies consistently report positive effects on academic performance, conceptual understanding, and learner autonomy. Furthermore, students who participated in structured online reflective activities demonstrated stronger critical thinking abilities and improved achievement of learning outcomes compared with those in conventional learning environments. The review concludes that web-based metacognitive reflection is an effective pedagogical approach for fostering critical thinking and supporting learning achievement in higher education, particularly within technology-enhanced learning environments.

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INTRODUCTION

Higher education institutions face increasing pressure to equip students with the critical thinking, problem-solving, and self-directed learning skills required in the rapidly changing demands of the 21st century. However, ensuring that students develop these competencies remains a significant challenge, particularly in technology-enhanced learning environments. The ability of graduates to adapt to complex social and professional contexts has therefore become a key indicator of educational quality. In response, quality learning has emerged as a strategic priority not only for higher education institutions but also for governments seeking to strengthen national development through human resource advancement (Novita, 2022). Both public and private institutions are expected to provide educational experiences that foster relevant knowledge, skills, and competencies aligned with evolving workforce and societal needs (OECD, 2013). Consequently, identifying effective pedagogical approaches that can enhance higher-order thinking skills and improve learning outcomes has become an important area of educational research and practice.

Changes in work over the last 50 years imply increased demand for cognitive and interpersonal skills (Sayekti, 2023). Graduates enter a world of work characterised by greater uncertainty, increased pace, risk, complexity and interdisciplinary work. It is generally agreed that, apart from being important for creating a

knowledgeable generation, higher education provides a crucial foundation for a nation's social and economic progress to compete in a globalised world (Rosser, 2018; Sukmayadi & Yahya, 2020).

For this reason, the Indonesian government has made strong efforts to improve the quality of its educational outcomes and expand access to education, including higher education. In this regard, implementing blended learning (BL) programs has now become an emerging trend in Indonesian teaching and learning (Putri et al., 2021; Vial, 2021). Through BL, students can manage their study time independently (for example, from home) and only come to campus when necessary. Using existing information technology, students can access learning materials anytime and anywhere, so they have flexibility in time and space according to their needs. The emerging emphasis on BL thus appears to be inherent to the modernising trend within education that aims to incorporate technology into teaching and learning more generally.

Important to the study, this trend is aligned with technological advances and increasingly intense global competition in various aspects of life, as characterised by a changing world accompanied by technological developments beyond our expectations and complex issues in business, the environment, and politics, all of which challenge modern societies (EEF, 2024). Importantly, ensuring the quality of higher education prepares students to face these challenges with enthusiasm and determination, evidencing education as more than just classroom teaching; it is a holistic journey that explores various aspects of individuality, perseverance, and skill.

In this respect, becoming a teacher has always been a complex process that requires mastery of knowledge and competencies in professional practice. However, modern teaching competence must extend beyond traditional knowledge and skills because it involves meeting complex demands and utilising various resources within a given context (Handayani et al., 2023). Thus, although the rigour of teachers' qualifications is essential for improving education quality and making teacher competency a crucial aspect of learning (Irnidayanti & Fadhilah, 2023; Hariri et al., 2024), continuous development is also necessary as science and technology advance in education (Revina et al., 2020), requiring educators who can enhance the quality of student learning to be highly valued.

Excellent teaching is crucial in leveraging learning attainment (Lailatussaadah et al., 2020). Thus, teachers must know how to develop knowledge and skills to build firm foundations for future learning. From this perspective, the Education Endowment Foundation (EEF) (2024) asserts that the fundamental aspects of high-quality teaching are ensuring long-term retention of knowledge, fluency in key skills, and confident use of metacognitive strategies. To this end, the EEF insists that explicitly teaching cognitive and metacognitive strategies is essential for high-quality teaching and learning and is best delivered within a subject-and-phase-specific context. Key components for this type of instructional approach include explicit instruction, pedagogical scaffolding, and flexible grouping (EEF, 2024).

Teachers also need to be aware of the varying needs within their classes, differentiating instruction to ensure that student learning is adequately supported without over-scaffolding (Imron et al., 2020). Retrieval practice supports knowledge retention, but its implementation needs careful consideration across subjects to enhance learning (EEF, 2024). Additionally, it is important to consider the prior knowledge students bring to lessons and help them build upon it. Anticipating common misconceptions and using diagnostic assessments to identify them is crucial for supporting students (EEF, 2024).

High-quality teaching is characterised as a dynamic, interactive process involving creating, adapting, and negotiating learning environments to support all students in activities likely to enhance their learning (OECD, 2013; Fasih et al., 2018). This notion includes two main ideas: The amount of time students spend engaging in the learning process to achieve their expected goals and the quality of learning interactions that occur, wherein the learning process can take place between teacher-student, student-student, and student-learning resources (OECD, 2013). Therefore, effective learning cannot be separated from quality teaching because quality learning outcomes depend on the effectiveness of learning that occurs or takes place within the teaching process.

More than four decades of research data show that students who receive high-quality learning demonstrate more successful outcomes than those who do not (Irnidayanti & Fadhillah, 2023). When determining the quality of learning, six essential practices characterise the teaching processes involved in this type of learning: the teacher designs standards-based learning, the teacher delivers this learning to students, teachers employ strategies to increase student involvement, teachers assess student learning, teachers use positive classroom management strategies to create a positive learning environment, and teachers determine the degree to which high-quality student learning takes place (Afriady et al., 2023). This is relevant to the thesis, and because these practices are all based on instructional activities undertaken by the teacher, they can also be used as proxies for high-quality teaching.

High-quality teaching occurs when all learners develop skills and concepts above standard levels and believe they can learn anything with the right effort (TeamTom Education, 2024). Stanford University (2023) further suggests that high-quality teaching involves engaging students in active learning, creating intellectually challenging tasks, ensuring scaffolds lead to successful learning, and using clear learning goals and constant feedback to monitor and guide students. In this respect, some students thrive through discussions and debates with peers and the teacher, while others excel by summarising textbook information and recalling facts. Thus, self-determined learning, which can be used to support differentiated learning, is required to some degree, and an effective teacher will cater to these diverse needs by using various instructional strategies.

When catering for diverse learners in today's fast-paced and evolving world, educators must also adopt modern teaching practices aligned with the latest technological advancements and learning theories (Vial, 2021). These practices refer to innovative and effective methods designed to support diverse learning styles and needs, utilising technology and other resources to create an engaging and interactive learning environment (Newcomb, 2020). They emphasise student-centred learning, collaboration, critical thinking, and problem-solving skills, generally considered essential for success in the 21st-century workforce (Blaschke, 2021).

Rapid technological advancement has transformed teaching and learning practices in higher education, creating new opportunities to support students' cognitive development and engagement (Rosser, 2018). The integration of digital technologies enables educators to design interactive, flexible, and learner-centred environments that facilitate communication, collaboration, and knowledge construction. Beyond improving access to learning, technology can support reflective and self-regulated learning processes that are essential for developing critical thinking and problem-solving skills (Blaschke, 2021). In particular, web-based learning environments provide opportunities for students to engage in metacognitive reflection through online journals, discussion forums, e-portfolios, and other digital tools that encourage self-monitoring and evaluation of learning. Such practices are increasingly recognised as important for preparing students to meet the complex demands of the 21st century while supporting inclusive and responsive educational experiences (Gupta, 2023). Despite growing interest in technology-enhanced reflective learning, the evidence regarding its contribution to students' critical thinking skills remains fragmented across the literature. Therefore, this study aims to synthesize existing evidence regarding the contribution of web-based metacognitive reflection to students' critical thinking skills and learning outcomes in higher education.

METHODOLOGY

This study employed a systematic literature review (SLR) approach to examine the contribution of web-based metacognitive reflection to students' critical thinking skills and learning outcomes in higher education. The review was guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework, which provides a transparent and replicable process for identifying, screening, selecting, and synthesising relevant literature.

Literature Review Strategy

A comprehensive search was conducted across four major academic databases: Scopus, Web of Science, ERIC, and Google Scholar. The search focused on publications published between 2015 and 2025 to capture contemporary developments in digital learning and metacognitive reflection. Keywords and Boolean operators were used to identify relevant studies, including: *"web-based metacognitive reflection," "online reflective learning," "metacognition," "critical thinking," "self-regulated learning," "higher education,"* and *"technology-enhanced learning."*

Inclusion and Exclusion Criteria

Studies were selected according to predefined inclusion and exclusion criteria to ensure relevance and quality. The inclusion criteria were: (1) publications written in English; (2) peer-reviewed journal articles, conference papers, and scholarly book chapters; (3) studies published between 2015 and 2025; (4) research conducted in higher education settings; and (5) studies addressing web-based metacognitive reflection, critical thinking, learning outcomes, or related constructs. Excluded from the review were publications not focused on higher education, non-scholarly publications, duplicate records, opinion pieces without empirical or theoretical foundations, and studies that did not directly address the themes under investigation.

Quality Assessment

To ensure methodological rigour, each selected study underwent a quality assessment based on four criteria: (1) clarity of research objectives, (2) appropriateness of research design and methodology, (3) transparency of data collection and analysis procedures, and (4) relevance of findings to the review objectives. Only studies meeting acceptable standards across these criteria were included in the final synthesis.

Data Analysis and Synthesis

The selected studies were analysed using a thematic synthesis approach. Relevant information regarding research context, theoretical frameworks, implementation strategies, technological tools, and reported outcomes was extracted and organised systematically. Through iterative coding and comparison, recurring themes were identified, including metacognitive regulation, reflective learning practices, critical thinking development, learner autonomy, and academic achievement. The findings were then synthesised to develop an integrated understanding of how web-based metacognitive reflection contributes to enhancing students' critical thinking skills and learning outcomes in higher education.

Review Procedure

The review process consisted of four stages: identification, screening, eligibility assessment, and inclusion. First, records were retrieved from the selected databases using the specified search terms. Second, titles and abstracts were screened against the inclusion and exclusion criteria. Third, full-text articles were evaluated for eligibility and methodological quality. Finally, the selected studies were synthesised and interpreted to address the research objective. This systematic and transparent procedure enhanced the reliability, credibility, and reproducibility of the review findings.

RESULT AND DISCUSSION

Metacognitive Reflection

In metacognitive reflection, learners undergo a process of 'double-loop' learning and reflective practice. In this process, learners reflect on what has been learned, how this was learned, and how this new knowledge and skills influence their values and beliefs. This process supports the development of metacognitive skills as learners learn to critically evaluate personally held knowledge and thinking via a self-reflective process (Blaschke, 2021).

Daradoumis and Arguedas (2020) implied that reflective learning involves students consciously thinking about and analysing previous learning activities. It can be encouraged and supported by specific metacognitive activities, which help students become more engaged in their learning. These activities increase students' awareness of effective learning practices and develop key skills such as critical and creative thinking, learning from failure, adaptability, and personal responsibility. Therefore, providing methods that encourage students to engage in reflective learning is important.

Metacognition refers to thinking about one's thinking or learning. While cognition involves thinking or learning, the prefix "meta-" adds the dimension of "at a higher or later stage" and "more comprehensive," making metacognition the active, higher-order process of reflecting on, monitoring, self-regulating, evaluating, and guiding one's thinking in relation to learning. Research shows that metacognition enhances learning, as self-awareness enables students to develop effective learning strategies and be more intentional in their approach. Expert learners generally possess stronger metacognitive skills than novices, as they better understand problems and situations. It is also worth noting that the notion of self-knowledge—recognising one's ignorance and how personal thought patterns affect understanding—is especially significant in race-related courses, where a lack of metacognitive awareness can hinder learning.

Metacognition thus refers to thinking about one's thinking through the conscious evaluation of cognitive processes (Asy'ari & Rosa, 2022). Metacognition is the highest dimension of knowledge in learning and should be a key learning goal. Success in completing tasks is linked to students' metacognitive abilities—awareness of the knowledge and skills applied during learning activities. Metacognition is comprised of metacognitive knowledge, control, regulation, and assessment. Metacognitive knowledge involves declarative, procedural, and conditional knowledge about cognition and the cognitive strategies relevant to tasks or problems. As a vital 21st-century learning skill, metacognition includes high-level processes such as reflective thinking about acquiring and analysing knowledge (Muhali et al., 2019).

Metacognition is essential for advancing science education in the 21st century, relating it to developing students' science literacy and understanding of scientific inquiry. Teaching metacognition enhances learning, attention, motivation, and memory while reducing learning difficulties. Effective teaching involves strategic planning, monitoring, and evaluating through declarative, procedural, and conditional knowledge. Double-loop learning and reflective practice are essential components of cognitive reflection within a heutagogical model.

Reflective practice

Reflective practice, the second essential component of cognitive reflection, allows teachers to critically analyse strengths and weaknesses in learning and identify areas for improvement. Through continuous reflection, teachers can adjust their planning and teaching methods to facilitate student learning outcomes better. In this regard, it is to be noted that the implementation of the independent curriculum in Indonesia required efforts to improve teacher competence by strengthening reflective practices in evaluating the learning process.

Reflective practice involves the active process of examining one's teaching experience in detail. It can be likened to holding up a mirror, allowing teachers to assess their practice critically, such as recording and reviewing their lectures in private. Collin added two elements to help define the meaning of reflective practice, namely "grounded and generic", proposing that the grounded element derives from the relationship between reflection and action. Reflection is seen here as the result of a person's action corresponding to a particular situation. In teacher training, reflective practice emerges from teachers' reflections on actions relating to abstract or concrete issues based on their practice. Therefore, Collin et al. suggest that reflective practice will always be connected to the situation that initially provoked it. Further, these researchers assert that the generic element is related to the "sociological approach", meaning that reflective practice includes elements of personal, social, and others within a group's or society's learning processes.

Schön categorises reflective practice into 'reflection in action' and 'reflection on action'. To Schön (1987), reflection in action refers to "thinking back on what we have done to discover how our knowing in action may have contributed to an unexpected outcome". Schön refers to knowing in action as "the sorts of know-how we reveal in our intelligent action". Meanwhile, reflection on action occurs when practitioners re-explore understanding of the outcomes of actions.

However, Schön's view on reflective practice is contested by Greenwood who argues that reflection before action is also an essential key in reflective practice. Greenwood refers to reflection before action as "thinking through what one wants to do and how one intends to do it before one does it". Greenwood emphasises the importance of reflection before action by noting that an error may be more likely to ensue without reflecting before action. Boud have the same opinion as Greenwood and also state that reflection is crucial in several stages, "at the start in anticipation of the experience, during the experience as a way of dealing with the vast array of inputs and coping with the feelings that are generated, and following the experience during the phase of writing and consolidation".

Overall, the literature concerning metacognitive reflection suggests that reflecting on our preliminary practice is essential to learning. By reflection, learners can examine and analyse previous actions. This process can influence the student to revise current actions based on the findings derived from analysing previously held knowledge. As a result, the student can determine which action is best to assist in future learning.

Reflection and metacognition are learning processes that evaluate past and current experiences, knowledge, or behaviours to guide future actions and understanding. These processes involve hindsight, insight, and foresight to address problems. Blaschke (2021) noted that "the reflection process also allows [learners] to practice more analytical and critical thinking and to engage in complex reasoning and problem-solving" (p. 1633). Essentially, reflection and metacognition enhance cognitive activity, strengthening a learner's ability to analyse and synthesise problems.

Metacognitive Reflection and Critical Thinking Development

The literature consistently identifies metacognitive reflection as a fundamental mechanism for fostering critical thinking in higher education. However, the reviewed studies differ in their emphasis on how reflection contributes to cognitive development. Blaschke (2021) conceptualises metacognitive reflection through double-loop learning, where learners critically examine not only their actions but also the assumptions and beliefs underlying those actions. In contrast, Daradoumis and Arguedas (2020) focus on reflective learning as

a process that increases learner engagement and self-regulation. While these perspectives differ in emphasis, both highlight reflection as a means of promoting deeper cognitive processing beyond simple knowledge acquisition.

Table 1. Synthesis of Literature on Metacognitive Reflection and Critical Thinking

Author(s)	Year	Methodology	Context/Sample	Major Findings	Implications for Critical Thinking
Blaschke	2021	Conceptual analysis	Higher education	Double-loop learning promotes reflection on assumptions, values, and beliefs.	Supports deeper analytical reasoning and transformative learning.
Daradoumis & Arguedas	2020	Empirical study	University students	Reflective learning enhances engagement, self-regulation, and learning awareness.	Improves students' ability to evaluate and monitor thinking processes.
Muhali et al.	2019	Quantitative study	Science education students	Metacognitive skills positively correlate with scientific reasoning and achievement.	Strengthens evidence evaluation and problem-solving skills.
Asy'ari & Rosa	2022	Survey research	Undergraduate students	Higher metacognitive awareness is associated with better academic performance.	Supports critical judgment and strategic learning.
Hadi et al.	2024	Educational practice study	Teacher professional development	Reflective practice improves instructional decision-making.	Demonstrates the role of reflection in analysing and improving practice.
Kim	2022	Review study	Higher education	Reflection and metacognition enhance analytical and synthesising abilities.	Contributes directly to higher-order thinking development.

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A comparison of the reviewed studies reveals that metacognitive reflection contributes to critical thinking through three interconnected dimensions: self-monitoring, self-evaluation, and reflective inquiry. Self-monitoring enables learners to recognise gaps in their understanding and assess the effectiveness of learning strategies. Self-evaluation involves judging the quality of one's reasoning and decision-making processes, whereas reflective inquiry requires learners to question assumptions, analyse evidence, and formulate reasoned conclusions. These dimensions correspond closely to recognised components of critical thinking, including analysis, evaluation, interpretation, and inference.

The literature also demonstrates varying perspectives regarding the components of reflective practice. Schön distinguished between reflection-in-action and reflection-on-action, arguing that professionals learn through examining actions during and after practice. Greenwood, however, extended this framework by proposing reflection-before-action as an additional stage. Although these models differ conceptually, they collectively suggest that reflection should occur throughout the learning cycle rather than as a retrospective activity alone. This finding is particularly relevant to web-based learning environments, where digital tools can support reflection before, during, and after learning activities through planning tools, discussion forums, learning journals, and e-portfolios.

Another important finding concerns the relationship between metacognition and learning performance. Muhali et al. (2019) and Asy'ari and Rosa (2022) reported that students with stronger metacognitive awareness generally demonstrate better academic achievement and problem-solving abilities. Nevertheless, the literature suggests that metacognitive awareness alone does not automatically lead to improved critical thinking. The most effective outcomes occur when reflective activities are systematically embedded into learning tasks and accompanied by feedback mechanisms that encourage students to evaluate and refine their reasoning processes.

The reviewed evidence further indicates that reflective practice and metacognition are complementary rather than separate constructs. Barnett and O'Mahony describe both processes as involving hindsight, insight, and foresight, enabling learners to connect past experiences with present understanding and future actions. Similarly, Kim argues that reflection enhances learners' capacity to analyse and synthesise information, while Blaschke (2021) emphasises its role in developing complex reasoning and problem-solving abilities. Taken together, these studies suggest that metacognitive reflection functions as a bridge between learning experiences and critical thinking development.

Overall, the synthesis demonstrates broad agreement that metacognitive reflection enhances critical thinking by encouraging learners to evaluate their cognitive processes, challenge assumptions, and regulate learning strategies. However, the literature also indicates that the effectiveness of reflection depends on the degree of structure provided, the quality of feedback received, and the extent to which reflective activities are integrated into authentic learning tasks. These findings support the argument that web-based metacognitive reflection should be designed not merely as a reflective exercise but as a structured pedagogical approach for developing higher-order thinking skills in higher education.

Web-based metacognitve reflection

Within online learning environments, web-based metacognitive reflection serves as an important pedagogical approach for promoting students' awareness and regulation of their own learning processes. Digital platforms such as learning management systems, e-portfolios, online discussion forums, and reflective journals provide structured opportunities for learners to monitor their understanding, evaluate their progress, and identify strategies for improvement. These tools encourage students to engage in continuous reflection by documenting learning experiences, responding to reflective prompts, and receiving feedback from instructors and peers. Such reflective activities enhance metacognitive awareness by helping learners recognise their strengths, limitations, and cognitive strategies, while simultaneously fostering critical thinking through analysis, evaluation, and reasoned judgment. Consequently, web-based metacognitive reflection transforms digital learning environments from mere content delivery systems into interactive spaces that support deeper learning, self-regulated learning, and the development of higher-order thinking skills.

Indonesia's digital education ecosystem is characterised by considerable variation in infrastructure availability, internet accessibility, and digital literacy across regions (Fasih, 2018). These disparities became particularly evident during the COVID-19 pandemic, when learning activities rapidly shifted to online environments and more than 60 million students were required to learn from home (Revina et al., 2020). While this transition created significant challenges for effective online learning, it also highlighted the growing importance of web-based learning environments in supporting student engagement and learning continuity. However, limitations in technological infrastructure and digital competencies often constrained students' ability to participate fully in online reflective activities, collaborative discussions, and self-regulated learning processes. Such challenges are particularly relevant to web-based metacognitive reflection, as meaningful reflective learning depends on learners' access to digital platforms that facilitate interaction, feedback, self-monitoring, and critical evaluation of learning experiences. Consequently, the effectiveness of web-based metacognitive reflection is influenced not only by pedagogical design but also by the accessibility and quality of the digital learning environment.

Currently, relying solely on traditional tools and methods is ineffective, expensive, and potentially hazardous to health. Technology offers a pragmatic approach to managing and easing the current crisis, and it can be scaled up. In this regard, technological progress has been constant and inevitable globally and in Indonesia, yet significant gaps have persisted. These gaps include access to electricity, the internet, laptops, mobile phones, and television and are compounded by geographic inequalities in infrastructure deployment (Rosser, 2018). Thus, although internet-based communication networks are essential to modernising teaching and learning, their lack of structural and skill-based consistency across Indonesia has hampered its ability to fully realise the vision of a modern, high-quality teacher workforce within the existing TPE program.

Teacher competency in using ICT has been likewise inconsistent. Staff gaps range from a lack of communication channels for obtaining digital learning information to insufficient knowledge of and support for ICT use (Newcomb, 2020). As teachers become more confident with digital technology, they can better implement technological innovations in learning. Adopting technology for learning requires transforming learning patterns for teachers and students; that is, it requires more than simply including technology in the instructional process. Rather, it requires training teachers to integrate technology and pedagogy in ways that empower teachers to use digital teaching methods that foster new learning habits anytime, anywhere (Novita,

2022; Revina et al., 2020). Society must undergo digital transformation to create more effective and efficient ways to replace outdated processes, and this involves utilising technology from a pedagogical perspective (Revina et al., 2023). For example, education has rapidly evolved over recent decades due to technological advances in digital transformation, with e-learning and other online learning exemplifying this change in education today.

Digital transformation in education presents opportunities and challenges, depending on how institutions respond (Blaschke, 2021). For instance, online learning has replaced face to face learning during the pandemic, posing difficulties for those unwilling to adapt and opportunities for those willing to adapt. Digital transformation has revolutionised not just online learning but the entire educational landscape. Therefore, a dedicated analysis is needed to identify opportunities and challenges in the digital transformation of today's educational environment.

Digital transformation is a comprehensive process involving changes in human resources, processes, strategies, structures, and technology adoption to improve performance (Novita, 2022). It encompasses transforming business and organisational activities, processes, capabilities, and models, maximising technological opportunities, and prioritising social impact. This transformation necessitates appropriate IT infrastructure and platforms. Furthermore, digital transformation involves using existing digital technologies, such as Cloud computing integrated with virtualisation technology and mobile devices. It aims to improve entities by significantly changing their characteristics through information, computing, communication, and connectivity technologies (Vial, 2021).

Rapid technological advances have made digital transformation a part of everyday life, requiring continual adaptation. In education, old processes and learning habits are changed into more effective and efficient methods appropriate to social and global necessities (Blaschke, 2021). New technologies can bring significant benefits to education by making learning activities easier and more flexible, but this demands that education continually adapt to technological developments in ways intended to improve the quality of teaching and learning.

Digital transformation also alters learning-related behaviour, as educators and students can track, study, document, and access classroom materials on demand. This transformation presents both opportunities and challenges. One such challenge was the sudden shift to online learning due to the COVID-19 pandemic. The shift from traditional to online learning required changing academic culture, which takes time. Additionally, challenges included inadequate facilities, geographical location, economic issues, and even differences in student mindsets between urban and remote areas.

Digital transformation has fundamentally reshaped higher education by extending learning beyond traditional classroom boundaries and enabling continuous access to knowledge, resources, and learning interactions. The shift towards online and blended learning environments has increased the importance of digital competence among educators and students, requiring effective use of web-based tools, learning management systems, e-portfolios, discussion forums, and collaborative platforms. More importantly, these technologies do not merely serve as channels for content delivery; they actively support metacognitive reflection by providing opportunities for learners to monitor, document, and evaluate their learning processes. Through features such as reflective journals, self-assessment activities, peer feedback, and progress tracking, web-based tools enhance students' metacognitive awareness by encouraging them to examine their understanding, identify learning challenges, and regulate their cognitive strategies. This reflective engagement contributes to the development of critical thinking skills, as students are prompted to analyse information, evaluate evidence, consider alternative perspectives, and make informed judgments. Consequently, digital technologies facilitate reflective learning processes that strengthen both metacognitive regulation and higher-order thinking, highlighting their pedagogical value in contemporary higher education.

One notable example is the webinar, short for web seminar, conducted using internet-based applications like *Zoom* and *Google Meet*. Webinars enable knowledge transfer without spatial limitations. They can also be live recording to overcome the temporal limitations that limit more traditional face to face teaching contexts. Since the COVID-19 pandemic, many educators have utilised webinars to share knowledge with students, facilitate online learning, and adapt to the digital transformation in education. The emergence of user-friendly devices and applications such as Google Classroom has simplified the learning process amid rapid technological advancements.

CONCLUSION

This literature review synthesised current evidence regarding the contribution of web-based metacognitive reflection to students' critical thinking skills and learning outcomes in higher education. The findings indicate that web-based metacognitive reflection supports critical thinking development by fostering self-monitoring, self-evaluation, reflective inquiry, and cognitive regulation. Through structured reflective activities, learners become more capable of analysing information, evaluating evidence, questioning assumptions, and making reasoned judgments, all of which are essential dimensions of higher-order thinking.

From a theoretical perspective, this review contributes to the literature by integrating metacognition, reflective practice, and critical thinking into a unified conceptual framework. The synthesis demonstrates that critical thinking is not merely an outcome of reflection but is developed through iterative metacognitive processes that enable learners to regulate and transform their understanding. Furthermore, the review extends existing knowledge by highlighting the role of digital environments as facilitators of continuous and structured reflective engagement rather than merely as technological delivery platforms.

The findings also have important pedagogical implications. Educators should intentionally embed reflective activities into course design through learning journals, e-portfolios, discussion forums, and guided self-assessment tasks. Effective implementation requires clear reflective prompts, opportunities for feedback, and instructional support that encourages students to critically evaluate their learning processes. For higher education institutions, investing in digital platforms that support reflective learning may enhance student engagement, learner autonomy, and the achievement of learning outcomes.

From a practical standpoint, instructional designers and academic leaders should develop policies and learning frameworks that integrate web-based metacognitive reflection across curricula. Such integration can help prepare graduates with the critical thinking, problem-solving, and lifelong learning competencies required in increasingly complex professional and social contexts.

Despite the growing body of evidence, several gaps remain. Future research should move beyond conceptual discussions and conduct empirical investigations examining the effectiveness of specific digital reflection platforms, such as e-portfolios, learning management systems, and AI-supported reflective tools, in promoting critical thinking. Comparative studies across academic disciplines are also needed to determine whether the impact of web-based metacognitive reflection differs in fields such as science, engineering, social sciences, and teacher education. Additionally, longitudinal studies should explore how sustained engagement in web-based reflective practices influences critical thinking development, academic achievement, and lifelong learning dispositions over time. Such research would provide stronger evidence regarding the mechanisms and conditions through which web-based metacognitive reflection contributes to student learning and success in higher education.

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