Research Article

Empowering Thinkers: Unlocking the Potential of Digital Learning Efficacy in Fostering Critical Thinking Skills

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Abstract

This research examines the impact of digital learning efficacy on students' critical thinking skills. As digital platforms increasingly shape modern classrooms, students' ability to effectively engage with these tools plays a key role in developing their capacity to analyse information, assess credibility, and make informed decisions in an increasingly complex digital landscape. Differences in digital learning efficacy are associated with how students interact with digital content, influencing their ability to think critically in a digital learning environment. Using a quantitative methodology, the research surveyed 440 students, assessing their digital learning efficacy with a self-constructed tool and examining critical thinking competencies using the Critical Thinking Scale by Hemant Lata Sharma and Priyamvada (2012). ANOVA and Post Hoc tests were used to analyse differences in critical thinking across varying levels of digital learning efficacy. The results indicated that students with higher efficacy in using digital learning tools demonstrated significantly stronger critical thinking skills. These findings highlight the importance of enhancing digital learning efficacy to improve critical thinking, offering valuable insights for educators and policymakers.

Keywords Digital learning, critical thinking, digital learning efficacy, education technology

Introduction

In the digital age, the shift from traditional to online and hybrid learning environments has become increasingly prevalent. Educational institutions worldwide are integrating digital learning platforms to enhance access to information, flexibility, and personalised learning experiences. As technology reshapes education, understanding how students engage with and navigate these digital tools is crucial. Digital learning efficacy, a student's confidence and ability to use these platforms effectively, is emerging as a key determinant of academic success. Given that online education requires students to be more autonomous, self-regulated, and adaptable, digital learning efficacy plays a vital role in shaping their academic performance and engagement in virtual learning spaces.

Critical thinking, defined as the ability to reason, analyse, and make decisions based on evidence and logic (Paul and Elder, 2014), is a fundamental skill for success in the digital learning environment. It enables students to process complex information, solve problems, and make informed judgements—abilities that are crucial

in an era where digital platforms serve as primary sources of knowledge. In digital learning contexts, critical thinking becomes even more essential as students navigate vast amounts of online content, evaluate the credibility of sources, and engage in self-directed learning. However, fostering this skill presents unique challenges, requiring students to discern relevant information from misinformation and develop independent analytical capabilities (Akyüz and Samsa, 2009; Ayad, 2010).

The primary goal of instruction is to empower learners to take responsibility for their own learning by equipping them with the necessary tools and skills (Noll and Wilkins, 2002). With technological advancements, learning has expanded beyond traditional classrooms into virtual environments, yet there is no clear consensus on how best to cultivate critical thinking in these settings. Scholars have debated the effectiveness of different instructional approaches, including constructivist learning, active learning, team-based learning, and discussion using digital media (Benson and Samarawickrema, 2009; Saadé and Kira, 2009; Saadé and Otrakji, 2007). MacKnight (2000) cautioned that modern digital media often present pre-packaged information so convincingly that critical thinking may seem redundant. However, research also suggests that online learning environments can support critical thinking by enabling mastery learning, flexible pacing, and anonymous discussions (Burgess, 2009; Thomas and Morin, 2010).

Student engagement in online courses is a multifaceted concept influenced by factors such as limited social interactions, weaker student-teacher relationships, and the need for learners to adapt to virtual environments (Derakhshesh et al., 2022; Yuyun, 2023). Sustaining consistent engagement can be challenging due to concerns related to persistence and efficiency (Lorenzo, 2012). Rahman (2021) emphasised that low student engagement remains a significant obstacle in online learning.

Self-efficacy plays a crucial role in shaping individual behaviour, fostering goal achievement, and driving motivation for progress (Stice et al., 2006). Bandura (1977, 1986) introduced self-efficacy into psychological literature, defining it as an individual's belief in their ability to organise and execute actions required to achieve specific outcomes. Grounded in Social Cognitive Theory (Bandura, 1977) and Locus of Control Theory (Rotter, 1966), self-efficacy influences learners' competence, as individuals with higher self-efficacy are more likely to accomplish desired outcomes due to their confidence in managing tasks (Bandura, 2006; Chang et al., 2014; Bernacki et al., 2015).

The rapid advancement of computer-based technologies has coincided with the widespread adoption of web and internet-based learning, driving researchers to examine self-efficacy within virtual learning environments. As a result, distinct self-efficacy constructs tailored to online contexts—such as computer self-efficacy, internet self-efficacy, and online learning self-efficacy—have garnered increasing attention (Gautam et al., 2020; Kuo et al., 2021). Self-efficacy in using digital systems has been shown to significantly enhance their effective utilisation (Ulfert et al., 2022).

Online self-efficacy has been associated with other key constructs, including online engagement (Han et al., 2021; Heo et al., 2021; Kuo et al., 2021). For example, Kuo et al. (2021) investigated the relationship between online learning self-efficacy and student engagement in web-based learning. Analysing data from 4,285 students, they found that higher online learning self-efficacy positively influenced learners' engagement in online courses. Similarly, Alemayehu and Chen (2021)

examined the impact of online learning self-efficacy on engagement among 354 students. Using structural equation modeling, their study confirmed a significant positive effect of learning self-efficacy on engagement in virtual learning environments. Derakhshan and Fathi (2023) examined the interactive role of online self-efficacy in predicting online engagement, finding that higher online learning self-efficacy positively influenced engagement among EFL students. Investigating self-efficacy in virtual learning environments is crucial, as it offers valuable insights into the factors that enhance learners' engagement and success in online education.

Given the growing reliance on digital platforms for educational delivery, it is imperative to examine how digital learning efficacy fosters critical thinking skills. This study explores the relationship between digital learning efficacy and critical thinking, investigating how students' confidence in using digital tools influences their ability to analyse, reason, and make informed decisions. By identifying the mechanisms through which digital learning efficacy enhances critical thinking, this research contributes to the ongoing discourse on improving the quality and effectiveness of digital education.

Literature Review

Critical thinking has long been recognised as an essential skill in education, fostering students' ability to analyse, evaluate, and synthesise information logically (Ennis, 1985; Facione, 2000). It plays a crucial role in problem-solving and decision-making, enabling individuals to navigate complex academic and professional environments. Employers increasingly value critical thinking as a key competency, emphasising its importance in workforce readiness (Desai et al., 2013; Preiss et al., 2013; Sarkar et al., 2016). Research indicates that students who develop strong critical thinking skills tend to adapt more effectively to the evolving demands of the workplace, highlighting the need for educational strategies that enhance these cognitive abilities (Lowden et al., 2011).

With the rise of digital learning, technology has been increasingly integrated into educational settings to support the development of critical thinking. Studies suggest that digital learning platforms, when used effectively, provide interactive and student-centred experiences that enhance cognitive engagement (Lopez-Perez et al., 2011; Carmichael and Farrel, 2012; Foo and Quek, 2019). Digital tools, such as Moodle and other e-learning systems, facilitate problem-solving and reasoning by offering diverse learning resources, collaborative activities, and immediate feedback. More recently, Lionenko and Huzar (2023) examined how structured digital interventions contribute to the development of problem-solving and analytical skills in primary school students. Their findings emphasise that digital tools significantly enhance critical thinking when structured learning approaches are applied, though they also highlight barriers such as technological limitations and insufficient teacher training.

The positive impact of digital learning on critical thinking is further supported by Wardani et al., 2019, who found that web-based learning environments lead to significant improvements in students' analytical and reasoning skills. Similarly, Pedraja-Rejas et al. (2024) conducted a systematic review on mobile learning and concluded that mobile-supported reflective learning, immersive experiences like augmented reality, and interactive applications positively influence students' ability to critically analyse and synthesise information.

Their research highlights the importance of self-regulation in digital learning, emphasising that structured and adaptive digital environments maximise cognitive engagement.

Self-efficacy has been identified as a key factor influencing students' ability to engage effectively in digital learning environments. Bandura (1997) defined self-efficacy as an individual's belief in their ability to perform specific tasks successfully. Research suggests that students with higher digital learning efficacy exhibit greater engagement, leading to improved critical thinking outcomes (Bandura, 2006; Chang et al., 2014; Bernacki et al., 2015). Kuo et al. (2021) found that students with higher online learning self-efficacy participated more actively in web-based learning, demonstrating stronger analytical skills. Alemayehu and Chen (2023) further confirmed that self-efficacy positively influences student engagement, reinforcing the idea that confidence in digital skills enhances students' ability to process complex information critically.

Derakhshan and Fathi (2023) explored the relationship between digital learning efficacy and cognitive engagement among EFL students, finding that higher self-efficacy led to increased participation and deeper cognitive processing. Hysaj and Hamam (2023) examined multicultural students in digital learning environments, revealing that structured online discussions significantly improved their critical thinking skills. Their study emphasised that digital learning efficacy enables students to engage more meaningfully in discussions, leading to stronger analytical reasoning. Al-Shaye (2021) further supported this perspective, demonstrating that digital storytelling enhances critical reading, critical thinking, and self-regulated learning, particularly in language education.

Despite the potential of digital learning to foster critical thinking, some scholars have raised concerns about its limitations. George et al. (2024) warned that over-reliance on AI-driven decision-making may erode independent cognitive effort, potentially diminishing students' ability to engage in critical analysis. The Pew Research Centre (2023) also reported concerns about cognitive offloading, suggesting that automation and algorithm-driven learning could contribute to the decline of independent reasoning skills. These studies highlight the need for structured digital learning interventions that prioritise engagement without compromising critical thinking development.

Although digital learning tools have the potential to foster critical thinking, there is limited research examining how students' efficacy in using these tools affects their development of such skills. As schools and universities increasingly adopt digital learning platforms, understanding the link between students' proficiency in digital competence and their capacity for critical thinking is crucial for optimising educational outcomes. The gap in literature regarding the direct link between digital learning efficacy and critical thinking among school students creates a compelling case for the study. This research offers significant unique perspectives into this relationship, supporting as well as expanding upon existing literature in several ways.

Research Objectives and Questions

This research aims to achieve the following objectives:

- To assess the level of critical thinking among students.
- To evaluate the level of digital learning efficacy among students.
- To examine variations in students' critical thinking skills across different levels of digital learning efficacy.
- This study endeavours to explore the following questions:

- What is the level of critical thinking among students?
- What is the level of digital learning efficacy among students?
- How do students' critical thinking skills differ across varying levels of digital learning efficacy?

Hypothesis: Students' critical thinking shows no significant difference across different levels of digital learning efficacy.

Methodology

Research Framework

A quantitative research model was adopted to examine the association between digital learning efficacy and critical thinking among students. The study utilised a descriptive survey method, incorporating both descriptive and inferential statistical analysis. Data collection was conducted through surveys and standardised tests, ensuring a structured and comprehensive approach to the research.

Participants

The population consists of secondary school students of Class X enrolled in private unaided recognised schools affiliated with the Central Board of Secondary Education (CBSE) in Delhi. To ensure a representative sample, a stratified random sampling technique was employed. The list of CBSE-affiliated private unaided recognised secondary schools was sourced from the official CBSE website (SARAS Portal), which categorises schools of Delhi into 11 districts. The data collection process followed a structured approach, beginning with the compilation of a comprehensive list of these schools, followed by district-wise segregation. A random selection method using an MS-Excel formula was then employed to choose two schools from each district, resulting in a total of 22 schools, ensuring fair representation.

Schools were formally approached through email correspondence and follow-ups, with written applications submitted where necessary. Approvals were secured through telephonic discussions or in-person meetings with school authorities. In cases where schools declined participation, the process was repeated to select an alternative school through randomisation. Once approvals were obtained, students of class X were randomly chosen from each selected school to participate in the study. A total of 440 respondents evenly distributed across schools were included in the final analysis, ensuring a robust and diverse dataset. This systematic selection process enhanced the reliability and validity of the collected data, making it truly representative of the target population. Finally, the completed questionnaires were collected from students, concluding the structured data collection process. The student cohort was organised into three groups according to their digital learning efficacy scores: high, medium, and low efficacy.

Data Collection Tools

Digital learning efficacy was assessed using a self-constructed survey tool, where students rated their confidence and competence in utilising digital learning platforms. The Digital Learning Scale comprises 25 items distributed across eight parameters to ensure balanced representation. The parameters include Awareness, Accessibility, Usability, Engagement, Relevance, Satisfaction, Long-Term Impact and Challenges. Each item in the scale is rated on a five-point Likert scale, with response options ranging from Strongly Agree to Strongly Disagree. The scoring weights vary for positive and negative statements to ensure

accurate response representation, where positive items are scored from 1 (Strongly Agree) to 5 (Strongly Disagree) and negative items are scored inversely, from 5 (Strongly Agree) to 1 (Strongly Disagree). The total digital learning score for each participant is derived by summing the individual scores across all items, ranging from a minimum of 25 to a maximum of 125. A higher score reflects a more positive experience and higher digital learning efficacy, whereas a lower score indicates lower digital learning efficacy. The face and content validity of the scale was confirmed through consultations with five experts in the field of digital education. Reliability was measured using Cronbach's alpha, yielding a high score of 0.86, indicating strong internal consistency and reliability of the survey instrument.

The Critical Thinking Scale, designed by Hemant Lata Sharma and Priyamvada (2012), served as a tool to measure critical thinking abilities. It is designed to assess the skill of forming conclusions from reasoning (thinking process) and reflecting on the resulting conclusions (thought outcomes), with a focus on both affective and cognitive dimensions. Cognitive disposition includes analysis, evaluation, inference and self-regulation. The scale contains 85 items to measure critical thinking. Reliability was confirmed with a test-retest score of 0.987 and a split-half reliability of 0.915. Validity was established through face and construct validity, reviewed by 20 experts in psychology and educational psychology (Shinde, 2023).

Data Analysis

To analyse the association between digital learning efficacy and critical thinking, ANOVA was conducted, comparing the mean critical thinking scores across the three levels of digital learning efficacy (high, medium, and low). Additionally, Tukey's Test, as a Post Hoc analysis, was utilised to examine specific group distinctions.

Findings

Table 1 provides comprehensive descriptive statistics on students' digital learning efficacy, highlighting their confidence and perceived effectiveness in using digital platforms for education. The mean score of 95.59 indicates that, overall, students have a marked degree of proficiency and self-confidence in digital learning abilities. The median result of 95, closely aligning with the mean, suggests a balanced distribution of efficacy scores, with an equal number of students achieving scores above and below 95. The most frequent score, represented by the mode of 91, indicates that many students feel moderately effective in using digital tools for learning. Additionally, the standard deviation of 10.25 reflects moderate variability in digital learning efficacy among the student population.

Table-1: Descriptive Statistics for Digital Learning Efficacy Among Students

Variable	Mean	Median	Mode	Standard Deviation
Digital Learning	95.59	95	91	10.25

To further analyse the variable, digital learning, which originally has a continuous score ranging up to 125, it is converted into a categorical variable. This transformation is achieved by segmenting the scores based on the mean and standard deviation, following a commonly used statistical method. Specifically, scores are grouped into three categories: 'Low' for scores that are less than one standard deviation below the mean, 'Medium' for scores lying

within one standard deviation of the mean, and 'High' for scores surpassing one standard deviation above the mean. This approach simplifies analysis, improves comparability, and helps identify distinct patterns and relationships that might be obscured in a purely continuous analysis. Research suggests that categorising continuous variables enhances the clarity of findings, making them more meaningful and accessible in educational research.

The UNESCO Guidelines for Data Collection to Measure SDG 4.4.2 highlight the importance of robust data categorisation in research to ensure comparability across different educational settings. The document provides strategies for segmenting and classifying educational data to improve its utility for policy-making and analysis. It stresses that organising data into meaningful categories can yield deeper insights into digital literacy and educational trends (UNESCO Institute for Statistics, 2022). By transforming Digital Learning scores into categorical data (Refer Table 2), this study aims to provide clearer insights into how students' critical thinking skills differ across varying levels of digital learning efficacy.

High Efficacy: Scores > 105.84 (16 per cent of students)

Medium Efficacy: Scores between 85.34 and 105.84 (72 per cent of students)

Low Efficacy: Scores < 85.34 (12 per cent of students)

Table-2: Distribution of Digital Learning Efficacy Levels Among Students

Digital Learning Efficacy	Percentage of Students
High (>105.84)	16%
Medium (85.34 ≤ Scores ≤ 105.84)	72%
Low (<85.34)	12%
Total	100%

Table 3 provides detailed descriptive statistics on students' critical thinking abilities, which reflect their capacity to engage in higher-order thinking and problem-solving. The average score of 328.40 reflects that students possess a significantly advanced critical thinking aptitude. This implies that most students demonstrate strong cognitive abilities. The median score of 328, being close to the mean, indicates that the distribution of critical thinking scores is balanced, reflecting an equal division of students scoring above and below the threshold. The mode of 340 shows that 340 is the most common score among students, suggesting that a notable portion of students perform well in critical thinking tasks. With a standard deviation of 29.83, there is a moderate spread in critical thinking abilities among students, implying that while many students display similar critical thinking skills, there is some degree of variation. This analysis highlights the overall high performance in critical thinking among the student population, with some variation in individual abilities.

Table-3: Descriptive Statistics for Critical Thinking Among Students

Variable	Mean	Median	Mode	Standard Deviation
Critical Thinking	328.40	328	340	29.83

In Table 4, the differences in mean scores across the three groups were examined to determine if there are significant variations in critical thinking skills among students with varying levels of digital learning efficacy. The calculated F-value for critical thinking in relation to digital learning efficacy is 31.47, which is notably higher than the critical value at the 0.01 significance level. This suggests that the differences observed between the groups are statistically significant. Since the p-value ($p < 0.001$) is less than 0.05, it confirms that there is a significant difference in critical thinking skills among students with different levels of digital learning efficacy. Consequently, the null hypothesis, which posited that there is no significant difference in critical thinking skills across these groups, is rejected.

Table 4: ANOVA Results Comparing Critical Thinking Across Digital Learning Groups

Source	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	48741.50	2	24370.75	31.47	<.001
Within Groups	338454.40	437	774.50		
Total	**387195.90**	**439**			

Notes: ANOVA = Analysis of Variance; df = degrees of freedom; F = F-ratio; Sig. = significance level (p-value).

To further explore where these differences occur, a Post Hoc Test (Tukey's Test) was conducted (Refer Table 5). The results of this test helped pinpoint which specific groups of students, categorised by their levels of digital learning efficacy, show significant differences in their critical thinking skills.

Table-5: Post Hoc Test Results for Critical Thinking Across Digital Learning Groups

(I) Digital Learning Efficacy	(J) Digital Learning Efficacy	Mean Difference (I-J)	Std. Error	Sig.
High Digital Learning Efficacy	Medium Digital Learning Efficacy	22.841*	4.491	.020
	Low Digital Learning Efficacy	39.029*	6.293	.004
Medium Digital Learning Efficacy	High Digital Learning Efficacy	-22.841*	4.491	.020
	Low Digital Learning Efficacy	16.187	5.174	.217
Low Digital Learning Efficacy	High Digital Learning Efficacy	-39.029*	6.293	.004
	Medium Digital Learning Efficacy	-16.187	5.174	.217

Notes: The mean difference is significant at the 0.05 level for values highlighted with

Asterisks (*). Negative mean differences indicate that the second group (J) had higher scores than the first group (I). Std. Error = Standard Error, Sig. = Significance (p-value).

The mean difference in critical thinking skills between students with high and medium digital learning efficacy is 22.841, with a standard error of 4.491. This difference is statistically significant (p = .020), indicating that students with high digital learning efficacy have significantly better critical thinking skills compared to those with medium efficacy. Additionally, the mean difference between students with high and low digital learning efficacy is 39.029, with a standard error of 6.293. This difference is also statistically significant (p = .004), demonstrating that students with high efficacy outperform those with low efficacy in critical thinking. However, the mean difference between students with medium and low digital learning efficacy is 16.187, with a standard error of 5.174, and is not statistically significant (p = .217), suggesting that critical thinking skills do not differ significantly between these two groups. Overall, the Post Hoc Test results indicate that students with high digital learning efficacy show significantly stronger critical thinking skills compared to those with medium or low efficacy, while the difference between medium and low efficacy groups is not statistically significant.

The results of the study provide strong evidence that digital learning efficacy plays a significant role in shaping students' critical thinking abilities. Students with high digital learning efficacy demonstrated significantly better critical thinking outcomes compared to their peers with medium or low efficacy. These findings highlight the importance of fostering digital learning efficacy as a pathway to improving critical thinking.

Discussion

While previous research has explored the potential of digital learning in fostering critical thinking, this study contributes to literature by examining the specific role of digital learning efficacy. The findings align with existing studies that emphasise the importance of self-efficacy in digital education, reinforcing the idea that students who feel confident in their digital abilities engage more effectively with learning materials and develop stronger critical thinking skills. Kuo et al. (2021) and Alemayehu and Chen (2023) similarly found that students with higher digital learning efficacy exhibit greater engagement and analytical reasoning, supporting the argument that self-efficacy plays a crucial role in shaping learning outcomes. Derakhshan and Fathi (2023) further confirmed that digital learning efficacy predicts cognitive engagement, indicating that confidence in using digital tools facilitates deeper cognitive processing.

The study's findings also align with research emphasising the role of structured digital interventions in enhancing critical thinking. Lionenko and Huzar (2023) demonstrated that digital learning tools, when structured effectively, significantly improve problem-solving and analytical reasoning skills. Similarly, Pedraja-Rejas et al. (2024) highlighted that mobile learning applications and immersive digital experiences enhance students' ability to critically evaluate information. These studies reinforce the conclusion that digital learning efficacy not only facilitates engagement but also enables students to navigate digital resources effectively, leading to stronger critical thinking development.

Despite these positive findings, the study also acknowledges challenges associated with digital learning. George et al. (2024) cautioned that over-reliance on AI may lead to cognitive offloading, this study suggests that digital learning efficacy acts as a mitigating factor, ensuring that students actively engage in analytical reasoning rather than passively consuming information.

Conclusion

This study demonstrates that digital learning efficacy significantly impacts students' critical thinking skills. As digital learning becomes more embedded in education, fostering students' confidence in using digital platforms is crucial for enhancing critical thinking and other higher-order skills. Educators and policymakers should prioritise the development of digital learning efficacy as part of broader educational reforms aimed at improving student outcomes. The findings have important implications for educational practice. Educators should focus not only on providing access to digital tools but also on building students' confidence and competence in using these tools. Targeted digital literacy programs, structured online discussions, and personalised support mechanisms can help students develop digital learning efficacy, ultimately enhancing their critical thinking skills. This study also reinforces Bandura's self-efficacy theory in educational contexts, demonstrating that students' belief in their digital abilities influences both their engagement and higher-order cognitive skills.

As digital education continues to evolve, future research should explore strategies to further enhance digital learning efficacy, ensuring that technology serves as a catalyst for enhancing critical thinking skills rather than passive information consumption.

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