Identifying Web-Based Components for a Critical Academic Reading Instructional Model: A Systematic Literature Review Using PRISMA

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Abstract

Critical academic reading skills are essential in higher education, yet many students face challenges in developing them because of language-related limitations, including restricted vocabulary, and non-linguistic factors such as low confidence, limited engagement, and insufficient instructional support. Although interest in digital learning continues to grow, a research gap remains in theory-based instructional models that integrate web-based components to support the acquisition of higher-order critical academic reading skills. This review addresses that gap through a systematic literature review (SLR) conducted in accordance with the PRISMA 2020 guidelines. The review identified six critical recurring web-based components: interactive multimedia, online discussion forums, gamification, adaptive learning, automated feedback, and digital critical reading pedagogy. Beyond identifying these components, the review explains how they function cognitively and affectively to support critical reading processes such as inferencing, argument evaluation, and metacognitive monitoring. Grounded in constructivism, self-determination theory, cognitive load theory, and personalisation principles, the findings inform a theory-driven instructional model that demonstrates how web-based components can be designed to support critical academic reading. This review contributes theoretically by showing that digital tools are most effective when aligned with pedagogical goals rather than added in isolation. The findings also provide direction for future research and instructional practice.

Keywords**:** *critical academic reading skills, web-based learning, instructional model, digital pedagogy, higher education, PRISMA.*

INTRODUCTION

Critical academic reading skills have become increasingly important in higher education and workplaces, especially in the era characterised by information overload and digital knowledge exchange. For EFL learners, these skills are particularly important because reading serves as a primary means of language development, knowledge acquisition, and academic learning (Al Roomy, 2022). Unlike basic comprehension, critical academic reading requires students to analyse arguments, evaluate evidence, identify assumptions, and construct logical interpretations from texts. (Niculescu & Dragomir, 2023; Özensoy, 2021). These competencies are essential not only for academic success but also for lifelong learning and adaptability in increasingly flexible, knowledge-rich workplaces (Abduvoidova, 2024).

Despite its importance, many English as a Second Language (ESL) students continue to struggle to acquire critical academic reading skills. Previous research indicates that students frequently struggle with linguistic limitations, cognitive processing demands, and insufficient instructional support, and that difficulty evaluating arguments often restricts students' capacity to engage critically with academic texts (Aziz et al., 2024a; Nguyen, 2020).

To address these challenges, higher education has increasingly incorporated web-based learning environments and digital instructional tools to support reading development. Technologies such as interactive multimedia, online discussion forums, adaptive learning systems, and automated feedback mechanisms have demonstrated potential to enhance engagement, support comprehension, and facilitate differentiated learning (Bond et al., 2020; Hew et al., 2020).

At the same time, the effectiveness of digital environments depends largely on their pedagogical alignment rather than on technological features alone. Learning theories such as constructivism, self-determination theory, cognitive load theory, and the personalisation principle remain highly relevant in guiding the design of web-based instruction because they collectively address cognitive, motivational, and student-centred dimensions of reading development (Piaget, 1976; Vygotsky, 1978; Deci & Ryan, 1985; Sweller, 1988; and Mayer, 2014).

Consequently, there remains limited guidance on how web-based instructional components can be pedagogically organised to support the linguistic, cognitive, and affective needs of ESL students engaged in critical academic reading. This gap highlights the need for comprehensive synthesis that identifies relevant web-based components and explains how they may be integrated into a theoretically grounded instructional model.

By utilising a systematic literature review (SLR) guided by the PRISMA framework, this study synthesises empirical evidence on web-based instructional components that support the development of critical academic reading skills among ESL students in higher education. The review aims to identify key pedagogical and technological components and explain how these components contribute to a theory-driven instructional model for enhancing critical academic reading skills in digital learning environments.

METHODS

Research Design

This study employed a systematic literature review (SLR) to identify and synthesise empirical evidence on web-based instructional components that support the development of critical academic reading skills among ESL students in higher education. The review followed the PRISMA 2020 guidelines (Page et al.,2021) to ensure methodological transparency and replicability. Procedures were adapted from the SLR framework proposed by Shaffril et al. (2020). The review aimed to identify recurring web-based instructional components and examine their relevance in supporting critical academic reading development.

Stage 1: Identification

A literature search was conducted across five academic databases: Scopus, Web of Science, ERIC, ScienceDirect, and Google Scholar. These databases were selected to ensure broad coverage of peer-reviewed studies related to web-based learning and critical academic reading in higher education contexts.
Search terms were developed based on key instructional constructs identified in the study, including interactive multimedia, online discussion forums, gamification, adaptive learning systems and digital critical reading pedagogy. Boolean operators were used to combine terms related to digital instruction, critical academic reading, and higher education contexts. The core string was as below, and only peer-reviewed journal articles published in English between 2019 and 2025 were included.

> ("web-based learning" OR "online learning tools" OR "digital reading platforms") AND ("critical academic reading" OR "analytical reading skills") AND ("higher education" OR "university students").

Stage 2: Inclusion and Exclusion Criteria

Studies were included if they;

i. Examined web-based instructional components or digital learning environments related to critical or higher-order literacy,
ii. Focused on higher education or ESL/EFL contexts,
iii. Were published in peer-reviewed journals between 2019 and 2025, and
iv. Provided accessible full texts.

Studies were excluded if they:

i. Focused on primary or secondary education,
ii. Were non-academic publications such as editorials or reports, or
iii. Lacked methodological or pedagogical relevance to critical academic reading instruction.

Stage 3: Screening and Selection Process

The initial search identified 115 records. After duplicate removal, 86 articles remained for title and abstract screening. Studies that did not address critical reading, higher education, or web-based

components were excluded. Following application of the inclusion and exclusion criteria, 44 studies were retained for final synthesis. The screening and selection procedures are presented in the PRISMA flow diagram (Figure 1).

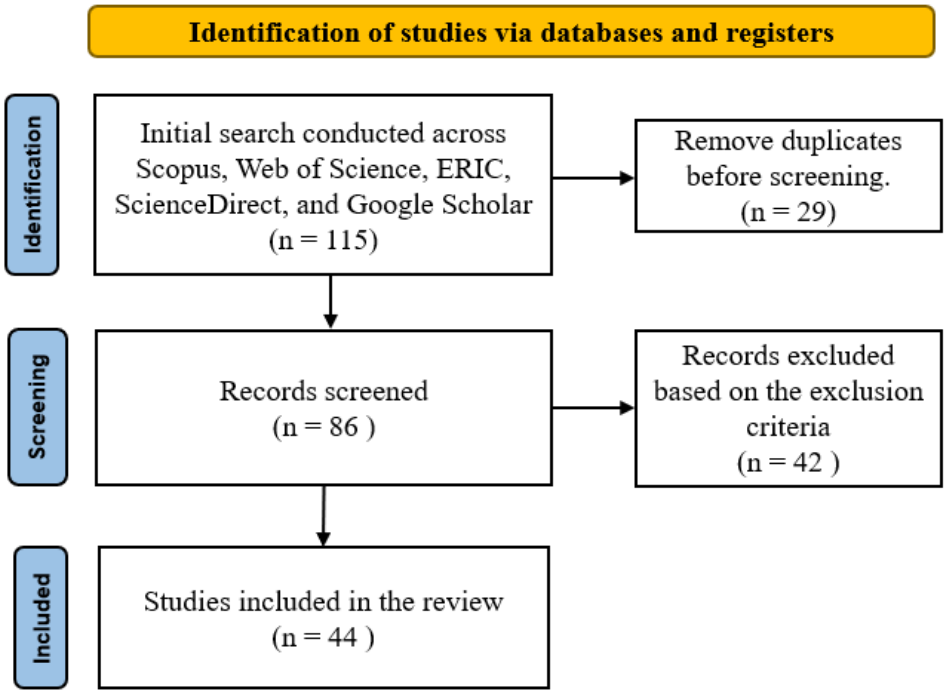

Figure 1 Reporting of Systematic Review Using PRISMA (2020)

Quality Appraisal

All selected studies underwent qualitative appraisal focusing on conceptual clarity, contextual relevance, methodological transparency, and alignment with ESL or higher-education instructional contexts, following Boell and Cecez-Kecmanovic, 2015). Coding discrepancies and thematic interpretations were resolved through peer debriefing and consensus discussions among the research team to enhance analytical credibility.

Data Analysis and Synthesis

Thematic synthesis was conducted using Braun and Clarke's (2006) thematic analysis and Schreier's (2012) qualitative content analysis framework. Open coding was first applied to identify recurring web-based instructional strategies associated with linguistic, cognitive, and affective dimensions of critical academic reading. The identified strategies were subsequently organised into six recurring themes: interactive multimedia, online discussion forums, gamification, adaptive learning systems, automatic feedback mechanisms, and digital critical reading pedagogy.

Each theme was then analysed in relation to its pedagogical function and theoretical alignment with constructivism, self-determination theory, cognitive load theory, and personalisation principles. Table 1 summarises the distribution of selected studies across the six identified instructional components.

Table 1 Distribution of Selected Studies by Web-Based Instructional Component

Web-Based Component	Number of Studies	Example References
Interactive Multimedia	8	Rogti (2024); Fitrawati et al. (2023)
Online Discussion Forum	6	Jamali & Krish (2021); Wafiroh et al. (2024)
Gamification	7	Anggrainy et al. (2024); Matyakhan et al. (2024)
Adaptive Learning Systems	7	Mehanni (2023); Yuan et al. (2023)
Automated Feedback Mechanisms	7	Li and Kim (2024); Cavalcanti et al. (2021)
Digital Critical Reading Pedagogy	9	Jensen and Scharff (2019); Yang and Mei (2024)

FINDINGS

The first research objective sought to identify web-based instructional components that support the development of critical academic reading skills among ESL students in higher education. Analysis of the 44 selected studies revealed six recurring components: interactive multimedia, online discussion forums, gamification, adaptive learning systems, automated feedback mechanisms, and digital critical reading pedagogy. Collectively, these components contribute to the development of critical academic reading subskills, including identifying main ideas, evaluating evidence, making inferences, constructing interpretation, and monitoring comprehension.

Across the reviewed studies, four recurring pedagogical functions emerged. First, web-based instructional components promote sustained engagement with academic reading tasks. Second, they provide instructional support to help students process complex texts and develop higher-order reading skills. Third, they help to address affective barriers commonly experienced by ESL students, including low confidence and reading-related anxiety. Finally, they encourage metacognitive awareness and self-regulated learning. Despite these benefits, the literature also highlights potential risks associated with poor instructional design, including cognitive overload, superficial participation, excessive dependence on technology, and reduced student autonomy.

Rather than functioning as isolated technologies, the identified components operate as pedagogical mechanisms that influence both cognitive and affective dimensions of learning. Table 2 summarises the primary cognitive and affective functions, and potential risks associated with each component. The subsequent sections synthesise how these components contribute to critical academic reading development and highlight the conditions under which their implementation is most effective.

Table 2 Pedagogical Functions and Risks of Web-based Components for Critical Academic Reading Skills

Components	Primary Cognitive Function	Primary Affective Function	Potential Risk
Interactive Multimedia	Cognitive load management; multimodal comprehension	Reduce anxiety; increased accessibility	Cognitive overload; split attention
Online Discussion Forums	Collaborative meaning-making; elaborative processing	Psychological safety; sense of belonging	Superficial participation;0 unequal participation
Gamification	Goal orientation; sustained attention; persistence	Motivation; autonomy; engagement	Over-competition; distraction from deep processing
Adaptive Learning Systems	Personalised progression; task-learner alignment	Confidence; perceived competence	Over-automation; reduced learner agency
Automated Feedback Mechanisms	Metacognitive monitoring; self-regulation	Reduced fear of failure; reassurance	Feedback dependency; surface correction
Digital Critical Reading Pedagogy	Strategic reading regulation; evaluative reasoning	Self-efficacy; control over learning	Skimming behaviour; shallow comprehension

As shown in Table 2, the six web-based components contribute to critical academic reading through distinct but complementary mechanisms. Interactive multimedia primarily supports cognitive load management and multimodal comprehension (AlShaikh et al., 2024; Fitrawati et al.,2023), while online discussion forums facilitate collaborative meaning-making and elaborative processing (Jamali & Krish, 2021; González-Cacho & Abbas, 2022). Gamification promotes persistence and sustained participation (Anggrainy et al., 2024; Matyakhan et al., 2024), whereas adaptive learning systems support personalised progression and task-learner alignment (Mehanni, 2023; Yuan et al., 2023). Automated feedback mechanisms encourage metacognitive monitoring and self-regulation (Li & Kim, 2024; Cavalcanti et al., 2021), while digital critical reading pedagogy develops strategic and evaluative reading practices (Jensen & Scharff, 2019; Yang & Mei, 2024).

Interactive Multimedia: Supporting Comprehension and Cognitive Processing

The reviewed studies consistently indicate that interactive multimedia plays a significant role in supporting critical academic reading among ESL students by enhancing comprehension, reducing cognitive burden, and facilitating engagement with complex academic texts. By integrating visual, auditory, and interactive elements, multimedia environments enable students to process information through multiple channels. This could improve understanding and retention while reducing the demands associated with dense academic content. Empirical studies on interactive multimedia have reported positive effects in solving the most significant problems faced by ESL

students, including limited linguistic proficiency, cognitive overload, low motivation, and difficulty in engaging with complex academic texts (AlShaikh et al., 2024; Fitrawati et al., 2023; Haleem et al., 2022).

A recurring finding in the literature is that multimedia resources can support critical reading processes. Features such as visual representations, simulations, interactive tasks, and guided activities assist students in identifying main ideas, analysing evidence, making inferences, and evaluating arguments. These supports are particularly beneficial for ESL students who often face linguistic challenges and difficulties processing complex texts. By segmenting information into manageable units and providing multimodal representations, interactive multimedia helps students allocate cognitive resources more effectively to higher-order reading tasks rather than basic comprehension demands (Basri et al., 2021; Nikitina et al., 2024).

Beyond its cognitive benefits, multimedia also contributes to a more accessible and supportive learning environment. Studies suggest that interactive multimedia can increase students' willingness to engage with academic texts by making content more approachable and reducing the intimidation frequently associated with challenging reading materials. (Fitrawati et al., 2023; Rogti, 2024). However, these benefits depend on effective instructional design. Poorly structured multimedia environments may increase cognitive overload or create split-attention effects that hinder learning rather than support it (Mayer, 2014; Sweller et al., 1988). Consequently, the instructional value of interactive multimedia lies not merely in the use of technology itself, but in its capacity to strategically support comprehension, reasoning, and critical engagement with academic texts.

Online Discussion Forums for Collaborative Learning

The reviewed studies indicate that online discussion forums (ODFs) play an important role in supporting critical academic reading by creating opportunities for collaborative meaning-making, reflective dialogue, and peer interaction. Unlike traditional teacher-centred approaches, ODFs encourage students to actively engage with texts by questioning ideas, negotiating interpretations, and evaluating alternative perspectives. These interactions promote deeper comprehension and foster the analytical thinking required for critical academic reading (Jamali & Krish, 2021; González-Cacho & Abbas, 2022; Wafiroh et al., 2024).

A consistent finding across the literature is that ODFs support higher-order reading processes through structured discussion and collaborative inquiry. By engaging in peer questioning, argument evaluation, and evidence-based discussion, students are encouraged to move beyond surface-level comprehension and develop skills in inference, interpretation, and critical evaluation. Digital discussion environments also provide students with opportunities to revisit conversations, reflect on feedback, and monitor the development of their understanding over time. These practices strengthen metacognitive awareness and promote more deliberate engagement with academic texts (Mochizuki & Tsubakimoto, 2021; González-Cacho & Abbas, 2022).

The literature further suggests that ODFs provide a supportive learning environment that encourages participation among students who may be hesitant to contribute to traditional classroom settings. The asynchronous nature of many online forums allows students additional time to process information, formulate responses, and engage thoughtfully with complex texts. However, the effectiveness of ODFs depends on appropriate instructional design and facilitation. Without clear guidance and meaningful interaction, participation may become superficial,

resulting in limited critical engagement and unequal contributions among students (Bachtiar, 2024; Ramalingam et al.,2021). Therefore, online discussion forums are most effective when structured as purposeful spaces for collaborative reasoning, reflective dialogue, and critical exploration of academic texts.

Gamification: Promoting Persistence and Higher-Order Engagement

The reviewed studies consistently demonstrate that gamification enhances students' willingness to engage with critical academic reading activities by transforming reading tasks into structured, goal-oriented learning experiences. By incorporating elements such as points, badges, leaderboards, progress indicators, and rewards, gamified environments encourage sustained participation and persistence among students who encounter challenging academic texts (Anggrainy et al., 2024; Maspufah et al., 2025; Matyakhan et al., 2024; Wang et al., 2024).

A recurring theme in the literature is that gamification supports critical reading by maintaining students' attention and encouraging continuous interaction with texts. Rather than treating reading as a passive activity, gamified environments promote active participation through incremental challenges, immediate feedback, and clearly defined learning goals. These features encourage students to engage in higher-order cognitive processes such as analysing information, evaluating arguments, and reflecting on their understanding. Studies further suggest that gamified reading environments can improve comprehension and task completion by making complex academic content more approachable and manageable for students (Bourke, 2021; Song & Cai, 2024; Suryadi et al., 2023).

The effectiveness of gamification, however, depends on its pedagogical implementation. While reward systems and competitive elements can strengthen student participation, excessive emphasis on external rewards may shift attention away from meaningful learning and critical engagement with texts. Poorly designed gamification may encourage superficial participation or over-competition rather than thoughtful analysis and reflection (Jun & Lucas, 2024; Wang et al., 2024). Consequently, gamification is most effective when game elements are strategically aligned with instructional objectives and designed to support deep engagement with critical academic reading rather than merely increasing participation.

Adaptive Learning Systems: Personalising Critical Academic Reading Development

The reviewed studies indicate that adaptive learning systems support critical academic reading by tailoring instructional content, learning pathways, and task difficulty to individual learner needs. Unlike standardised instructional approaches, adaptive systems continuously adjust learning experiences based on students' performance. This enables more personalised progression through complex reading tasks. This personalised support is particularly beneficial for ESL students, whose linguistic proficiency, reading competence, and cognitive readiness often vary considerably within the same learning environment (Mehanni, 2023; du Plooy et al., 2024; Nguyen, 2025).

A key finding across the literature is that adaptive learning environments facilitate the development of higher-order reading skills by aligning instructional demands with students' current levels of understanding. Through targeted recommendations and adaptive feedback, students receive appropriate support as they engage in tasks involving inference-making, evidence evaluation, summarisation, and critical analysis. Such alignment reduces unnecessary cognitive burden while allowing students to focus on progressively more complex reading processes. Studies

further suggest that adaptive systems can enhance student autonomy by encouraging self-paced progression and greater responsibility for learning decisions (Yuan et al., 2023; Mehanni, 2023). Despite these advantages, the effectiveness of adaptive learning depends on responsible implementation and pedagogical oversight. The literature highlights concerns related to over-automation, limited AI literacy, data privacy, and excessive reliance on algorithmic decision-making (Ismaili, 2024; Vorobyeva et al., 2025). Consequently, adaptive learning systems should be viewed as instructional supports rather than a replacement for educator guidance. When integrated within a pedagogically coherent learning environment, adaptive systems provide valuable opportunities for personalisation while supporting the development of critical academic reading among ESL students.

Automated Feedback Mechanisms: Supporting Metacognitive Monitoring and Self-Regulated Reading

The reviewed studies suggest that automated feedback mechanisms play a valuable role in supporting critical academic reading by providing timely, personalised, and actionable guidance to students. Unlike traditional feedback approaches that may be delayed or limited by instructor availability, automated feedback systems offer immediate responses that help students identify misunderstandings, monitor comprehension, and adjust reading strategies during the learning process (Li & Kim, 2024; Khasawneh & Belton, 2025; Cavalcanti et al., 2021).

A consistent finding across the literature is that automated feedback promotes metacognitive awareness and self-regulated learning. Through targeted prompts, corrective suggestions, and performance-based recommendations, students are encouraged to reflect on their understanding, evaluate their reasoning, and identify areas requiring further attention. These processes are particularly important in critical academic reading, where students must continuously assess interpretations, evaluate evidence, and refine judgments while engaging with complex texts. Automated feedback therefore functions not only as a corrective mechanism but also as a tool for developing independent learning behaviours and strategic reading practices (Brown et al., 2025; Sinclair et al., 2020).

Recent developments in artificial intelligence have expanded the potential of automated feedback by enabling more adaptive and personalised responses. However, the literature also highlights important limitations, including the risk of student dependency, overreliance on automated recommendations, and concerns regarding the accuracy and transparency of AI-generated feedback (Michel-Villarreal et al., 2023; Li & Kim, 2024). Consequently, automated feedback is most effective when integrated into a broader instructional framework that combines technological support with pedagogical guidance. When appropriately implemented, automated feedback mechanisms can strengthen students' self-monitoring capabilities and support the development of critical academic reading skills.

Digital Critical Reading Pedagogy

The reviewed studies consistently demonstrate that the effectiveness of digital reading environments depends less on the technology itself and more on the pedagogical approaches used to support critical engagement with texts. Digital critical reading pedagogy provides structured instructional support that enables students to analyse arguments, evaluate evidence, identify assumptions, and construct informed interpretations as they interact with digital texts. These

pedagogical practices are particularly important for ESL students, who often face challenges related to language proficiency, information processing, and higher-order reasoning (Jensen & Scharff, 2019; Yang & Mei, 2024; van der Weel & Mangen, 2022).

A recurring finding across the literature is that strategically designed digital reading activities promote deeper engagement with academic content. Instructional supports such as guided annotation, digital notetaking, questioning prompts, vocabulary assistance, and reflective activities encourage students to actively monitor comprehension and critically evaluate textual information. These practices strengthen critical reading subskills including identifying main ideas, assessing evidence, making inferences, and recognising bias, while also promoting student autonomy in technology-mediated learning environments (Henry & Mohamad, 2021). Furthermore, digital reading pedagogy assists students in developing the strategic reading behaviours required to navigate increasingly complex and multimodal academic environments (Alshaye, 2021; Jardón-Gallegos et al., 2024).

However, the literature also highlights important challenges associated with digital reading. Without explicit instructional guidance, students may engage in superficial reading behaviour such as skimming, fragmented processing, and reduced critical reflection. These risks are particularly evident in highly digitised learning environments where access to information does not automatically translate into critical understanding (van der Weel & Mangen, 2022; Tathahira, 2020). Consequently, digital critical reading pedagogy should be viewed as an important instructional component that transforms digital tools into meaningful learning experiences. When supported by appropriate pedagogical design, digital reading environments can facilitate the development of strategic, reflective, and evaluative reading practices that are central to critical academic reading.

Structuring the Web-Based Components into a Theoretically Grounded Instructional Model

The second research objective sought to determine whether the identified web-based instructional components could be organised into a coherent instructional model for enhancing critical academic reading among ESL undergraduates. Analysis of the reviewed studies indicates that the six components, which are interactive multimedia, online discussion forums, gamification, adaptive learning systems, automated feedback mechanisms, and digital critical reading pedagogy, are effective when integrated within a theoretically grounded instructional framework rather than implemented as isolated technologies.

The findings suggest constructivism (Piaget, 1976; Vygotsky, 1978), self-determination theory (Deci & Ryan, 1985), cognitive load theory (Sweller, 1988), and the personalisation principle (Mayer, 2014) collectively provide a suitable foundation for organising these components. Cognitive load theory informs the use of multimedia and structured reading activities to reduce unnecessary processing demands and support comprehension of complex academic texts. Constructivist principles emphasise collaborative learning processes facilitated by online discussions and knowledge sharing activities that promote interpretation, reasoning, and critical evaluation. Self-determination theory highlights the importance of motivational supports, such as gamification and collaborative engagement, in sustaining students' participation in cognitively demanding reading tasks. Meanwhile, personalisation principles support the integration of adaptive learning and automated feedback mechanisms that accommodate individual learner needs and progression.

Although the reviewed studies generally reported positive outcomes associated with the web-based components, several challenges were also identified. Interactive multimedia may overwhelm students if too much information is presented at once. Online discussion forums may lead to limited or unequal participation, while gamification may cause students to focus on rewards rather than on critical reading. Besides that, adaptive learning systems and automated feedback mechanisms can make students become overly dependent on technological supports. Digital learning environments may encourage skimming, rather than careful reading. These findings suggest that the success of web-based components depends not only on the technology itself but also on how effectively it is designed and integrated into teaching and learning. Figure 2 illustrates the proposed instructional model derived from the synthesis of the reviewed literature. The phases are intended as interconnected and iterative rather than a strict step-by-step order.

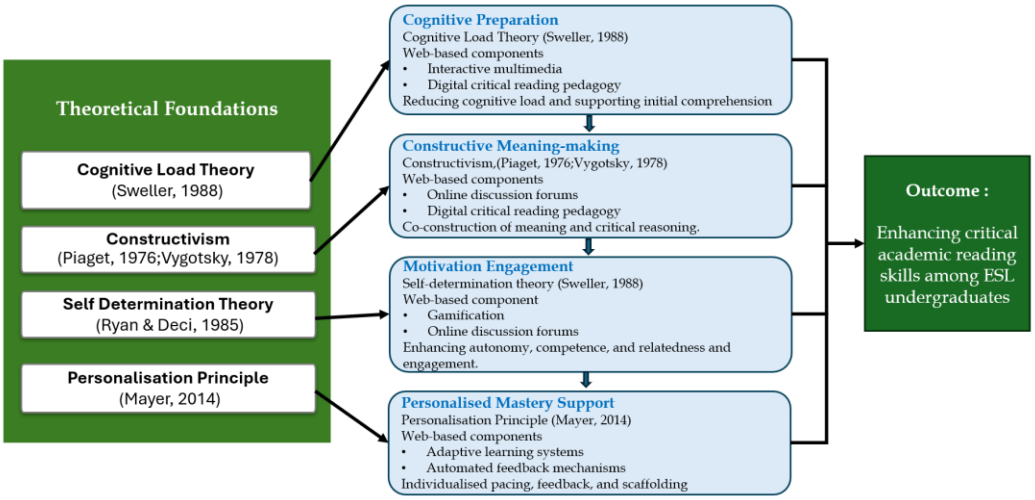

Figure 2 Integrated Web-Based Instructional Model for Enhancing Critical Academic Reading Skills Among ESL Undergraduates

DISCUSSIONS

This systematic review demonstrates that the development of critical academic reading skills in digital environments depends on the integration of pedagogically aligned instructional components rather than adopting individual technologies. Although the reviewed studies examined different forms of web-based instruction, the findings collectively suggest that critical academic reading is a multidimensional process requiring coordinated, cognitive, social, motivational, and metacognitive support. The six identified components contribute to these dimensions in complementary ways, reinforcing the view that effective reading instruction extends beyond technological implementation to encompass purposeful instructional design (Jamali & Krish, 2021; Yang & Mei, 2024).

A key implication of this review is that technology alone may not improve critical academic reading. Instead, learning outcomes appear to depend on how digital tools are pedagogically organised to support comprehension, reasoning, reflection, and learner engagement. This finding extends previous discussions of technology-enhanced learning by demonstrating that web-based components function primarily as pedagogical enablers rather than independent

determinants of learning outcomes. Consequently, the effectiveness of digital reading environments should be evaluated not by the quality of technological features provided but by the extent to which those features support meaningful engagement with academic texts (Tathahira, 2020; van der Weel & Mangen, 2022).

The findings further suggest that critical academic reading requires a balance between cognitive support and learner autonomy. Table 3 helps explain how the identified web-based components contribute to critical academic reading development. The table highlights the primary rather than exclusive contribution of each component to critical reading development. Together, these components provide complementary cognitive, motivational, and metacognitive support that collectively contribute to the development of higher-order reading skills among ESL students.

Table 3 Contribution of Web-based Components to Critical Academic Reading Development

Web-based Components	Primary Critical Reading Skill Supported
Interactive Multimedia	Inferencing, comprehension, identifying main ideas
Online Discussion Forums	Argument evaluation, interpretation, evidence-based reasoning
Gamification	Sustained engagement, persistence in reading tasks
Adaptive Learning Systems	Differentiated support, personalised progression
Automated Feedback Mechanisms	Metacognitive monitoring, self-regulated learning
Digital Critical Reading Pedagogy	Strategic reading, evaluative reasoning, critical reflection

While supporting mechanisms such as multimedia, adaptive learning, and automated feedback can reduce barriers to comprehension, excessive dependence on technological guidance may limit opportunities for independent reasoning and critical judgment. This tension highlights an important design challenge for educators and instructional designers: creating learning environments that support students without diminishing the reflective and evaluative processes central to critical academic reading. Rather than viewing this tension as a limitation, it may be interpreted as evidence that successful digital reading instruction requires careful pedagogical decision-making and ongoing instructional moderation.

Digital Critical Reading Pedagogy as the Central Organising Element

One of the most significant contributions of this review is the identification of digital critical reading pedagogy as the central organising element within the proposed instructional model. While interactive multimedia, online discussion forums, gamification, adaptive learning systems, and automated feedback mechanisms provide important forms of support, their effectiveness fully depends on how they are pedagogically integrated into reading instruction. This finding suggests that technology does not inherently promote critical academic reading; rather, meaningful learning occurs when students are explicitly guided to analyse arguments, evaluate evidence, identify assumptions, and construct reasoned interpretations of texts (Jensen & Scharff, 2019; Yang & Mei, 2024).

This interpretation extends existing research on digital reading by emphasising that access to digital tools alone is insufficient for developing higher-order reading skills. Students may have access to technological tools yet continue to engage in surface-level reading behaviours if instructional guidance is absent. The findings therefore reinforce the importance of explicit reading strategies, guided questioning, reflective activities, and structured engagement with academic texts. Such support assists students to move beyond information consumption towards critical evaluation and knowledge construction, which are fundamental characteristics of critical academic reading (Tathahira, 2020; van der Weel & Mangen, 2022).

Furthermore, the emergence of digital critical reading pedagogy as the central component highlights an important shift from technology-centred approaches towards pedagogy-centred instructional design. This shift is particularly relevant in higher education contexts where increasing access to digital resources does not automatically translate into deeper learning. The findings thus suggest that the success of web-based reading instruction depends less on technological sophistication than on the quality of pedagogical support embedded within digital learning environments.

Theoretical Integration and Model Coherence

The proposed instructional model contributes to the literature by demonstrating how multiple learning theories can be integrated to support critical academic reading in web-based environments. Rather than applying a single theoretical perspective, the model combines constructivism, cognitive load theory, self-determination theory and personalisation principles to address different dimensions of the learning process. This integration reflects the complexity of critical academic reading, which requires students to process information, construct meaning, sustain motivation, and regulate their own learning simultaneously.

The findings suggest that cognitive load theory provides an important foundation for designing learning experiences that support comprehension without overwhelming students, especially when engaging with complex academic texts. Constructivist principles complement this perspective by emphasising dialogue, collaboration, and knowledge construction through interaction with others. At the same time, self-determination theory highlights the importance of supporting students' autonomy, competence, and motivation, while personalisation principles emphasise the value of adapting learning experiences to individual needs and progression. Collectively, these theoretical perspectives provide a coherent framework for understanding how different web-based components contribute to critical academic reading development.

The proposed instructional model supports students' development from understanding a text to thinking critically about it. Interactive multimedia and adaptive learning systems help students understand information, identify main ideas, and make inferences, while online discussion forums and digital critical reading pedagogy encourage students to discuss ideas, evaluate evidence, consider different viewpoints and form their own interpretations. Gamification and automated feedback help maintain motivation and encourage students to monitor their own learning. Together, these components support gradual development of the skills, allowing them to move from basic comprehension to critical analysis of academic texts.

The model also reveals several design tensions that require careful consideration. For instance, increasing instructional support may improve comprehension but could potentially reduce student independence if overused. Similarly, personalisation may enhance engagement and progression but may also limit opportunities for students to encounter unfamiliar perspectives or

challenges. These tensions do not weaken the proposed model; rather, they highlight the importance of instructional judgement in balancing support, autonomy, challenge, and reflection within digital learning environments.

Implications for Research and Practice

The findings have several implications for both education practice and future research. For practitioners, the review suggests that successful web-based instruction should prioritise pedagogical alignment rather than technological novelty. Digital tools should be selected and implemented based on their capacity to support critical reading processes, rather than their technological features alone. Particular attention should be given to instructional supports, student interaction, and opportunities for reflection, as these elements appear central to the development of critical academic reading skills.

For researchers, the proposed instructional model provides a theory-driven framework that can be tested, refined, and validated across different educational contexts. Future studies may examine the effectiveness of individual components, investigate interactions among components or evaluate the complete instructional model in authentic learning environments. Such research would contribute to a deeper understanding of how web-based instructional design can support critical academic reading development among diverse groups of ESL students.

Overall, this review reconceptualises web-based critical academic reading instruction as a pedagogically integrated process rather than a collection of independent technological tools. By clarifying the roles of six interconnected instructional components and their theoretical foundations, the study provides a coherent framework to support critical academic reading in contemporary digital learning environments.

CONCLUSIONS

This systematic literature review identified six web-based instructional components that support the development of critical academic reading skills among ESL students in higher education: interactive multimedia, online discussion forums, gamification, adaptive learning systems, automated feedback mechanisms, and digital critical reading pedagogy. The findings suggest that effective web-based reading instruction depends not on the use of individual technologies in isolation, but on the pedagogical integration of these components to address students' cognitive, social, motivational, and metacognitive needs. The review further demonstrates that digital critical reading pedagogy serves as the central organising element that enables technology to support meaningful engagement with academic texts. By integrating constructivism, self-determination theory, cognitive load theory, and personalisation principles, the proposed instructional model provides a theoretically grounded framework for supporting critical academic reading in digital learning environments.

The study contributes to the growing literature on technology-enhanced literacy instruction by shifting attention from technological tools to the pedagogical processes that underpin critical reading development. Specifically, this review identifies the web-based components that support critical academic reading, and how these components contribute to reading skills. The proposed instructional model provides a theory-driven framework that integrates constructivism, cognitive load theory, self-determination theory and personalisation principles. The findings also highlight

the importance of instructional alignment, learner autonomy, and reflective engagement in the design of web-based learning environments. While the proposed model offers a coherent framework for instructional design, future research should empirically validate its effectiveness across different educational contexts, student populations, and levels of language proficiency. Such investigations will further enhance understanding of how web-based instructional design can support the development of critical academic reading skills among ESL students.

LIMITATIONS OF THE STUDY

Several limitations should be considered when interpreting the findings of this review. The included studies were conducted across diverse educational contexts that varied in technological infrastructure, institutional readiness, and student characteristics, which may affect the transferability of the findings. In addition, some studies relied on self-reported perceptions rather than direct measures of critical academic reading performance. The review was limited to selected databases, which may have excluded relevant studies indexed elsewhere. As digital and AI-supported learning technologies continue to evolve, the pedagogical implications identified in this review may require further refinement over time.

Future studies should empirically evaluate the proposed instructional model as an integrated framework rather than examining individual components in isolation. Longitudinal and experimental studies are particularly needed to investigate its impact on higher-order reading skills such as inferencing, argument evaluation, and evidence-based reasoning. Further research should also explore how student characteristics, including language proficiency, academic discipline, and digital literacy, influence the effectiveness of web-based instructional design and AI-supported learning environments.

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As the authors are non-native English speakers, advanced large language models (specifically ChatGPT 5.2 and Claude 4.6 Opus) were utilised to refine the academic phrasing and ensure the manuscript meets the standards of high-impact journals. All AI-generated suggestions were thoroughly reviewed, edited, and verified by the authors, who retain full responsibility for the final content.

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DATA AVAILABILITY STATEMENT

The data supporting the findings of this study are available within the article and its referenced sources. No new datasets were generated during the current study.

CONFLICT OF INTEREST

The author declares that this research does not have a conflict of interest in terms of conduct, analysis, or reporting. All findings were generated without any outside interference, and the design, interpretation of data, and conclusion of the research were not affected by any other party.

DECLARATION OF GENERATIVE AI

The authors used generative artificial intelligence tools (ChatGPT and Claude) solely for language refinement, proofreading, and editorial assistance during manuscript preparation. All conceptual development, analysis, interpretation of findings, and final content remain the responsibility of the authors.

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