

## REVIEW

# A Systematic Review of Critical Thinking Development in Information and Communication Technology-Supported English as a Foreign Language Teaching from 2015 to 2024

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## ABSTRACT

Critical thinking is an essential skill for students in the 21st century and plays a pivotal role in language education. With the rapid advancement of Information and Communication Technology (ICT), English as a Foreign Language (EFL) education has significantly benefited from tools that support the development of critical thinking. While existing research has examined the impact of ICT on critical thinking in EFL classrooms, there is a lack of systematic reviews focusing specifically on the role of ICT tools in enhancing critical thinking within EFL teaching. This systematic review aims to address that gap by examining recent advancements and the effectiveness of ICT tools used in EFL instruction to foster critical thinking from 2015 to 2024, with a focus on tools such as digital mapping, WebQuest, and online games. The findings indicate that communicative, informative, and constructive ICT tools are widely used in EFL classrooms and are particularly effective in enhancing analysis, evaluation, and inference skills. This study provides an in-depth analysis of how these technologies are currently applied in EFL education to foster critical thinking skills. Additionally, the study also provides guidance for future research, highlighting the need to expand the use of emerging technologies, such as artificial intelligence (AI), virtual reality (VR), and augmented reality (AR), and explore their integration into diverse EFL contexts to maximize their potential in promoting critical thinking.

**Keywords:** Critical Thinking; Informative Communication Technology (ICT); ICT Tools; EFL Teaching; Systematic Review

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# 1. Introduction

Critical thinking is widely regarded as a core competence for global citizens and a fundamental educational skill that should be cultivated throughout primary, secondary, and tertiary education<sup>[1-4]</sup>. In language education, critical thinking is crucial for enhancing language acquisition, improving overall proficiency<sup>[5]</sup>, fostering learner awareness, promoting autonomous learning<sup>[6]</sup>, and encouraging active use of language learning strategies to improve outcomes<sup>[7]</sup>. In EFL classrooms, the learning environment is particularly conducive to critical thinking development, as it exposes students to diverse cultural perspectives and thought processes<sup>[8]</sup>. This exposure positively influences cognitive abilities and language proficiency<sup>[9]</sup>, emphasizing the importance of integrating critical thinking into foreign language education<sup>[10, 11]</sup>.

The evolution of Information and Communication Technology (ICT) has further expanded the potential for critical thinking development in EFL education<sup>[12, 13]</sup>. ICT encompasses tools and processes that facilitate the generation, storage, and dissemination of information in various forms, including text, voice, data, and multimedia<sup>[14]</sup>. Its integration into EFL classrooms has enhanced language skills and provided opportunities for students to engage with diverse cultures and practices, thus broadening their critical thinking<sup>[15-17]</sup>. While several studies have highlighted the effectiveness of ICT tools such as digital storytelling, WebQuest, and online games in promoting critical thinking in EFL classrooms<sup>[18-20]</sup>, there remains a notable lack of systematic reviews focusing on the specific role of ICT tools in fostering critical thinking in EFL instruction.

Although some reviews have explored the broader role of technology in promoting critical thinking within English language teaching and TESOL<sup>[21, 22]</sup>, the literature lacks a focused review on the use of ICT tools for critical thinking in EFL contexts. Given the rapid advancements in ICT, many technologies previously used in language education became obsolete after 2014, underscoring the need for frequent reviews and reassessments of instructional practices<sup>[23]</sup>. To address this, the present review examines articles published between 2015 and 2024, focusing on recent ICT applications and their effectiveness in fostering critical thinking in EFL education. The review offers an in-depth analysis of how ICT tools are currently applied and evaluates their overall

impact on critical thinking skills. Additionally, this review seeks to guide both educators and researchers in integrating ICT effectively into EFL contexts, ultimately enhancing the development of critical thinking skills among EFL learners.

This article is structured as follows: first, it reviews the existing literature on critical thinking, ICT in EFL classrooms, and the role of ICT in fostering critical thinking in language education. It then analyzes empirical studies from 2015 to 2024 on the effectiveness of ICT tools in promoting critical thinking. Finally, it discusses the implications of these findings for future research and practice and concludes with recommendations for educators and researchers.

## 2. Literature Review

### 2.1. ICT in EFL Classroom

Despite widespread agreement that fostering critical thinking is a crucial educational goal, there remains a lack of consensus on its definition and scope<sup>[24]</sup>. The concept of critical thinking dates back over 2,000 years to the “Socratic method” of ancient Greek philosopher Socrates (Vandenberg, 2009). However, systematic research into critical thinking is relatively recent, emerging in the past century. The modern notion of critical thinking originated with American educational philosopher John Dewey, who described it as “reflective thinking,” defining it as the “active, persistent, and careful consideration of any belief or supposed form of knowledge in light of the grounds that support it and the further conclusions to which it tends”<sup>[25]</sup>.

Since its emergence, scholars have defined critical thinking from various perspectives. Ennis<sup>[26]</sup> initially described it as “the correct assessing of statements,” and later redefined it as “reflective and reasonable thinking focused on deciding what to believe or do”<sup>[27]</sup>, a definition that has significantly influenced the field. Paul and Elder<sup>[28]</sup> expanded on this, defining it as “disciplined, self-directed thinking that exemplifies the perfections of thinking appropriate to a particular mode or domain of thought.” A widely accepted definition emerged from the Delphi Report, which reflected a consensus among experts from various fields. The report defined critical thinking as “purposeful, self-regulatory judgment resulting in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations

upon which that judgment is based”<sup>[29]</sup>.

Leading scholars in critical thinking, such as Facione<sup>[29]</sup>, Ennis<sup>[30]</sup>, and Paul and Elder<sup>[28]</sup>, conducted extensive research on critical thinking skills and dispositions. Ennis, in his early work, emphasized logical reasoning and developed a model of six critical thinking skills, known as FRISCO: Focus, Reasons, Inference, Situation, Clarity, and Overview. These skills, according to Ennis<sup>[30]</sup>, are essential for effective decision-making and provide a framework for analyzing and evaluating information:

1. Focus: Identifying the main point, question, or issue at hand.
2. Reasons: Providing reasons or evidence to support a conclusion or point of view.
3. Inference: Making inferences or drawing conclusions based on the evidence or reasons provided.
4. Situation: Understanding the context or situation in which the reasoning is taking place.
5. Clarity: Ensuring that the language and argument are clear and understandable.
6. Overview: Being able to see the overall picture, including the relationships among the parts of the argument or reasoning.

These FRISCO skills are integral to the critical thinking process as outlined by Ennis<sup>[30]</sup> and serve as a guide for effectively analyzing and evaluating information. The Delphi Report<sup>[29]</sup> also contributed significantly to the field by categorizing critical thinking into two main dimensions: cognitive skills and dispositions. The cognitive dimension comprises six core skills: interpretation, analysis, evaluation, inference, explanation, and self-regulation, each further divided into specific sub-skills, providing a detailed framework for understanding and teaching critical thinking. Interpretation involves three key sub-skills: categorization, decoding significance, and clarifying meaning. Analysis consists of examining ideas, identifying arguments, and analyzing arguments, which are essential for breaking down complex information and understanding underlying structures. Evaluation includes assessing both claims and arguments, ensuring that judgments are made based on the quality and validity of evidence. Inference encompasses querying evidence, conjecturing alternatives, and drawing conclusions. This skill set is crucial for generating hypotheses and reaching well-founded conclusions. Explanation requires stating results, justifying

procedures, and presenting arguments, all of which are necessary for clearly communicating one’s reasoning and conclusions. Lastly, Self-regulation involves self-examination and self-correction, highlighting the importance of reflecting on and improving one’s cognitive processes throughout the critical thinking cycle<sup>[29]</sup>.

Given the broad applicability of critical thinking, some argue that discipline-specific definitions may be less effective in the context of English language education<sup>[31]</sup>. As a result, this review adopts a general working definition of critical thinking, encompassing a range of skills including the expression of critical opinions, consideration of alternative viewpoints, analysis, evaluation, synthesis, and the provision of reasoned justifications.

The diversity in critical thinking definitions is reflected in the variety of tools used to evaluate it. Common assessment tools include:

1. The Ennis-Weir Critical Thinking Essay Test<sup>[32]</sup>, designed for individuals from age seven to college students, which assesses skills such as identifying key points, recognizing reasons and assumptions, expressing viewpoints, making inferences, considering alternatives, and evaluating arguments.
2. The Watson-Glaser Critical Thinking Appraisal<sup>[33]</sup>, aimed at college students, which measures inference, assumption identification, deductive reasoning, interpretation, and argument evaluation.
3. The California Critical Thinking Skills Test<sup>[29]</sup>, intended primarily for college students but also suitable for high school students, assessing skills like analysis, reasoning, evaluation, induction, and deduction.
4. The California Critical Thinking Dispositions Inventory<sup>[34]</sup>, a multiple-choice test that evaluates dispositions toward critical thinking, including truth-seeking, open-mindedness, analytical ability, systematicity, self-confidence, inquisitiveness, and cognitive maturity. These tools reflect the multifaceted nature of critical thinking, allowing for comprehensive evaluation across different educational contexts.

## 2.2. ICT in EFL Classroom

Various scholars have offered different interpretations of Information and Communication Technology (ICT). UN-

ESCO<sup>[35]</sup>, broadly defines ICT as “forms of technology used to transmit, process, store, create, display, share, or exchange information by electronic means.” This encompasses a wide range of technologies, including radio, television, video, DVD, landline and mobile telephones, satellite systems, and computer hardware and software, as well as services associated with these technologies, such as videoconferencing, email, and blogs. Similarly, Akintunde and Danlami<sup>[36]</sup> describe ICT as “an umbrella term that includes the utilization of communication devices or applications such as radios, televisions, cellular phones, computers, satellite systems, and so on.”

For a more systematic approach, Lim and Tay<sup>[37]</sup> classified ICT into four types: informative, situating, constructive, and communicative tools. This classification was adopted in this review for three reasons. First, it provides a comprehensive framework covering various dimensions of ICT use in education, enabling a systematic analysis of ICT applications<sup>[38]</sup>. Second, its adaptability allows it to be applied across diverse educational contexts and objectives<sup>[39]</sup>. Third, its empirical validation across multiple studies, such as Cheung and Slavin’s<sup>[40]</sup> research, demonstrated that the strategic use of ICT tools—categorized by Lim and Tay—significantly enhances student achievement.

In the context of English as a Foreign Language (EFL) education, ICT is regarded as an essential and innovative resource for improving students’ learning outcomes and engagement (Waluyo, 2024). ICT offers a flexible array of tools that not only motivate and facilitate language acquisition, such as writing<sup>[41]</sup>, reading<sup>[42]</sup> and speaking<sup>[43]</sup>, but also foster critical thinking skills<sup>[12]</sup>. ICT tools such as digital storytelling, online debates, discussion forums, collaborative platforms, and WebQuests are increasingly used to develop critical thinking in EFL learners. These tools engage students in higher-order thinking processes—such as analysis, evaluation, and content creation—while encouraging critical engagement with diverse perspectives, ultimately enhancing their reasoning and problem-solving abilities<sup>[18, 44]</sup>.

### **2.3. Critical Thinking Cultivation in ICT Assisted-EFL Teaching**

The integration of ICT in EFL classrooms not only enhances language acquisition but also plays a pivotal role in fostering critical thinking skills<sup>[45]</sup>. For example, the use

of WebQuests has been shown to promote critical thinking by engaging students in higher-order cognitive tasks such as analysis, synthesis, and evaluation<sup>[45]</sup>. WebQuests facilitate critical thinking by providing authentic, problem-solving activities that require non-standard solutions, encouraging students to think deeply and critically about the content. The collaborative nature of WebQuests further enables students to contribute insights, discuss different perspectives, and collaboratively reach well-reasoned conclusions. This approach not only enhances cognitive abilities but also promotes knowledge transfer across different contexts, fostering metacognitive skills essential for critical thinking.

Zhang<sup>[47]</sup> investigated the use of online materials, including audio and video, based on Systemic Functional Linguistics (SFL) to equip students with tools for critically analyzing texts, evaluating authors’ attitudes, understanding logical relationships, and organizing information coherently. These materials were found to enhance students’ analytical, evaluative, and organizational skills, particularly in the EFL writing classroom. Meanwhile, Tang<sup>[48]</sup> explored the use of digital immersive technologies such as virtual and augmented reality to create interactive learning environments. These technologies provide immediate feedback, personalized learning paths, and opportunities for collaborative learning, actively engaging students in language learning and effectively developing their critical thinking skills.

Although these studies demonstrate the use of diverse ICT tools for cultivating critical thinking, they reflect a fragmented landscape, with varying tools emphasizing different aspects of critical thinking development. This has led to varied outcomes in terms of effectiveness. While some reviews have explored the role of technology in promoting critical thinking within English language teaching and TESOL<sup>[21, 22]</sup>, there remains a noticeable gap in the literature regarding the specific use of ICT tools to enhance critical thinking in EFL instruction. To date, no systematic reviews have summarized the application of ICT in promoting critical thinking in EFL teaching over the past decade, nor have there been in-depth explorations of how ICT facilitates the development of critical thinking among EFL learners.

To address this gap, this study aimed to comprehensively review literature from the past ten years, providing an in-depth analysis of ICT applications in EFL teaching and evaluating their effectiveness in fostering critical think-

ing. The study sought to offer insights and guidance for researchers and practitioners in the field of technology-assisted EFL teaching. Specifically, it addressed the following research questions:

RQ1: What is the effect of utilizing ICT to assist in the development of students' critical thinking in EFL teaching?

RQ2: How is ICT used to cultivate students' critical thinking in EFL teaching?

### 3. Method

#### 3.1. The Review Process: PRISMA

To systematically address the research questions, Boolean expressions were utilized for the primary search, using TS = (“critical thinking” AND (“English as a foreign language” OR “EFL” OR “foreign language”)). The study did not restrict the search for “ICT”, because technology can exist in various forms. Therefore, filtering was conducted during the abstract and full-text review stages. Following the Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) guidelines<sup>[49]</sup>, a flow diagram was created as illustrated in **Figure 1**. The central databases for this primary search on critical thinking pedagogies in EFL writing classrooms included Web of Science (WoS), Scopus, ERIC, and Proquest, chosen to ensure the review encompasses high-quality articles. As shown in **Figure 1**, after scanning and assessing 3,168 results across four databases, and removing duplicates, 2,366 results were identified as potentially relevant to this review. Through a screening process of abstracts and titles, 76 items were retained for full-text review. Subsequently, we applied the following inclusion and exclusion criteria to further refine the selection of publications that would be useful for this systematic review. The articles collected in this systematic review must comply with the following criteria:

1. The studies must be empirical rather than theoretical or review studies.
2. The studies must be related to English language education.
3. Participants in the studies should be EFL learners.
4. The studies must show how EFL students' critical thinking is developed using ICT in EFL teaching.

Based on the established screening criteria, a total of 20

publications were ultimately included in this review. While the initial pool of studies was substantial, the number of eligible studies decreased significantly following the screening process. This reduction is due to two primary factors: first, relatively few studies simultaneously explore the application of ICT and the development of critical thinking within EFL environments. Second, this review specifically focuses on the use of ICT within classroom-based EFL teaching to foster critical thinking, excluding studies that examine EFL learners' experiences outside the classroom, which further narrowed the scope.

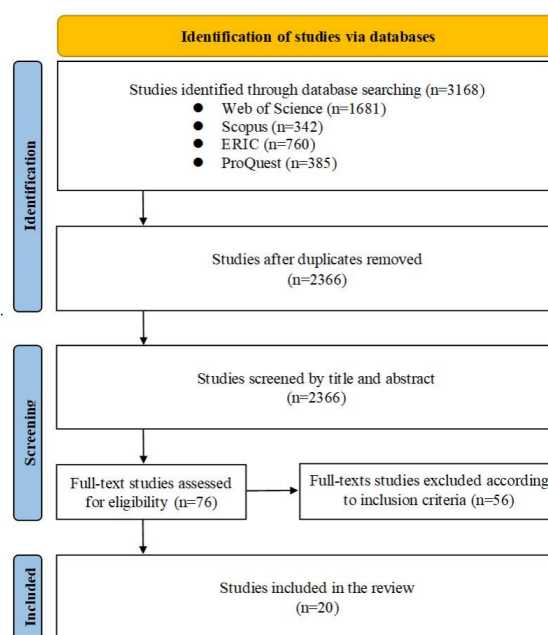


Figure 1. PRISMA flow diagram of literature retrieval.

#### 3.2. Data Analysis

The extracted studies were analyzed according to a series of thematic axes, which include the countries of the studies, research contexts, research designs, theoretic framework, improvement of critical skills, types of ICT used, and critical thinking measurements.

### 4. Results

#### 4.1. Publication Timeline

As illustrated in **Figure 2**, the publication trends of the 20 selected studies from 2015 to 2024 were categorized into two-year intervals. The number of publications remained

consistent at three in both the 2015–2016 and 2017–2018 periods. However, there was a slight increase to four publications in 2019–2020, indicating a growing interest in the field. This upward trend continued, with five publications in 2021–2022 and reaching six in 2023–2024. These findings demonstrate a steady rise in research activity, reflecting an increasing scholarly focus on the integration of ICT in fostering critical thinking in EFL teaching over the past decade.

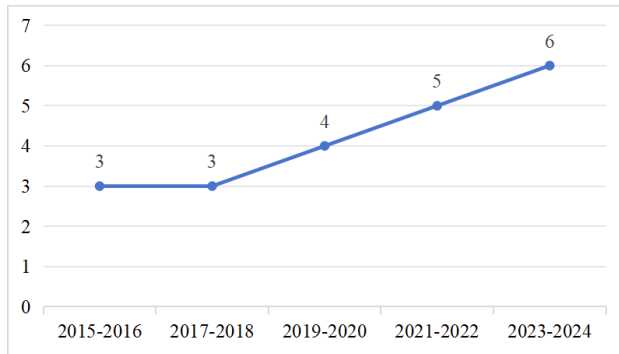


Figure 2. Publications from 2015 to 2024.

#### 4.2. Distribution by Country of (N = 20) Empirical Studies

In terms of the geographic distribution of the 20 reviewed studies, the majority (45%) were conducted in China, with nine studies originating from this country. This was followed by Iran (N = 3), India (N = 2), and Lebanon (N = 1). Other countries, including Turkey, Algeria, Thailand, Ecuador, Indonesia, and Russia, each contributed one study, as depicted in Figure 3. It can be observed that the majority of research on the topic of interest has been carried out in China, with significantly fewer studies from other regions. This distribution suggests that the application of ICT in critical-thinking development has attracted more attention in China, possibly due to the country’s rapid advancements in educational technology integration.

#### 4.3. Education Phase

As shown in Figure 4, the research contexts of the reviewed studies were diverse, with the majority (67%) conducted in universities. Private institutes and primary schools each accounted for 9% of the studies, while high schools comprised 10% of the research contexts. This distribution suggests that there is a stronger focus on investigating critical-thinking development within higher education, while studies

in private institutes, primary, and high schools remain comparatively underrepresented.

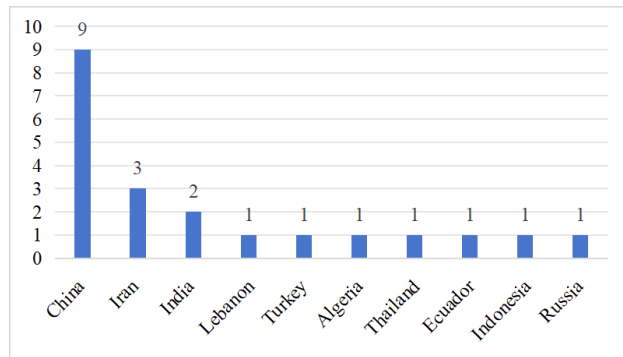


Figure 3. Distribution of reviewed studies by countries.

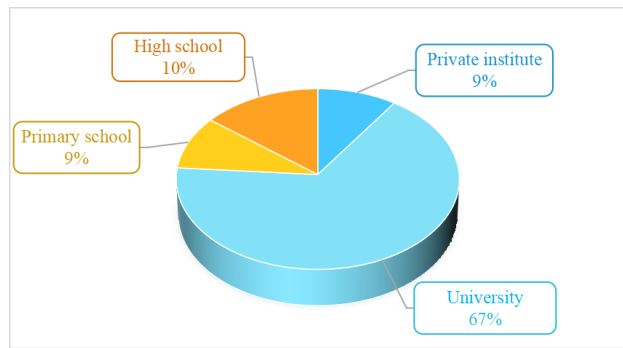


Figure 4. Distribution of reviewed studies by education phase.

#### 4.4. Research Design and Measurement of Critical Thinking

In the reviewed studies, the development of critical thinking was examined through a variety of research designs and measurement tools, as summarized in Table 1. Mixed-method designs were frequently employed, with studies using both quantitative tools, such as critical thinking tests<sup>[18, 46]</sup> and critical thinking scales<sup>[50]</sup>, alongside qualitative methods like content analysis and interviews<sup>[19, 51]</sup>. This combination enabled a comprehensive analysis by capturing both measurable outcomes and deeper insights into how critical thinking was demonstrated in student behavior and written work.

In contrast, purely qualitative studies relied on methods such as content analysis, interviews, and observations<sup>[52, 53]</sup> to explore critical thinking in detail, particularly focusing on student interactions and responses. These approaches provided rich, contextualized data but were more limited in terms of generalizability. On the other hand, purely quantita-

tive studies employed critical thinking tests and scales<sup>[54, 55]</sup> to statistically measure students' progress, offering broader insights through the use of standardized metrics.

The diversity in research designs highlights the complexity of assessing critical thinking, with mixed-method approaches providing a more holistic view by leveraging the strengths of both qualitative and quantitative methodologies. This combination allowed for both depth and breadth in understanding how ICT impacts critical thinking development in EFL classrooms.

#### 4.5. Types of ICT and Specific ICT Used in EFL Teaching

In the current review, as shown in **Table 2**, a variety of ICT tools were used in EFL teaching to foster critical thinking skills. These tools were categorized into four primary types: informative, constructive, communicative, and situating technologies. Among the informative tools, video and online resources were frequently used<sup>[47, 60]</sup>, while constructive tools such as concept mapping and digital mapping applications<sup>[50]</sup> were also employed to enhance critical thinking. Communicative ICT tools, including online games and platforms like Instagram<sup>[19, 63]</sup>, played a significant role in enabling peer interaction and collaborative learning. In contrast, situating technologies like immersive virtual reality (VR) and artificial intelligence (AI) applications<sup>[54, 56]</sup> were still emerging and less frequently utilized. Additionally, some studies combined multiple types of ICT, such as informative, constructive, and communicative technologies<sup>[18, 51]</sup>, indicating a trend toward integrating different tools to create a comprehensive learning environment. Overall, informative and communicative tools dominate, while the adoption of more advanced situating technologies remains in its early stages.

#### 4.6. Types of ICT and Improvement of Critical Thinking in Specific EFL Teaching

As shown in **Table 3**, the analysis highlighted different types of ICT tools that contribute to the enhancement of critical thinking and language skills in EFL teaching. First, most studies on the use of ICT to cultivate critical thinking were conducted in general English courses, followed by writing, speaking, and finally reading courses. Second, in

terms of the effectiveness of different ICT tools in fostering critical thinking in EFL classrooms, informative tools and constructive tools demonstrated relatively less impact compared to other types of ICT tools. The finding indicated that informative tools contribute to the enhancement of critical thinking skills, including analysis, evaluation, inference, and self-regulation, in a variety of courses that focus on writing, reading, speaking, and general English instruction. Constructive ICT tools, including computer-aided argument mapping and concept mapping were found to improve interpretation, analysis, and inference skills, especially in reading and oral-aural teaching. Communicative tools were shown to effectively enhance students' critical thinking sub-skills, including interpretation, analysis, evaluation, inference, explanation, and self-regulation, in both English major courses and non-English major English courses. ICT tools that combine both constructive and informative elements, such as WebQuest, were no longer merely auxiliary tools in English language skills courses. Rather, they evolved into a specialized course format, such as WebQuest-based English classrooms, to promote the development of critical thinking. ICT tools that fell under both the communicative and situating categories were primarily utilized in general English classrooms and promoted various aspects of critical thinking. The wiki platform, an ICT tool that integrated informative, constructive, and communicative elements, was employed in writing courses to simultaneously develop writing skills and foster students' critical thinking abilities.

#### 4.7. Functions of ICT in the Development of Critical Thinking

As shown in **Table 4**, different categories of ICT tools had specific functions in enhancing critical thinking. **Informative ICT tools**—such as videos, audio, and e-portfolios—provided interactive and reflective learning experiences that engaged students in critical thinking processes. For example, videos and audio enabled students to analyze real-world language use, fostering critical engagement through tasks requiring inference, argument evaluation, and idea connection. Zhang<sup>[47]</sup> demonstrated that online resources, including audio and video, helped EFL learners critically analyze linguistic and content elements in academic texts, improving their evaluative and analytical skills. Similarly, e-portfolios, as illustrated by Afrilyasanti et al.<sup>[58]</sup>,

**Table 1.** Research design and measurement of critical thinking.

Research Design	Measurement of Critical Thinking	Reviewed Studies
Mixed method	<ul style="list-style-type: none"> <li>• Critical thinking test</li> <li>• Critical thinking scale</li> <li>• Content analysis</li> <li>• Questionnaire</li> <li>• Questionnaire, observation</li> <li>• Interview and observation</li> </ul>	Eftekhari et al. (2016) <sup>[46]</sup> , Ebadi and Rahimi, (2018) <sup>[18]</sup> Robillos (2022) <sup>[50]</sup> Liang and Fung (2020) <sup>[51]</sup> Averkiewa (2015) <sup>[45]</sup> Muthmainnah et al. (2022) <sup>[56]</sup> Ochoa-Cueva et al. (2024) <sup>[19]</sup>
Qualitative method	<ul style="list-style-type: none"> <li>• Content analysis</li> <li>• Questionnaire</li> <li>• Content analysis, observation</li> </ul>	Soufi et al. (2015) <sup>[52]</sup> , Lee (2018) <sup>[53]</sup> , Zhang (2018) <sup>[47]</sup> , Mete (2020) <sup>[57]</sup> Tang (2024) <sup>[48]</sup> Afrilyasanti et al. (2024) <sup>[58]</sup>
Quantitative method	<ul style="list-style-type: none"> <li>• Questionnaire</li> <li>• Critical thinking test</li> <li>• Critical thinking scale</li> <li>• Critical thinking test, critical thinking scale</li> </ul>	Chen and Hwang (2020) <sup>[59]</sup> Chang et al. (2024) <sup>[55]</sup> , Djamàa (2018) <sup>[60]</sup> Chien et al. (2020) <sup>[54]</sup> , Darvenkumar and Devi (2022) <sup>[61]</sup> , Yin et al. (2024) <sup>[62]</sup> Zalani and Yousofi (2024) <sup>[63]</sup>

**Table 2.** Types of ICT and specific ICT used in EFL teaching.

Types of ICT	Specific ICT Used	Reviewed Studies
Informative	<ul style="list-style-type: none"> <li>Video</li> <li>Online resource (Audio and video)</li> <li>E-portfolios</li> </ul>	Djamàa (2018) <sup>[60]</sup> , Mete (2020) <sup>[57]</sup> Zhang (2018) <sup>[47]</sup> Afrilyasanti et al. (2024) <sup>[58]</sup>
Constructive	<ul style="list-style-type: none"> <li>Computer-aided argument mapping</li> <li>Concept mapping</li> <li>LoiLooNote Digital Mapping</li> <li>Diigo (an annotation tool)</li> </ul>	Eftekhari et al. (2016) <sup>[46]</sup> Chen and Hwang (2020) <sup>[59]</sup> Robillos (2022) <sup>[50]</sup> Chang et al. (2024) <sup>[55]</sup>
Communicative	<ul style="list-style-type: none"> <li>Blog</li> <li>Instagram</li> <li>Online games (on Quizizz, Kahoot, Genially, and Socrative)</li> <li>Text-Based Game</li> <li>Xue Xi Tong application</li> </ul>	Soufi et al. (2015) <sup>[52]</sup> Zalani and Yousofi (2024) <sup>[63]</sup> Ochoa-Cueva et al. (2024) <sup>[19]</sup> Darvenkumar and Devi (2022) <sup>[61]</sup> Yin et al. (2024) <sup>[62]</sup>
Constructive and informative	<ul style="list-style-type: none"> <li>WebQuests</li> </ul>	Averkiewa (2015) <sup>[45]</sup> , Ebadi and Rahimi (2018) <sup>[18]</sup> , Liang and Fung (2020) <sup>[51]</sup>
Communicative and situating	<ul style="list-style-type: none"> <li>AI applications (AI friends)</li> <li>Spherical video- based virtual reality (SVVR)</li> <li>Digital immersive technology (including virtual reality (VR), and augmented reality (AR))</li> </ul>	Muthmainnah et al. (2022) <sup>[56]</sup> Chien et al. (2020) <sup>[54]</sup> Tang (2024) <sup>[48]</sup>
Informative, constructive and communicative	<ul style="list-style-type: none"> <li>wiki platform</li> </ul>	Lee (2018) <sup>[53]</sup>

promoted critical and reflective thinking by encouraging students to track their learning, engage in self-assessment, and apply feedback. This reflective process enhanced problem-solving and reasoning abilities.

**Constructive ICT tools**—such as computer-aided argument mapping, concept mapping, LoiLooNote digital mapping, and Diigo—offered structured methods for visually organizing and analyzing information. These tools helped students map relationships between concepts, clarify thoughts, and identify logical connections, which were critical for developing analytical, evaluative, and problem-solving skills. For instance, concept mapping facilitated cognitive processing by helping students chunk information and illustrate connections between new and prior knowledge<sup>[59]</sup>. Argument

mapping supported students in structuring logical arguments, fostering deeper engagement with complex issues and improving reasoning abilities<sup>[50]</sup>. Diigo, by allowing students to highlight and categorize online resources in real-time, encouraged collaborative learning and critical thinking dispositions such as open-mindedness and systematic thinking<sup>[55]</sup>.

**Communicative ICT tools**—such as blogs, Instagram, online games, and text-based games—promoted interactive, collaborative, and reflective learning environments. These tools encouraged active participation, facilitating higher-order thinking processes like analysis, evaluation, and synthesis. For instance, blogs and Instagram allowed students to interact with diverse perspectives, articulate their thoughts, and engage in discussions that required content analysis, re-



**Table 3.** Types of ICT and improvement of critical thinking in specific EFL teaching.

Types of ICT	Improvement of Critical Thinking	EFL Courses	Reviewed Studies
Informative (Video, audio and e-portfolios)	<ul style="list-style-type: none"> <li>• Analysis</li> <li>• Evaluation</li> <li>• Inference</li> <li>• Self-regulation</li> </ul>	Film-literature course Intercultural communication course Expository writing course General English course	Djamàa (2018) <sup>[60]</sup> Mete (2020) <sup>[57]</sup> Zhang (2018) <sup>[47]</sup> Afrilyasanti et al. (2024) <sup>[58]</sup>
Constructive (Computer-aided argument mapping, concept mapping, LoiLooNote digital mapping and Diigo)	<ul style="list-style-type: none"> <li>• Interpretation</li> <li>• Analysis</li> <li>• Evaluation</li> <li>• Inference</li> </ul>	Critical thinking-infused reading course Oral-Aural Drills in English course Speaking course Writing course	Eftekhari et al. (2016) <sup>[46]</sup> Chen and Hwang (2020) <sup>[59]</sup> Robillos (2022) <sup>[50]</sup> Chang et al. (2024) <sup>[55]</sup>
Communicative (Blog, Instagram, Online games on Quizizz, Kahoot, Genially, and Socrative, Text-Based Game and Xue Xi Tong application)	<ul style="list-style-type: none"> <li>• Interpretation</li> <li>• Analysis</li> <li>• Evaluation</li> <li>• Inference</li> <li>• Explanation</li> <li>• Self-regulation</li> </ul>	Intensive English Program (IEP): (including reading, writing, listening and speaking) Critical thinking course English major course (including Theory for Teaching Grammar, Semantics and Pragmatics, Discourse Analysis, and Teaching Practice) Reading course Writing course	Soufi et al. (2015) <sup>[52]</sup> Zalani and Yousofi (2024) <sup>[63]</sup> Ochoa-Cueva et al. (2024) <sup>[19]</sup> Darvenkumar and Devi (2022) <sup>[61]</sup> Yin et al. (2024) <sup>[62]</sup>
Constructive and informative (WebQuests)	<ul style="list-style-type: none"> <li>• Interpretation</li> <li>• Analysis</li> <li>• Evaluation</li> <li>• Inference</li> <li>• Explanation</li> <li>• Self-regulation</li> </ul>	ESP course IELTS course WebQuest-based critical thinking course	Averkieva (2015) <sup>[45]</sup> Ebadi and Rahimi (2018) <sup>[18]</sup> Liang and Fung (2020) <sup>[51]</sup>
Communicative and situating (AI application, SVVR, digital immersive technology including AR and VR)	<ul style="list-style-type: none"> <li>• Interpretation</li> <li>• Analysis</li> <li>• Evaluation</li> <li>• Inference</li> <li>• Explanation</li> <li>• Self-regulation</li> </ul>	General English course Writing course General English course	Muthmainnah et al. (2022) <sup>[56]</sup> Chien et al. (2020) <sup>[54]</sup> Tang (2024) <sup>[48]</sup>
Informative, constructive and communicative (wiki platform)	<ul style="list-style-type: none"> <li>• Analysis</li> <li>• Evaluation</li> <li>• Inference</li> <li>• Explanation</li> <li>• Self-regulation</li> </ul>	Writing course	Lee (2018) <sup>[53]</sup>

flection on feedback, and argument refinement<sup>[52, 63]</sup>. Online games such as Kahoot and Quizizz provided real-time feedback, motivating students to critically reflect on their answers and enhance problem-solving skills through repetition and competition<sup>[19]</sup>. Text-based games, as highlighted by Darvenkumar and Devi<sup>[61]</sup>, engaged students in decision-making scenarios, fostering critical reading and logical reasoning.

**Constructive and informative ICT tools** like WebQuests encouraged critical thinking through inquiry-based learning, collaborative problem-solving, and reflective thinking. WebQuests required students to gather, analyze, and synthesize information from multiple online resources, promoting higher-order thinking processes such as evaluation and analysis<sup>[18, 45, 51]</sup>. By presenting real-world problems, WebQuests fostered cognitive and metacognitive skills, guiding students to connect new knowledge with prior understanding and encouraging group collaboration for critical

idea evaluation and solution development.

**Communicative and situating ICT tools**, such as AI applications, Social Virtual Reality (SVVR), and immersive technologies like Augmented Reality (AR) and Virtual Reality (VR), created interactive and immersive environments conducive to developing critical thinking skills. These technologies provided real-time simulations and virtual problem-solving scenarios, encouraging students to apply critical thinking in practical, real-world contexts. In these immersive environments, students navigated complex situations, assessed information critically, and made informed decisions, which promoted higher-order thinking through problem-solving, evaluation of diverse perspectives, and collaborative learning<sup>[48, 56]</sup>.

Finally, the **wiki platform**, functioning as **an informative, constructive, and communicative ICT tool**, enhanced critical thinking by engaging students in collabora-

rative writing, knowledge sharing, and critical reflection. Wikis allowed students to analyze diverse resources, organize ideas, revise work, and construct arguments. Peer interaction and feedback further developed problem-solving and higher-order thinking skills, such as evaluation, synthesis, and interpretation of complex ideas, fostering deeper cognitive engagement essential for critical thinking development<sup>[53]</sup>.

**Table 4.** Functions of ICT in the development of critical thinking.

Types of ICT	Specific ICT Used	Functions of ICT	Reviewed Studies
Informative (Video, audio and e-portfolios)	• Analysis	Providing rich contextualized information and encouraging students to engage in deep thinking and comparison from multiple perspectives.	Djamàa (2018) <sup>[60]</sup> , Mete (2020) <sup>[57]</sup> , Zhang (2018) <sup>[47]</sup> , Afrilyasanti et al. (2024) <sup>[58]</sup>
	• Evaluation	Prompting students to make judgments about the content, supporting or opposing the presented viewpoints with arguments.	
	• Inference	Encouraging students to reflect on the purpose of content creation and the underlying intentions.	
	• Self-regulation	Offering a platform for self-assessment, fostering repeated reflection and improvement	
Constructive (Computer-aided argument mapping, concept mapping, LoiLooNote digital mapping and Diigo)	• Interpretation	Engaging students in the active process of knowledge construction, helping them organize and understand complex information by extracting meaning through breaking down and reconstructing information.	Eftekhari et al. (2016) <sup>[46]</sup> , Chen and Hwang (2020) <sup>[59]</sup> , Robillos (2022) <sup>[50]</sup> , Chang et al. (2024) <sup>[55]</sup>
	• Analysis	Encouraging students to identify relationships between pieces of information and analyze the logic of each part.	
	• Evaluation	Providing an environment for self-reflection and peer evaluation.	
	• Inference	Encouraging students to draw logical conclusions and connect diverse concepts by visualizing complex relationships through mapping.	
Communicative (Blog, Instagram, Online games on Quizizz, Kahoot, Genially, and Socratic, Text-Based Game and Xue Xi Tong application)	• Interpretation	Prompting students to explain others' viewpoints in discussions and interactions, and to understand information from different perspectives.	Soufi et al. (2015) <sup>[52]</sup> , Zalani and Yousofi (2024) <sup>[63]</sup> , Ochoa-Cueva et al. (2024) <sup>[19]</sup> , Darvenkumar and Devi (2022) <sup>[61]</sup> , Yin et al. (2024) <sup>[62]</sup>
	• Analysis	Facilitating the breakdown of information and the identification of connections between different viewpoints	
	• Evaluation	Providing a platform where students practice critical evaluation during peer assessments.	
	• Inference	Encouraging students to make reasonable inferences based on available information and peer input.	
	• Explanation	Encouraging students to explain their reasoning process.	
Constructive and informative (WebQuests)	• Interpretation	Guiding students to collect, analyse, and interpret a large amount of online information, helping them better organize and understand the information.	Averkiewa (2015) <sup>[45]</sup> , Ebadi and Rahimi (2018) <sup>[18]</sup> , Liang and Fung (2020) <sup>[51]</sup>
	• Analysis	Requiring students to analyse different aspects of a problem, identify relevant and irrelevant information, and break down complex topics.	
	• Evaluation	Helping students evaluate the credibility and quality of the collected information.	

Table 4. Cont.

Types of ICT	Specific ICT Used	Functions of ICT	Reviewed Studies
Constructive and informative (WebQuests)	• Inference	Encouraging students to make inferences based on existing information through tasks and questions, leading them to draw reasonable conclusions.	Averkieva (2015) <sup>[45]</sup> , Ebadi and Rahimi (2018) <sup>[18]</sup> , Liang and Fung (2020) <sup>[51]</sup>
	• Explanation	Requiring students to provide supporting arguments when explaining their answers and conclusions.	
	• Self-regulation	Helping students reflect on their thought processes and decisions, adjusting their reasoning strategies through task feedback mechanisms and reflective activities.	
Communicative and situating (AI application, SVVR, digital immersive technology including AR and VR)	• Interpretation	Facilitating dialogue and interaction among students, helping them interpret the meaning of information and understand problems from different perspectives.	Muthmainnah et al. (2022) <sup>[56]</sup> , Chien et al. (2020) <sup>[54]</sup> , Tang (2024) <sup>[48]</sup>
	• Analysis	Enabling students to immerse themselves in the context, analyse various aspects of a problem, and identify key elements in complex phenomena.	
	• Evaluation	Providing a platform for peer evaluation.	
	• Inference	Encouraging students to make inferences based on the discussed information and derive reasonable conclusions.	
	• Explanation	Prompting students to clearly express their reasoning process in discussions and explain their conclusions through interaction.	
	• Self-regulation	Encouraging students to continuously adjust their thinking strategies in response to feedback and reflect on their performance in tasks.	
Informative, constructive and communicative (wiki platform)	• Analysis	Helping students search and collect reference materials, and analyse and categorize information from different sources to better understand relationships and identify relevant points for their arguments.	Lee (2018) <sup>[53]</sup>
	• Evaluation	Encouraging students to make judgments about collected information, evaluate its credibility and relevance, and learn to assess different perspectives through interactions with peers.	
	• Inference	Helping students infer by analysing historical images and events, encouraging them to form hypotheses based on existing information and find supporting evidence.	
	• Explanation	Requiring students provide detailed explanations of historical images.	
	• Self-regulation	Requesting students reflecting on their writing and adjusting their arguments based on feedback and self-assessment.	

## 5. Discussion

This systematic review demonstrated a steady increase in the number of studies that applied ICT tools to promote critical thinking in EFL teaching from 2015 to 2024. The rise in research volume reflects a growing recognition among scholars of the potential that ICT tools hold in fostering

critical thinking. This increased attention has impacted the integration of new tools (such as AI, SVVR, AR), and VR in EFL teaching to improve critical thinking, which enriches the pool of educational resources and strategies available to teachers and offers more choices for enhancing their instructional practices<sup>[48, 54, 56]</sup>.

Most of the studies reviewed focused on higher edu-

cation contexts, with limited attention given to primary and secondary education. This gap highlights the need for further exploration of ICT applications in younger learner populations to understand how critical thinking can be cultivated at earlier educational stages. To address this gap, future research should prioritize investigating the role of ICT in primary and secondary education, particularly in fostering critical thinking among younger learners. Proposing this as a crucial direction for forthcoming studies would contribute to a more comprehensive understanding of how ICT can be effectively utilized across all levels of education. A significant portion of the studies (45%) were conducted in China, with fewer studies representing other regions. While this provides valuable insights into the Chinese EFL context, it also highlights a potential limitation regarding the generalizability of the findings to other cultural and educational settings. Cultural and regional dynamics, such as differing pedagogical approaches and educational priorities, may influence how ICT is perceived and utilized in fostering critical thinking. Therefore, future research should critically engage with these dynamics and expand its scope to include more diverse geographical areas. This would not only enhance the robustness of the findings but also offer a more nuanced understanding of ICT's role in developing critical thinking in a broader range of EFL contexts.

In terms of measurement, many studies relied on either quantitative or qualitative methods alone. However, critical thinking is a complex, higher-order skill that requires holistic validation through multidimensional investigation<sup>[64]</sup>. A combination of qualitative and quantitative research could capture critical thinking's various dimensions more comprehensively. Quantitative studies often utilize standardized tests like the CCTST<sup>[29]</sup>, CCTDI<sup>[34]</sup>, WGCTA<sup>[33]</sup>, and EWCTET<sup>[27]</sup> to assess critical thinking performance. In contrast, qualitative research delves deeper into students' cognitive processes and behaviors through interviews, observations, or case studies. Purely qualitative studies, while rich in context, may lack generalizability, and purely quantitative studies may not capture the nuances of critical thinking development. A mixed-methods approach provides not only a more holistic evaluation of critical thinking but also insights into its development pathways in specific contexts. Therefore, future research should increasingly adopt the mixed-methods approach to ensure a comprehensive assessment of

critical thinking.

When integrating critical thinking into EFL courses, most research focused on general foundational courses, with less emphasis on specific skills courses like writing, speaking, and reading. This contrasts with the findings of Lu and Xie<sup>[22]</sup>, which indicated that ICT tools are most frequently applied in TESOL writing instruction, followed by speaking and reading, with the least use in listening and general proficiency courses. The difference may stem from curriculum design variations for different target groups. TESOL studies often explore how to cultivate critical thinking across multiple English language skills, while EFL research typically includes non-English majors whose general English courses aim to improve overall language proficiency, covering fundamental skills such as listening, speaking, reading, and writing, rather than specific academic or professional skills.

Additionally, while writing courses have received the most attention in developing critical thinking, speaking and reading courses remain relatively underexplored. Future research could investigate strategies and conduct empirical studies on using ICT to foster critical thinking in these underexplored areas, such as listening, speaking, and reading.

Different types of ICT tools (informative, constructive, communicative, as well as combinations such as constructive & informative, communicative & situating, and informative & constructive & communicative) were utilized in various ways to enhance EFL learners' critical thinking sub-skills. Particularly, the reviewed studies indicated that ICT tools primarily promote the development of critical thinking in English classrooms by providing contextualized information, helping students construct knowledge logically, offering platforms for self-assessment, and creating communicative environments. The review found that certain ICT tools, particularly those with communicative & situating functions, informative & constructive & communicative functions, and purely communicative functions, can comprehensively enhance six critical thinking sub-skills: interpretation, analysis, evaluation, inference, explanation, and self-regulation. This suggests that educators should focus on selecting ICT tools with multiple functions to cultivate students' critical thinking in English instruction. For example, they could choose communicative & situating ICT tools such as AI applications, SVVR, and digital immersive technologies, or informative &

constructive & communicative tools like wiki platforms, as well as purely communicative ICT tools such as online games, blogs, and Instagram, to effectively develop all levels of critical thinking sub-skills among students. Additionally, the current review found that communicative, informative, and constructive tools were the most widely applied in EFL classrooms to foster critical thinking, aligning with Liang's<sup>[21]</sup> review. Liang revealed that these ICT tools were the most commonly used in English language education to enhance critical thinking. One plausible explanation for the limited use of situating tools, such as AI and SVVR, is that teachers may be less familiar with these technologies and lack the necessary skills to integrate them effectively into English classrooms<sup>[65]</sup>. To address this, specialized training programs are needed<sup>[66]</sup>. These programs should not only focus on developing technical skills but also emphasize the pedagogical integration of advanced ICT tools like AI, VR, and AR to enhance students' critical thinking abilities<sup>[67]</sup>. Providing teachers with such training would facilitate the adoption of these technologies and maximize their potential in fostering critical thinking in EFL education. Furthermore, the utilization of AR and VR technologies has been shown to enhance engagement and social interaction, thereby promoting critical thinking skills among students in educational settings<sup>[68]</sup>. Future studies can investigate more effective ways for enhancing critical thinking in both offline EFL classrooms and online EFL teaching and learning environments by applying VR and AR technologies.

## 6. Conclusions

This systematic review highlighted the potential of ICT tools in fostering critical thinking in EFL instruction, particularly by enhancing sub-skills such as analysis, evaluation, and inference. The findings indicated that communicative, situating, and multifunctional ICT tools are especially effective in promoting critical thinking, as they engage learners in interactive and immersive environments. By providing platforms for collaboration, problem-solving, and reflection, these tools foster cognitive engagement and contribute to improved critical thinking outcomes.

Across the reviewed studies, common characteristics and conditions emerged regarding the role of ICT in enhancing critical thinking in EFL classrooms. However, substantial

potential remains for further exploration. The implications of these findings suggest several key actions:

1. Prioritize the exploration of emerging technologies, particularly ICT-driven intelligent technologies such as AI, AR, and VR, for critical thinking development. Further research should investigate innovative methods for deeper integration of these technologies in EFL instruction.
2. Conduct comprehensive research into the relationship between modern ICT and critical thinking. This includes designing teaching strategies aligned with these technologies and implementing relevant EFL teaching activities to better understand how modern ICT influences critical thinking development.
3. Develop EFL teaching models tailored to different educational stages. Recognizing that educational objectives for critical thinking vary across primary, secondary, and tertiary levels, it is essential to design models that correspond to these stages. Such models can offer guidance for effectively nurturing critical thinking throughout all levels of EFL education.

While this review underscores the significant potential of ICT tools in fostering critical thinking, one limitation is the relatively small sample size of studies included. The narrow focus on specific contexts may limit the generalizability of the findings across diverse educational settings. Future systematic reviews should aim to incorporate a larger and more diverse range of studies, including those from various educational contexts and learner demographics. Expanding the sample size would enable more robust conclusions and a deeper understanding of how ICT tools foster critical thinking across different EFL environments.

Additionally, future research should prioritize longitudinal studies to assess the long-term impact of ICT tools on critical thinking development. By addressing these gaps, future studies can provide more detailed insights and practical guidance for integrating ICT into EFL teaching practices, thereby enhancing both instructional quality and critical thinking outcomes.

## Author Contributions

Conceptualization, J.W.; methodology, J.W.; software, J.W.; validation, J.W.; formal analysis, J.W.; investigation,

J.W.; resources, J.W.; data curation, J.W.; writing—original draft preparation, J.W.; writing—review and editing, J.W.; visualization, J.W.; supervision, H.L. Both authors have read and agreed to the published version of the manuscript.

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## Conflicts of Interest

The authors declare no conflict of interest.

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