

The Impact of Digital Technologies on Students' Critical Thinking: An Experimental Study

تأثير استخدام التقنيات الرقمية على مهارات التفكير النقدي للمتعلمين في أقسام
تدريس اللغة الانجليزية كلغة أجنبية : دراسة تجريبية

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تاريخ القبول: 2025/06/04

تاريخ الإرسال: 2025/03/28

Abstract:

The integration of digital technologies (DT) into educational settings has raised important questions about their role in enhancing students' critical thinking skills (CTs). The current study investigates the impact of DT on EFL students' CTs. Adapting a randomized experimental design, the research involved 37 secondary school students, divided into an experimental and a control group. An adapted CT assessment measured students' CTs before and after a four-week intervention. The findings show a statistically significant improvement in the experimental group's CTs. The study therefore calls for sustained efforts to embed technology meaningfully within EFL curricula.

Key words: Digital technologies, critical thinking, EFL students.

المخلص:

إن استخدام التقنيات الرقمية في الأوساط التعليمية ، يقودنا إلى التساؤل حول دور هذه الأخيرة في تعزيز مهارات التفكير النقدي لدى المتعلمين. وعليه فإن الدراسة الحالية تهدف إلى قياس أثر استخدام هذه التقنيات على مهارات التفكير النقدي لدى متعلمي اللغة الإنجليزية كلغة أجنبية في المدارس الثانوية بالجزائر. تبنت الدراسة المنهج التجريبي بمشاركة 37 طالبا ، مقسمين إلى مجموعتين. تم قياس مهارات التفكير النقدي قبل وبعد التجريب باعتماد أداة تقييم معيارية. أشارت النتائج إلى تحسن في مهارات التفكير النقدي لدى المجموعة التجريبية. وعليه فإن الدراسة تدعو إلى بذل جهود حثيثة لدمج التكنولوجيا بشكل مناسب بغية تعزيز مهارات التفكير النقدي لدى المتعلمين.

الكلمات المفتاحية : التفكير النقدي ، متعلمي اللغة الانجليزية كلغة أجنبية.

1-Introduction

In today's rapidly changing educational settings, cultivating critical thinking (CT) is widely recognized as an essential goal of teaching. (Alnofaie, 2013; Chou et al., 2019; Espey, 2018; Saxton et al., 2012). According to Moon (2008), critical thinking is believed to be a principal concept in education and a fundamental goal of learning. In the context of English as a Foreign Language (EFL) instruction, developing students' higher order thinking skills (HOTS), such as analysing, synthesizing, criticizing, evaluating, and creating has become a crucial necessity for dealing with complex cognitive and societal challenges (Schenck, 2024). However, many EFL classrooms remain dominated by rote learning and memorization, with little or no focus at all on critical thinking skills. (Agustina, Mayuni, Iskandar, & Ratminingsih, 2022).

At the same time, digital technologies (DT), such as online collaborative platforms, digital problem-solving tools, and online discussion forums have permeated classrooms worldwide, creating new affordances for learner- independence, scaffolding, and interaction. (Williams & Bower, 2025). Researchers have begun to explore how digital tools and Information Communication Technologies (ICTs) contribute to the development of students' critical thinking skills (Williams& Bower, 2025).

Despite the burgeoning consensus on the benefits of digital integration, "little research exists concerning technology's role in enhancing critical thinking (CT) in a foreign language". (Schenck, 2024, p.2). In the Algerian EFL context, there is a dearth of research investigating how the incorporation of digital tools may influence critical thinking development among secondary school learners. The present study therefore is motivated by the need to address the recognized deficiency in empirical research on the direct causal -link between the strategic use of digital technology and the development of students' critical thinking skills. Guided by the question: what is the impact of digital technologies on Algerian secondary school students' critical thinking skills?

The study contributes to the growing body of literature on educational technology and provides a strong evidence-based case for incorporating digital technologies to foster critical thinking skills.

The main objective is to empirically assess the causal impact of integrating digital technologies on Algerian EFL secondary school students' critical thinking skills. To achieve this objective, this paper will first review the theoretical and empirical underpinnings of critical thinking development in technology-rich environments. The methodology section will then detail the randomized experimental study design employed. Following sections will present the findings that report the statistical difference in measured CT skills among students. Ultimately, the discussion and interpretation will consider the evidence for a direct causal link between digital tools and enhanced critical thinking skills. The study concludes by providing strategic recommendations and practical suggestions for educational practice.

2- Critical Thinking Defined

Critical Thinking (CT) is a central topic in educational and philosophical literature, with various scholars offering nuanced, yet largely overlapping definitions. One of the most comprehensive and widely cited definitions was written by the philosopher Facione (1990) who stated, “we understand critical thinking to be purposeful, self-regulatory judgement which results in interpretation, analysis, evaluation, and inference.” (p.2). Similarly, Ennis (1996) wrote, “critical thinking is reasonable reflective thinking that is focused on deciding what to believe or do.” (p.2). Ennis ‘s definition highlights two core elements: the need for reflection and the practical focus on making a decision.” Following the same drift, Paul and Scriven (1987) defined critical thinking as “the intellectually disciplined process of actively and skillfully conceptualizing, applying, analysing, synthesizing, and evaluating information gathered from or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action.”

In 1956, a group of scholars led by Benjamin Bloom, set an educational taxonomy for the learning objectives, it was then known as “Bloom’s Taxonomy” (see figure 1).

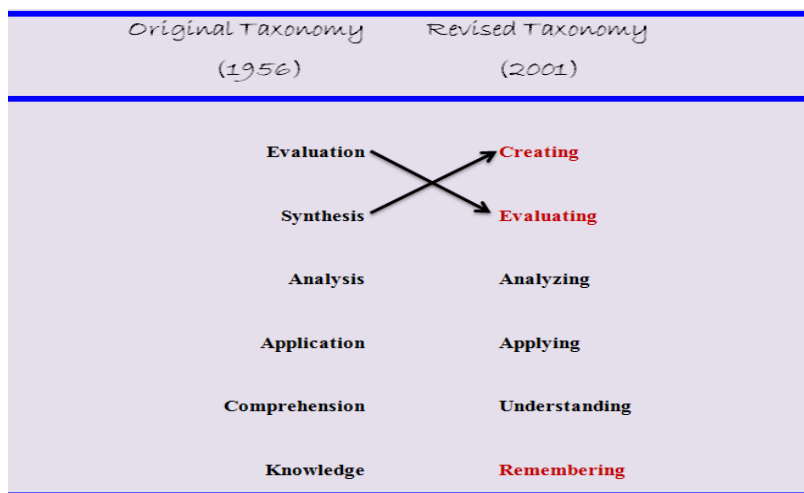


Figure 1. Old vs. Revised Taxonomy

This classification system was later revised by Anderson in 2001 to better reflect modern educational practices. The taxonomy distinguishes between lower order thinking skills (LOTS) and higher order thinking skills (HOTS). Lower order thinking skills encompass foundational cognitive processes such as remembering and recalling information, demonstrating basic understanding, and using learnt material in new situations and contexts. These skills form the building blocks of learning and are typically emphasized with beginners.

Higher order thinking skills, on the other hand, represent more sophisticated cognitive processes, including analysis, synthesis, evaluation and creation. These advanced skills require students to engage deeply with content to be able to analyze, synthesize, criticize and evaluate or judge.

For some scholars, genuine critical thinking relates only to higher order thinking skills. Paul and Elder (2008) consider that “critical thinking is not being able to process information well enough to know to stop for red lights or whether you received the correct

change at the supermarket. Such low order thinking, critical and useful though it may be, is sufficient only for personal survival; most individuals master this. True critical thinking is higher order thinking.” (p.2).

In the Algerian context, specifically in secondary school education, critical thinking stands as a fundamental pillar, playing a significant role in equipping students to become effective individuals capable of resolving problems systematically. However, Baghoussi (2021) notes that despite its importance, critical thinking is not emphasized by numerous Algerian secondary school teachers due to time constraints, large class sizes, and extensive curricula.

3- The Significance of Critical Thinking in an EFL Context

Critical thinking stands as a fundamental pillar of contemporary education. This cognitive skill enables students to analyse information, make informed judgements, and solve problems systematically. For an EFL learner, critical thinking enhances autonomy which requires recognizing one's own strengths and weaknesses to be able to represent the thinking in an improved form. (Judge & al, 2009). Additionally, students need to be open-minded, more flexible, self- confident, and honest if they are to be regarded as competent critical thinkers. Echoing this view, Cottrell (2005) added that “students are expected to develop critical thinking skills so that they can dig deeper below the surface of the subjects they are studying and engage in critical dialogue with its main theories and arguments.” (p.6).

Cosgun and Atay (2021), similarly, stress the significance of critical thinking for EFL learners by stating, “problem- based learning ...enhances critical thinking, creativity, and language skills in EFL classrooms.” (p. 101). In a similar vein, Begimqulova and Bahodir (2025) put that “the integration of critical thinking into language learning encourages students to analyse, interpret, and evaluate information rather than simply memorizing it.” (p.95). Begimqulova and Bahodir's view emphasizes the significant role of critical thinking in helping students move beyond superficial and rote learning to develop deeper understanding and effective communication.

4- Digital Technologies and Critical Thinking

Beyond linguistic skills, digital technologies- including AI tools, digital storytelling and online platforms, significantly contribute to the development of the students' critical thinking skills. However, before delving deeply and providing more insights about the positive impact of digital tools on EFL learners' critical thinking skills, it is safer to refer to the term digital technologies itself. Broadly speaking, digital technologies (DTs) are electronic tools, devices, systems, and resources that generate, store, or process data in a numerical or binary forms. The Oxford Research Encyclopedia mentions, "digital technologies offer potential applications using tablets, smartphones, cloud computing, artificial intelligence, and wearable technology to enable whole new possibilities for human services."

Many scholars, such as Algouzi (2023) believe that digital technologies significantly shape the development of EFL students' critical thinking skills. In a seminal study titled "Enhancing EFL students' critical thinking skills using a technology-mediated self-study approach: EFL graduates and labor market in perspective", he explained, "the findings showed that students slightly improved their critical thinking skills in analysis, inferencing, and deduction; ...the implemented program motivated them to think critically via a video-mediated self-study program." (p.14). Similarly, Schenck (2024) reported that in a study of Iranian EFL learners, WebQuest-based tasks were more effective than traditional face-to-face tasks for the development of CT and academic writing skills. El-Saadi et al. (2025) in their study entitled "Empowering EFL Student Teachers through AI: Promoting Creativity, Critical Thinking Skills and Collaboration" stress the positive impact of using digital technologies on students' critical thinking skills. The researchers explained that technologies such as AI-based apps give students prompt feedback, helping them think critically about their output and adjust accordingly. They provide access to diverse learning resources and scenarios that promote analysis and evaluation.

In a like manner, Rungsawang and Pookcharoen (2023) put that "integrating technologies in English language learning activities could help students improve their abilities to analyse and evaluate information...Digital storytelling was one type of technology that was commonly used in English language classrooms."

Conversely, scholars such as Darwin (2024) introduce important challenges of digital tools. Darwin et al. (2024) explained that AI tools can create ‘echo chambers’ by recommending similar content and may not promote the diversity of viewpoints needed for genuine critical thinning. Schenck (2024) considers that over-reliance on AI-generated content risks diminishing students’ ability to think independently and critically. In this context he claimed, “over-reliance on technology hampers the cultivation of CT in EFL classrooms.”

5- Research Questions and Hypotheses

The present study aims at answering the following research questions:

RQ1: What impact do digital technologies have on EFL students’ critical thinking skills?

RQ2: Are there any statistical differences in students’ critical thinking skills of both groups (experimental and control) at the pre-test and post-test stages?

Based on the previously mentioned questions, the following hypotheses were formulated:

H1: When digital tools are used strategically, they can serve as powerful tools, leading to a significant improvement in students’ critical thinking skills.

H2: There are statistical differences of both groups at both stages (pre-test and post-test).

6- Methodology

6.1- Research Instruments:

Critical thinking skills were measured using an adapted version of Watson- Glaser Critical Thinking Appraisal applied at two points: the base-line (pre-test) and the conclusion of the intervention (post-test). The focus was mainly on assessing higher order thinking skills such as: analysing, inference, and evaluation. (see appendix A).

6.2- Participants and Settings

The participants in the current study were 37 secondary school students from Kerzazi Abderrahmane secondary school, Chlef, Algeria.

- Sampling: a non-probability convenience sampling method was used.
- Grouping: Students were randomly assigned to one of the two groups (experimental and control).

6.3- Intervention Procedures

The intervention period lasted for four weeks and differed significantly between the two groups.

- **Experimental Group (EG):** their curriculum incorporated multiple digital technologies as pedagogical tools. The strategic use of these technologies included: (1) Online collaborative platforms, employing group discussions. (2) Digital- problem solving tools, using interactive software and web-based apps that required students to apply English language skills to solve complex problems.
- **Control Group:** with the control group, instruction relied exclusively on traditional teaching methods, including the textbook, printed materials, and traditional classroom discussions.

6.4- Data Analysis

Quantitative data collected from the pre-test and post-test scores were analysed using inferential statistics.

Pre- test Analysis: Independent sample t-tests was conducted to ensure that there was no statistically significant difference in critical thinking scores between the two groups prior to the intervention.

Post- test Analysis: An independent sample t-test was then used to compare the mean gain achieved by the digital group and the traditional group.

7- Results

The tables below present the findings of both groups at the start and after the intervention.

Group	N	Mean	Standard deviation	t	df	p-value
Experimental	18	48.11	3.56	0.128	35	0.898
Control	19	47.95	3.71			

Table 1: Baseline Equivalence (Pre-test)

The non-significant result ($t(35) = 0.128$, $p = 0.898$) confirms that the two groups were statistically equivalent in their critical thinking scores at the beginning. This equivalence is crucial as it ensures that any subsequent differences in post-test performance can be confidently attributed to the intervention.

To directly assess the effectiveness of the teaching methods, gain scores were calculated (post-test scores minus pre-test scores) to calculate the amount of improvement for each group. An independent samples t-test was later used to compare the mean gain achieved by the digital group against the traditional group. Table 2 below explains the statistical differences between the two groups.

Group	N	Mean	Standard deviation	t	df	p-value
Experimental	18	8.72	1.89	4.95	35	< 0.001
Control	19	2.21	1.58			

Table 2: Impact of the Digital Intervention (post-test)

The analysis yielded a highly significant statistical difference ($t(35) = 4.95$, $p < 0.001$). This finding provides empirical evidence that strategic use of digital technologies led to a greater improvement (four times greater) in critical thinking skills than traditional teaching methods.

8- Discussion of the Results

The main objective of the current study was to investigate the causal effect of strategically incorporating digital technologies on EFL

students' critical thinking skills. The finding of a statistically significant main effect for the intervention group (with a mean gain of 8.72 points) compared to (2.21 points) for the control group confirms that the four-week exposure to digital technologies resulted in a meaningful and superior development of critical thinking skills compared to the traditional curriculum. These findings align with Algouzi (2023); and El Saadi et al. (2025) studies' findings, confirming the direct causal link between strategic use of digital technologies and the improvement of EFL students' critical thinking skills.

The nature of the intervention, which involved online collaboration and digital problem-solving, necessitates that learners constantly engage in peer-review tasks and articulate reasoned arguments that directly foster analytic and evaluative competencies. These specific gains align with constructivist and socio-cultural learning theories, which posit that knowledge construction is optimized when learners actively engage with complex, authentic activities within a scaffolded, interactive environment. Therefore, the digital platform did not serve merely as a content delivery system but functioned as a catalyst for cultivating essential cognitive skills.

9- Limitations of the Study

Despite the compelling nature of the results, the current study is subject to different limitations. First, the relatively small sample size (consisting of only 37 students) may not be considered as representative. Second, the restricted four-week duration necessitates caution when generalizing the findings. While the short period was suitable for gathering numerical data, it does not account for the long-term durability of these enhanced skills.

10- Suggestions and Recommendations

Based on the empirical evidence presented in the current experimental study, the following suggestions and recommendations are proposed.

First, teachers are strongly encouraged to move beyond the conventional use of digital technologies merely for content delivery or passive consumption. They should, instead, strategically integrate digital technologies to engage students in analysis, synthesis and evaluation.

Webb's model, which emphasizes the increasing depth of knowledge, from simple recall to extended strategic thinking using digital technologies can be mapped across Bloom's taxonomy for cognitive learning objectives.

The framework below is very beneficial for teachers as it illustrates how artificial intelligence tools can be mapped across Bloom's taxonomy and Webb's Depth of knowledge levels to enhance critical thinking skills.

AI Across Bloom's Taxonomy and DOK Levels

By Med Kharbach, PhD

Bloom's Revised Taxonomy	Webb's Depth of Knowledge (DOK)	What It Involves	AI Tools
 Remember	Level 1: Recall	- Repeat facts and definitions - List terms or items - Carry out basic procedures	     
 Understand	Level 2: Skills & Concepts	- Compare and summarize ideas - Organize or categorize information - Explain cause-and-effect - Make simple predictions	     
 Apply	Level 3: Strategic Thinking  Level 4: Extended Thinking	- Solve unfamiliar problems - Support answers with evidence - Design investigations - Reason through alternatives	     
 Analyze		- Combine knowledge from multiple areas - Conduct long-term projects - Transfer solutions across contexts	     
 Create		- Put parts together in new ways - Generate original ideas or products - Combine skills to design innovative solutions	     
 Evaluate		- Make judgments or decisions - Critique ideas or products - Use evidence and criteria for reasoning	  

Inspired by Martin, M. (2016). Blending instruction with technology: A blueprint for teachers to create unique, engaging, and effective learning experiences. Rowman & Littlefield.

Figure 2: Mapping Cognitive Skills and AI Tool Integration: Bloom's Taxonomy, Webb's Depth of Knowledge, and Educational Technologies.

Second, educational authorities should officially revise the EFL curriculum to mandate the systematic, strategic integration of digital tools as a core component of critical thinking instruction. Moreover,

they should provide comprehensive professional development programs for teachers who should be well-trained on how to use digital technologies to enhance EFL students' critical thinking skills. Finally, future research efforts should address the limitations of the present study through longitudinal studies and replication with larger and diverse groups of students.

11- Conclusion :

The present study was undertaken with the aim of empirically investigating the direct causal impact of integrating digital technologies on the improvement of EFL students' critical thinking skills. The findings confirm the previously stated hypothesis: when digital technologies are used strategically and wisely, they can generate praiseworthy outcomes, resulting in a significant improvement of students' critical skills.

Ultimately, this research contributes to the growing body of literature on educational technology and provides a strong evidence-based case for integrating digital tools to foster deeper, more meaningful learning.

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