

A Study on Non-English Majors' Digital Literacy and Critical Thinking Skills

Huang Caixia^{a,*}, Yao Xuan^b, Jiang Liwen^c

College of Foreign Languages and Literature, Northwest Normal University, Lanzhou, China

^ahuangcx2012@126.com, ^b2382752225@qq.com, ^c2624371076@qq.com

*Corresponding author

Abstract: Digital literacy and critical thinking skills are essential competencies for university students in the 21st century. In this study, questionnaires are used to explore the effects of digital-driven instruction on non-English majors' digital literacy and critical thinking skills. The results show that students demonstrated relatively high levels in both digital literacy and critical thinking skills before instruction intervention. After two months' intervention, students' digital literacy showed a statistically significant improvement, whereas their critical thinking skills did not. This study implies that students' digital literacy and critical thinking skills may not develop automatically and simultaneously. Therefore teachers need to consider explicitly integrating critical thinking into instruction for non-English majors.

Keywords: Non-English majors, Digital literacy, Critical thinking skills

1. Introduction

Generative Artificial Intelligence tools such as ChatGPT and DeepSeek are changing the way students access, convey information and express ideas. However, it may carry potential ethical risks, such as information distortion and data privacy breaches. Digital literacy and critical thinking play an essential role for university students to access, identify, integrate and utilize information. The College English Teaching Guide (2020 edition) highlights the importance of cultivating students' critical thinking ability and highlights modern information technology as a vital tool in teaching [1]. This study explores university students' digital literacy and critical thinking skills within the context of college English teaching.

2. Literature Review

2.1 Digital literacy

Digital literacy, often used interchangeably with digital competence, was initially introduced by Israeli scholar Yoram Eshet Alkalai in 1994. Gilster (1997), first used the term "digital literacy," and defined it as "the ability to understand and use information in multiple formats from a wide range of sources when it is presented via computers" (p. 1) [2]. The framework of digital literacy proposed by the European Union (2016) includes five digital competence areas in DigComp 2.0: 1) information and data literacy; 2) communication and collaboration; 3) digital content creation; 4) safety; and 5) problem solving [3]. UNESCO's Institute of Statistics Digital Literacy Global Framework (2018) adds two additional competence areas: devices and software operations, and career-related competences [4].

Digital literacy has evolved into an essential competency for students, fundamentally supporting their academic success and preparing them for active participation in society. In the learning context, it enables efficient access to and critical evaluation of diverse information sources. It further empowers students to create digital content, collaborate effectively, and solve complex problems—all vital skills in the 21st century.

2.2 Critical Thinking

Critical thinking is the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action [5]. This

definition directs critical thinking toward a practical purpose and emphasizes active engagement over passive reception and lists core cognitive operations.

The most influential models of critical thinking include the two-dimensional framework, which encompasses cognitive skills and affective dispositions, proposed by the Delphi Project team [6], the tripartite model, which focuses on the elements, standards, and intellectual traits of reasoning, developed by the American scholar Richard Paul [7], Lin Chongde's "Three-Plane Structure Model", which covers cognitive, personality, and social-cultural dimensions [8], and Wen Qiufang's "Hierarchical Model of Critical Thinking" with meta-cognitive skills as its core component [9].

Critical thinking is an active and reflective thought process that goes beyond simply receiving information. It is indispensable for university students and plays an important role in students' academic success. Cultivating critical thinking is therefore one of the key aims of higher education, as it empowers students to become autonomous, responsible, and adaptable lifelong learners.

2.3 Research on Digital Literacy and Critical Thinking

As to digital literacy, besides studies on fostering students' digital literacy, surveys of students' digital literacy, constructing digital literacy frameworks, and developing digital literacy scales, some studies focus on digital literacy and student learning: In studies related to student learning and classroom teaching practices, Hua (2020) found a positive correlation between students' digital literacy and their autonomous English learning ability [10]. Zhang (2025) pointed out a significant correlation between university students' digital literacy and learning outcomes, with factors such as the application of digital tools influencing learning effectiveness [11].

Some studies explore how digital technologies in subject teaching empower and promote students' critical thinking. Li and Zhang (2024) found that digital storytelling holds potential for empowering traditional narratives through digital technology and integrating critical thinking into the English curriculum, thereby effectively promoting the development of EFL learners' critical thinking abilities [12]. A study by Cai (2025) showed that students' critical thinking is effectively improved when the generated article was finished with better quality [13]. Jiang and Yang(2025) investigates an innovative approach to fostering critical thinking by integrating Large Language Models (LLMs) into the EFL reading instruction[14].

These studies provide rich theoretical and practical references for this research. However, studies specifically combining College English course teaching with the development of students' digital literacy and critical thinking remain relatively scarce. Therefore, this study, grounded in the College English course, aims to explore non-English majors' digital literacy and critical thinking skills.

3. Research Design

This study is aimed to explore whether there are changes in non-English majors' digital literacy and critical thinking skills after two-month digital-driven English instruction. The subjects in this study are 107 freshmen and the valid samples are 105.

3.1 Research Instrument

In this study, questionnaires are used to investigate university students' digital literacy and critical thinking ability. Both questionnaires use a five-point Likert scale ranging from 1 (strongly inconsistent) to 5 (strongly consistent).

Questionnaire of digital literacy is adapted from Zhang (2025) [11] and Yang (2025) [15]. There are 45 items in the questionnaire, covering 6 areas: 1) digital awareness: the recognition and willingness to utilize digital technologies and tools to solve problems. 2) digital knowledge and skills: the ability to acquire digital information. 3) digital tool application: the comprehensive use of various digital tools. 4) digital ethics: the principles to be followed in diverse digital scenarios. 5) digital innovation and construction: the ability to integrate acquired information with one's own knowledge for creation and sharing. 6) digital literacy for supporting learning.

Questionnaire of critical thinking skills is adapted from Liu & Jin (2025) [16]. The questionnaire has 22 items, covering 6 areas including interpretation, explanation, analysis, inference, evaluation and self-regulation. The six areas in the questionnaire are derived from the cognitive skill dimension of critical

thinking, as defined by the Delphi Project [6].

3.2 Research Procedure

Two weeks after the start of the university semester, freshmen were asked to complete questionnaires assessing their digital literacy and critical thinking skills. Both questionnaires were conducted again two months later. During these two months, the College English course employed a blended learning model; specifically, besides normal English learning with physical textbooks, Unipus of AI version platform developed by Foreign Language Teaching and Research Press was used.

In classroom activities, students were guided to use generative AI tools. For example, for a public speaking assignment, they first drafted their speeches independently, and then used generative AI such as DeepSeek or Doubao to evaluate these drafts. Based on the AI-generated feedback, they revised their drafts to produce the second ones, which they then recorded and uploaded to the AI-Unipus platform. The final step involved delivering the speeches live in class, with peers acting as the audience and providing feedback on their delivery.

4. Research Findings

4.1 Results of Non-English Majors' Digital Literacy

Students received questionnaire surveys of digital literacy two weeks after the start of the university semester and before the end of the semester respectively. Descriptive statistics and paired-samples t-test were conducted on students' pre- and post surveys of digital literacy. The results are summarized in Table 1.

Table 1: Results of non-English majors' digital literacy

Variable	N	Pre-test (M ± SD)	Post-test (M ± SD)	Mean Difference	T	P	95% CI of Difference
Total Digital Literacy	105	3.803 ± 0.545	4.181 ± 0.590	0.378	4.851	< .001***	[0.22, 0.53]
Digital awareness	105	3.925 ± 0.705	4.251 ± 0.630	0.326	3.545	< .001***	[0.14, 0.51]
Digital knowledge and skills	105	3.819 ± 0.630	4.171 ± 0.622	0.352	4.093	< .001***	[0.18, 0.52]
Digital tool application	105	3.592 ± 0.631	4.102 ± 0.655	0.510	5.776	< .001***	[0.34, 0.68]
Digital ethics	105	4.192 ± 0.570	4.340 ± 0.586	0.148	1.864	.032*	[-0.01, 0.30]
Digital innovation and construction	105	3.667 ± 0.627	4.133 ± 0.699	0.467	5.118	< .001***	[0.29, 0.65]
Digital Literacy for Supporting Learning	105	3.753 ± 0.638	4.152 ± 0.666	0.399	4.455	< .001***	[0.22, 0.58]

Notes: *p < .05, **p < .01, ***p < .001

Table 1 presents the statistics of non-English majors' digital literacy before and after the intervention. Overall, the total digital literacy score increased from a mean of 3.803 (SD = 0.545) in the pre-test to 4.181 (SD = 0.590) in the post-test.

All six measured dimensions also showed notable improvements. The improvements in total digital literacy and five of the six dimensions (digital awareness, digital knowledge & skills, digital tool application, digital innovation & construction, and digital literacy for supporting learning) were highly statistically significant, with p-values < .001. Compared with the other dimensions, the improvement in digital ethics was less pronounced, but statistically significant (p = .032).

In summary, post-intervention mean scores were higher across all dimensions, with digital innovation and construction demonstrating the largest gain, while digital ethics remained the strongest area both before and after the survey.

4.2 Results of Non-English Majors' Critical Thinking Skills

Descriptive statistics and paired-samples t-test were conducted on students' pre- and post surveys of critical thinking skills. The results are summarized in Table 2.

Table 2: Results of non-English majors' critical thinking skills (CTS)

Variable	N	Pre-test (M ± SD)	Post-test (M ± SD)	Mean Difference	T	P	95% CI of Difference
Total CTS	105	3.593 ± 0.740	3.629 ± 1.076	0.036	-0.292	.771	[-0.29, 0.21]
Interpretation	105	3.655 ± 0.856	3.645 ± 1.171	-0.010	0.070	.944	[-0.27, 0.29]
Explanation	105	3.627 ± 0.831	3.648 ± 1.063	0.021	-0.156	.877	[-0.28, 0.24]
Analysis	105	3.549 ± 0.816	3.569 ± 1.102	0.020	-0.154	.878	[-0.28, 0.24]
Inference	105	3.565 ± 0.791	3.600 ± 1.126	0.035	-0.264	.792	[-0.30, 0.23]
Evaluation	105	3.549 ± 0.776	3.648 ± 1.095	0.099	-0.757	.450	[-0.35, 0.16]
Self-regulation	105	3.602 ± 0.766	3.686 ± 1.137	0.084	-0.633	.527	[-0.35, 0.18]

Table 2 shows the statistics of non-English majors' critical thinking skills before and after the intervention. Overall, the total critical thinking score showed a slight increase from a mean of 3.593 (SD = 0.740) in the pre-test to 3.629 (SD = 1.076) in the post-test.

Changes across the six dimensions were minimal but varied: interpretation decreased slightly from 3.655 to 3.645. Overall, post-intervention scores showed slight increases in explanation, analysis, inference, evaluation, and self-regulation. No statistically significant improvements were found in any dimension of critical thinking skills between pre-test and post-test.

In summary, while minor improvements were observed in most dimensions, especially in evaluation and self-regulation, the overall gains in critical thinking skills were small. It is worth noting that standard deviations increased considerably in the post-survey across all dimensions, suggesting greater variability in participants' responses after the intervention.

5. Conclusion

This study investigated the effects of digital-driven instruction on the digital literacy and critical thinking skills of non-English majors. The results show different outcomes for the two competency domains.

Regarding digital literacy, students demonstrated a relatively high level at the pre-test stage, with the total mean score (M=3.803) and it improved significantly to 4.181. All six sub-dimensions showed statistically significant gains. In summary, the digital-driven instruction was highly successful in improving students' digital literacy.

In contrast, the results of critical thinking skills present a different picture. The pre-test total mean (M = 3.593) also indicated a relatively high level. However, the post-test mean (M = 3.629) showed only a minimal and statistically non-significant increase. All six sub-skills remained at a similar level with no significant change. This indicates that while students possessed and retained a reasonably good baseline of critical thinking, the digital-driven instruction did not lead to a measurable enhancement in these higher-order cognitive skills within the research period.

This study suggests that students' digital literacy and critical thinking skills, while potentially complementary, may not be automatically integrated. To foster both essential 21st-century competencies simultaneously, future pedagogical designs may need to incorporate more explicit, structured scaffolding such as reflective prompts, structured peer debate, and analytical tasks to develop students' critical thinking skills within the digital learning framework.

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