RDME
Research and Development in Medical Education
Res Dev Med Educ, 2024, 13, 6
doi: 10.34172/rdme.33187
https://rdme.tbzmed.ac.ir
TUOMS PRESS

Original Article

A comparative study of critical thinking implementation in face-to-face and online classrooms: Medical students' critical thinking and reading comprehension

Zohreh Ghorbani, Mehry Haddad Narafshan*, Valeh Jalali

Department of Foreign Languages, Kerman Branch, Islamic Azad University, Kerman, Iran

Article info
Article History:
Received: December 14, 2023
Accepted: March 29, 2024
epublished: July 10, 2024

Keywords:
Critical thinking, Critical thinking framework, Face-to-face classrooms, Medical students, Online classrooms, Reading comprehension

Abstract

Background: The enhancement of critical thinking (CT) is an essential goal in the educational strategic framework of medical universities across the globe. Therefore, it is of utmost importance to evaluate the competence in CT abilities as well as the inclination of medical students to actively participate in CT practices. Moreover, educational decision-makers believe that granting medical students the opportunity to utilize technology can enhance their academic performance and stimulate their CT ability level. Hence, this research aimed to compare the influence of implementing a CT framework in traditional classroom settings and online platforms on the CT and reading comprehension of medical students.

Methods: Over four months, two groups of 60 medical students (30 students in each group) were exposed to two environments of face-to-face and online English language instruction. The current quasi-experimental study was conducted at a general English language classroom, situated in Islamic Azad University, Kerman branch. Pre-tests and post-tests of CT and reading comprehension were used to measure learners' improvements in CT and reading comprehension levels before and after the project.

Results: The results of this study showed some improvements in the CT and reading comprehension abilities of both face-to-face and online groups ($P<0.01$). However, the improvements were particularly noticeable in the online group regarding the reading comprehension (M=17.98) and CT (M=107.462) variables compared to the face-to-face group (M=11.39) and (M=51.438).

Conclusion: Medical education experts strongly believe that developing and nurturing CT skills among medical students is crucial for improving the overall quality of medical education. In today's globalized era, the importance of CT cannot be overstated, as it equips students with essential skills needed to navigate complex challenges. Integrating CT into online learning environments is a testament to the progressive nature of medical education in the modern world.

Introduction

Critical thinking (CT) has been recognized as a vital skill in the 21st century that enables individuals to effectively navigate the abundance of information and rapid societal changes in contemporary times.[1] This competency involves evaluating cognitive processes with the aim of continuous improvement, self-monitoring, control, and correction.[2] Ennis[3] and Haber[4] have described CT as a combination of different cognitive abilities and affective dispositions. The application of these skills goes beyond mere skill accumulation, as CT encompasses more than just acquiring knowledge. In other words, thinking critically requires acquiring specific subject matter knowledge and a willingness to utilize CT skills.[5] With its focus on rational and self-regulatory thought, CT can assist individuals in justifying their beliefs or actions. Lipman[6] argued that the thinking process is more important than the outcome, suggesting that attention should be directed towards the specific thinking process rather than the resulting outcome. The importance of CT is highlighted in the field of education because it enhances individual learning through the promotion of reflective thinking.[7] This is evident in the requirement for individuals to provide the rationale for accepting a claim or perspective.[8] Education aims to go beyond the mere transmission of factual knowledge to students. It also involves developing 21st-century competencies that are crucial for success in the job market and preparing learners for real-life situations.[9]

Medical institutions engaged in the education and

***Corresponding author:** Mehry Haddad Narafshan, Email: hnarafshanmehri@gmail.com

training of healthcare professionals are perpetually concerned with enhancing the caliber of their graduates in delivering healthcare services. Physicians within the healthcare system are confronted with unprecedented challenges in their work environment, for which there exists no definitive or absolute solution. Consequently, they frequently find themselves making clinical judgments on intricate matters with minimal guidance and constrained time and resources. The ability to solve problems at the patient's bedside is truly invaluable.[10] CT plays a pivotal role in providing a broader perspective, innovative solutions, and diverse approaches when tackling these issues.[11] Extensive evidence suggests that CT skills are strongly associated with improved patient outcomes, higher quality patient care, and enhanced health outcomes within the healthcare system. Thus, CT stands as a crucial skill in the process of clinical decision-making. Strengthening this skill enables physicians to deliver the finest healthcare services by making well-informed decisions.[12] Considering this, the World Federation for Medical Education (WFME) has designated CT as the paramount skill that medical students must acquire during their educational journey.[13]

According to Floyd,[14] the challenge faced by second language (L2) learners in expressing CT in their L2 can be likened to a formidable obstacle. This is because they are not only required to engage in CT but also to do so in a language that is not their first. Hence, it becomes imperative to incorporate both language and thinking skills in the English language teaching curriculum, enabling students to employ language as a tool for cogitation.[15] By augmenting the CT abilities of students, they can nurture effective communication, formidable leadership qualities, teamwork proficiencies, cross-cultural and cross-border cognizance, and make positive contributions to society, thereby ensuring their triumph.[16] Consequently, there is a burgeoning interest in implementing CT programs, specifically in the realm of foreign languages or English as a Second Language (EFL/ESL).[17]

CT and technology are the two dominant pillars deeply ingrained in the modern globalized educational environment.[18] Driven by the swift progress of innovative technology, distance learning has assumed a pivotal role in the current educational landscape. The utilization of online learning initiatives has the potential to foster the development of CT skills among medical students. Moreover, online learning requires educators to actively engage with their students in interactive sessions, thereby instilling self-confidence in the analysis of instructional content, exercising discernment when confronted with diverse information, and diligently working towards verifying the accuracy of information and devising viable solutions. CT is widely acknowledged as a crucial attribute in the realm of online education, possessed by adept students and conducive to sustainable learning. Consequently, these learners can assimilate and evaluate various sources of knowledge while also integrating with social-networking-based learning.[19] This type of engagement delineates the application of CT conduct. To effectively disseminate information and facilitate discussions in a systematic fashion, the cultivation of CT should be actively promoted throughout all online educational courses.[20] This type of engagement exemplifies the application of CT behavior. To effectively disseminate information and facilitate discussions in a systematic manner, the cultivation of CT should be actively promoted across all online educational courses. By integrating the process of CT with online-based activities, such as asynchronous online discussions, students are provided with the advantage and opportunity to nurture their interests and attain an elevated level of knowledge.[21]

In addition to the ongoing discourse surrounding various pedagogical approaches, the education of CT also encounters hurdles due to the limited opportunity for critical discussions and evaluation of educational content in traditional teacher-led instructional methods.[22] These challenges are not confined to in-person teaching formats but also expand to online pedagogy concerning CT. Moreover, the abrupt transition of the education sector to online teaching as a response to the recent COVID-19 pandemic has presented educators with additional barriers in teaching CT. Online education necessitates students to feel at ease utilizing and engaging in real-time discussion boards, virtual debates, and focused groups. However, this may impede their ability to access and participate in activities that are relevant to the application of CT skills, particularly when students are unfamiliar with the online learning environment.[23] Additionally, there is a scarcity of research on instructional methods that are specifically tailored to foster CT in online settings.[24] The advent of information and communication technologies (ICTs) has opened new possibilities for developing CT skills, such as through asynchronous discussion groups. One potential benefit of computer-mediated discussion is its asynchronous nature, which allows for more time to ponder before responding. The extended duration for reflection and consultation of information sources in asynchronous computer-mediated discussions may result in greater utilization of formal, evidence-based research and an enhancement in the caliber of CT.

The "3Es CT framework" used in this study takes inspiration from Bloom's[25] original and revised[26] CT model. It has been carefully adapted and implemented to guide students through three crucial stages of CT in the context of L2 reading comprehension: exposure, exploration, and evaluation. The exposure stage, which marks the beginning, focuses on acquiring knowledge and understanding. It involves a simple act of seeing, followed by basic reflection. Moving on to the exploration phase, learners delve into application and analysis. Through analytical reflections, they are encouraged to perceive the world more analytically. Lastly, the evaluation stage,

the final phase of the framework, emphasizes the practice of evaluation and creation. It is characterized by critical reflection and culminates in a critical seeing. Accordingly, the current study sought to answer the following research questions:

1. Is implementing the CT framework in online classrooms statistically effective in boosting medical students' reading comprehension?
2. Is implementing the CT framework in online classrooms statistically effective in enhancing medical students' CT?

Methods

In this quasi-experimental quantitative study, we selected two intact classes of medical students who were enrolled at the Islamic Azad University of Kerman. Since the researchers were faculty members at the Islamic Azad University of Kerman, the selection of participants for the sample was based on their accessibility to the researchers. The university had organized two classes of general English specifically for medical students. The initial class consisted of 35 students, while the second one comprised 33 students. The participants from the first group were assigned to the face-to-face instructional approach, while those from the second group were assigned to the online instructional approach. Before commencing the intervention, the researcher administered the Longman Placement Test[27] to ensure that all participants in both groups possessed a comparable level of English language proficiency. The outcomes of the English language placement test revealed that 88% of the participants exhibited an intermediate level of English language skills, while the remaining 12% demonstrated an upper-intermediate level. Consequently, the upper-intermediate students were excluded from the final analysis, resulting in a final sample size of sixty participants who possessed an intermediate level of English language proficiency. The first group (face-to-face) consisted of thirty-two participants, whereas the second group (online) comprised twenty-eight participants. The class sessions took place twice a week, with each session lasting 90 minutes, over a period of four months.

To assess the participants' reading comprehension abilities both before and after the project, a total of four separate reading comprehension tests were administered. Each of these tests contained nine individual items that were used to determine how well the students understood the readings. After reading the passages, the participants were asked to complete sentence completion and multiple-choice question tasks. In the sentence completion task, they had to write sentences that accurately reflected the content of the readings, while in the multiple-choice question task, they had to choose the correct answer from a set of four options. The reliability of the scale used in this study was evaluated and found to have a coefficient of 0.89. To give the participants enough time to answer the reading questions, they were given a period of thirty minutes.

To assess the participants' CT abilities, specifically their analysis, inference, evaluation, and reasoning skills, a Persian version of the CT questionnaire developed by Honey[28] was administered at the beginning and end of the treatment implementation. This questionnaire consists of 30 items that are rated on a five-point Likert scale ranging from "never" to "always". Each option is assigned a numerical value (1 for never, 2 for rarely, 3 for sometimes, 4 for often, and 5 for always) to measure the participants' attitudes and calculate the test results. The internal reliability of the questionnaire was assessed using Cronbach's alpha, which yielded a value of 0.85.

During the initial stage of exploration, the learners were introduced to a diverse range of texts that revolved around a particular subject. In the online setting, these texts were displayed digitally on the screens, granting the students unrestricted access to peruse them according to their preferences. Conversely, in the face-to-face setting, the texts were provided in a traditional paper format. This allowed them to gain different perspectives and insights on the topic from various angles. Once they had familiarized themselves with the reading materials, the learners were encouraged to engage in introspection and contemplate the contexts they had been exposed to. They were prompted to articulate their thoughts and perceptions, serving as a stepping stone for expressing their ideas and emotions. This exercise aimed to provide them with an opportunity to explore and communicate their observations about the world, while also being receptive to the viewpoints shared by others. Consequently, the participants were able to encounter a myriad of perspectives on the same issue. The repetition of this stage across multiple sessions depended on the level of participation displayed by the students. Throughout these sessions, the instructor assumed the role of a facilitator, refraining from expressing any form of support, agreement, or disagreement toward any specific idea. This phase was characterized by a simple act of observation, where the learners superficially examined objects as they presented themselves, without engaging in critical analysis.

During the second phase (exploration), participants were encouraged to embark on a journey of discovery within the reading passages, exploring them from various aspects and breaking down the text into smaller fragments. In the online group, participants utilized Internet and Google-based sources, while in the face-to-face group, they relied on their textbooks, the viewpoints of their classmates, and hints provided by the teacher. This endeavor aimed to activate their powers of observation, perception, and attention to detail. Through this process, they were able to grasp all aspects of the reading material, enabling language learners to approach texts analytically, dissect and identify relevant details, uncover patterns, and critically evaluate information.

To accomplish this, learners were prompted to apply WH-Questions (who, what, when, where, why, etc.) to delve deeper into the text, bringing forth the intricacies of the subject matter. This exercise involved a profound analysis of their experience, followed by an attempt to compile a list of potential answers. In the present stage of cognitive processing, a state of analytical perception is induced, wherein individuals strive to comprehend their current observations by discerning similarities and differences with past encounters. This transcends mere sensory perception and delves into a more profound level of analysis.

In the third phase, the learners were instructed to partake in an evaluative process. The students were expected to competently evaluate the information presented to them and come to conclusions based on their perceived worth or potential biases. In the online group, participants responded to online reading comprehension questions. Meanwhile, in the face-to-face group, participants completed paper-based reading comprehension tests. This task may have required drawing from various subjects to synthesize an enlightened conclusion. The focus was on objectively and critically analyzing the experience in detail, while considering both internal and external knowledge when evaluating the information. The participants were given the task of reading the text, identifying all possible assumptions related to it, and then choosing the best answer based on the connections between internal and external clues. This process involved identifying, questioning, and evaluating deeply ingrained assumptions, ultimately leading to the development of the ability to assess values based on logical and plausible reasoning. The act of critical perception represents a more advanced and refined form of visual observation, as it necessitates the analytical application of knowledge and a rigorous interpretation of what is seen. Through this process, individuals can perceive objects and their inherent properties beyond their surface-level appearance.

Results

To examine the research hypotheses, the first step involved assessing the normality of the data distribution. One way to do this is by conducting the Shapiro-Wilk test. Importantly, all variables showed a significance level greater than 0.05. This suggests that the variables in this study followed a normal distribution, which in turn allowed for the use of parametric tests to investigate the research questions.

To address the initial research question and assess the primary null hypothesis pertaining to the effects of implementing the CT framework in online classrooms on medical students' reading comprehension, while also controlling for the influence of other variables, we employed the analysis of covariance (ANCOVA) test. Initially, we conducted Levene's test and normality checks, both of which yielded results that satisfied the required assumptions. Specifically, we observed homogeneity of variance, a linear relationship between the dependent variable and covariate, and homogeneity of regression slopes. As the *P* value ($P = 0.8$) in the present study exceeds 0.05, the researcher has successfully met the assumption of homogeneity of variance and is therefore able to proceed with conducting a one-way ANCOVA. Furthermore, upon examining the homogeneity of regression slopes, we found no evidence of an interaction between the covariate and the dependent variable ($P = 0.09$). Consequently, the ANCOVA test was conducted specifically for the reading comprehension variable.

According to the information provided in Table 1, a significant difference exists between the mean scores of the experimental group and the control group regarding the post-test outcomes of Reading Comprehension. This suggests that the utilization of technology-integrated CT instruction had a notable influence on enhancing the reading comprehension abilities of learners ($P < 0.01$). The estimated partial eta squared value of (partial $\eta 2 = 0.81$) indicates a considerable effect size. Consequently, we can refute the first null hypothesis.

Based on the estimated marginal means, it is apparent that the experimental group ($M = 17.98$) exhibited a higher level of achievement in Reading Comprehension in comparison to the control group ($M = 11.39$), as evidenced by the information presented in Table 1.

To address the second research question and assess the second null hypothesis pertaining to the effects of implementing the CT framework in online classrooms on medical students' CT, while also controlling for the influence of other variables, we employed the ANCOVA test. Initially, we conducted Levene's test and normality checks, both of which yielded results that satisfied the required assumptions. Specifically, we observed homogeneity of variance, a linear relationship between the dependent variable and covariate, and homogeneity of regression slopes. As the *P* value ($P = 0.3$) in the present study exceeds 0.05, the researcher has successfully met the assumption of homogeneity of variance and is therefore able to proceed with conducting a one-way ANCOVA. Furthermore, upon examining the homogeneity of regression slopes, we found no evidence of an interaction between the covariate and the dependent variable ($P = 0.4$). Consequently, the ANCOVA test was conducted specifically for the CT variable.

According to the information provided in Table 2, a significant difference exists between the mean scores of the experimental group and the control group with regard to the post-test outcomes of CT. This suggests that the utilization of technology-integrated CT instruction has a notable influence on enhancing the CT abilities of learners ($P < 0.01$). The estimated partial Eta squared value of (partial $\eta 2 = 0.81$) indicates a considerable effect size.

Table 1. Covariance analysis and estimated marginal means of reading comprehension

Source	Sum of squares	*df*	Mean	F	*P* value	Partial η^2
Group	646.819	1	646.819	235.371	0.000	0.81
Control	-	-	11.39	-	-	-
Experimental	-	-	17.98	-	-	-

Table 2. Covariance analysis and estimated marginal means of critical thinking

Source	Sum of squares	*df*	Mean	F	*P* value	Partial η^2
Group	46818.391	1	46818.391	497.489	0.000	0.90
Control	-	-	51.438	-	-	-
Experimental	-	-	107.462	-	-	-

Consequently, we can refute the second null hypothesis.

Based on the estimated marginal means, it is apparent that the experimental group (107.462) exhibited a higher level of achievement in CT in comparison to the control group (51.438), as evidenced by the information presented in Table 2.

Discussion

Using an experimental research approach involving two groups of medical students in English reading classrooms, the study uncovered improvements in the CT and reading comprehension abilities of both face-to-face and online cohorts. However, the improvements were particularly noticeable in the online group.

The current findings of the current investigation, in line with previous research[19,21] have shown that when CT procedures are integrated with online activities, participants can gain an advantage. This integration not only enhances their interests and thinking abilities but also helps them achieve a higher level of knowledge. To further support this claim, Kinne and Eastep[29] argued that the cognitive domain of the thinking process is particularly well-suited for online learning. Adding weight to our findings, MacKnight[23] confirmed that CT skills are developed through various online platforms, including web-based chats, discussion boards, and email exchanges. Given the numerous challenges that the medical training system currently encounters in meeting societal expectations for health promotion, it becomes imperative to cultivate graduates who possess the qualities of creativity, thoughtfulness, and efficiency, along with a strong aptitude for decision-making. Undoubtedly, CT plays a pivotal role in enabling physicians to deliver enhanced and valuable care by facilitating accurate decision-making throughout the caregiving process.[30]

Experts in the field of medical education hold the belief that the enhancement and cultivation of CT abilities among medical students are of utmost importance to enhance the overall quality of medical education. Consequently, these experts advocate for the inclusion of CT as one of the fundamental skills to be developed and evaluated within the framework of medical education. This proposition is particularly relevant when considering the accreditation process for schools of medicine, wherein the establishment and adherence to certain standards are assessed.[31,32]

Training medical students to provide appropriate care for patients in today's developed world necessitates the provision of education that reinforces the cultivation of CT skills. Consequently, to ascertain the efficacy and caliber of the education dispensed in universities, it becomes imperative to undertake an evaluation of the progression and maturation of CT capabilities among medical students. Despite the paramount significance that CT holds in the educational sphere, the findings of numerous research endeavors indicate that by and large, students exhibit a paucity of aptitude to employ CT skills. The trajectory of CT among university students has yielded divergent outcomes. On the one hand, certain studies have documented an upward trend in the degree of CT exhibited by students, whereas, on the other hand, other studies have reported a dearth of disparity in the level of CT among students across different academic years, thus indicating a downward trajectory.[33,34]

To ensure that medical students are equipped with the necessary skills to provide proper care for patients, it is crucial to adopt an educational method that emphasizes the development of CT. Therefore, evaluating the growth and enhancement of CT abilities in students becomes essential to gauge the effectiveness of the education provided in universities. The research conducted by Taheri et al[33] yielded significant findings that demonstrated a discernible disparity between the disposition towards CT in students during their initial and final semesters. Notably, the analysis revealed that the CT disposition observed in students during their last semester surpassed that of their counterparts in the first semester.[33]

Several studies[35,36] have provided evidence supporting our findings, which demonstrate the positive effects of online educational activities on students' academic performance. The acquisition of CT values can be greatly enhanced using online-based learning. Jang[35] suggested that the incorporation of online interaction can enrich students' creativity. Students have extensively utilized the accessibility, abundance, diversity, and convenience of internet information to expand their boundaries and generate innovative ideas.[36] Additionally, certain scholars, according to our study, have acknowledged the beneficial impact of new forms of contemporary education on digital learning platforms in various universities. The utilization of digital learning platforms is believed to facilitate the development of students' reasoning, problem-solving, and decision-making skills.[37]

Through the utilization of online education, participants have been granted an extended period to delve deeper into and expand upon their answers and

ideas, allowing for a more comprehensive and elaborate understanding. In stark contrast to traditional classes, where students are often constrained by limited time to formulate their responses, the asynchronous nature of online learning provides students with the flexibility to adjust the amount of time they need for personalized contemplation, exploration, and investigation. Rather than feeling pressured to immediately analyze and address questions posed within a physical classroom environment, students who participate in online coursework are given the invaluable opportunity to engage in reflection, exploration, and questioning before submitting their thoughtful and well-considered responses.[38]

Moreover, e-learning has been demonstrated to be more favorable for integrating and implementing CT behaviors, resulting in active learning, in contrast to the time-limited interactions that are characteristic of conventional classrooms.[39] In addition, remote education may inspire students with a sense of confidence, encouraging them to actively participate in their academic endeavors. The justification behind advocating for non-synchronous interactions in an online classroom to promote CT has primarily focused on the student's capacity to actively process information, contemplate, and explore inquiries before formulating their responses.[40] In brief, it can be argued that online learning possesses greater appeal, adaptability, and compatibility compared to traditional pedagogical approaches, thus facilitating the development of participants' CT skills within the contemporary educational landscape.

Conclusion

It can be argued that the amalgamation of CT within an online setting encompasses the entirety of contemporary education among students of medical sciences, thereby highlighting its significance and relevance in the field. The indispensability and advantageous nature of CT have become highly sought-after abilities in confronting the era of globalization, owing to its ability to foster independent and analytical thought processes. The principles, notions, and conduct associated with CT are greatly advocated by medical educators, as they serve as the fundamental objective of today's higher education landscape, aiming to develop well-rounded and intellectually sound individuals. Moreover, the presence of technologies such as online learning has undeniably emerged as a significant factor that impacts all aspects of instructional systems among medical students, necessitating the need for educators to familiarize themselves with this ever-evolving tool. Online learning, with its myriad of resources and interactive platforms, has demonstrated its excellence in bolstering participants' CT skills, providing them with opportunities to engage in collaborative problem-solving, research-based approaches, and effective decision-making processes. Ultimately, the integration of CT within an online setting serves as a catalyst for holistic education and empowers medical students to navigate the complex and dynamic landscape of healthcare with confidence and competence. According to Hurwitz and Schmitt,[41] technology-integrated programs can be implemented through a broad range of scenarios that replicate learners' real-life experiences, enabling them to engage with computer programs through interactive technologies as a means of support. These programs should not only be accessible to medical educators for utilization as instructional materials in their classrooms but also for medical students to utilize as mediators within both classroom and extracurricular experiences.

Every research study possesses its own set of constraints, and the current work is no exception. Hence, it is imperative to consider these constraints while interpreting the outcomes. In the first place, because of the rules and regulations set forth by the university, the researcher was prohibited from randomly assigning learners to two groups. Instead, the study adopted a quasi-experimental research design utilizing pre-existing classes. Despite the absence of notable discrepancies between the conditions during the pre-tests, there remains the possibility that selection bias could have influenced the results. Secondly, the generalizability of the findings presented in this article may be restricted due to the relatively small and selective sample size. To enhance the representativeness of the study, it would be advantageous to replicate it with a larger and more diverse sample. Furthermore, it is crucial to note that the sustainability of the intervention results over time remains unclear within this type of study. Consequently, it would be imperative to undertake future measurements to examine the long-term impact of technology mediation.

Acknowledgments

We express our gratitude to the students and faculty members affiliated with the Department of Medical Sciences at the Islamic Azad University of Kerman, who graciously and voluntarily consented to partake in this study.

Authors' Contribution

Conceptualization: Zohreh Ghorbani, Mehry Haddad Narafshan.
Data curation: Zohreh Ghorbani.
Investigation: Zohreh Ghorbani.
Methodology: Zohreh Ghorbani, Mehry Haddad Narafshan, Valeh Jalali.
Project administration: Zohreh Ghorbani.
Resources: Zohreh Ghorbani, Mehry Haddad Narafshan, Valeh Jalali.
Software: Zohreh Ghorbani, Mehry Haddad Narafshan, Valeh Jalali.
Supervision: Mehry Haddad Narafshan, Valeh Jalali.
Writing–original draft: Zohreh Ghorbani.
Writing–review & editing: Mehry Haddad Narafshan.

Competing Interests

The authors declared no conflict of interest.

Ethical Approval

The objective and methodology of the study were communicated to the participants before the initiation of the project. Approval for the current study was obtained from the Ethics Committee of the Medical Sciences Department at the Islamic Azad University of Kerman, under reference number 400/09/27. Moreover, the participants were provided with assurance that the collected data would exclusively serve research purposes, and their identities would remain undisclosed.

Funding

Not applicable.

References

1. Anggraeni DM, Prahani BK, Suprapto N, Shofiyah N, Jatmiko B. Systematic review of problem-based learning research in fostering critical thinking skills. Think Skills Creat. 2023;49:101334. doi: 10.1016/j.tsc.2023.101334.
2. Paul R, Elder L. The Miniature Guide to Critical Thinking Concepts and Tools. Rowman & Littlefield; 2019.
3. Ennis RH. Critical thinking across the curriculum: a vision. Topoi. 2018;37(1):165-84. doi: 10.1007/s11245-016-9401-4.
4. Haber J. Critical Thinking. MIT Press; 2020.
5. Halpern DF, Sternberg RJ. An introduction to critical thinking: Maybe it will change your life. In: Critical Thinking in Psychology. Cambridge University Press; 2020. p. 1-9. doi: 10.1017/9781108684354.002.
6. Lipman M. Thinking in Education. Cambridge University Press; 2003. doi: 10.1017/cbo9780511840272.
7. Dewey J. The School and Society [Šola in Družba]. Afterword Studies by Slavko Gaber and Ana Pešikan. Ljubljana: University of Ljubljana; 2012.
8. Tomasello M. Becoming Human: A Theory of Ontogeny. Harvard University Press; 2019. doi: 10.4159/9780674988651.
9. Chu C, Buchman-Schmitt JM, Stanley IH, Hom MA, Tucker RP, Hagan CR, et al. The interpersonal theory of suicide: a systematic review and meta-analysis of a decade of cross-national research. Psychol Bull. 2017;143(12):1313-45. doi: 10.1037/bul0000123.
10. Shakurnia A, Fazelinia T, Khajeali N. The trend of critical thinking disposition in medical students and its relationship with their academic performance. J Educ Health Promot. 2021;10:479. doi: 10.4103/jehp.jehp_55_21.
11. D'Alessio FA, Avolio BE, Charles V. Studying the impact of critical thinking on the academic performance of executive MBA students. Think Skills Creat. 2019;31:275-83. doi: 10.1016/j.tsc.2019.02.002.
12. Aein F, Aliakbari F. Effectiveness of concept mapping and traditional linear nursing care plans on critical thinking skills in clinical pediatric nursing course. J Educ Health Promot. 2017;6:13. doi: 10.4103/jehp.jehp_49_14.
13. Sjöström H, Christensen L, Nystrup J, Karle H. Quality assurance of medical education: lessons learned from use and analysis of the WFME global standards. Med Teach. 2019;41(6):650-5. doi: 10.1080/0142159x.2018.1536259.
14. Floyd CB. Critical thinking in a second language. High Educ Res Dev. 2011;30(3):289-302. doi: 10.1080/07294360.2010.501076.
15. Ghanizadeh A, Al-Hoorie AH, Jahedizadeh S. Higher Order Thinking Skills. In: Higher Order Thinking Skills in the Language Classroom: A Concise Guide. Cham: Springer International Publishing; 2020. p. 1-51. doi: 10.1007/978-3-030-56711-8_1.
16. ŽivkoviĿ S. A model of critical thinking as an important attribute for success in the 21st century. Procedia Soc Behav Sci. 2016;232:102-8. doi: 10.1016/j.sbspro.2016.10.034.
17. Heidari K. Critical thinking and EFL learners' performance on textually-explicit, textually-implicit, and script-based reading items. Think Skills Creat. 2020;37:100703. doi: 10.1016/j.tsc.2020.100703.
18. Tathahira T. Promoting students' critical thinking through online learning in higher education: challenges and strategies. Englisia. 2020;8(1):79-92. doi: 10.22373/ej.v8i1.6636.
19. Carmichael E, Farrell H. Evaluation of the effectiveness of online resources in developing student critical thinking: review of literature and case study of a critical thinking online site. J Univ Teach Learn Pract. 2012;9(1):4. doi: 10.53761/1.9.1.4.
20. Ricci FA. Encouraging critical thinking in distance learning: ensuring challenging intellectual programs. Distance Learn. 2013;10(1):1-15.
21. Foo SY, Quek CL. Developing students' critical thinking through asynchronous online discussions: a literature review. Malays Online J Educ Technol. 2019;7(2):37-58.
22. Peter EE. Critical thinking: essence for teaching mathematics and mathematics problem solving skills. Afr J Math Comput Sci Res. 2012;5(3):39-43. doi: 10.5897/ajmcsr11.161.
23. MacKnight CB. Teaching critical thinking through online discussions. Educause Quarterly. 2000;23(4):38-41.
24. Richardson JC, Ice P. Investigating students' level of critical thinking across instructional strategies in online discussions. Internet High Educ. 2010;13(1):52-9. doi: 10.1016/j.iheduc.2009.10.009.
25. Bloom BS. Taxonomy of Educational Objectives: The Classification of Educational Goals. Vol 1. Longmans, Green & Co; 1956.
26. Anderson LW, Krathwohl DR. A Taxonomy for Learning, Teaching, And Assessing: A Revision of Bloom's Taxonomy of Educational Objectives. New York, NY: Longman; 2001.
27. ELT PL. Pearson Longman ELT. 2004. Available from: https://www.pearson.com/english. Accessed September 10, 2023.
28. Honey P. Critical Thinking Questionnaire. 2004. Available from: http://www.PeterHoney.com. Accessed April 10, 2013.
29. Kinne LJ, Eastep SM. Instructional design in online learning: components of quality. Kentucky Journal of Excellence in College Teaching and Learning. 2011;6(1):4.
30. Pu D, Ni J, Song D, Zhang W, Wang Y, Wu L, et al. Influence of critical thinking disposition on the learning efficiency of problem-based learning in undergraduate medical students. BMC Med Educ. 2019;19(1):1. doi: 10.1186/s12909-018-1418-5.
31. Schmaltz RM, Jansen E, Wenckowski N. Redefining critical thinking: teaching students to think like scientists. Front Psychol. 2017;8:459. doi: 10.3389/fpsyg.2017.00459.
32. Sharples JM, Oxman AD, Mahtani KR, Chalmers I, Oliver S, Collins K, et al. Critical thinking in healthcare and education. BMJ. 2017;357:j2234. doi: 10.1136/bmj.j2234.
33. Taheri A, Azadeh F, Moradi-Joo M, Yousefianzadeh O. Surveying critical thinking dispositions between freshmen and senior students in school of allied medical sciences in 2012-2013 academic year. Payavard Salamat. 2017;11(3):1-9. [Persian].
34. Shakurnia A, Baniasad M. Critical thinking disposition in the first-and last-year medical students and its association with achievement goal orientation. Stride Dev Med Educ. 2018;15(1):e85046. doi: 10.5812/sdme.85046.
35. Jang SJ. Exploration of secondary students' creativity by

integrating web-based technology into an innovative science curriculum. Comput Educ. 2009;52(1):247-55. doi: 10.1016/j.compedu.2008.08.002.
36. Chang YS. Student technological creativity using online problem-solving activities. Int J Technol Des Educ. 2013;23(3):803-16. doi: 10.1007/s10798-012-9217-5.
37. López-Pérez MV, Pérez-López MC, Rodríguez-Ariza L. Blended learning in higher education: students' perceptions and their relation to outcomes. Comput Educ. 2011;56(3):818-26. doi: 10.1016/j.compedu.2010.10.023.
38. Pyle R. Teaching Critical Thinking Online. 1997. Available from: http://reach.ucf.edu/~aln/pyle/main.html. Accessed October 1, 2023.
39. Astleitner H. Teaching critical thinking online. Journal of Instructional Psychology. 2002;29(2):53-76.
40. Mandernach BJ. Thinking critically about critical thinking: integrating online tools to promote critical thinking. Insight: A Collection of Faculty Scholarship. 2006;1:41-50.
41. Hurwitz LB, Schmitt KL. Can children benefit from early internet exposure? Short- and long-term links between internet use, digital skill, and academic performance. Comput Educ. 2020;146:103750. doi: 10.1016/j.compedu.2019.103750.