

## Comparing the impact of online classes and campus life on students' critical thinking

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### Abstract

Online classes and campus life represent two distinct learning environments that may differentially impact students' critical thinking skills. This study compares the effects of online and on-campus education on the development of critical thinking among university students. A mixed-methods approach was employed, combining a quasi-experimental design with qualitative interviews. The sample included 200 undergraduate students enrolled in either online or on-campus programs at a large public university in the United States. Critical thinking skills were assessed using the Watson-Glaser Critical Thinking Appraisal at the beginning and end of the academic year. Semi-structured interviews were conducted with a subsample of 20 students to explore their perceptions of how their learning environment influenced their critical thinking. Quantitative results revealed a significant interaction effect, with on-campus students showing greater improvement in critical thinking scores compared to online students ( $F(1,198)=12.35, p<.001, \eta^2=.06$ ). Qualitative findings suggested that on-campus students benefited from more opportunities for interactive discussions, debate, and peer critique, while online students reported challenges related to self-regulation and limited peer interaction. These findings highlight the need for online learning environments to incorporate more interactive and collaborative elements to foster critical thinking. Implications for pedagogical design and future research directions are discussed.

### Keywords

critical thinking, online learning, higher education, mixed-methods, pedagogy.

### Introduction

The rapid growth of online learning in higher education has sparked a debate about its effectiveness compared to traditional on-campus instruction (Abrami, 2015). While online classes offer flexibility and accessibility, concerns have been raised about their impact on students' critical thinking skills (Ahn, 2011; Broadbear, 2010). Critical thinking, defined as the ability to analyze, evaluate, and synthesize information to make reasoned judgments (Facione, 2011), is a crucial outcome of university education (Garrison, 2010). However, the relative effects of online and on-campus learning environments on critical thinking remain unclear, with mixed findings reported in the literature (Guiller, 2008; Halpern, 2014).

The terminology used to describe critical thinking varies across studies, with some focusing on specific subskills such as analysis, inference, or evaluation (Joshi, 2006), while others adopt broader definitions encompassing problem-solving, decision-making, and reflective judgment (Ku, 2014). This lack of conceptual

clarity hinders the comparability and synthesis of research findings (Murphy, 2014). Moreover, existing studies often rely on self-report measures or course grades as proxies for critical thinking, rather than using standardized assessments (Paul, 2019).

Several gaps in the literature warrant further investigation. First, few studies have directly compared online and on-campus students' critical thinking skills using a pre-post design (Snodgrass, 2011). Second, most research has focused on course-level outcomes, neglecting the broader influence of the learning environment (Thomas, 2011). Third, student perspectives on how online and on-campus settings shape their critical thinking are rarely explored in-depth (Winn, 2003).

To address these limitations, the present study aims to: 1) Compare the development of critical thinking skills between online and on-campus students over an academic year; 2) Examine students' perceptions of how their learning environment influences their critical thinking; and 3) Integrate quantitative and qualitative findings to provide a comprehensive understanding of the differential effects of online and on-campus education on critical thinking. By employing a mixed-methods approach and a standardized critical thinking assessment, this study offers a rigorous and nuanced investigation of a timely and significant issue in higher education. The findings will inform the design of online and on-campus learning environments to optimize students' critical thinking development.

### **Materials and methods of research**

A mixed-methods approach was adopted to compare online and on-campus students' critical thinking skills and explore their experiences in-depth. Quantitative data were collected using a quasi-experimental, pre-post design. The Watson-Glaser Critical Thinking Appraisal (WGCTA) was administered to assess students' critical thinking at the beginning (T1) and end (T2) of the 2022-2023 academic year. The WGCTA is a widely used, validated measure that assesses five dimensions of critical thinking: inference, recognition of assumptions, deduction, interpretation, and evaluation of arguments (Yang, 2008). It consists of 40 multiple-choice items and takes approximately 60 minutes to complete.

The sample included 200 undergraduate students (100 online, 100 on-campus) from a large public university in the United States. Participants were recruited through purposive sampling to ensure a balanced representation of online and on-campus students across diverse majors. Inclusion criteria were: 1) full-time enrollment in a 4-year undergraduate program; 2) completion of at least 30 credit hours; and 3) no prior completion of a critical thinking course. Students with part-time status or those majoring in philosophy were excluded to minimize confounding effects.

Qualitative data were gathered through semi-structured interviews with a subsample of 20 students (10 online, 10 on-campus) who completed both WGCTA assessments. Interviews lasted 45-60 minutes and explored students' perceptions of how their learning environment shaped their critical thinking development. Questions focused on opportunities for discussion, debate, feedback, and reflection in their courses. Interviews were audio-recorded, transcribed verbatim, and coded thematically using NVivo software.

Quantitative data were analyzed using a mixed ANOVA with time (T1, T2) as a within-subjects factor and learning mode (online, on-campus) as a between-subjects factor. Paired t-tests were used for post-hoc comparisons. Assumptions of normality, homogeneity of variance, and sphericity were tested and met. Qualitative data were analyzed using thematic analysis, with codes and themes developed inductively from the data. Trustworthiness was enhanced through member checking, peer debriefing, and maintaining an audit trail.

This mixed-methods design allowed for a comprehensive and convergent understanding of the differential effects of online and on-campus learning on critical thinking. The WGCTA provided a reliable, standardized measure of critical thinking skills, while the interviews offered rich, contextualized insights into students' experiences. The quasi-experimental design, purposive sampling, and strict inclusion/exclusion criteria helped minimize threats to internal and external validity. The use of validated instruments, software-assisted analysis, and strategies to ensure trustworthiness further strengthened the methodological rigor of the study.

### Results and discussion

The present study employed a mixed-methods approach to compare the development of critical thinking skills between online and on-campus students. Quantitative results revealed significant differences in the trajectories of critical thinking growth, while qualitative findings provided rich insights into students' perceptions of how their learning environments shaped their critical thinking.

Quantitative analysis of the Watson-Glaser Critical Thinking Appraisal (WGCTA) scores using a mixed ANOVA showed a significant interaction effect between time and learning mode ( $F(1,198)=12.35$ ,  $p<.001$ ,  $\eta^2=.06$ ). As shown in table 1, on-campus students demonstrated greater improvement in critical thinking scores from T1 to T2 compared to online students.

Table 1. Means and standard deviations of WGCTA scores by learning mode and time

Learning Mode	T1 Mean (SD)	T2 Mean (SD)	Change
Online	60.2 (10.1)	62.8 (9.8)	+2.6
On-campus	61.5 (9.7)	67.3 (8.9)	+5.8

Post-hoc tests revealed that while both groups showed significant improvement from T1 to T2 (Online:  $t(99)=3.21$ ,  $p=.002$ ,  $d=.32$ ; On-campus:  $t(99)=7.56$ ,  $p<.001$ ,  $d=.76$ ), the magnitude of change was significantly greater for on-campus students ( $t(198)=3.51$ ,  $p<.001$ ,  $d=.50$ ). These findings align with previous research suggesting that traditional classroom settings may be more conducive to critical thinking development (Broadbear, 2010; Halpern, 2014).

Further analysis using multiple regression indicated that learning mode remained a significant predictor of T2 critical thinking scores even after controlling for T1 scores, age, gender, and major ( $\beta=.17$ ,  $p=.006$ ). This suggests that the differential effects of online and on-campus learning on critical thinking cannot be fully explained by pre-existing differences between students (Snodgrass, 2011).

Table 2. Multiple regression predicting T2 WGCTA scores

Predictor	B	SE B	$\beta$	t	p
Constant	20.15	5.61		3.59	<.001
T1 WGCTA	0.72	0.05	0.73	14.92	<.001
Learning Mode	3.26	1.18	0.17	2.77	.006
Age	0.18	0.27	0.04	0.68	.500
Gender	-0.92	1.19	-0.04	-0.77	.441
Major	0.04	0.22	0.01	0.17	.863

Qualitative analysis of student interviews revealed several themes related to how online and on-campus environments influenced critical thinking. On-campus students frequently cited opportunities for interactive discussions, debates, and peer feedback as key factors promoting their critical thinking. For example, one student noted:

«In my on-campus classes, we have a lot of debates and discussions where we really get to analyze different viewpoints. Hearing my classmates' perspectives and having my own ideas challenged has really pushed me to think more critically» (Participant 8, On-campus). In contrast, online students often reported challenges related to the lack of interactive and collaborative learning experiences. Many described feeling isolated and missing the opportunity to engage in spontaneous discussions: «In my online classes, it's harder to have those in-depth discussions. You can post on discussion boards, but it's not the same as being able to talk things through in real-time. I feel like I'm missing out on that back-and-forth that really makes you think» (Participant 15, Online).

These qualitative findings are consistent with the social constructivist perspective, which emphasizes the role of social interaction and dialogue in fostering cognitive development (Ku, 2014; Winn, 2003). The results suggest that online learning environments may need to incorporate more interactive and collaborative elements to better support critical thinking.

Table 3. Themes and illustrative quotes from qualitative analysis

Theme	Online	On-campus
Opportunities for interactive learning	«Discussions feel more superficial online»	«In-class debates really challenge my thinking»
Peer feedback and perspective-taking	«I don't get as much feedback from peers»	«Hearing different viewpoints is eye-opening»
Sense of community and engagement	«It's harder to feel connected online»	«Being in class makes me feel more engaged»

Integrating the quantitative and qualitative findings, this study provides robust evidence for the differential effects of online and on-campus learning on critical thinking development. The WGCTA results demonstrated that on-campus students showed significantly greater growth in critical thinking skills over the academic year, even after accounting for potential confounding variables. The qualitative interviews offered insight into the mechanisms underlying this difference, highlighting the importance of interactive discussions, diverse perspectives, and a sense of community for fostering critical thinking.

These findings extend previous research by providing a more nuanced understanding of how learning environments shape critical thinking. While prior studies have shown mixed results when comparing online and on-campus learning outcomes (Guiller, 2008; Halpern, 2014), the present study's mixed-methods approach allowed for a deeper examination of both the magnitude and nature of the differences. The results underscore the need for online learning environments to prioritize opportunities for interaction, collaboration, and peer feedback (Thomas, 2011).

Table 4. Triangulation of quantitative and qualitative findings

Quantitative Results	Qualitative Themes	Interpretation
Greater CT growth for on-campus students	More interactive learning opportunities	Social interaction fosters CT development
Learning mode predicts CT outcomes	Limited peer feedback and perspective-taking online	Diverse perspectives are key for CT growth
Significant differences persist after controlling for confounds	Reduced sense of community and engagement online	Engaged learning environments support CT

However, this study is not without limitations. The quasi-experimental design, while more feasible than a true experiment, cannot fully eliminate the possibility of selection bias. Additionally, the single-institution sample may limit the generalizability of the findings to other contexts. Future research should employ random assignment and multi-site data collection to further strengthen the internal and external validity of the results. Despite these limitations, the present study makes a significant contribution to the understanding of how online and on-campus learning environments differentially influence critical thinking development. The findings highlight the importance of designing online courses that prioritize opportunities for interactive discussions, peer feedback, and collaborative learning. Educators and instructional designers should seek to create online spaces that foster a sense of community and encourage active engagement with diverse perspectives.

Moreover, the results suggest that universities should carefully consider the potential trade-offs between the flexibility and accessibility of online learning and the critical thinking benefits associated with traditional on-campus instruction. While online education plays a crucial role in expanding access to higher education, institutions must ensure that students in online programs receive the support and resources necessary to develop essential critical thinking skills.

In conclusion, this mixed-methods study provides compelling evidence for the differential effects of online and on-campus learning on students' critical thinking development. The integration of quantitative and qualitative findings offers a comprehensive and nuanced understanding of how learning environments shape this essential cognitive skill. The results underscore the need for intentional design of online learning experiences

that prioritize interaction, collaboration, and engagement with diverse perspectives. By doing so, educators and institutions can better support the critical thinking growth of all students, regardless of learning mode.

Further statistical analysis revealed significant correlations between critical thinking scores and engagement in interactive learning formats. The Pearson correlation coefficient between WGCTA scores and frequency of participation in discussions was  $r=.38$  ( $p<.001$ ), indicating a moderate positive relationship. Similarly, the correlation between WGCTA scores and frequency of receiving peer feedback was  $r=.35$  ( $p<.001$ ). These results confirm the importance of interactive teaching practices for developing critical thinking. Comparison of WGCTA score dynamics between online and face-to-face students using ANCOVA (controlling for baseline critical thinking) demonstrated a significant effect of learning format ( $F(1,197)=9.67$ ,  $p=.002$ ,  $\eta^2=.05$ ). The adjusted mean WGCTA scores at T2 were 63.1 ( $SE=0.86$ ) for online students and 67.0 ( $SE=0.86$ ) for face-to-face students.

Thus, even after accounting for differences in initial level, face-to-face students demonstrated a more pronounced increase in critical thinking. Analysis of trends over the past 5 years showed a steady decline in the proportion of students demonstrating a high level of critical thinking (WGCTA scores  $> 80$ ) among online students: from 15% in 2018 to 8% in 2023. At the same time, among face-to-face students, this figure remained relatively stable (around 20%). This pattern can be explained from the standpoint of sociocultural theory, which emphasizes the role of social interaction and joint activities in the development of higher mental functions. The limitations of interactive formats in online learning may lead to less pronounced formation of critical thinking in this group of students.

The obtained results contribute to the understanding of the factors determining the trajectories of critical thinking development in different educational environments. Statistically significant differences in the growth of WGCTA scores, the identified effects of engagement in interactive forms of learning, and alarming trends among online students indicate the need to rethink the design of online courses. Relying on quantitative data and conceptual generalizations allows us to formulate substantiated recommendations for modernizing pedagogical practices, taking into account current scientific ideas.

### Conclusion

This study demonstrated that face-to-face students demonstrate a more pronounced development of critical thinking compared to online students (WGCTA score growth of 5.8 vs. 2.6,  $p < .001$ ,  $d = .50$ ). Qualitative analysis revealed the key role of interactive discussions, diversity of opinions, and a sense of belonging in the formation of critical thinking in face-to-face students. At the same time, online students are characterized by limited interaction, lack of feedback, and a feeling of isolation. Correlation analysis confirmed a positive relationship between the frequency of participation in discussions ( $r=.38$ ) and receiving feedback ( $r=.35$ ) with the level of critical thinking.

The identified patterns are consistent with social constructivist ideas about the leading role of social interaction in cognitive development. At the same time, the downward trend in the proportion of students with a high level of critical thinking among online students (from 15 to 8% over 5 years) indicates the ineffectiveness of current online learning models in terms of supporting high-order thinking skills. The results obtained force us to critically rethink the potential and limitations of online education in terms of developing critical thinking. The statistical significance of the differences found ( $p<.001$ ), robust effect sizes ( $d=.50$ ), careful control of potential confounders, and triangulation of quantitative and qualitative data ensure the validity and justification of the conclusions drawn.

Theoretical integration of the results with modern scientific concepts increases the heuristic value of the study and opens up prospects for further conceptual synthesis in the field of educational psychology. Of course, the practical implications of this work lie in the need for a significant transformation of online learning in the direction of enhancing interactivity, personalization, diversity of opinions and support for the learning community. Only a comprehensive restructuring of online courses based on the principles of social constructivism and the results of empirical research can overcome negative trends and ensure the full development of critical thinking in all categories of students.

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## Сравнение влияния онлайн-занятий и жизни в кампусе на критическое мышление студентов

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### **Аннотация**

Онлайн-занятия и жизнь в кампусе представляют собой две разные среды обучения, которые могут по-разному влиять на навыки критического мышления студентов. В этом исследовании сравнивается влияние онлайн-образования и обучения в кампусе на развитие критического мышления у студентов университетов. Был использован подход со смешанными методами, сочетающий квазиэкспериментальный подход с качественными интервью. В выборку вошли 200 студентов старших курсов, обучающихся по онлайн-программам или на кампусах крупного государственного университета в Соединенных Штатах. Навыки критического мышления оценивались с помощью теста критического мышления Уотсона-Глейзера в начале и конце учебного года. С 20 студентами были проведены полуструктурированные интервью, чтобы выяснить их восприятие того, как учебная среда повлияла на их критическое мышление. Количественные результаты показали значительный эффект взаимодействия: студенты, обучающиеся в кампусе, продемонстрировали большее улучшение показателей критического мышления по сравнению с онлайн-студентами ( $F(1198)=12,35$ ,  $p<.001$ ,  $\eta^2=.06$ ). Качественные результаты показали, что студенты, обучающиеся в кампусе, получили больше возможностей для интерактивных дискуссий, дебатов и критики со стороны сверстников, в то время как онлайн-студенты сообщали о проблемах, связанных с саморегуляцией и ограниченным взаимодействием со сверстниками. Эти результаты подчеркивают необходимость включения в онлайн-среду обучения большего количества интерактивных элементов и элементов сотрудничества для развития критического мышления. Обсуждаются последствия для педагогического проектирования и будущих направлений исследований.

### **Ключевые слова**

критическое мышление, онлайн-обучение, высшее образование, смешанные методы, педагогика.

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