



IMPROVING CRITICAL THINKING SKILLS AMONG COLLEGE STUDENTS USING COMPUTER-ASSISTED INSTRUCTION (CAI): AN ACTION RESEARCH APPROACH

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ABSTRACT

Critical thinking is an essential higher-order skill in higher education, yet some college students continue to experience difficulties in analyzing information, evaluating evidence, making logical inferences, and solving problems, highlighting the need for responsive instructional interventions. This action research completed in November 2025 examined the use of Computer-Assisted Instruction (CAI) in improving the critical thinking skills of college students. The study employed a single-group pretest-posttest quasi-experimental design involving purposively selected college students from the Teacher Education, Business Administration, and Information Technology programs who initially demonstrated Moderate, Low, or Very Low critical thinking performance. Critical thinking was assessed before and after the intervention using a researcher-developed Critical Thinking Skills Test, while descriptive statistics and a paired-samples t-test were used to analyze the data. The findings revealed a substantial improvement in the participants' critical thinking skills following the intervention, with most participants progressing to higher proficiency levels. The analysis further established a statistically significant difference between the participants' critical thinking skills before and after the implementation of CAI. The findings suggest that Computer-Assisted Instruction can serve as a useful targeted intervention for strengthening students' abilities to analyze information, evaluate evidence, draw logical inferences, and solve problems. It is therefore recommended that CAI be continued for students who demonstrate difficulties in critical thinking, with the integration of more challenging case analyses, simulations, problem-based activities, source-evaluation exercises, and reflective tasks that require students to explain and justify their reasoning.

Keywords: *Computer-Assisted Instruction, critical thinking skills, college students, action research, higher-order thinking skills*

INTRODUCTION

Developing critical thinking skills has become an essential goal in higher education, as it equips students with the ability to analyze, evaluate, and create solutions in both academic and real-world settings (Zhong & Song, 2024). In the context of a faith-based educational institution, this issue has become particularly urgent. It has been observed that students across the three college programs—Teacher Education Program (TEP), Bachelor of Science in Business Administration (BSBA), and Bachelor of Science in Information Technology (BSIT)—struggle with critical thinking, as reflected in their poor conceptual understanding and weak performance in both oral and written tasks. These deficiencies hinder students' academic growth and their potential to become effective professionals in their respective fields (Roohr & Burkander, 2020). As educators, there is a pressing need to explore practical and innovative instructional methods that can improve students' higher-order thinking skills and help them become independent, analytical learners.

One promising approach that has gained attention in educational research is Computer-Assisted Instruction (CAI). CAI refers to the use of computer-based tools and software to deliver instructional content, facilitate guided practice, assess learning outcomes, and provide immediate feedback (Álvarez-Huerta et al., 2022). It has been shown to support differentiated learning, enhance student engagement, and promote autonomy in the learning process. Past studies, such as those by Hitchcock (2004) and Van Peppen et al. (2018), have demonstrated that CAI can be an effective method in improving critical thinking skills when it is designed to include problem-solving tasks, simulations, and interactive feedback.

However, despite this growing body of evidence, there is a notable gap in the literature regarding the use of CAI as an intervention specifically aimed at improving critical thinking among college students in the local context, particularly in a faith-based institution. Existing research primarily focuses on either Western educational settings or specific disciplines, and often fails to consider the broader student population across diverse programs. Furthermore, there has been no documented action research within the institution that examines the direct impact of CAI on critical thinking skills among students who have been identified as having low performance in this area.

Given this gap, there is a clear need for localized, classroom-based research that evaluates how CAI can be effectively implemented as an instructional intervention to address critical thinking deficiencies. This study filled that gap by employing an action research approach that assessed the impact of CAI on improving the critical thinking skills of college students from TEP, BSBA, and BSIT programs, spanning first-year to fourth-year levels.

Research Questions

This study is conducted to enhance the critical thinking skills of college students through the use of Computer-Assisted Instruction (CAI). To effectively guide the investigation and assess the impact of the intervention, the study aimed to answer the following research questions:

1. What is the level of the students' critical thinking skills prior to the implementation of the Computer-Assisted Instruction?
2. What is the level of the students' critical thinking skills after the implementation of the Computer-Assisted Instruction?
3. Is there a statistically significant difference in the students' critical thinking skills before and after the intervention?

METHODOLOGY

Research Design

This study utilized a pretest-posttest quasi-experimental design to evaluate the effectiveness of Computer-Assisted Instruction (CAI) in enhancing the critical thinking skills of college students. This design involved measuring the participants' critical thinking abilities through a standardized test administered before (pretest) and after (posttest) the intervention. By comparing the scores from both assessments, the researcher was able to determine whether a significant improvement in critical thinking skills occurred as a result of the CAI intervention.

Participants of the Study

The participants of the study were college students at a faith-based educational institution in Labason who were enrolled in the Teacher Education Program (TEP), Bachelor of Science in Business Administration (BSBA), and Bachelor of Science in Information Technology (BSIT) for the first semester of academic year 2025-2026.

The sample included students from first-year to fourth-year levels who were identified as having low levels of critical thinking based on initial classroom observations and diagnostic assessments conducted by their instructors. The study utilized purposive sampling, a non-probability sampling technique, to intentionally select participants who meet the specific criterion of exhibiting low critical thinking skills. This sampling method was appropriate for this action research, as it allowed the researcher to focus on a particular group experiencing a common challenge—in this case, limited critical thinking ability—with the aim of implementing and evaluating a targeted intervention.

Research Instrument

To measure the critical thinking skills of college students across the Teacher Education Program (TEP), Bachelor of Science in Business Administration (BSBA), and Bachelor of Science in Information Technology (BSIT), the researcher developed a Critical Thinking Skills Test (CTST) consisting of 20 multiple-choice questions. This standardized test was designed to assess four core components of critical thinking: analysis, evaluation, inference, and problem-solving, based on Bloom's Revised Taxonomy (Anderson & Krathwohl, 2001) and Facione's (1990) framework of critical thinking skills. The structure and format were also inspired by items used in previously published researches, such as Hitchcock (2004), Valencia (2016), and Pilli & Aksu (2013), which investigated the impact of Computer-Assisted Instruction on students' cognitive and academic performance.

Each test item presented a realistic situation or scenario that challenged students to apply higher-order thinking skills rather than recalling facts. The test was structured as follows: Analysis – 5 items (e.g., identifying logical flaws, examining arguments), Evaluation – 5 items (e.g., judging source credibility, assessing evidence), Inference – 5 items (e.g., drawing conclusions, interpreting patterns), and Problem-Solving – 5 items (e.g., proposing solutions, decision-making in contextual problems).

The instrument was administered as both a pretest and posttest, enabling the researcher to measure changes in students' critical thinking skills before and after the implementation of the Computer-Assisted Instruction (CAI) intervention. The test used a multiple-choice format, with each question offering four options and only one correct answer. Each correct response was awarded one point, for a total possible score of 20.

Students' total scores on the CTST were interpreted using a five-level proficiency scale: Very High (17–20), High (13–16), Moderate (9–12), Low (5–8), and Very Low (0–4). This classification allowed the researcher to describe and compare the distribution of critical thinking levels across the Teacher Education Program (TEP), Bachelor of Science in Business Administration (BSBA), and Bachelor of Science in Information Technology (BSIT).

Validity of Instrument

To ensure content validity, the instrument was reviewed by three experts in the fields of education, research, and curriculum development, who evaluated the alignment of items with the target skills and their appropriateness for the college level. Modifications were made based on their feedback, particularly in terms of item clarity and relevance. The CTST provided a practical, objective, and standardized means of assessing the effectiveness of the CAI intervention in enhancing critical thinking skills among college students.

Statistical Tools

To analyze the data gathered in the study, appropriate statistical tools were employed to address each of the research questions.

For research questions 1 and 2, descriptive statistics—specifically, the mean, standard deviation, and frequency distribution—were utilized to analyze the students' pretest and posttest scores and describe their level of critical thinking after undergoing the Computer-Assisted Instruction (CAI).

To answer research question 3, a Paired Sample t-test was used. This statistical procedure was appropriate for comparing the means of two related groups measured at two points in time—before and after an intervention. In this study, it was used to determine whether there was a statistically significant difference between the pretest and posttest scores of the same group of college students who underwent the Computer-Assisted Instruction (CAI) intervention. This method allowed the researcher to assess whether the observed changes in students' critical thinking skills are due to the intervention rather than chance. A significance level of 0.05 was used; a p-value less than 0.05, indicated a significant improvement in critical thinking performance, thereby supporting the effectiveness of the CAI-based instructional strategy.

RESULTS

Table 1 presents the critical thinking skills of the 32 participants before the implementation of Computer-Assisted Instruction. The participants included in the action research were specifically those whose pretest scores fell within the Moderate, Low, and Very Low categories. Students who obtained High and Very High ratings were excluded because they did not demonstrate the learning difficulty that the intervention intended to address.

Table 1. Critical Thinking Skills of the Participants Before the Intervention

Score Range	Interpretation	Frequency	Percentage
17-20	Very High	0	0.00%
13-16	High	0	0.00%
9-12	Moderate	9	28.13%
5-8	Low	18	56.25%
0-4	Very Low	5	15.63%
Total		32	100.00%
Mean		7.03	
Interpretation		Low	
SD		2.26	

Table 2 presents the critical thinking skills of the 32 participants after the implementation of Computer-Assisted Instruction.

Table 2. Critical Thinking Skills of the Participants After the Intervention

Score Range	Interpretation	Frequency	Percentage
17–20	Very High	15	46.88%
13–16	High	6	18.75%
9–12	Moderate	8	25.00%
5–8	Low	3	9.38%
0–4	Very Low	0	0.00%
Total		32	100.00%
Mean		14.72	
Interpretation		High	
SD		3.87	

Table 3 presents the paired-samples t-test comparing the critical thinking skills of the 32 participants before and after the implementation of Computer-Assisted Instruction.

Table 3. Paired-Samples t-Test of the Participants' Pretest and Posttest Scores

Assessment	N	Mean	SD	Mean Difference	<i>t</i>	df	<i>p</i>	Decision
Pretest	32	7.03	2.26	7.69	-9.86	31	< .001	Reject H ₀
Posttest	32	14.72	3.87					

DISCUSSION

Research Question 1: What is the level of the students' critical thinking skills prior to the implementation of Computer-Assisted Instruction?

The results showed that 18 participants or 56.25% demonstrated a Low level of critical thinking, representing the largest group. Nine participants or 28.13% were classified as Moderate, while five or 15.63% obtained a Very Low rating. None of the selected participants attained a High or Very High level because the selection criterion focused only on students who demonstrated a need for intervention.

The participants obtained a mean pretest score of 7.03, which falls within the score range of 5–8 and is interpreted as Low. This finding indicates that, before the intervention, the participants generally experienced difficulty applying critical thinking when responding to situations that required analysis, evaluation, inference, and problem-solving. They may have struggled to identify flaws in arguments, evaluate the credibility of information, draw logical conclusions from available evidence, and determine appropriate solutions to contextual problems.

The standard deviation of 2.26 indicates some variation in the participants' initial critical thinking performance. Although most were classified as Low, the scores were distributed across the Moderate, Low, and Very Low categories. This suggests that the

participants did not have identical learning needs. Those in the Very Low category may have required more structured guidance and foundational exercises, while those in the Moderate category may have needed more challenging opportunities to strengthen and consistently apply their reasoning skills.

Overall, the pretest results confirmed the need for an instructional intervention focused on developing the participants' critical thinking skills. The findings provided an appropriate baseline for the action research and justified the use of Computer-Assisted Instruction as a targeted response to the identified learning difficulty.

Research Question 2: What is the level of the students' critical thinking skills after the implementation of Computer-Assisted Instruction?

The results showed a considerable movement toward the higher proficiency categories. Fifteen participants or 46.88% attained a Very High level, representing the largest group, while six or 18.75% demonstrated a High level. Taken together, 21 participants or 65.63% reached the High and Very High categories after the intervention.

Meanwhile, eight participants or 25.00% were classified as Moderate, while three or 9.38% remained at the Low level. None of the participants was classified as Very Low after the intervention. Compared with the pretest distribution, in which all participants were within the Moderate, Low, and Very Low categories, the posttest findings show that most participants progressed toward more favorable levels of critical thinking.

The participants obtained a mean posttest score of 14.72, which falls within the score range of 13–16 and is interpreted as High. This represents a substantial improvement from their Low pretest level. The finding suggests that, following the intervention, the participants became more capable of examining information, evaluating evidence and sources, making reasonable inferences, and identifying appropriate solutions to given problems.

The standard deviation of 3.87 indicates that the participants' posttest scores became more varied. Although most reached High or Very High levels, some remained within the Moderate and Low categories. This suggests that the participants did not respond to the intervention in the same manner or at the same rate. Differences in engagement, learning pace, prior knowledge, digital familiarity, and ability to apply feedback may have influenced their posttest performance (Rosali, 2020).

The absence of participants in the Very Low category is a particularly favorable outcome. It indicates that even participants who initially demonstrated the greatest difficulty showed some degree of progress. Nevertheless, the three participants who remained at the Low level may still require additional guidance, reinforcement activities, and individualized support.

In summary, the posttest findings indicated that the participants demonstrated a High level of critical thinking after the implementation of Computer-Assisted Instruction. The movement of most participants into the High and Very High categories suggested

that the interactive exercises, guided activities, immediate feedback, and problem-based tasks (Wulansari & Nabawi, 2021) included in the intervention supported the development of their critical thinking skills (Sari et al., 2021). However, an inferential test was necessary to establish whether this improvement was statistically significant.

Research Question 3: Is there a statistically significant difference in the students' critical thinking skills before and after the intervention?

The pretest yielded a mean score of 7.03, interpreted as Low, whereas the posttest produced a mean score of 14.72, interpreted as High. The results showed a mean increase of 7.69 points following the intervention.

The paired-samples analysis produced a computed t-value of -9.86 with 31 degrees of freedom and a p-value of less than .001. Since the p-value is lower than the .05 level of significance, the null hypothesis is rejected. Therefore, there is a statistically significant difference between the participants' critical thinking skills before and after the implementation of Computer-Assisted Instruction.

The significant increase indicated that the change in the participants' scores was unlikely to have occurred merely because of chance. Of the 32 participants, 29 obtained higher posttest scores, one maintained the same score, and only two obtained lower scores. This pattern demonstrates that the improvement was experienced by nearly all participants rather than being produced by only a small number of unusually high posttest scores.

The findings suggested that the Computer-Assisted Instruction was effective in addressing the identified critical thinking difficulties of the targeted participants. Its interactive exercises, guided analysis (Nasution, 2019), problem-solving activities (Wulansari & Nabawi, 2021), and immediate feedback have provided the structured practice needed to help the students examine information, evaluate claims, draw logical conclusions, and make appropriate decisions (Tedla & Chen, 2024).

The result also highlighted the importance of targeting the intervention toward participants with identified learning needs. When the students who already demonstrated High and Very High pretest performance were excluded, the analysis more accurately reflected the outcomes of those for whom the intervention was intended. This approach was consistent with the purpose of action research, which seeks to respond to a specific classroom problem and evaluate an intervention among the learners directly experiencing that problem.

As a whole, the findings provided evidence that the participants' critical thinking skills significantly improved following the intervention. The rejection of the null hypothesis supports the continued use of Computer-Assisted Instruction for students with Moderate, Low, and Very Low critical thinking performance. However, because the study employed a single-group pretest-posttest design, the improvement should be interpreted as being

associated with the intervention rather than as definitive proof that the intervention alone caused the change.

Conclusions

The findings demonstrated that Computer-Assisted Instruction was associated with a meaningful improvement in the critical thinking skills of participants who initially demonstrated Moderate, Low, or Very Low performance. After the intervention, most participants progressed to the High and Very High categories, while none remained at the Very Low level. This indicated that the interactive activities, guided exercises, immediate feedback, and problem-solving tasks provided opportunities for the participants to strengthen their abilities to analyze information, evaluate evidence, make logical inferences, and solve problems.

The significant difference between the pretest and posttest results supports the value of using Computer-Assisted Instruction as a targeted intervention for students experiencing difficulties in critical thinking. The findings also emphasized the importance of identifying the learners who need support before implementing an intervention. Nevertheless, because the study used a single-group pretest-posttest design, the improvement should be understood as being associated with the intervention and not as conclusive evidence that Computer-Assisted Instruction alone caused the change.

Recommendations

Computer-Assisted Instruction may be continued as an intervention for students who demonstrate Moderate, Low, or Very Low critical thinking performance. Future implementation may include more challenging case analyses, simulations, problem-based activities, source-evaluation exercises, and reflective tasks that require students to explain and justify their reasoning. Participants who continue to demonstrate difficulty should receive additional scaffolding, individualized feedback, and follow-up activities based on their specific areas of weakness.

Future action research may extend the duration of the intervention and regularly monitor progress in analysis, evaluation, inference, and problem-solving. Researchers may also use a comparison group, a more comprehensive and validated critical thinking assessment, and qualitative data from observations, interviews, and student reflections. These measures may provide stronger evidence concerning the effectiveness of the intervention and a deeper understanding of how Computer-Assisted Instruction supports the development of critical thinking.

Intervention Program

The intervention consisted of eight sessions over four weeks, conducted twice per week in the college computer laboratory. Each session lasted approximately 60–90 minutes. The sessions followed a structured sequence that progressed from foundational critical thinking concepts to more complex, real-world problem-solving applications.

Activities were based on Bloom's Taxonomy of Higher-Order Thinking Skills, specifically focusing on analysis, evaluation, inference, and problem-solving.

In week 1, students were introduced to the intervention and oriented on how to navigate the CAI platform. The first session involved administering a pre-test to assess students' baseline critical thinking skills. This was followed by an introductory module on the fundamentals of critical thinking, including recognizing facts vs. opinions and identifying assumptions. In the second session of the week, students explored the structure of arguments by analyzing components such as claims, evidence, and logical reasoning. They were engaged in guided activities such as identifying valid and invalid arguments with the help of drag-and-drop tasks and immediate digital feedback.

During week 2, the focus shifted to developing students' analytical abilities. In the third session, students learned to interpret and analyze information using data sets, graphs, and short case scenarios. They were tasked with identifying cause-and-effect relationships and recognizing logical inconsistencies. The fourth session focused on identifying bias and evaluating evidence. Students critically examined different sources of information, such as news articles and opinion pieces, to distinguish between reliable and unreliable evidence. Automated quizzes with real-time feedback were used to reinforce their learning.

In week 3, students began to practice inference and synthesis. The fifth session engaged students in scenario-based learning, where they draw inferences and make predictions from structured data. This was followed by a group simulation where students make decisions based on unfolding events in a realistic problem-solving task. The sixth session involved synthesizing information from multiple sources. Students created digital concept maps to organize and integrate information, demonstrating how different pieces of evidence could be combined to form logical conclusions.

Finally, in week 4, students applied their critical thinking skills to real-world problems. The seventh session involved evaluating alternatives and making decisions in professional or ethical scenarios. Students used a decision-tree tool within the CAI program to track their reasoning and participate in peer reviews to evaluate each other's logic. In the final session, a post-test was administered to measure any improvement in critical thinking skills. The CAI system recorded all performance metrics for further analysis by the researcher.

Compliance with Ethical Standards

The study adhered to ethical standards in the conduct of educational research. Informed consent was obtained from the participants before their participation, and they were informed of their right to withdraw from the study at any time without penalty. The anonymity and confidentiality of the participants were maintained, and data were handled in accordance with applicable Data Privacy principles. The researchers safeguarded the well-being of the participants throughout the conduct of the study and ensured that participation did not cause undue harm or disadvantage. The researchers declared that

there was no conflict of interest in the conduct of the study. Proper acknowledgment of all sources was observed, and plagiarism was strictly avoided. The data were analyzed and interpreted objectively without intentional bias or manipulation of findings, and the results were used solely for research and educational purposes. Artificial intelligence tools were used in the preparation and refinement of the manuscript, and such use is disclosed in accordance with principles of transparency and responsible research practice.

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