

Enhancing Critical Thinking through AI-Assisted Collaborative Task-Based Learning: A Case Study of Prospective Teachers in Japan

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Received 19 April 2024 | Received in revised form 15 May 2024 | Accepted 1 June 2024

APA Citation:

Sako T. (2024). Enhancing Critical Thinking through AI-Assisted Collaborative Task-Based Learning. *Journal of English Language Teaching and Linguistics, 9(2)*, August 2024, 157-170. doi: <http://dx.doi.org/10.21462/jeltl.v9.i2.1319>

Abstract

This study explores the potential of integrating generative AI into collaborative task-based language learning to foster critical thinking (CT) skills in computer-assisted learning environments. Employing a mixed-methods approach, the research examines the experiences of 18 pre-service teachers engaging in AI-assisted collaborative activities. Quantitative analysis of the Critical Thinking Disposition Scale and qualitative analysis using the modified grounded theory approach (M-GTA) reveal that AI tools can alleviate collaboration challenges by bridging perceptual gaps, clarifying objectives, and promoting deeper understanding. The findings suggest that AI-assisted collaborative learning enhances students' intellectual autonomy, creativity, and digital literacy skills. However, the effectiveness of AI tools in fostering collaboration depends on their proper application, the supportive role of educators, and the careful design of evaluation criteria. The study emphasizes the importance of balancing the use of AI tools with authentic language production and highlights the crucial role of educators in moderating discussions and providing guidance where AI tools may have limitations. While the findings offer valuable insights, the study acknowledges its limitations and recommends future research to explore the impact of AI-assisted collaborative learning on CT with larger and more diverse samples.

Keywords: critical thinking, collaborative learning, generative AI, task-based learning, teacher training

1. Introduction

The COVID-19 pandemic has accelerated the shift to computer-assisted learning, compelling educators to rapidly adapt their teaching practices to virtual environments. One of the primary challenges in this transition has been engaging students and fostering interaction and collaboration in computer-assisted classrooms (Vellanki & Bandu, 2021). At the same time, collaborative learning, which emphasizes student interaction and mutual knowledge construction, has also emerged as a powerful approach for enhancing critical thinking (CT) skills (Abrami et al., 2008; Anazifa & Djukri, 2017; Belecina & Ocampo, 2018; Gokhale, 1995; Laal & Ghodsi, 2012; Mutakinati, Anwari & Kumano, 2018; Osborne, 2010; Petersen & Nassaji, 2016; Ramdani, Susilo, Suhadi & Sueb, 2022; Sasson, Yehuda & Malkinson, 2018; Thayer-Bacon, 2000; Warsah, Morganna, Uyun, Hamengkubuwono & Afandi, 2021). CT, a vital skill in the 21st century, is fostered through collaborative problem-solving, as evidenced by a meta-analysis conducted by Xu, Wang, and Wang (2023). Moreover, it has been shown that critical thinking education through Task-Based Language Teaching (TBLT), a concrete example of collaborative learning, is also effective in raising awareness about global issues such as human rights and environmental problems (Farias & da Silva, 2021).

The integration of technology with collaborative learning approaches such as TBLT has gained increasing attention as a framework for designing effective computer-assisted language learning experiences (González-Lloret & Ortega, 2014; Vellanki & Bandu, 2021). However, the effectiveness of technology-mediated task-based language teaching depends on factors like learners' experience with technology, familiarity with tasks, peer commitment, learner autonomy and proficiency, and teacher coaching (Chong & Reinders, 2020). Rusandi, Saripah, Khairun, and Mutmainnah (2023) discuss the role of AI in education and research, focusing on developing CT skills and maintaining academic integrity. Furthermore, Chen, Kirschner, and Tsai (2018), who analyzed 425 empirical computer-supported collaborative learning (CSCL) studies published between 2000 and 2016, suggest that it is crucially important to thoughtfully integrate collaboration and computer use with additional tools and strategies such as group awareness tools, visual representation tools, and collaboration scripts.

As Zhu and Doo (2020) state, in terms of the roles and responsibilities of instructors and learners in technology-enhanced learning, learner autonomy, including self-monitoring and self-management, is required more than before. In collaborative learning as well, instructors will likely need to support students' self-directed learning. In this context, generative AI is now gaining increasing attention because it has the potential to facilitate collaboration among students and support both teachers and learners in the computer-assisted collaborative learning process.

Based on the aforementioned literature, the following question could be formulated:

How can the integration of generative AI in collaborative task-based learning approaches, such as technology-mediated Task-Based Language Teaching (TBLT), enhance the development of CT skills?

This study aims to investigate how generative AI can be effectively integrated into collaborative task-based learning approaches to foster CT skills in computer-assisted learning environments. Furthermore, it seeks to explore how generative AI can help overcome the challenges associated with implementing collaborative learning, such as ensuring participants have the necessary digital skills, assisting teachers in designing suitable tasks and encouraging students' active participation.

2. Literature Review

Collaborative learning is grounded in the philosophy that respect for individual contributions and abilities is essential for meaningful interaction and learning (Laal & Ghodsi, 2012; Paniz, 1996). Closely related to collaborative learning is cooperative learning, which is characterized by positive interdependence, face-to-face promotive interaction, individual accountability, interpersonal and small

group skills, and group processing (Johnson, Johnson & Holubec, 1993). Despite some differences in structure and teacher control, cooperative and collaborative learning share substantial commonalities in facilitating active, student-centered learning experiences (Kirschner, 2001; Prichard & Woollard, 2010). Given the considerable overlap between these approaches, this thesis opts to treat cooperative and collaborative learning collectively under the broader umbrella term of “collaboration” or “collaborative learning,” as suggested by Barkley, Major, and Cross (2014).

Building on the compelling evidence supporting collaborative learning as an effective strategy for enhancing CT and the increasing importance of technology-mediated cooperation or collaboration, it is essential to understand how and why these approaches succeed in fostering CT skills. As Altowairiki (2021) suggests, fostering meaningful online collaboration requires thoughtful preparation, active facilitation by instructors, and alignment of learning tasks and assessments. The instructor must play a key role in creating a supportive environment, modeling expectations, monitoring group processes, and providing ongoing guidance and feedback. In this context, generative AI is expected to have the potential to facilitate cooperation or collaboration among students and support both teachers and learners in the collaborative learning process.

The literature review raises two important research questions (RQ) that warrant concrete investigation:

RQ(1): Given the compelling evidence supporting collaborative learning as an effective strategy for enhancing CT and the increasing importance of technology-mediated collaborative learning, how and why do these approaches succeed in fostering CT skills?

RQ(2): What is the potential role of generative AI in facilitating collaboration among students and supporting both teachers and learners in the collaborative learning process?

These questions aim to deepen the understanding of the mechanisms underlying the success of collaborative learning in promoting CT skills and explore the possibilities afforded by generative AI in enhancing these processes. By addressing these questions, the study seeks to contribute to the growing body of research on technology-enhanced collaborative learning and provide valuable insights for educators and researchers looking to leverage AI tools to support students’ CT development in the context of collaborative task-based learning.

3. Research Methods

3.1 Research Design

This study adopted the design principles outlined by Vincent-Lancrin et al. (2019) for developing collaborative task-based learning activities, which could also be considered useful for integrating generative AI to support students’ CT skills. The relevant design principles for this study include:

1. Creating students’ interest to learn by addressing “big questions” or topics related to their interests, which can serve as motivational triggers for critical problem-solving.
2. Setting challenging goals that are accessible and worthwhile for students to maintain their engagement and create conditions for effective learning and assessment.
3. Developing clear technical knowledge in one or more curriculum domains, as content knowledge is essential for any CT process.
4. Including the development of a visible product or artifact to make the learning process observable and facilitate formative assessment.
5. Having students co-design part of the product or solution to promote their autonomy, agency, and collaboration in the learning process.
6. Dealing with problems that can be looked at from different perspectives, favoring open-ended and exploratory tasks that foster student inquisitiveness and imagination.

7. Leaving room for the unexpected by designing activities and tasks that encourage students to explore and share their personal ideas and venture into unknown territory.
8. Including time and space for students to reflect and give and receive feedback, which helps them become aware of their progress and possibilities for improvement.

By incorporating these design criteria, this study devised concrete teaching plans for a “Cross-cultural Understanding 2” class to investigate the impact of collaborative task-based learning utilizing AI tools on students’ CT and English communication skills, particularly in terms of their ability to express their opinions.

The students were divided into six groups of three and asked to select a lesson of their choice from a textbook on contemporary global issues such as SDGs. They were then required to deliver an explanatory lesson to their classmates and create an English commercial (CM) for a “dream product” that can solve the problem described in the selected lesson, using various AI tools.

The students were given specific instructions on the procedure of the CM making, its time limit, and language use for the CM. They were allowed to use their smartphones for recording and editing, and the instructor supplied necessary equipment such as green screens. The students were introduced and encouraged to AI tools such as DeepL, Quillbot, and ChatGPT (3.5) to assist them in creating the content of CM.

The collaborative process and the resulting CM were evaluated by the instructor and through peer review.

3.2 Participants

The participants were 17 third-year students and one fourth-year student from a teacher training program at a private university in Tokyo, Japan, and they are targeted in this study for the following two key reasons. First, pre-service teachers will play a crucial role in promoting AI integration in future educational settings. Exposing them to AI-assisted collaborative learning allows them to understand its potential and challenges, laying the foundation for educational innovation. Second, the findings will provide implications for developing AI integration competencies within teacher education curricula, contributing to the creation of effective methods for fostering AI literacy among future teachers.

3.3 Instruments

Prior to the study, all participants were informed about the research both verbally and in writing, and their written consent was obtained. The participants were notified of the following:

1. Participation in the research is voluntary, and participants have the right to refuse or withdraw their participation at any time verbally without any negative consequences.
2. The research does not involve any physical or mental burden or risks to the participants.
3. The collected data will be managed with the utmost care and confidentiality.
4. Regarding the publication of results, no personal information will be handled (including anonymous surveys), and the research collaborators (subjects) will not be identifiable by any means, such as not creating a correspondence table that can identify individuals.

The questionnaire was administered to the students during the final class session. In the last item of the questionnaire, students were asked to provide a free-response answer to the following question: “Please describe your thoughts and impressions about this CM production class in as much detail as possible. In particular, please provide specific information on how you used ICT (such as utilizing generative AI tools).”

3.4 Data Analysis

Quantitative analysis was conducted on the results of a questionnaire about the lesson and the Critical Thinking Disposition Scale by Hirooka, Ogawa and Motoyoshi (2000) and Hirooka, Motoyoshi, Ogawa and Saito (2001), measuring students' CT disposition. In Japan, efforts to measure CT orientation have led to the development of this scale, aimed at determining respondents' orientation towards engaging in CT. Subsequent adaptations and validations of this scale have been undertaken by many notable scholars (e.g. Isowa and Minami (2015)) who explored its reliability and validity.

The Critical Thinking Disposition Scale was administered in the first session, the beginning of the course, and in the 14th session, after the completion of the CM production and appreciation sessions, to examine pre-post changes. A questionnaire asking for students' impressions, such as their satisfaction with the lesson, was distributed in the final class session, and 16 students responded (out of 18 enrolled students, 2 were absent on that day). Subsequently, follow-up interviews were conducted to gather students' opinions about the lesson, and the content was analyzed using the modified grounded theory approach (M-GTA), details of which will be explained in section 4.4.

4. Results

4.1 Survey Responses on Educational Activities

Table 1 presents participants' responses to various educational activities, including textbook lectures, commercial production, and group activities. A total of 16 subjects' responses were collected because two students were absent on the day of the survey. Responses were rated on a 5-point scale, with higher scores indicating more positive evaluations.

Table 1: Summary of Survey Responses on Educational Activities (N=16)

Activity Type	Item Description	Mean(M)	Standard Deviation(SD)
Textbook Lecture Explanations	Positive impact on learning	4.44	0.70
	Interest in other groups' classes	4.81	0.53
	Insights gained by comparing classes	4.69	0.46
	Perceived areas for improvement in own class	4.31	0.85
	Willingness to engage in similar opportunities again	4.38	0.78
Commercial Production	Positive impact on learning	4.63	0.48
	Interest in viewing other groups' commercials	4.94	0.24
	Insights gained by comparing commercials	4.88	0.33
	Perceived areas for improvement in own commercial	4.25	0.90
	Willingness to engage in similar opportunities again	4.31	0.92
Group Activities	Positive impact on learning	4.44	0.86
	Ability to collaborate with other members	4.13	1.41
	Insights gained by comparing group efforts	4.50	0.79
	Perceived areas for improvement in group efforts	4.44	1.06
	Willingness to engage in similar opportunities again	4.06	1.25

Note: "CM" refers to visual products by the students as part of the curriculum.

Students showed particularly high interest in creative and interactive elements of the curriculum, as evidenced by the strong engagement with commercial production. The interest in viewing other groups' commercials receives the highest mean score ($M = 4.94$, $SD = 0.24$), indicating that activities which allow for creativity and viewing peers' work are highly valued.

Students valued the opportunity to gain insights through comparing their work with that of other groups. This is particularly notable in the context of commercial production ($M = 4.88$, $SD = 0.33$) and textbook lecture explanations ($M = 4.69$, $SD = 0.46$), suggesting that comparative analysis is an effective learning tool.

The standard deviations, while generally low, indicate some variability in responses, particularly in the ability to collaborate with other members in group activities ($SD = 1.41$) and in the perceived areas for improvement in group efforts ($SD = 1.06$). This variability illustrates differing individual experiences and perceptions, which point will be explored further for a deeper understanding and improvements in the subsequent interviews and their analysis.

4.2 Qualitative Data Analysis

The participants' responses to the questionnaire were analyzed using thematic analysis (Braun & Clarke, 2006). The researcher coded the responses, identifying recurring themes and patterns. The emergent themes are categorized and interpreted in relation to the research questions.

The analysis revealed that the collaborative task-based learning experience using AI tools provided students with a novel and engaging opportunity to develop new skills in video production and editing. Students recognized the potential of AI tools in enhancing their future teaching practices, particularly in creating engaging learning materials and activities. The integration of AI tools facilitated the creative process, enabling students to generate ideas, create visuals, and enhance the overall quality of their CMs. However, students faced challenges in managing time, balancing individual contributions, and aligning their ideas with group members, highlighting the importance of effective collaboration skills. The use of AI tools also raised concerns about the evaluation of students' language skills, as some groups relied heavily on AI-generated content while others actively engaged in speaking tasks.

From this analysis, it follows that integrating AI tools in collaborative task-based learning can enhance prospective teachers' digital literacy skills and prepare them for incorporating technology in their future classrooms. It also implies that teacher training programs should provide opportunities for students to engage in collaborative projects that leverage AI tools to foster creativity, CT, and English communication skills. However, educators must carefully consider the evaluation criteria and process when incorporating AI tools in language learning activities to ensure a fair assessment of students' skills and progress. Balancing the use of AI tools with authentic language production is crucial to maintain the focus on developing students' communication skills.

4.3 Analysis of Critical Thinking Disposition Scale

According to Hirooka, Ogawa and Motoyoshi (2000), a principal component analysis of the 30-item Critical Thinking Disposition Scale reveals three main components: I. Objectivity, II. Honesty, and III. Curiosity. To investigate the impact of the intervention on these components, Wilcoxon signed-rank tests are conducted to compare the pre- and post-intervention mean scores for each component. The results show no significant differences between the pre- and post-intervention scores for any of the three components (I. Objectivity: $Z = -1.31$, $r = -0.31$, $p = 0.19$; II. Honesty: $Z = -0.96$, $r = -0.23$, $p = 0.34$; III. Curiosity: $Z = -0.96$, $r = -0.23$, $p = 0.34$).

Although the overall mean scores did not show significant differences between the pre- and post-intervention assessments, two students (B and R) demonstrated notable increases in their individual mean scores across the 30 items, with an increase of 1.5 or more points. These students showed substantial changes (3 points or more) in their responses to items 2, 6, 11, 12, 18, 21, and 22 (see

Appendix for each item). Judging from these items, it is evident that the attitude of analyzing and evaluating “based on reason and evidence” has been enhanced. In terms of CT dispositions, this reflects the attitude of “emphasis on evidence” as described by Kusumi (2011) and the increase in “intellectual autonomy” as mentioned by Paul and Elder (2002).

To further investigate the factors that may have contributed to these changes in students B and R, semi-structured interviews were conducted with the members of their respective groups (6 students in total). The follow-up interviews specifically aimed to explore (1) what, if any, aspects of the group interactions might have influenced the transformation of the students’ CT dispositions and (2) whether the use of AI tools had any role in these changes.

4.4 Qualitative Data Analysis using M-GTA

The qualitative data from the interviews were analyzed using M-GTA, a theory-generating method that interprets the process of transforming relationships between multiple concepts through continuous comparative analysis (e.g., Kinoshita, 2007; 2020). GTA is characterized by its data-based principles and orientation towards theory generation, making it particularly effective for research that seeks to understand transformative phenomena (Saiki, 2019). Following Kinoshita’s (2003) proposal that M-GTA can be used to summarize analysis results even when theoretical saturation has not been reached, the M-GTA analysis conducted in this study was processed in three stages: (1) generating explanatory concepts based on interview transcription data, (2) creating categories to clarify the relationships between multiple concepts, and (3) creating a storyline and a result diagram of the analysis results. The qualitative data analysis software NVivo 14 was used for these tasks.

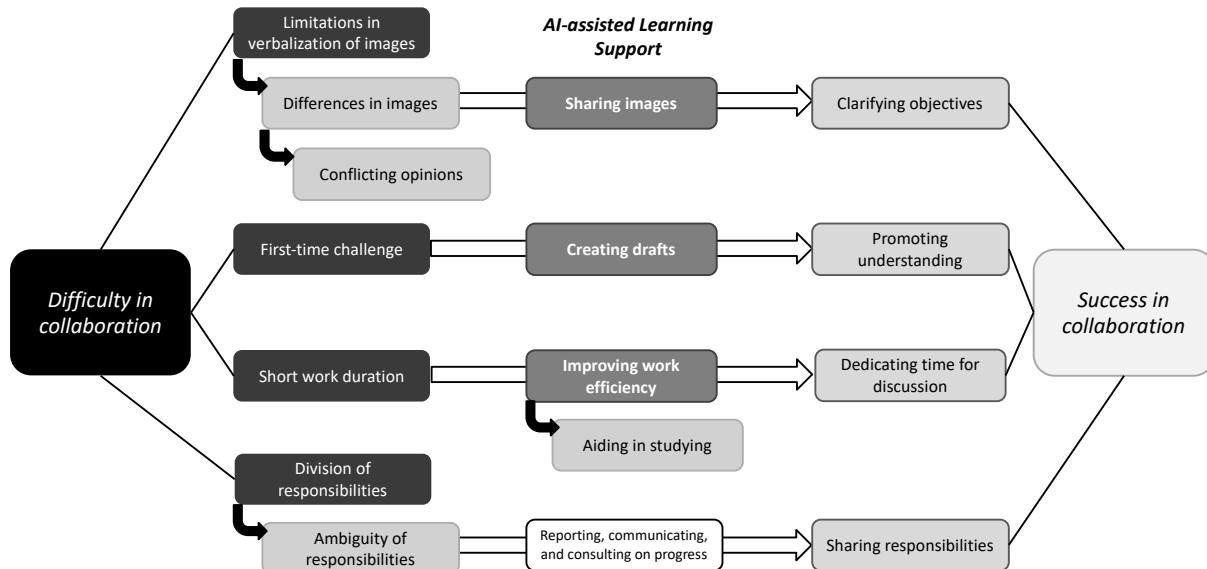
Using the analysis sheet, as proposed by Kinoshita (2007; 2020), 16 different concepts were generated based on the interview data. Simultaneously, three categories were generated by organizing the relationships between concepts, and a result diagram was created. Below are examples of representative concept analysis sheets, a result diagram, and a storyline.

Table 2: Analysis Sheet (Example 1)

Theme of Analysis	How the collaborative process is influenced when AI support is available
Focal Person	Student (learner)
Concept Name	Differences in images
Definition	Gaps between the images, perceptions, and understandings that each individual has regarding the task
Specific Examples (Excerpt)	<i>“There were some parts where what we wanted to shoot and the image I had in mind were a bit different.”</i>
Translated by the Author	<i>“The differences in our images didn’t come up at all when we were discussing.”</i>
The parts in parentheses () have been added by the author for context clarification.	<i>“When we actually got to the filming stage and tried it out, we noticed the discrepancies.”</i> <i>“For example, when I said, ‘Let’s take a picture like this,’ he was like, ‘Huh?’ and I felt something was off, like, ‘Huh? This seems a bit different from what I had in mind.’”</i> <i>“When there were two images, there was a conflict about which one would have a stronger (impact) as a video.”</i> <i>“I consistently thought that sharing images was definitely a challenge.”</i>
Theoretical Note	When each person’s imagined ideas are different, it can be difficult to fully convey them through verbalization alone. In such cases, by generating images using generative AI and sharing those images, it becomes visible where the discrepancies in imagination are occurring. This is a process of visualizing the substance of “friction”.

Table 3: Analysis Sheet (Example 2)

Theme of Analysis	How the collaborative process is influenced when AI support is available
Focal Person	Student (learner)
Concept Name	Sharing responsibilities
Definition	Not only understanding one's own responsibilities but also accurately understanding the work content of other group members and keeping an eye on them
Specific Examples (Excerpt) Translated by the Author The parts in parentheses () have been added by the author for context clarification.	<p><i>"I realized that (the other members) were really more involved."</i></p> <p><i>"(The other two members) were also saying things like, 'I think this (footage) would be good for the intent of the video.'"</i></p> <p><i>"(It's important to) be able to explain even what's not your own responsibility."</i></p> <p><i>"When explaining the work assigned in class, the other members, even if they weren't in charge of it themselves, (they understood it)."</i></p> <p><i>"I thought maybe it would have been better if we didn't completely divide the work, but also got a little involved in other areas."</i></p> <p><i>"What's important is that you can explain the responsibilities and roles of others, not just your own."</i></p>
Theoretical Note	In collaborative work, it may seem that individual work is streamlined by dividing and assigning roles and responsibilities in advance. However, this attitude leaves "tasks that no one was assigned to do" untouched, resulting in ambiguity of responsibility. The key to success in collaboration is how well this responsibility can be "shared".

**Figure 1:** Result Diagram

Storyline

Note: In the following storyline, concepts are enclosed in quotation marks (" "), and categories are italicized.

In “first-time challenges” like creating a CM video, the success of collaboration greatly influences the quality of the final product. Students feel “limitations in verbalization of images”, which leads to “differences in images” and “conflicting opinions” among group members. Additionally, the “short work duration” and the “division of responsibilities” can lead to “ambiguity of responsibilities”. All these elements contribute to the *difficulty in collaboration*.

AI-assisted Learning Support can alleviate some of these elements of *difficulty in collaboration*. First, “differences in images” can be mitigated by the image generation function of generative AI, which makes “sharing images” easier. This, in turn, enables “clarifying objectives” when “conflicting opinions” arise, a challenge that was previously difficult to overcome.

In “first-time challenges”, students often feel overwhelmed and don’t know where to start. However, by using generative AI, they can get help in “creating drafts”, overcoming the difficulty of starting from scratch, which ultimately “promotes understanding” of the task.

The “short work duration” can be managed by effectively utilizing AI tools to “improve work efficiency” and “aid in studying”. The time saved can then be “dedicated to discussion”.

“Clarifying objectives”, “promoting understanding”, and “dedicating time for discussion” greatly contribute to the *success in collaboration*.

On the other hand, one challenge that AI tool support may not effectively address is the “ambiguity of responsibilities”. In successful collaborative groups, “reporting, communicating, and consulting on progress” are well-managed, resulting in the promotion of “sharing responsibilities”. In groups where collaboration is insufficient, even with the support of AI tools, “reporting, communicating, and consulting on progress” may not function properly. This is an area where teachers should actively provide support as facilitators.

This qualitative data analysis revealed the dynamics of students’ experiences and perceptions in AI-assisted collaborative learning. In particular, the process by which generative AI reduces barriers to collaboration among group members and promotes intellectual autonomy and CT was described in detail. The importance of the effective utilization of AI tools and the supporting role of teachers was also highlighted.

5. Discussion

The results of this study provide valuable insights into the potential of AI-assisted collaborative learning for promoting CT skills in prospective teachers. The image generation and draft creation functions of generative AI can help alleviate barriers to collaboration among group members, such as cognitive dissonance in goal recognition and differences in perceptions. When generative AI moderately reduces such “friction” caused by conflicting opinions and dissatisfaction, it improves the students’ recognition of the importance of engaging with and evaluating opposing viewpoints fairly, a crucial aspect of CT highlighted by Paul and Elder (2020). Moreover, by facilitating the exchange of ideas and the recognition of diversity among members, AI tools enhanced the students’ “intellectual autonomy.” Paul (1995) characterizes “intellectual autonomy” as gaining “command over one’s thought process” and “it entails a commitment to analyzing and evaluating beliefs on the basis of reason and evidence” (p. 534). The analysis of the Critical Thinking Disposition Scale revealed that some students showed notable changes in specific items related to CT attitudes, particularly in “emphasis on evidence” and “intellectual autonomy.” The follow-up interviews and subsequent M-GTA analysis shed light on the concrete mechanisms underlying these changes. With this regard, the collaborative activities in this study encouraged the students toward independent thinking.

Moreover, AI-assisted work efficiency and understanding support make it easier for students to comprehend the task, promoting their learning and the development of their thinking skills. This, in a broader sense, contributes to the growth of their CT. Specifically, as part of the teacher training course,

integrating AI tools in collaborative task-based learning can enhance their digital literacy skills as prospective teachers and prepare them for incorporating technology in their future classrooms.

However, the effectiveness of AI tools in promoting collaboration depends on their successful utilization for reporting, communicating, and consulting on progress during the production process. Although Sahija and Cruz (2022) assert that ICT provides assessment tools for students to evaluate their understanding and academic progress and also enables flexibility in problem-solving, in this study, AI tools were not effectively used for these purposes, resulting in differences in the degree of success in collaboration between groups. Frequent reporting, communication, and consultation can surface “friction,” but groups that allocated extra time, generated with the help of AI, for thorough discussions successfully overcame this friction and demonstrated resilience. Saha, Mani and Narayanan (2023) stress the significance of a symbiotic partnership between humans and AI systems, where AI provides computational power, data analysis, and automation while humans contribute domain knowledge, intuition, and context. The role of the teacher’s support should lie in facilitating these discussions and providing guidance with their domain expertise, teaching experience, intuition, and contextual knowledge, where AI tools may not be effective.

From the analysis of the questionnaire, it should be pointed out that educators must carefully consider the evaluation criteria and process when incorporating AI tools in language learning activities to ensure a fair assessment of students’ skills and progress. As Jia, Sun, Ma and Looi (2022) demonstrate the feasibility of leveraging AI and mobile technologies to facilitate authentic, contextualized English vocabulary and grammar learning for L2 students, balancing the use of AI tools with authentic language production is crucial to maintaining the focus on developing students’ communication skills. Teacher training programs should provide opportunities for students to engage in collaborative projects that leverage AI tools to foster creativity, CT, and English communication skills while addressing the challenges associated with assessing AI-assisted learning.

This practice has shed light on the mechanisms by which the educational benefits of diverse perspectives, as advocated by Vygotsky’s social interaction theory (Vygotsky, 1980; Dillenbourg, Baker, Blaye & O’Malley, 1996), occur in AI-assisted collaborative learning. It has also revealed how generative AI can be helpful in this process and where human teachers should focus their support.

6. Conclusion

This study sought to investigate the potential of integrating generative AI into collaborative task-based learning approaches to foster CT skills within computer-assisted learning environments. The findings provide valuable insights into the factors contributing to the success of collaborative learning in promoting CT skills and the prospective role of generative AI in facilitating student collaboration and supporting both educators and learners throughout the collaborative learning process.

The qualitative analysis using M-GTA revealed that AI-powered learning support can alleviate collaboration challenges by bridging perceptual gaps, clarifying objectives, and promoting a deeper understanding of the assigned task. The visual generation and content drafting capabilities of generative AI can help reduce cognitive dissonance among team members and encourage the free flow of ideas, thereby enhancing students’ intellectual independence and autonomous thinking. Moreover, AI tools can improve productivity and provide study support, allowing more time for meaningful discussions, which are crucial for successful collaboration.

However, the effectiveness of AI tools in fostering collaboration depends on their proper application for reporting, communicating, and consulting on progress throughout the production phase. The study highlighted the importance of the educator’s role in moderating these discussions and providing guidance with their subject matter expertise, pedagogical experience, intuition, and contextual understanding, where AI tools may have limitations.

The research also emphasized the need for careful consideration of assessment criteria and procedures when incorporating AI tools in language learning activities to ensure an equitable evaluation of students' abilities and progress. Striking a balance between the use of AI tools and authentic language production is essential to maintain the focus on developing students' communication competencies.

While these results provide helpful implications, it is important to note the limitations of this study, such as the small sample size and the focus on just a couple of students who demonstrated notable changes in their CT dispositions, which limit the generalizability of the findings. Future research should explore the impact of AI-assisted collaborative learning on CT with larger and more diverse samples, employing rigorous research designs to establish causal relationships between AI tool use, group interactions, and the development of CT skills. Additionally, investigating the factors that contribute to individual students' changes in CT dispositions could provide valuable insights for optimizing AI-assisted collaborative learning experiences.

In conclusion, this study contributes to the growing body of research on technology-enhanced collaborative learning by providing insights into the mechanisms through which generative AI can nurture CT skills in prospective educators. The findings suggest that integrating AI tools in collaborative task-based learning can enhance students' digital literacy skills, creativity, and CT while preparing them to incorporate technology in their future classrooms. However, the success of AI-assisted collaborative learning is contingent upon the effective utilization of AI tools, the supportive role of educators, and the meticulous design of evaluation criteria and processes. Future research should further investigate the long-term impact of AI-assisted collaborative learning on students' CT skills and explore the most effective strategies for integrating AI tools in various educational contexts while addressing the limitations of this study.

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APPENDIX

Critical Thinking Disposition Scale

Instructions: Please indicate how well each statement describes you using the following 7-point scale: 7 - Strongly agree 6 - Agree 5 - Somewhat agree 4 - Neither agree nor disagree 3 - Somewhat disagree 2 - Disagree 1 - Strongly disagree

Items:

1. I question things that ordinary people do not even think about.
2. I make judgments with a calm attitude, not when I am in an excited state.
3. I look at both the good and bad aspects of things.
4. I do not become dogmatic or stubborn.
5. I do not believe in anything without having some doubts.
6. I try to seek all evidence, including those that are favorable and unfavorable to my position.
7. I can clearly distinguish between what is relevant and irrelevant to the problem.
8. I put a lot of effort into solving problems.
9. I do not hesitate when it is time to draw conclusions.
10. I can respect other people's opinions.
11. I like to take on new challenges.
12. When making judgments, I place more importance on facts and evidence than on personal relationships.
13. I try to consider all perspectives, not just one or two.
14. I can make compromises when necessary.
15. I am concerned about the presence or absence of solid evidence.
16. I strive to understand opinions that differ from my own.
17. I can construct arguments logically.
18. I examine all possible facts and evidence to the best of my ability.
19. I take actions based on evidence.
20. I accept excellent claims or solutions put forward by others.
21. I read books and am well-versed in various fields.
22. When making judgments, I try not to be influenced by my own preferences.
23. I try to make unbiased judgments.
24. When a problem cannot be solved in one way, I try various other ways.
25. I explore other possibilities when claims seem to have weak evidence.
26. I support what is right, even if it goes against my own position.
27. I keep conclusions directly derived from the evidence, without making unreasonable logical leaps.
28. I continue to seek answers even when others have given up.
29. I follow through on what I have decided to do until the end.
30. I recognize that my own thoughts are just one perspective.