The Effectiveness of Visual Mind Mapping Strategy for Improving English Language Learners' Critical Thinking Skills and Reading Ability

Wafa' A. Hazaymeh[*] iD
Al-Ain University, UAE

Moath Khalaf Alomery iD
Al-Ain University, UAE

Abstract: This study investigated the effectiveness of visual mind mapping as a reading strategy for improving English language learners' critical thinking skills. Students from two general English courses were randomly assigned to experimental and control groups. California Critical Thinking Test was used to assess participants' critical thinking skills. The findings revealed a statistically significant difference at ($p < .005$) in the mean scores of the experiment and control groups in the post-test due to visual mind mapping strategy in favor of the experimental group with a positive and significant impact on participants' critical thinking skills. The findings also showed that the experimental group's scores were significantly improved in all indicators of critical thinking. The study results showed that visual mind mapping strategy affected the increased of critical thinking skills and reading comprehension ability. The study's findings revealed that using a visual mind mapping strategy had a significant improvement impact on English language learners critical thinking skills and reading ability.

Keywords: *Critical thinking skills, English language learners, visual mind mapping.*

Introduction

Critical thinking skills have been incorporated into the learning process as essential skills for building students' knowledge, solving problems, evaluating contents, acquiring reading comprehension, and, most importantly, increasing students' learning awareness to facilitate the learning process, particularly when teaching English language skills. Yang and Wu (2012) stated that learners need to be actively involved in communication processes to achieve this, problem-solving, analysis, synthesis, evaluation, and reflection through thinking critically; therefore, instructors need to select activities and tasks to help develop students' thinking levels. Technological tools, such as visual mind mapping, may create activities that improve students' critical thinking skills. Gillies and Haynes (2011) proposed redesigning learning approaches to meet college students' demand for adequate classroom engagement while also expanding their critical thinking skills. As a result, there are websites dedicated to assisting both instructors and students in exploring the relationship between critical thinking and their discipline area.

Visual mind mapping can be used as a tool to help learners discover, analyze, and share ideas and thoughts visually. Rosciano (2015) specified that visual mind mapping is a useful resource for developing and implementing activities that promote various levels of students' thinking skills, such as note-taking, analyzing, completing assignments, preparing for exams, and reflecting on their practices. Long and Carlson (2011) also stated that by using the mind mapping strategy instead of the conventional, students could create links between non-linear ideas that improve students' comprehension of the content and critical thinking skills.

According to Buzan (2018), a mind map is a revolutionary thinking tool that can help learners process information, create new ideas, improve the way they study, increase their power of creative thinking via a diagram used to organize information hierarchically. It can also help learners brainstorm and organize ideas to be presented directly or saved online on specified cloud computing services. As stated by Eppler (2006), mind mapping is simply an associational tool that connects concepts using diagrams and pictures in order to promote students' creative thinking and brainstorming. Most previous studies, however, focused on mind mapping in general, with little research into the use of visual mind

---

[*] **Corresponding author:**
Wafa' A. Hazaymeh, Al-Ain University, College of Education, United Arab Emirates. ✉ wafa.hazaymeh@aau.ac.ae

mapping strategies to improve undergraduate students' critical thinking skills and reading ability in the UAE. It has also been observed that Emirati undergraduate students struggle with reading skills (Eppard et al., 2020). Because of the facts stated above, critical thinking may be regarded as a necessary component contributing to students' success in learning English skills. Students will be able to successfully develop English language skills such as reading, listening, speaking, and writing if they develop critical thinking skills (Irawati, 2014). As a result, teachers must train their students to acquire or develop critical thinking skills while learning English. Learners may also fail to acquire English skills or comprehend the reading context if they do not practice critical thinking skills in the classroom. When teaching language in different contexts, English teachers may face challenges in transforming their students into critical thinkers and improving their reading skills. As a result, the most effective solution proposed here is to teach critical thinking and assist students in grasping and comprehending the main ideas of the reading texts by employing an effective strategy or technique. Accordingly, in order to contribute to the literature, the current study was designed and carried out to investigate the efficacy of a visual mind mapping strategy for improving students' critical thinking skills and reading abilities in an English language context. As a result, the study sought to provide answers to the following questions:

1. Is there a significant difference in the mean scores of the experimental and control groups on a critical thinking test?

2. Does the visual mind mapping strategy have a significant impact on students' critical thinking skills and reading ability?

Literature Review

The most recent educational trend has emphasized the importance of critical thinking skills development as a core component of the curriculum by designing some classroom activities for a college intensive reading course in an English classroom (Feng, 2013; Tang, 2016).

Harizaj and Hajrulla (2017) believe that stimulating students' thoughts through activities, projects, essays, debates, and discussions is necessary for university students to achieve reading comprehension and high academic performance. Because critical thinking poses a significant challenge for teachers (Feng, 2013), Paul and Elder (2019) argue that critical thinkers should be the primary goal of all academic institutions. As a result, it is critical to provide students with the necessary skills to logically and reasonably solve real-life problems, and instructors must motivate students to be innovative thinkers in order to make better decisions and make life a little easier (Moore et al., 2012). According to Santiago (2011), visual mapping can be used by learners to explicitly explore, analyze, synthesize, and share ideas. It also teaches students how to structure and organize information, as well as connect one concept to another, all of which improves their critical thinking skills and reading ability.

Jain (2015) stated that mind mapping is a visual form of note-taking that provides an overview of a topic and its complex information, enabling students to comprehend reading, generate new ideas, and make connections. The main idea should be in the center of the map, and it should be expanded externally into sub-ideas using colors, words, images, and arrows. This mapping technique could be an effective brainstorming technique as well as a useful note-taking tool for students to visualize and communicate their thoughts and ideas with their classmates. Besides, Ningsih and Said (2018) showed that students who used mind mapping as a teaching tool got higher scores than those taught by a group discussion strategy. Besides, they concluded that learning with mind mapping had a positive effect on students' learning outcomes. According to Buzan (2018), Mind mapping was an innovative form of note-taking combined with words and colors. It was transformed into a web-based mind mapping software, "MindMeister". Students can customize their mind mapping with MindMeister by selecting the best structure, style, and colors for efficient study. It also helps students visually and efficiently capture, develop, and share ideas online. The benefit of MindMeister is to help students think deeply and critically to generate more relevant ideas. Students can also add videos, comments, or attach different types of files to their maps.

Reading comprehension, on the other hand, has emerged as a topic of interest for a variety of researchers. A number of studies have found that using mind maps can help students improve their reading comprehension in a context (Gómez & King, 2014; Liu et al., 2010; Malekzadeh & Bayat, 2015; Mohaidat, 2018; Trang, 2017). Liu et al. (2010) indicated that a computer-assisted concept mapping learning strategy greatly benefits English language college students' reading comprehension through the listing, enforcing, and reviewing. According to Gómez and King (2014), images, symbols, and links in mind maps assisted learners in making connections between the vocabulary in the texts and these images and symbols. These factors were very effective in assisting learners to better understand the texts and recall the information. A study by Malekzadeh and Bayat (2015) investigated the impact of mind mapping on understanding and comprehending ideas in English texts. The findings revealed that using a mind map to improve students' English reading comprehension was very effective. Mohaidat (2018) found that using electronic mind maps in teaching reading texts has an effect on the development of students' reading comprehension and empowers students to understand texts and extract ideas. Additionally, Trang (2017) who studied the effects of concept mapping on students' reading comprehension had concluded that students had a positive attitude towards concept mapping because it was beneficial and suitable tool for learning reading lessons.

In light of the foregoing, it is worth noting that, despite its demonstrated efficacy, the visual mind mapping strategy is not widely used by instructors at various instructional levels (Santiago, 2011). Some studies were on the effect of mind mapping to broaden students' critical thinking skills and enhance their understanding of the content being presented (Buzan, 2018); Long and Carlson, 2011). Few studies have been conducted with undergraduate English teachers to foster college students' critical thinking skills through the design of some classroom activities for college intensive reading courses in English classrooms (Tang, 2016). Several studies have been on investigating the effect of mind mapping in general is focused (Jain, 2015; Ningsih & Said, 2018). As previously stated, the majority of research conducted to investigate the effects of mind mapping on EFL students' reading comprehension (Gómez & King, 2014; Harizaj & Hajrulla, 2017; Liu et al., 2010; Malekzadeh & Bayat, 2015; Mohaidat, 2018; Trang, 2017).

What is Critical Thinking?

According to Facione (2015), critical thinking is a higher-order cognitive skill that students need to be successful in their personal and professional lives by acquiring knowledge through the process of analyzing and thinking rather than simply accumulating information. He went on to say that these cognitive skills are at the heart of critical thinking, which consists of six types of skills: interpretation, analysis, evaluation, inference, explanation, and self-regulation. He also subdivided critical thinking skills into sub-skills, which encourage students to participate in practical activities to enrich their learning environment, as shown in Figure 1.
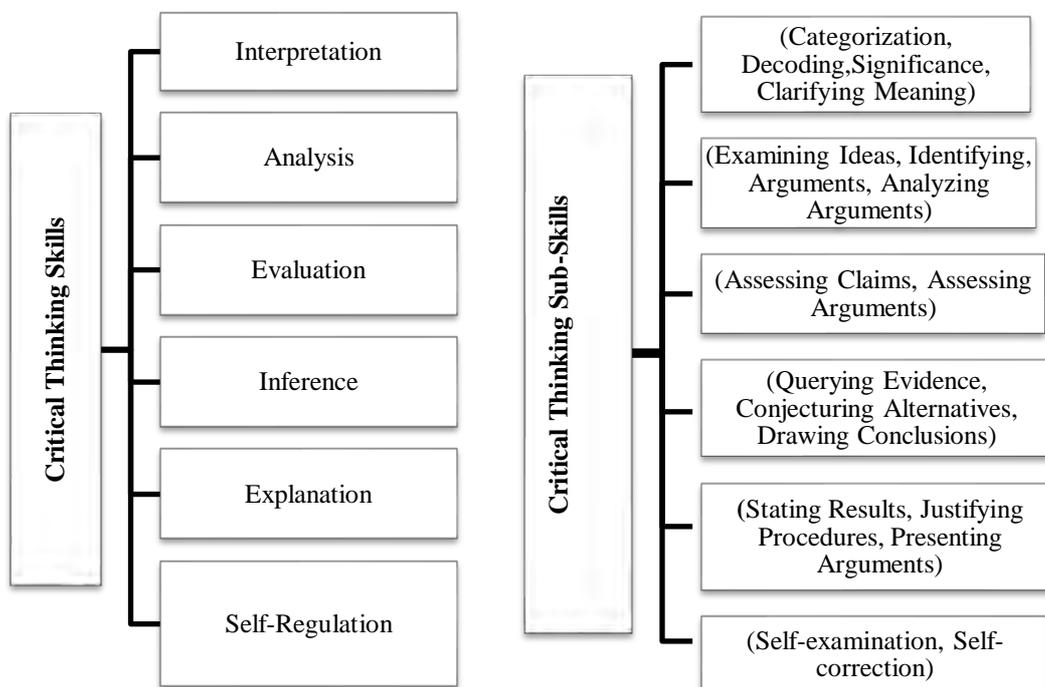

Figure 1. Core Critical Thinking Skills and Sub-Skills

Moreover, based on the six levels of Bloom's Taxonomy generated to promote higher thinking skills in education, instructors should identify a core set of questions related to the given skills, as illustrated in Table 1. The six types of questions are remembering knowledge, understanding facts and ideas, applying principles to solve problems, analyzing reading text into components to deduce their correlated relationship, evaluating ideas to judge correctly, and creating designs to demonstrate creativity (Yang & Wu, 2012). When students become familiar with these questions, particularly those at the highest levels of the Bloom's Taxonomy that test their critical and creative thinking abilities, they might be able to develop critical thinking skills and comprehend reading text more effectively.

Table 1. Types of Critical Thinking Skills Levels and Questions

Critical Thinking Levels	Critical Thinking Skills	Critical Thinking Questions
Lower levels		
Remembering	define, memorize, repeat, state, list, describe, retrieve, duplicate	What are the features of…? How can you describe…? What do you know about…?
Understanding	explain, classify, describe, recognize, discuss, identify, locate, report, select, translate, generalize, predict, estimate	Classify the… or describe the… What does it …. mean? What will happen….?
Higher levels		
Applying	use, solve, implement, execute, demonstrate, operate, interpret, schedule, sketch, carry out, show	How could you solve this problem? What would happen if you implement…? Show how could you carry out the…?
Analyzing	differentiate, organize, relate, compare, contrast, distinguish, deconstruct, examine, experiment, question, test	Compare and contrast between… How can you distinguish between the… and…? Why is it necessary to examine…?
Evaluating	appraise, argue, defend, judge, select, support, value, critique, weigh, conclude	What is the conclusion of …? Criticize why…. is the best solution? Select the best/worst decision you made in your life? How does… support?
Creating	design, assemble, construct, conjecture, develop, formulate, author, investigate, produce, plan	How can you design this lesson? What do you think is the best plan for…? Why? Formulate a system for…?

Adapted from Brown University's Harriet W Sheridan Centre for Teaching and Learning

As suggested in Table 1, associating the correct question with a specific skill could be a key value for assisting teachers and students in designing and implementing visual mapping to improve students' critical thinking skills and reading ability.

Methodology

Participants

The participants were 42 undergraduate English language students ranging in age from 18 to 22 years. They were enrolled in two general English courses during the first semester of the 2020-2021 academic year. Students were randomly assigned to an experimental group of 21 students taught through visual mapping as a reading strategy and a control group of 21 students taught using the conventional strategy. Both groups are given the same reading material. These courses were taught online via Microsoft Teams due to Coronavirus disease (COVID-19) Pandemic. It means that participants were taught in an e-learning environment that facilitates their learning process and stimulate their creativity. A visual mind mapping strategy was implemented to help accomplish the course learning outcomes, in which students have to utilize critical thinking in their learning process.

Treatment and Procedures

The researcher investigated the effect of the visual mind mapping strategy to improve participants' critical thinking skills through using MindMeister. Both groups are given the same reading material. To ensure that the participants were effectively using the visual mind mapping strategy to stimulate their critical thinking skills and organize their brainstorming ideas, they were asked to analyze and map out four reading texts taken from Passages Level 1 Student's Book of Richards and Sandy (2014). First, the researcher instructed the participants on how to create mind maps using MindMeister. In addition, students watched a tutorial video created by Buzan (2018) on how to customize and embellish their MindMeister maps.

The participants were then asked to discuss an article about critical thinking skills before beginning the study. The researcher and the experiment group then practically analyzed a reading text and created a mind mapping to ensure the effectiveness of the visual mind mapping strategy in improving participants' critical thinking skills. Following that, the experimental group was asked to analyze and comprehend four reading texts: "Chiang Mai, A Cultural Rule in Japan, Why Sleep?" Small Talk " using MindMeister. They were asked to design the visual mind mapping displaying the connections between main ideas, supporting ideas such as examples, and conclusions found in the text. Each student shared his or her maps with the other participants on Google Drive to be analyzed and corrected. Then the visual mind maps were checked

by the researcher to collect students' scores. Participants were following the steps of designing a visual map via MindMeister as clarified in Figure 2 below. The same four reading texts were taught to the control group through the traditional strategy but without using visual mind mapping strategy. The treatment period lasted eight weeks.
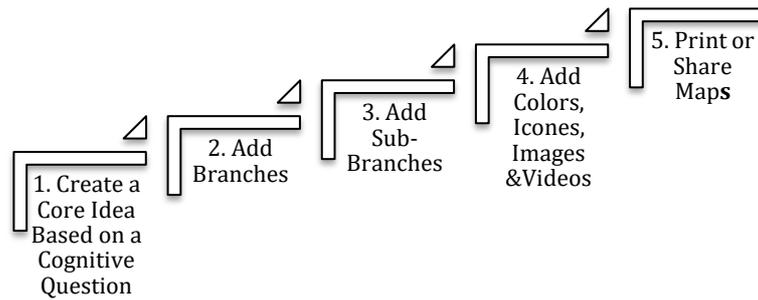

Figure 2. Steps for Creating a Mind Map with Meister

Instrument

The California Critical Thinking Skills Test (CCTST) was used as a pre-test and post-test to collect data for this study. The CCTST is a series of tests designed to assess students' critical thinking and reasoning abilities in solving authentic problem scenarios, which are required for sound decision making (Facione, 2015; Khalili & Hossein Zadeh, 2003). Thus, the CCTST items were chosen from a collection of previously used items to test critical thinking skills based on the participants' levels to gain information about their critical thinking skills and reading ability. It included five critical thinking skills indicators: interpretation, analysis, inference, explanation, and evaluation. Each of these indicators consisted of five multiple-choice questions, for a total of 25 multiple-choice questions based on daily scenarios, and each of these indicators was assigned a score. It had to be answered in 50 minutes.

The participants were required to carefully read the given scenario, comprehend the question, draw an inference, and select the best option that suited the question. Following the completion of the test, the five indicators were scored and the percentages assigned to three levels of value: 0-40%: below average (low value), 41-60%: average (good value), and 61-100%: above average (excellent value). The pre-test was administered to both groups two weeks before the treatment. Similarly, the post-test was carried out two weeks after the treatment. The quantitative data from both tests were analyzed by means of independent sample t-test by SPSS.

Findings/ Results

The study sought to determine the efficacy of a visual mind mapping strategy in improving the critical thinking skills and reading ability of English language learners. As a result, the pre-test and post-test scores were quantitatively obtainable in order to achieve the study's purpose and answer the proposed questions. The scores of the participants were statistically analyzed. Table 2 below describes the pre-tests results of the experimental and control groups.

Table 2. Descriptive Group Statistics for the Pre-tests

Groups	N	Mean	Standard Deviation	Std. Error Mean
Experimental	21	38.88	8.74	2.18
Control	21	38.19	11.26	2.80

According to the above table, the mean value of the experimental and control groups in the pre-tests was nearly identical at 38.88 and 38.19, respectively. Furthermore, an independent samples t-test is used to determine whether there is a significant difference between the two groups. The results of the independent sample test are shown in Table 3 below.

Table 3. Pre-test Scores Statistics

Groups	Mean Difference	Std. Error Difference	t	Sig. (2-tailed)
Pretest Results	.687	3.56	.193	.848

According to Table 3, the row data should be retained for more analysis because the p-value of the pre-tests is greater than 0.05, indicating that there was no significant difference in the pretest results between the experimental and control groups. Table 4 below describes the post-tests results of both groups.

Table 4. Descriptive Group Statistics for the Post-tests

Groups	N	Mean	Standard Deviation	Std. Error Mean
Experimental	21	65.69	11.80	2.95
Control	21	54.13	11.20	2.80

Table 4 presented that the mean scores of the post-tests given after teaching the experimental and control groups which were 65.69 and 54.13, respectively, indicating that teaching with a visual mind mapping strategy was superior to teaching with a traditional strategy. To be certain about the effectiveness of the visual mind mapping strategy, the independent sample t-test was used, as shown in Table 5.

Table 5. Post-test Scores Statistics

Groups	Mean Difference	Std. Error Difference	t	Sig. (2-tailed)
Posttest Results	11.56	4.07	2.84	.000

According to Table 5, the experimental group's mean result is greater than the control group by the specified value ($p < .005$), indicating that visual mind mapping is more effective in English classrooms than the traditional strategy. Furthermore, based on the average scores, the pre-test and post-test scores in both groups were categorized into three values: low value, good value, and excellent value, as shown in Table 6.

Table 6. Scoring Percentages of the Pre-test and Post-test Scores

Items	Experimental Group		Control Group	
	Pre-test	Post-test	Pre-test	Post-test
Number of students	21	21	21	21
Below average (0-40%)	43.75 %	0	50 %	12.5%
Average (41-60%)	56.25 %	37.5%	50 %	37.5%
Above Average (61-100%)	0	62.5%	0	50 %

Table 6 shows that both groups improved their scoring percentages during the learning process, but the experimental group still exceeded the control. The post-test results revealed that the experimental group scored 62.5% above average, while the control group scored 50% above average. The data were also analyzed based on the five indicators of critical thinking skills: interpretation, analysis, inference, explanation and evaluation, as indicated in Table 7 below.

Table 7. The Average Value of the Categories of Critical Thinking Skills

Critical Thinking Skills Indicators	Average Value of Experimental Group		Average Value of Control Group	
	Pre-test	Post-test	Pre-test	Post-test
Interpretation	25.27	66.87	26.16	38.30
Analysis	33.38	92.92	29.41	77.42
Inference	26.66	56.67	27.56	40.24
Explanation	43.56	92.81	42.23	81.11
Evaluation	30.97	90.61	32.64	80.43

The findings revealed that the experimental group's results in the five indicators of critical thinking skills were also higher than the control group, confirming that using a visual mind mapping strategy was very effective.

Furthermore, in order to evaluate the effectiveness of the visual mind mapping strategy and virtual comprehension of reading texts, participants in the experiment group were asked to analyze four reading texts using the mind mapping strategy. As shown in Table 8, Participants' productive design was evaluated using a valid and reliable rubric score, which included five items: Organization, Depth, Design, Creativity, and Spelling/Grammar; each item has three options: Good (4 points), Fair (3 points), and Poor (2 points). After the participants completed the visual mind mapping, the researcher reviewed them and calculated their total scores, categorizing them as good, fair, or poor as follows:

Table 8. Analysis Scores of Mind Maps

Text	Items	Good	Fair	Poor
1.Chiang Mai	Organization	13 (61.90%)	6 (28.58%)	2 (9.52%)
	Depth	15 (71.42%)	6 (28.58%)	0 (0.00%)
	Design	17(80.96%)	4 (19.04%)	0 (0.00%)
	Creativity	12 (57.16%)	5 (23.80%)	4 (19.04%)
	Spelling/Grammar	14 (66.66%)	3 (14.30%)	4 (19.04%)
Average		67.62%	22.86%	9.52%
2. A Cultural Rule in Japan	Organization	10 (47.61%)	8 (38.09%)	3 (14.30%)
	Depth	6 (28.58%)	9 (42.84%)	6 (28.58%)
	Design	11 (52.39%)	10 (47.61%)	0 (0.00%)
	Creativity	13 (61.90%)	5 (23.80%)	3 (14.30%)
	Spelling/Grammar	9 (42.84%)	8 (38.09%)	4 (19.04%)
Average		46.66%	38.09%	15.24%
3.Why sleep?	Organization	12 (57.16%)	8(38.09%)	1 (4.77%)
	Depth	10 (47.61%)	7 (33.33%)	4 (19.04%)
	Design	8 (38.09%)	9 (42.84%)	4 (19.04%)
	Creativity	9 (42.84%)	11 (52.38%)	0 (0.00%)
	Spelling/Grammar	12 (57.16%)	5 (23.80%)	4 (19.04%)
Average		48.57%	38.09%	12.38%
4.Small Talk	Organization	13 (61.90%)	6 (28.58%)	3 (14.30%)
	Depth	9 (42.84%)	7 (33.33%)	5 (23.80%)
	Design	11 (52.39%)	9 (42.84%)	1 (4.77%)
	Creativity	8 (38.09%)	7 (33.33%)	6 (28.58%)
	Spelling/Grammar	11 (52.38%)	6 (28.58%)	4 (19.04%)
Average		49.52%	33.33%	18.10%

The results showed that the average scores for the experiment group ranged from 90.48% to 82.85%, which was considered very high. "Chiang Mai" received the highest average score of 90.48%, followed by "Why sleep?" with an average score of 86.66%. Text four, "Small Talk," had the lowest average score of 82.85%, followed by text two, "A Cultural Rule in Japan," which had an average score of 84.75%. Participants in the experiment group were able to critically analyze and associate relationships between main ideas, supporting ideas, and deducing conclusions, according to the findings. This indicated that the scores were high because visual mind mapping was an effective strategy for improving students' critical thinking abilities, which resulted in good performance in the reading texts.

Discussion

A comparison of the experimental and control groups for improving critical thinking skills and reading ability is shown in the results above. The experimental group's score is higher than the control group. Based on this, it is concluded that there is a statistically significant difference in English language learner achievement between the experimental and control groups. The first question in this study was intended to investigate if there were any significant differences in the mean scores of the experimental and control groups on a critical thinking test. Based on the data analysis, the average scores of the two groups in the pre-test were nearly similar, which indicated that the participants' initial ability was nearly the same before conducting the experiment. However, it also revealed that the average post-test scores differed between the two groups. As shown in Table 5, the experimental group outperformed the control groups. This suggests that, when compared to a traditional teaching strategy, using visual mind mapping has had a positive and significant impact on participants' critical thinking skills and reading ability. There are several explanations for this finding. One is the usefulness of visual mind mapping strategies as proposed by Rosciano (2015) that it is a useful resource for developing and implementing activities that promote various levels of students' thinking skills. Furthermore, the improved performance of the experiment group may be attributed to the fact that MindMeister allows students to use an innovative form of note-taking to capture, develop, and share ideas online, as well as add videos, comments, or attach various types of files to their maps. It also encourages them to think critically and deeply in order to generate more relevant ideas (Buzan, 2018). Notably, the results confirmed previous research findings (Ningsih and Said, (2018); Trang, (2017) that learning with mind mapping had a positive effect on achieving students' learning outcomes, promoting active learning and problem-solving skills, inspiring students' creativity and thinking, and positively achieving meaningful reading comprehension.

In addition, the findings also showed that the strategy was effective and beneficial in assisting participants in analyzing and comprehending the reading texts. This could be because visual mind mapping strategies play an important role in assisting learners to explore, analyze, synthesize, share ideas, structure and organize information, and connect one

concept to another (Santiago, 2011). Another reason, according to Long and Carlson (2011), is that by using the mind mapping strategy rather than the traditional strategy, students can improve their critical thinking skills and reading ability by creating links between non-linear ideas. Furthermore, it enables students to effectively understand texts and extract ideas (Mohaidat, 2018). This is consistent with Trang's (2017) findings, according to which students regarded it as a valuable, appropriate, and motivating tool for learning reading comprehension.

Furthermore, the results of the post-tests revealed that all experimental group participants were developing critical thinking skills at or above the average level. In contrast, some participants in the control group performed below average. This indicated that the participants' achievement level in reading comprehension ability had significantly improved and their critical thinking skills had been effectively enhanced through the use of a mind mapping strategy in an e-learning environment. The reason for this could be that the instructors are aware of the six levels of Bloom's Taxonomy, which are used to effectively develop students' thinking skills and understanding of reading contexts (Yang & Wu, 2012). Furthermore, Facione (2015) asserts that students can achieve success by acquiring knowledge through the process of analyzing and thinking rather than accumulating information.

To answer the second question, whether the visual mind mapping strategy has a significant impact on students' critical thinking skills and reading ability, the researcher collected data from 21 visual mind maps designed by experimental group participants as shown in Table 8. According to the findings, the visual mind mapping strategy influenced participants' critical thinking skills and reading ability positively. Findings indicated that when teachers used visual mind mapping strategy to teach reading context, students become acquainted with this strategy as a tool for improving critical thinking skills and reading ability. This is due to the fact that it may provide students with enough experience and relevant practice of the skills they seek (Feng, 2013). It also gives students an overview of a topic and its complex information, allowing them to understand what they are reading, generate new ideas, and make connections (Jain, 2015). This is consistent with the findings of Gómez and King (2014), Malekzadeh and Bayat (2015), and Mohaidat (2018), who revealed that using a visual mind mapping strategy to improve students' English reading comprehension was very effective.

Conclusions

This study highlighted a significant relationship between visual mind mapping strategy, critical thinking skills, and reading ability, implying that students who use visual mind mapping strategy are more likely to be effective critical thinkers and readers. The findings of the study revealed that the visual mind mapping strategy was an effective strategy for improving students' understanding of reading texts by acquiring precise information, brainstorming their ideas, and creating an association between the given text's main ideas, supporting ideas, and conclusion. Visual mind mapping is also a creative technique that allows students to develop their critical thinking skills and foster their creativity by designing structured maps with colors and images.

Moreover, the findings of the study revealed visual mind mapping strategy has been shown to be effective in improving university students' critical thinking and reading ability by interpreting, analyzing, and inferring English language context. Finally, findings also aid instructors in the implementation of a practical method of teaching reading and critical thinking skills that inspires students to practice, generate, and organize their ideas and thoughts.

Recommendations

It is recommended that English language teachers incorporate the visual mind mapping strategy into their teaching process as a brainstorming tool to improve students' critical thinking and reading abilities. It is also suggested that English language teachers look for ways to improve their students' critical thinking skills and reading comprehension through innovative techniques. Teachers should be provided with training programs about visual mind mapping strategy and MindMeister to be applied in an online learning activities and to improve all English language skills. It is also suggested that more research be conducted into the impact of visual mind mapping on other English language skills. Furthermore, it is necessary to continue conducting experimental studies on the integration of critical thinking skills into writing, listening, and speaking skills.

Limitations

This research is limited to investigate the effectiveness of visual mind mapping strategy for improving the critical thinking skills and reading ability of 42 undergraduate English language students using MindMeister maps. The findings provide a framework for future researchers to expand on this topic by investigating its impact on various skills with a different data collection tool and more participants in order to improve their critical thinking ability and achieve meaningful reading comprehension.

Authorship Contribution Statement

Hazaymeh: Conceptualization, design, analysis, interpretation, writing, referencing. Alomery: Formal analysis, editing/reviewing, supervision.

References

Buzan, T. (2018). *Mind map mastery: The complete guide to learning and using the most powerful thinking tool in the universe*. Watkins Media Limited.

Eppard, J., Baroudi, S., & Rochdi, A. (2020). A case study on improving reading fluency at a university in the UAE. *International Journal of Instruction*, *13*(1), 747-766. https://doi.org/10.29333/iji.2020.13148a

Eppler, M. J. (2006). A comparison between concept maps, mind maps, conceptual diagrams, and visual metaphors as complementary tools for knowledge construction and sharing. *Information visualization*, *5*(3), 202-210. https://doi.org/10.1057/palgrave.ivs.9500131

Facione, P. A. (2015). *Critical thinking: What it is and why it counts.* Insight Assessment. https://bit.ly/3Bx73pB

Feng, Z. (2013). Using teacher questions to enhance EFL students' critical thinking Ability. *Journal of Curriculum and Teaching*, *2*(2), 147-153. https://doi.org/10.5430/jct.v2n2p147

Gillies, R. M., & Haynes, M. (2011). Increasing explanatory behaviour, problem-solving, and reasoning within classes using cooperative group work. *Instructional science*, *39*(3), 349-366. https://doi.org/10.1007/s11251-010-9130-9

Gómez, M., & King, G. (2014). Using mind mapping as a method to help ESL/EFL students connect vocabulary and concepts in different contexts. *Trilogy Science Technology Society, 10,* 69-85. https://doi.org/10.22430/21457778.439

Harizaj, M., & Hajrulla, V. (2017). Fostering learner's critical thinking skills in EFL: Some practical activities. *European Scientific Journal*, *13*(29), 126-133. https://doi.org/10.19044/esj.2017.v13n29p126

Irawati, L. (2014). Critical thinking in ELT: theory and practice. *English Teaching Journal: A Journal of English Literature, Language and Education*, *2*(1), 1–8. https://doi.org/10.25273/etj.v2i1.721

Jain, S. (2015). The comprehensive study of how mind mapping technique helps to understand concepts and ideas in science teaching. *International Journal of Scientific and Research Publications*, *5*(12), 284-286. https://bit.ly/3nzU0yO

Khalili, H., & Hossein Zadeh, M. (2003). Investigation of reliability, validity and normality of the Persian version of the California Critical Thinking Skills Test Form B (CCTST). *Journal of Medical Education, 3*(1), 29-32. https://bit.ly/3nJ97G8

Liu, P. L., Chen, C. J., & Chang, Y. J. (2010). Effects of a computer-assisted concept mapping learning strategy on EFL college students' English reading comprehension. *Computers & Education*, *54*(2), 436-445. https://doi.org/10.1016/j.compedu.2009.08.027

Long, D. J., & Carlson, D. (2011). Mind the map: How thinking maps affect student achievement. *Networks: An Online Journal for Teacher Research*, *13*(2), 262-262. https://doi.org/10.4148/2470-6353.1083

Malekzadeh, B., & Bayat, A. (2015). The effect of mind mapping strategy on comprehending implicit information in EFL reading texts. *International Journal of Educational Investigations*, *2*(3), 81-90. https://bit.ly/3buDuKK

Mohaidat, M. M. T. (2018). The impact of electronic mind maps on students' reading comprehension. *English Language Teaching*, *11*(4), 32-42. https://doi.org/10.5539/elt.v11n4p32

Moore, B. N., Parker, R., Rosenstand, N., & Silversa, A. (2012). *Critical thinking*. McGraw-Hill.

Ningsih, P., & Said, I. (2018). Application of guided inquiry learning model with mind map toward students' learning outcomes in chemistry material: Reaction rate. *Advances in Social Science, Education and Humanities Research*, *174*, 586–589. https://doi.org/10.2991/ice-17.2018.126

Paul, R., & Elder, L. (2019). *A guide for educators to critical thinking competency standards: Standards, principles, performance indicators, and outcomes with a critical thinking master rubric*. Rowman & Littlefield.

Richards, J. C., & Sandy, C. (2014). *Passages level 1 student's book* (Vol. 1). Cambridge University Press.

Rosciano, A. (2015). The effectiveness of mind mapping as an active learning strategy among associate degree nursing students. *Teaching and Learning in Nursing*, *10*(2), 93-99. https://doi.org/10.1016/j.teln.2015.01.003

Santiago, H. (2011). Visual mapping to enhance learning and critical thinking skills. *Optometric Education, 36*(3), 125–139. https://bit.ly/3Bqyh1k

Tang, L. (2016). Exploration on cultivation of critical thinking in college intensive reading course. *English Language Teaching*, *9*(3), 18-23. https://doi.org/10.5539/elt.v9n3p18

Trang, P. T. (2017). The effects of concept mapping on EFL students' reading comprehension. *European Journal of English Language Teaching*, *2*(2), 178-203. https://doi.org/10.5281/zenodo.581801

Yang, Y. T. C., & Wu, W. C. I. (2012). Digital storytelling for enhancing student academic achievement, critical thinking, and learning motivation: A year-long experimental study. *Computers & Education*, *59*(2), 339-352. https://doi.org/10.1016/j.compedu.2011.12.012