THE EFFECTS OF MIND MAPPING AT WHILE-READING STAGE ON EFL STUDENTS' READING COMPREHENSION AT A LOCAL HIGH SCHOOL IN KIEN GIANG PROVINCE, VIETNAM

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Abstract:

There is an increased attention to research into the use of mind mapping as a useful tool for enhancing students' reading comprehension. However, few studies have been conducted to examine the effects of mind mapping at the reading stage on students' reading comprehension within the Vietnamese context. This paper therefore investigates the effects of mind mapping on 11th graders' reading comprehension and their attitudes towards this strategy. Participants in this study include 60 students at a local school in Kien Giang province. The data discussed in this paper include tests and interviews. The findings reveal that using mind mapping in the teaching process of reading texts had a moderate impact. Pedagogical implications for teachers and school administrators are presented.

Keywords: mind mapping, reading comprehension, while-reading stage

1. Introduction

Research into mind-mapping has indicated that this strategy has an important role in improving students' reading comprehension of text passages (e.g., Grabe, 2009; Nuttall, 2005). Mind mapping is viewed as a visual representation of ideas and their relationships to a specific concept. therefore, mind mapping is a way to help students relate their prior knowledge to organizing and representing a text through the central idea and its corresponding subtopics (Buzan, 2018). Similarly, Tran (2019) contends that mind mapping is an excellent learning tool since it aids the teacher in making essential plans and makes it easier for students to remember and apply knowledge. Thus, in order to read and see the bigger picture of topic-related elements effectively, students need to develop their own learning ways to communicate ideas to other peers. However, in the

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teaching and learning context in Vietnam, students have encountered challenges in using English as a means to communicate ideas with others, particularly in reading comprehension (Pham & Nguyen, 2018). These authors further indicate that students lack the ability to read, comprehend, and apply critical thinking to the English texts presented to them. Research has indicated that students do not have the habit of reading or spend little time reading (Le & Nguyen, 2017). Also, little research has considered the effects of mind mapping at while-reading stage on high school students' reading comprehension. This paper, therefore, examines this area of interest since it serves as valuable tools for teachers and students at this school to enhance their teaching and learning experience and tailor on their reading practices respectively.

2. Literature review

2.1 Reading comprehension

There are several views of reading comprehension in the literature. Reading entails deriving meaning from written word symbols and therefore, it serves as a tool for aiding readers or students in understanding written communication (Wallace, 1998). Another view is that reading is an interactive process involving the reader, writer and the context in which a particular text or information is embedded (e.g., Le & Nguyen, 2017; Nuttall, 2005). From a sociocultural theory, Vygotsky (1978) contends that interactions are crucial for personal growth and language learning, including English as a foreign language. In other words, reading or comprehending a text is an active and interactive process that necessitates prior knowledge and creation of meaning (Grabe, 2009). This suggests the role of external factors in fostering the internal comprehension process to advance students' reading performance.

2.2 Reading and mind mapping relationship

Reading and mind mapping are closely related in ways that both involve organizing and processing information presented to learners or readers (e.g., Grabe, 2009; Nuttall, 2005). According to Grabe (2009), reading comprehension is based on the reader's understanding of a topic arrangement. Good readers are aware of the organizational elements (such as headings, subheadings and topic sentences) in the text they are reading and the cues that indicate new topics and subtopics. In addition to organizational patterns, skilled readers can identify common genre features, often known as 'rhetorical patterns' or 'knowledge structures' (Grabe, 2009). Discourse-structure reading skills (such as identifying important ideas, drawing links between textual sections, and spotting organizational patterns in texts) are frequently linked to awareness of these types of topics. To put it simply, while mind mapping provides a visual organized representation of the content of a specific text, allowing students to identify the main ideas, supporting details, and connections between concepts related to the main idea, reading requires active engagement of the students to process the text (e.g., Khodadady & Ghanizadeh, 2011; Pham & Nguyen, 2018; Phan, 2017).

2.3 While-reading activity

Several scholars have indicated that the while-reading activity (or stage) is essential for facilitating reading, promote engagement and critical thinking of the reader or student in their learning process (e.g., Grabe, 2009; Magliano, 1999). The while-reading activity refers to a stage within the process of teaching and learning where readers or students immerse themselves in a text. This stage which occurs between the pre-reading and post-reading allows students to grasp the reading content and make sense of its meaning. During this stage, it is expected that the teacher guides students to interact with the text, identify the main ideas, make connections within the text, and move beyond the explicit text (Buzan, 2018; Grabe, 2009; Schraw, 2000). Furthermore, students have the potential to anticipate the information generated from the text or advance their understanding by harnessing the use of mind maps as a guiding tool (Cain and Oakhill, 2006). In essence, using mind mapping as a while-reading activity in the context of reading comprehension proves to be effective for skimming, scanning and inferencing information (Praveen and Rajan, 2013).

2.4 Related studies

Several studies have addressed the effects of mind mapping on students' reading comprehension. According to Cahyani (2015), mind mapping can help students improve their reading comprehension. The purpose of this study is to determine whether and to what degree mind mapping enhances reading comprehension. However, the difficulties that the students encountered in reading classes include identifying the main idea, figuring out implied information, explicit information, and word meaning in the text.

A study by Pham and Nguyen (2018) indicates that mind mapping influenced students' ability to synthesize information from reading passages. Moreover, mind mapping can function as a tool to foster students' creativity. The results of this study, however, fail to consider the generalizability or limited applicability due to the relatively small sample size.

Collectively, the aforementioned literature underscores the significant role of mind mapping in helping students enhance their reading ability. However, there exists a gap in research with regard to the effects of mind mapping at the while-reading stage on English as a foreign language (EFL) students' reading comprehension at a local high school in the Mekong Delta, Vietnam. This present study therefore addresses the gap in the literature.

3. Methodology

The study was conducted using a mixed-methods approach that combined quantitative and qualitative data. This integration was thought to be appropriate (Creswell, 2014) because it provided greater understanding of the research topic. The experimental groups used mind mapping (MM), whereas the conventional technique-traditional method (TM) was used for the control group to teach English reading comprehension to students at the

while-reading stage. A cross-intervention design was used. With comparable pretest scores, sixty Vietnamese were students carefully chosen and divided into two groups.

There were two main phases of the research. In Phase One, group A (EGA) was taught five reading lessons by using MM-based instruction while Group B (CGB) learned five reading lessons based on the conventional way. In Phase One, group B (CGB) learned five English reading tests based on the characteristics of the traditional method, and group A (EGA) learned five reading lessons with MM-based treatment. In Phase Two, five other English reading lessons were taught to both groups. However, while group B (EGB) received MM-based intervention, group A (CGA) was taught based on the traditional method (TM).

Table 3.1: Research design

Groups	Period One	Period Two
GA	MM-based intervention (EGA)	Traditional method (TM) (CGA)
GB	Traditional method (TM) (CGB)	MM-based treatment (EGB)

Participants were chosen for the study based on convenience sampling (e.g., Fraenkel et al., 2012). According to Fraenkel and his colleagues (2012), this decision was based on their accessibility and closeness. Thirty-seven female and twenty-three male students of grade 11 from a local high school in Kien Giang participated in this study. The curriculum for the Vietnamese upper secondary schools was authorized by The Ministry of Education and Training since November 2012. Students in both classes had the same English proficiency level.

The data collected in this study included tests, questionnaires, and interviews. A pre-test, post-test 1, and post-test 2 were used to evaluate students' reading proficiency before and after mind mapping was implemented in reading lessons. A questionnaire and student interviews were used to examine their attitudes towards the benefits of using mind mapping in reading instruction and learning.

Sixty students of Grade 11 in a Kien Giang school were selected to participate in this study (Fraenkel, Wallen, & Hyun, 2012). The purpose of the questionnaire was to assess how each student responded to the above research topics. The Likert scale was among the most popular ways to evaluate responses. The question was put to participants who provided a choice of replies (typically five), ranging from the attitude measure 'strongly agree' to its precise opposite, 'strongly disagree' (Birmingham and Wilkinson, 2003). The questionnaire, according to Birmingham and Wilkinson (2003), was used to collect a large amount of data from a variety of respondents since the findings could be looked into quickly and easily.

A 38-item-questionnaire used in this study were adapted from questionnaires by Phan (2017) and Pham (2018). The questionnaire examined attitudes toward using mind mapping (items 1–7), the benefits of using MM (items 8–34), and challenges in using MM at the reading level (items 35–38). The questionnaire was written in both English and

Vietnamese to ensure that every participation student understood it without difficulty. The piloted questionnaire's reliability was .83, indicating the questionnaire was reliable.

According to Fraenkel and his colleagues (2012), an interview is a conversation in which a researcher involves a subject by asking questions that are relevant in order to gather data. Questions are useful in qualitative research because they allow the researcher to explore attitudes, feelings, or values as well as get insights into the topic under investigation.

4. Findings

4.1 Findings from the tests
4.1.1 Before the treatment
4.1.1.1 The findings of the pre-test for both

A Descriptive Statistic Test was run to measure the mean scores and standard deviation from the pre-test of the two groups (see Table 4.1). *An Independent-Sample t-test* was conducted in order to measure whether there was a difference in reading ability of the participants between the two groups after the study (see Table 4.2).

Table 4.1: *Descriptive Statistics Test* on the pre-test of GA and GB

	Group	N	Min.	Max.	Mean	SD	df	t	Sig. (2-tailed)
Pre-test	GA	30	2.5	7.5	5.68	1.10	58	-.904	.37
	GB	30	3.0	8.0	5.93	1.04	58		

Source: Data analysis

Table 4.1 shows the mean scores of the reading pre-test for GA (*M*pre = 5.68) and GB (*M*pre = 5.93), based on a scale of .5 to 10. The results of *Independent Sample-t-Test* indicate that there was no significant difference between the levels of individual reading comprehension of the two groups (*p*=.37>.05) before the intervention.

4.1.2 After the treatment
4.1.2.1 Comparison of both groups on the pre-test, post-test 1, and post-test 2

The results of post-tests 1 and 2 show a difference after the intervention, showing the experimental group's advancement. Table 4.2 shows that students in the experimental groups performed better than those in the control groups. Additionally, the alpha value 0.05 (*p* =.000, *p*<.05) was substantially smaller than the Sig (2-tailed) of .000.

Table 4.2: The comparison the significant differences
of three groups (the pre-test, post-test 1, & post-test 2)

Group	Pre-test			Post-test 1			Post-test 2		
	M	**Std**	**Sig.** **(2 tailed)**	**M**	**Std**	**Sig.** **(2 tailed)**	**M**	**Std**	**Sig.** **(2 tailed)**
GA	5.68	1.10	.370						
GB	5.93	1.04							
EGA1				7.93	0.83	.000			
CGB1				6.25	1.04				
CGA2							5.90	1.23	.000
EGB2							8.00	0.96	

Source: Data analysis

4.2 Findings from the questionnaire

The findings from the questionnaire show students' attitudes towards reading comprehension through the use of mind mapping (MM) at while-reading stage. *Cronbach's alpha* was used to measure the reliability of all the questionnaire items, as shown in Table 4.3.

Table 4.3: *Reliability statistics* of questionnaire items

	N of items	Cronbach's Alpha
Questionnaire items	38	.721
Items of attitude	7	.784
Items of benefits	27	.714
Items of challenges	4	.833

Source: Data analysis

Table 4.3 shows that the results of *Cronbach's alpha* of the questionnaire items are high value (>.7), indicating that the questionnaire was reliable for data collection in this study.

A. Students' attitudes in both experimental groups towards the use of mind mapping at while-reading stage

The questionnaire of seven items presents students' attitudes towards the use of mind mapping at while-reading stage.

Table 4.4 shows that participants' attitudes towards the use of mind mapping at while-reading stage were positive. To determine whether the mean score of students' attitudes was statistically different from the test value of 4.0, a high level of agreement in the five-point Likert scale (Oxford and Burry-Stock, 1995). The result shows that there was no significant difference between the test value of 4.0 and the mean score (*M*=4.32, *SD*=.63) (*t*=1.38, *SD*=.63, *p*=.69>.05).

Table 4.4 shows that 70.4% of the students (n=57) liked how the teacher used mind mapping to teach reading. 69.2% of the students felt encouraged to explore reading passages at WRS by using mind mapping (n=56). 67.9% of the students (n=55) agreed that mind mapping with many colors (electronic mind mapping) made classroom atmosphere

lively and active. 67.9% of the participants (n=55) found it fascinating to use mind mapping in reading lessons.

Table 4.4: Percentages of students' attitudes towards the use of MM at WRS

	Items	SD & D		N		A & SA		M	SD
		F	P(%)	F	P(%)	F	P(%)		
1	I like how the instructor uses mind mapping to teach reading.	0	0	3	3.7	57	70.4	4.5	.59
2	I find it fascinating to use mind mapping for lessons reading.	0	0	5	6.2	55	67.9	4.4	.64
3	Mind mapping with many colors (electronic mind mapping…) makes classroom atmosphere lively and active.	0	0	5	6.2	55	67.9	4.5	.65
4	I feel encouraged to explore reading passages at WRS by using mind mapping.	0	0	5	6.2	56	69.2	4.4	.65
5	I feel attracted when preparing the reading lessons at WRS.	0	0	4	4.9	56	69.2	4.5	.62
6	I prefer to acquire reading comprehension at WRS when I can utilize mind mapping.	0	0	11	13.6	49	60.4	4.0	.59
7	Mind mapping makes me more confident to deal with the text.	0	0	14	17.3	46	56.8	4.0	.64

B. Benefits of using mind mapping at while-reading stage

The questionnaire of twenty-seven items presents students' benefits of using mind mapping at while-reading stage. This part consists of three clusters: (1) Identifying the structure of the reading text; (2) Developing the reading comprehension skill; (3) Motivating students for active self-study and working in groups.

Table 4.5: Descriptive Statistics Test of three clusters of benefits of MM at WRS

Items	N	Min.	Max.	M	df	SD	t	Sig. (2 tailed)
Identifying the structure of the reading text.	60	3.00	5.00	4.22	58	.70	-1.69	.096
Developing the reading comprehension skill.	60	3.00	5.00	4.27	58	.69	.293	.77
Motivating students for active self-study and working in groups.	60	3.00	5.00	4.19		.68	-1.81	.076

Source: Data analysis

Table 4.5 shows that using mind mapping in teaching reading comprehension at WRS yielded positive effects on students' reading comprehension, with the mean scores of the students' agreement level ranging from 4.19 to 4.27. In particular, the three items include identifying the structure of the reading text (M= 4.22, SD=.70), improving reading comprehension skills (M=4.27, SD=.69) (highest mean score), and motivating students to self-study and work in groups (M=4.19, SD=.68). To check whether there was a difference in the mean score of students' level of developing reading comprehension skill from the

test value of 4.0, a high value of the agreement, *Independent-Sample-t-Test* was conducted. The results of the test show that no difference was found (*t*=.293, *df*=58, *p*=.77>.05).

Table 4.6: Percentage of identifying idea organization in reading text at WRS

	Items	SD & D		N		A & SA	
		F	P(%)	F	P(%)	F	P(%)
8	Mind mapping at WRS helps me understand the structure of the reading passages.	0	0	8	9.9	52	64.2
9	Mind mapping at WRS helps me to realize topic sentences and supporting ideas of the reading text easier.	0	0	3	3.7	57	70.4
10	Mind mapping at WRS helps me to totalize the main ideas and supporting information.	0	0	14	17.3	46	56.8
11	Mind mapping at WRS helps me to realize specific information easily.	1	1.2	18	22.2	41	50.7
12	Mind mapping at WRS provides the opportunities for me to reread whenever I want.	0	0	7	8.6	53	65.4

Note: F = Frequency; P = Percentage, SD & D = Strong Disagree and Disagree; N = Neutral; A & SA = Agree & Strongly Agree
Source: Data analysis

Table 4.6 shows that 70.4% of the students (n=57) acknowledged that using mind mapping at WRS aided them in identifying topic sentences and their corresponding supporting ideas embedded in reading texts. 65.4% of the students believed that the use of mind mapping at WRS provided them the opportunity to reread contents as wanted (n=53). Similarly, 64.2% of the surveyed students (n=52) affirmed that mind mapping at WRS helped them understand the structure inherent in reading passages. Moreover, 56.8% of the students (n=46) reported that mind mapping at WRS helped them summarize the main ideas and the associated supporting details.

Table 4.7: Percentages of developing the reading comprehension skill at WRS

	Items	SD & D		N		A & SA	
		F	P(%)	F	P(%)	F	P(%)
13	Mind mapping at WRS helps me understand better what I am reading.	0	0	6	7.4	54	66.7
14	The combination of the prior knowledge and mind mapping at WRS helps me to imagine a general picture about the content of the reading text.	0	0	11	13.6	49	60.5
15	Mind mapping at WRS helps me to connect new information to their prior knowledge.	0	0	4	4.9	56	69.1
16	Mind mapping at WRS helps me know how to guess the meaning of words and phrases in the context.	0	0	5	6.2	55	67.9
17	Mind mapping at WRS helps me to realize the relationships between different ideas in the reading text through the connect words.	0	0	17	21.0	43	53.1
18	Mind mapping at WRS helps me review prior vocabulary and knowledge related to the previous periods.	0	0	6	7.4	54	62.7

19	Mind mapping at WRS helps me facilitate the process of learning the reading comprehension.	0	0	6	7.4	54	66.7
20	Mind mapping at WRS helps me enhances my reading ability.	0	0	8	9.9	52	64.2
21	I find that mind mapping at WRS helps me read texts more quickly.	0	0	7	8.6	53	66.4
22	Mind mapping at WRS helps me strengthen my critical thinking.	0	0	9	11.1	51	62.9
23	Mind mapping at WRS helps me to summarize a passage easily.	0	0	7	8.6	53	65.4
24	Mind mapping at WRS is a useful tool for not only learning reading comprehension skill well but also improving speaking, listening and writing skills.	2	2.5	14	17.3	44	54.3

Note: F = Frequency; P = Percentage, SD & D = Strong Disagree and Disagree; N = Neutral; SA & A = Strongly Agree & Agree

Table 4.7 shows that 69.1% of the students (n=56) said that mind mapping at WRS helped them to connect new information to their prior knowledge. 67.9% of the students admitted that mind mapping at WRS helped them know how to guess the meaning of words and phrases in the context (n=56). 66.7% of the students (n= 54) agreed that mind mapping at WRS helped them facilitate the process of learning the reading comprehension. 66.4% of the students (n=53) said that mind mapping at WRS helped them read texts more quickly. 64.2% of the students (n=52) believed that mind mapping at WRS helped them raise their reading abilities, while 65.4% of the students (n= 53) identified that it made it easy for them to summarize a paragraph. 62.9% of the students (n=51) admitted that mind mapping at WRS helped them enhance their critical thinking.

Table 4.8: Percentage of student learning reading through MM at WRS

| | Items | SD & D | | N | | A & SA | |
		F	P(%)	F	P(%)	F	P(%)
25	Mind mapping at WRS helps me become more active for preparing lessons.	0	0	17	21.0	43	53.1
26	I am motivated in reading lessons when using mind mapping at WRS.	0	0	9	11.1	51	63.0
27	Mind mapping at WRS motivates my curiosity about what will happen next in the reading text.	0	0	8	9.9	52	64.2
28	Mind mapping encourages students to work in groups.	0	0	10	12.3	51	61.8
29	Mind mapping at WRS encourages my activity not only in studying individually, but also in interacting with partners in the class actively.	0	0	6	7.4	54	66.7
30	Mind mapping at WRS motivates my studiousness in preparing English reading lessons.	0	0	8	9.9	41	50.6
31	Mind mapping at WRS encourages my studiousness in reviewing lessons at home.	0	0	6	7.4	56	69.2
32	Mind mapping at WRS motivates me to work confidently with my teacher in the mind mapped – reading lessons.	0	0	4	4.9	56	69.2
33	Mind mapping at WRS stimulates my creation in the process of interaction.	0	0	5	6.2	55	67.9

34	Mind mapping at WRS encourages my active spirits in the interaction with peers and teachers in reading lessons.	0	0	4	4.9	56	69.1

Note: F = Frequency; P = Percentage, SD & D = Strong Disagree and Disagree; N = Neutral; SA & A = Strongly Agree & Agree

Table 4.8 illustrates that a consistent level of consensus existed among students. Specifically, 69.2% of the students expressed that mind mapping encouraged them to review lessons and enhanced their confidence when working with their teachers (n=56). Likewise, 67.9% of the students (n=55) said that mind mapping at WRS exposed them to more creative ideas or thoughts during interaction. Additionally, 66.7% of the students (n=54) said that mind mapping at WRS encouraged them to self-study and interact with partners in class. 64.2% of the students (n=52) agreed that mind mapping at WRS increased their curiosity regarding the approaching content of reading texts. When using mind mapping at WRS, 63.0% of the students (n=51) said they were motivated to read.

C. Students' challenges of using mind mapping at while-reading stage

The questionnaire consists of four items with students' challenges of using mind mapping at while-reading stage.

Table 4.9: Percentage of challenges of using mind mapping at WRS

	Items	SD & D		N		A & SA	
		F	P(%)	F	P(%)	F	P(%)
35	It is time- consuming to construct a mind mapping at WRS.	0	0	10	12.3	37	45.7
36	Mind mapping at WRS is new, thus it may cause some confusion.	0	0	3	3.7	45	55.6
37	Mind mapping at WRS is a difficult task for students who have limited vocabulary.	0	0	14	17.3	42	51.8
38	Mind mapping at WRS is found difficult for me to organize ideas and their links.	0	0	2	2.5	36	44.5

Note: F = Frequency; P = Percentage, SD & D = Strong Disagree and Disagree; N = Neutral; SA & A = Strongly Agree & Agree

Table 4.9 shows that 55.6% of the students (n=45) indicated that mind mapping was new to them at WRS, causing confusing. For students with little vocabulary, mind mapping at WRS is a difficult activity, according to 51.8% of the students (n=42). 45.7% of the students (n=37) agreed that mind map used at WRS took time. Only 44.5% of participants (n=36) agreed that the use of mind mapping at WRS to arrange ideas and their connections was found challenging.

4.3. Findings from the interviews
4.3.1 Students' attitudes towards teachers' use of MM in reading
Analysis from the interviews shows that each of the six interviewees valued the use of mind mapping in reading classes. When asked how they felt when the teacher used mind

mapping in reading class at the while-reading stage, all interviewed students expressed their interest in this instructional strategy. The following extracts illustrate their views.

> *"I enjoy how the teacher teaches reading through mind mapping."* (Student A- low-achieving-interview extract)

> *"I find it fascinating to apply mind mapping for reading classes, and I'm motivated to use mind mapping for studying reading passages at WRS."* (Student C- average-achieving-interview extract)

a. Benefits of using MM in reading comprehension in WRS

The importance of mind mapping in *identifying the structure of the reading text*: When asked about the benefits of using mind mapping in learning reading, almost all students acknowledged that mind mapping was useful to some extent. For example, they said,

> *"Mind mapping at WRS enables me to easily recognize the main concepts and supporting ideas of the reading text and it allows me to better understand the key ideas of reading text."* (Student A- low-achieving-interview extract)

> *"I learn more about the hierarchical order of the reading passages at WRS thanks to mind mapping. At WRS, mind mapping makes it simpler for me to understand the main concepts of the reading passage. Moreover, I use mind mapping at WRS to summarize the primary concepts and supporting details. Furthermore, mind mapping gives me an opportunity to read again the reading passage as desired."* (Student E- high-achieving-interview extract)

b. The role of mind mapping in developing student reading

When asked about the role mind mapping brought to their reading performance, two students from different levels of English proficiency noted that it was a useful tool for improved comprehension of the reading text through the relationships between different concepts. The following extracts illustrate their views.

> *"I learn how to guess a word's or phrase's meaning from context at WRS using mind mapping. My comprehension of the links between different ideas in the reading text is made easier."* (Student B- low-achieving-interview extract)

> *"I find using mind maps at WRS useful, making it easier for me to read. Mind mapping practice at this stage has improved my reading skills. Particularly, I discover that mind mapping facilitates text comprehension. Moreover, it helps me develop my critical thinking skills and also develop other skills such as speaking, listening, and writing."* (Student E-high-achieving-interview extract)

c. The motivation to use mind mapping for self-studying and group work

Mind mapping perceived by three out of six participants could be a motivational strategy in reading lessons. An example for this is shown in the following extract.

> *"I can use mind mapping at WRS not only to study on my own, but also to interact with my peers. At this stage, my friends working in teams provide feedback."* (Student A-low-achieving-interview extract)

5. Discussion

The findings from this study have contributed to understanding of how mind mapping can impact on high school students' reading comprehension at a local school in the Mekong Delta, Vietnam.

Regarding the first research question, the study reveals that the use of mind mapping during while-reading stage could yield a positive impact on students' reading comprehension. In the first post-test, a statistically significant difference in reading performance mean scores was observed between the experimental and control groups after the study. Similarly, in the second post-test, a significant difference in mean scores for reading performance emerged between the experimental and control groups after the study. The findings have indicated that the implementation of mind mapping as an activity during reading had potential to enhance comprehension among students in the experimental groups, surpassing the reading performance achieved by their counterparts in the control group. This observation aligns with the theoretical perspectives of several scholars (e.g., Canas & Novak, 2006; Buzan, 2018; Grabe, 2009; Saori, 2020) who argue that mind mapping effectively aids in improve their comprehension and can be used as a strategy. One possible reason for this impact is that students could visualize the structure of information presented to them by breaking down complex texts into manageable parts, making it easier to process text meaning. Once students interacted with the reading texts, they could identify the main ideas or key concepts, connections, and relationships, and then organize information in a meaningful way (Khodadady & Ghanizdeh, 2011; Pham & Nguyen, 2018; Phan, 2017).

With regard to the second research question, the findings from the questionnaire and interviews show that the participants liked to use mind mapping in learning reading comprehension. Mind mapping was used to help the participants comprehend reading materials, which led to an improvement in confidence in their reading skills. In particular, the total mean score for the attitudes of the students towards the use of mind mapping at while reading stage (M=4.32, SD=.63) was at a high level. This finding concurs with other studies in the literature (e.g., Duong et al., 2020; Novak & Canas, 2006) with regard to the benefits of implementing mind mapping while reading. The improvement in their reading abilities could be attributed to their optimistic attitudes. However, students reported that while using mind mapping in reading lessons, some challenges were identified as time restraints, limited vocabulary, and difficulty in organizing ideas and

connections of main ideas of a reading content. These challenges were documented in the literature (e.g., Phan, 2017; Novak and Gowin, 1984; Wandersee, 1990). Phan's (2017) study suggests that creating a map demands much time and effort from students as they decide what is included in the map. Once students identify links between concepts, they can develop the connections for their relationships.

6. Conclusions

The findings from the study provide insights into the effects of mind mapping on students' reading comprehension. Analysis of the interview data shows their positive attitudes towards the use of mind mapping at while-reading stage in reading classes. In particular, these students believed that mind mapping was beneficial to them through summarizing a reading text, enticing increased motivation in reading lessons, retaining ideas and information, activating prior knowledge, and developing thinking skills. Furthermore, the students agreed that mind mapping should be maintained as this strategy served as a useful source for their better reading in the long run. However, challenges encountered by students include time constraints, limited vocabulary, and difficulty in connecting ideas while creating maps.

The findings from the study have pedagogical implications for how mind mapping during reading sessions can be used to improve students' reading comprehension. It implies that mind mapping encourages students to participate actively in their learning process. Additionally, to boost student reading comprehension, it is necessary for this strategy to be used in a wider context and at different stages of reading lesson.

Conflict of Interest Statement
The authors declare no conflicts of interest.

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